Studying Soundscapes and Avian Bioacoustics in the Western Ghats using Automated Recording Units

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Introduction

The soundscape of an area refers to the entirety of sounds produced in a given landscape. (Pijanowski, Bryan, et al 2011). Biological sounds (biophony) produced in a landscape can be used to estimate the biodiversity in a given landscape. Biodiversity can vary with type and age of vegetation, season and other factors (Ricklefs and Schluter, 1993; Huston, 1999). To record biophony we make use of Automated Recording Units (ARUs). Automated Recording Units are increasing being employed to study various acoustic aspects of the landscape (Ehnes , Dech, Foote 2018, Patrick, Robert et al 2015). ARUs can conduct a large number of acoustic surveys continuously for extended periods of time in inaccessible and inhospitable environments while avoiding any biases from subject disturbance (Alldredge et al. 2007). With newer technological advancements the costs of recording, storing and analysing large sets of data have become significantly cheaper, in some cases, less expensive than manually performed surveys. (Rempel et al. 2013; Yip et al. 2017). Long duration False Color (LDFC) spectrograms can be developed from the recorded data help us visualise recordings, especially from long duration recordings that span days. These images help us rapidly process large amounts of data and help us observe patterns that change from season to season. (Phillips, Towsey, Roe 2018).

Studies have compared species detection by means of ARUs and compared them to point counts.(Alquezar, Machado 2015, Haselmayer, Quinn 2000). In general the detection rates are at par with point counts. The ARUs do not exhibit an observer induced-avoidance effect which is very advantageous in detecting rare birds. If detection distances were systematically measured and characterised for a given habitat the species densities, along with avian biodiversity can be accurately measured with ARUs. (Kevin, Brett, et al 2018)

My summer project involved the use of ARUs in studying the soundscapes in the Kodaikanal Wildlife Sanctuary. In addition to this I have also done intensive work studying the Biophony of the animals found here. I have primarily focused on the avian species found here, studying their calling activity, learning to identify them by their calls, extracting and annotating the calls in sound files. Other classes of animals such as insects and frogs were also studied. In this report below I will elaborate on the methods I have used to analyze the recorded sounds.

Methods

Study area

The study area was limited to the Kodaikanal Wildlife Sanctuary. We particularly focused on one of the natural forest inside the city limits called Bombay Shola which was just adjacent to our field station in the Palani Hills Conservation Society.

Sampling

The ARUs we have used were Song Meters SM4. Each ARU was tied to a tree at a height 1.5 m from the ground and 20 meters from the road. It was programmed to record for a period of 15 minutes out of every 20 minutes every day for a month. The ARUs were configured to record at a sampling frequency of 44.1KHz in WAV format. The ARUs were then removed at the end of sampling and the data was retrieved from the memory cards and processed.

Data analysis

To become acquainted with the calls of the birds field visits to the nearby forest were conducted twice a day for a duration of 2 hours each over a period of 2 months. I first spotted the the bird and visually identified the species. I then used a handheld recorder with a shotgun microphone to record the call if was singing. A catalogue of sounds produced by each species of bird was constructed from these recordings. Spectrograms were constructed from these recording and the individual notes and phrases corresponding to each species were annotated using software called Raven (Bioacoustics Research Program. (2014). Raven Pro).

The sound files from the ARUs were processed using Raven. Oscillograms and Spectrograms were constructed using a preset setting. Vocalizations of different birds from these recordings were heard and annotated in the Spectrogram.

The bird calls were identified by comparison with prior recordings and then successively reaffirmed by an expert who is well acquainted with bird calls. All vocalizations from all animals such as dogs, insects, squirrels and amphibians were annotated. Anthropogenic sounds like bells and vehicles were also marked.

Long Duration False Color Spectrograms were constructed and prominent and periodic sound sources were identified and annotated using a software package in MATLAB (HARP). This was done by first observing the patterns in the LDFC Spectrogram and navigating to the respective 15 minute WAV file and identifying the sounds from the smaller Spectrogram. These observed patterns were closely related to time of day and other weather phenomena like rain.

Results

Sounds of rain, insects, frogs, squirrels and birds are the more predominant sounds in addition to other anthropogenic sounds like loud speakers and sounds from vehicles. Vocalizations from 25 species of bird were identified from the recordings Table1.. Vocalizations of mammals like squirrels and dogs and vocalizations from unidentified species of crickets and frogs were also found. Spectrograms of the most common sounds in all of the recordings are shown in Fig1-7.

A Long Duration False Color Spectrogram was constructed from 5 consecutive days of recordings is shown in Fig.8. Prominent regions were highlighted and named.

Sl.No	Species
1	Besara
2	Black and Orange Flycatcher
3	Brown Fish Owl
4	Grey Jungle Fowl
5	Grey-Headed Canary Flycatcher
6	House crow
7	Indian Blackbird
8	Indian Scimitar Babbler
9	Indian Yellow Tit
10	Large-billed Crow
11	Malabar Whistling Thrush
12	Nilgiri Flowerpecker
13	Nilgiri Flycatcher
14	Nilgiri Wood Pigeon
15	Oriental White Eye
16	Palani Laughingthrush
17	Red Spurfowl
18	Red Whisered Bulbul
19	Red Whiskered Bulbul
20	Rooster
21	Squared-Tailed Bulbul
22	Velvet-Fonted Nuthatch
23	White-Bellied Blue Robin
24	White-Cheeked Barbet
25	White-throated Kingfisher

Table.1

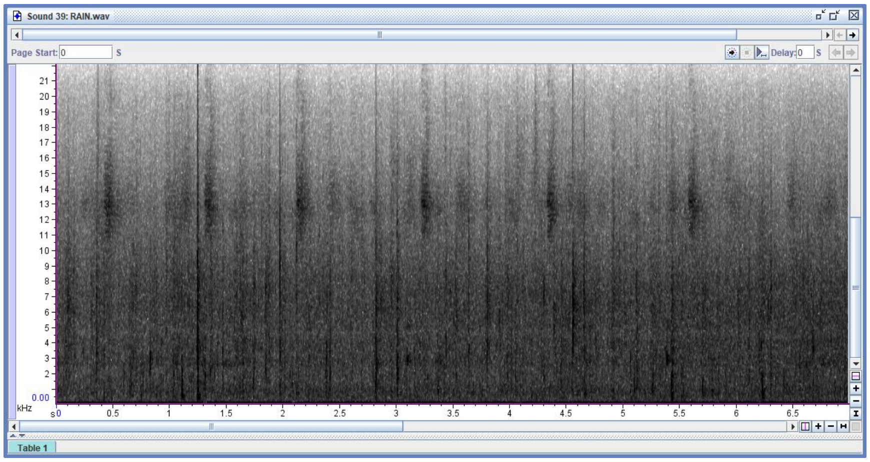

Fig 1. Rain sounds

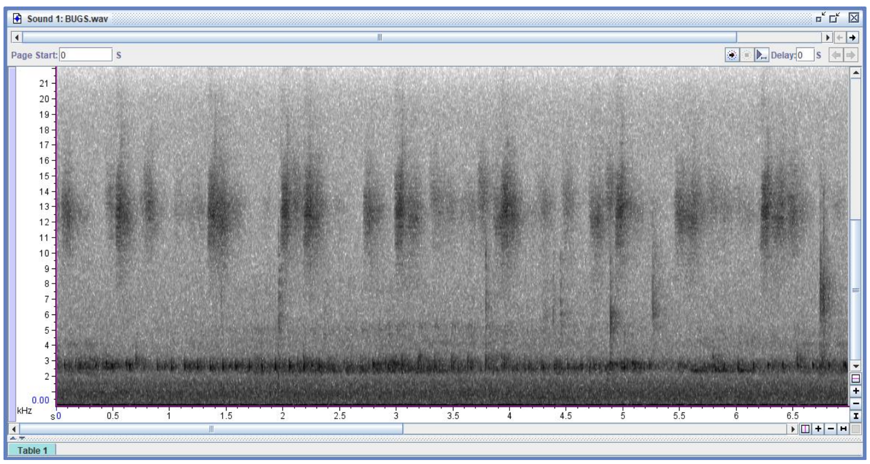

Fig 2. Insect calls(≈13Khz) and frog calls(≈2.5KHz)

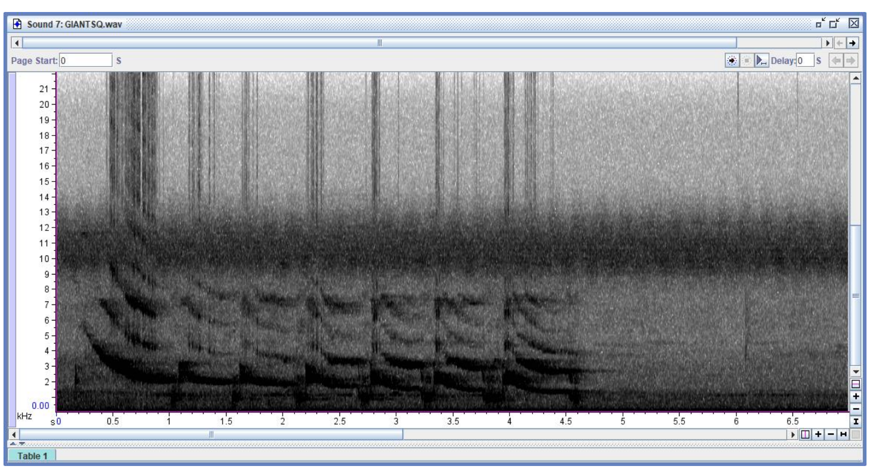

Fig 4. Malabar Giant Squirrel

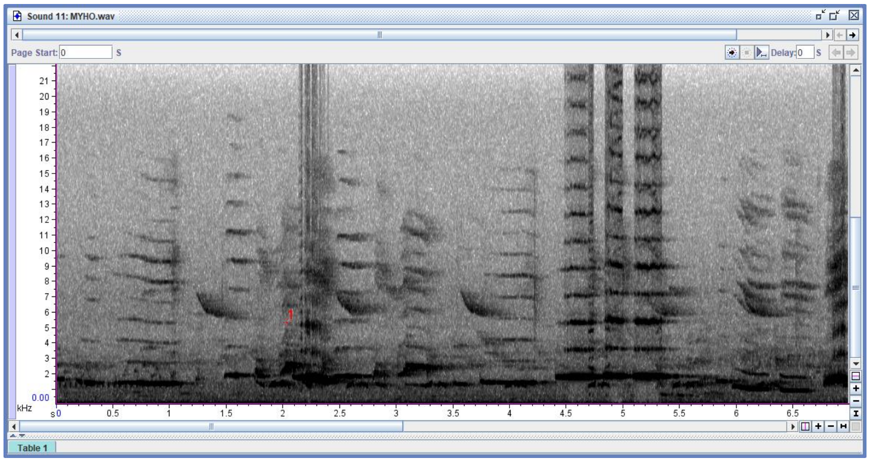

Fig 3. Malabar Whistling Thrush

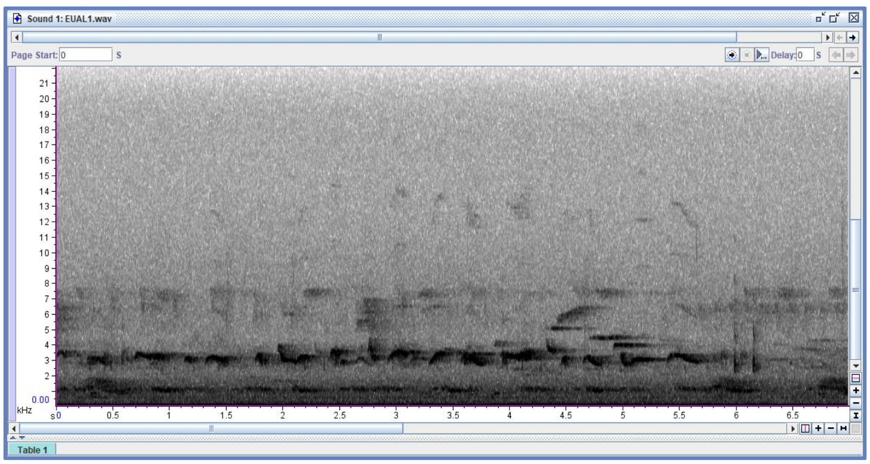

Fig 5. Nilgiri Flycatcher

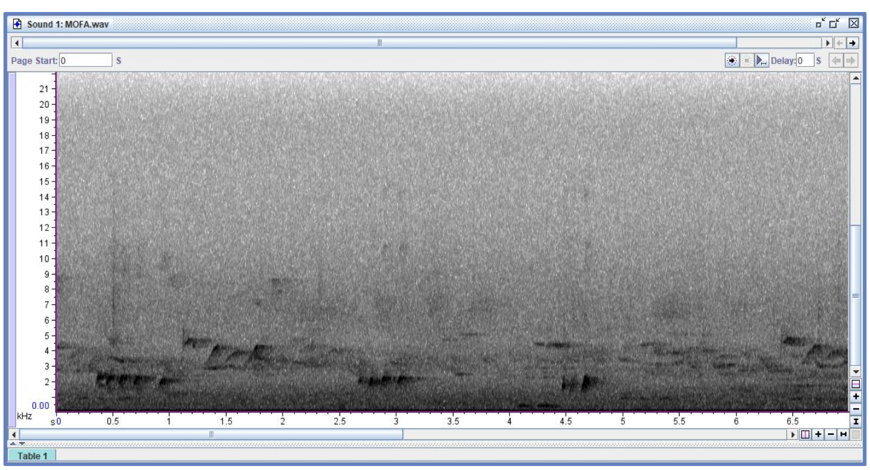

Fig 6. Palani Laughingthrush

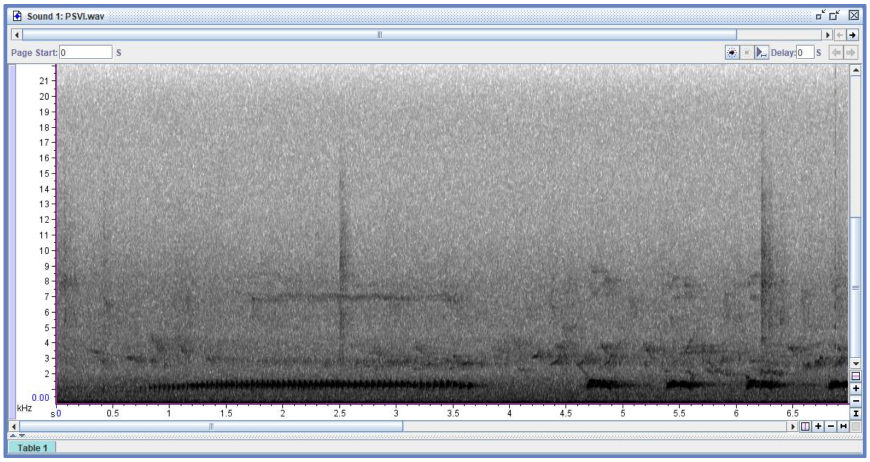

Fig 7. White-Cheeked Barbet

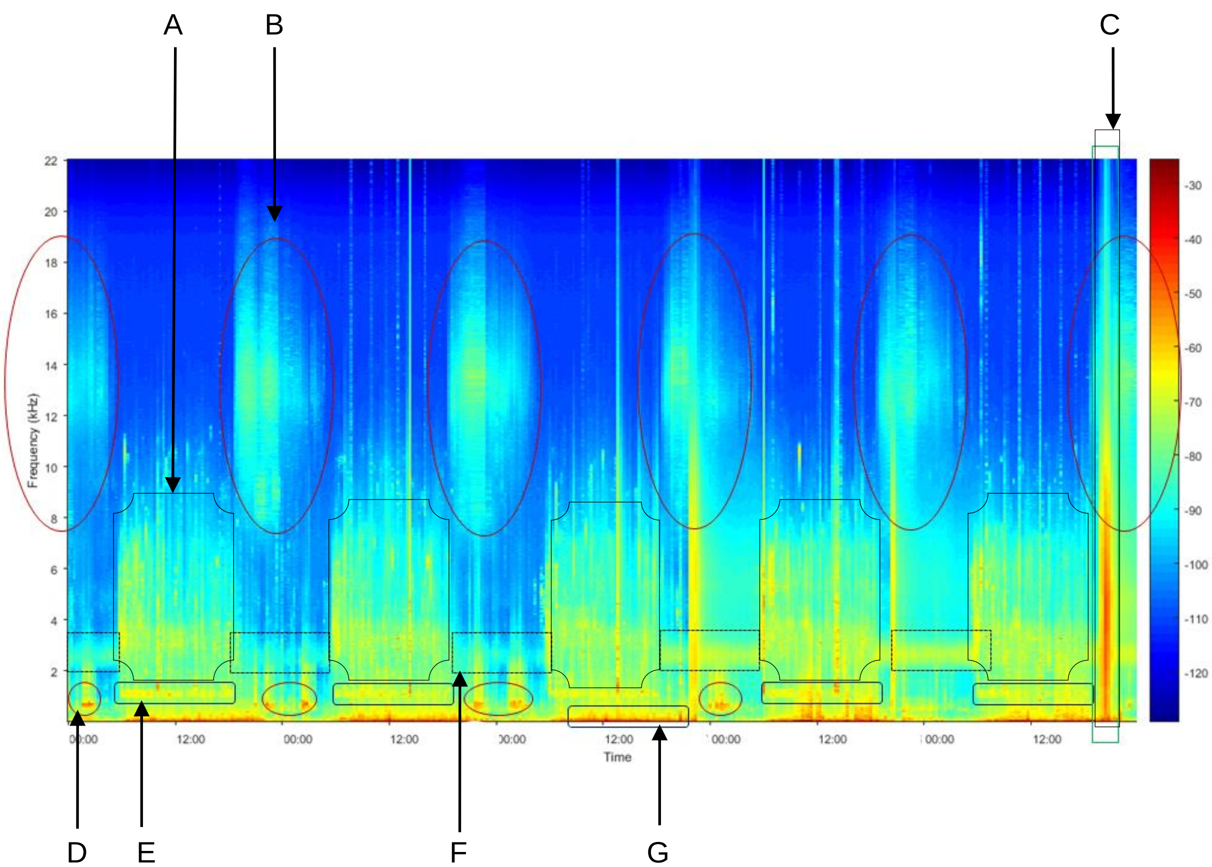

Fig 8. Long Duration False Colour Spectrogram of a period of 5 days. A= High to Medium Frequency Bird calls, B= Insects, C= Rain, D, G=Anthropogenic sounds (Loudspeakers, Vehicles), E=Low Frequency Bird calls, F=Frogs

Disscussion

Over the course of my summer project I have become acquainted with the methods used to study the acoustics in natural environments. I have used a variety of tools to visualize and interpret sound files both quantitatively and qualitatively. LDFC Spectrograms specifically are a novel and powerful tool to see how the soundscape changes with time. Acoustic indices can be calculated from these recording and would give us a range of variables than can be used to interpret the state of the environment (Buxton R. T et al 2018)

ARUs are now increasing used to study a variety of natural phenomena such a sound propagation through different habitats (Yip. D et al 2017), to study the biodiversity or to measure the effect of habitat loss. A variety of both aural and visual experiments can used in tandem in the perceptibly limitless field of bioacoustics (A. Gasc et al 2016) Now that we have the technology to record and store and process large number of sound files at relatively low costs the field of bioacoustics becomes more accessible to more scientists and even the general public. Citizen science driven initiatives can pool a large number of sound files of all kind of species from all around the world (http://ebird.org/). These vast compilations can be processed to make global data sets that could give us a broad picture of the distributions of sounds. This could aid conservation efforts and make people more sensitive to the environment.

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