# Using acoustic monitoring and machine learning to automate the detection of illegal logging and hunting in Costa Rica

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## Introduction

Passive audio monitoring is becoming a useful tool for conservationists as it allows huge amounts of data to be collected at an increasingly low cost (Hill et al. 2018). The automation of the processing of this data through machine learning is improving the use to conservationists further as many human hours can be saved with similar or lower error rates (Kalan et al. 2015). In Costa Rica, these techniques have already been used to track endangered species like the Geoffroys spider monkey, *Ateles geoffroyi*, resulting in a large audio dataset, predominantly collected by Jenna Lawson. If machine learning can be successfully applied to this dataset, it would save a lot of conservationist time and potentially reduce the rates of illegal activity in protected areas of Costa Rica.

## Materials & methods

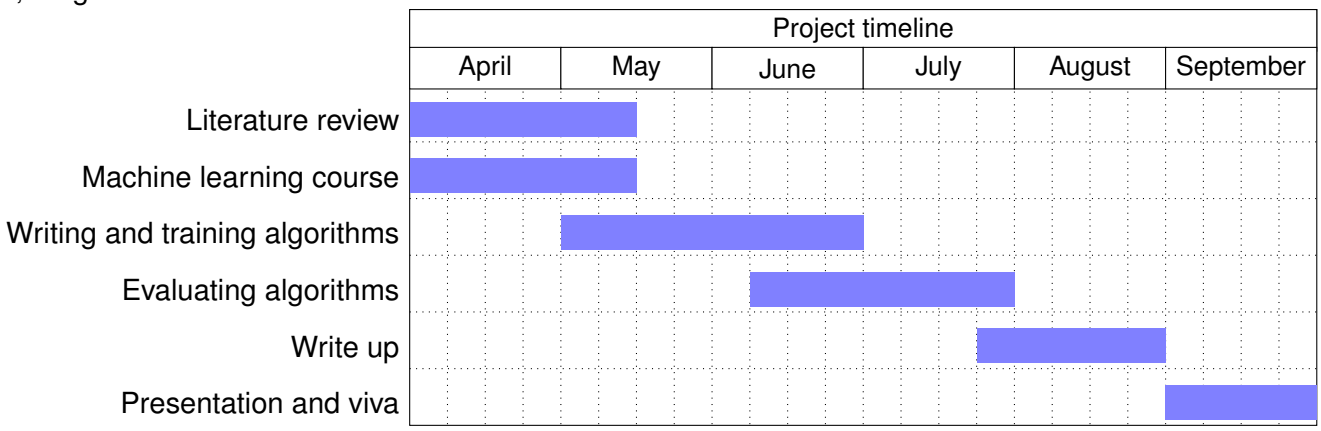
The dataset for this project has been provided by Jenna Lawson. It consists of data obtained from over 200 different sites, from fully protected areas, areas with limited protection, and areas with no protection. Each site has at least one week of audio data available for it and the devices used are the same as those used by Hill et al. (2018). A training dataset has also been provided by Hill et al. (2018) who used similar techniques to automatically detect gunshots in Belize. Training data for both chainsaw and dog barking noises will need to be sourced. Python will be used to write the code as it has proved an intuitive and robust language for machine learning when packages such as scikit-learn are used. Audio data will be converted to a visual representation, a spectogram, which the algorithm will learn to find patterns in, rather than using the audio directly.

## Anticipated outcomes

I hope to create a fully-functioning machine learning algorithm that can detect gunshot, chainsaw and dog barking noises when presented with audio data from the rainforest, with the lowest error rate possible. I anticipate that gunshot detection is the most likely to be successful as I have a training dataset already and in general, gunshots are quite a distinct noise to hear in a rainforest. Chainsaws may be slightly harder to identify as they could be confused with other motor sounds such as cars and motorbikes but it may be possible to train these other sounds out.

## Feasibility

A similar project was undertaken by Duncan last year, with limited success. However, he didn't have a training dataset and this is a crucial aspect of creating a successful machine learning algorithm and makes this project a lot more feasible. Furthermore, the study by Hill et al. (2018) has shown it can be done, for gunshots at least.




## Budget

At this moment in time, neither myself or my supervisors see any potential expenses for this project. If any software or data does require a fee, I will submit a request if and when necessary.

## References

Hill, A. P., Prince, P., Piña Covarrubias, E., Doncaster, C. P., Snaddon, J. L. & Rogers, A. (2018), 'AudioMoth: Evaluation of a smart open acoustic device for monitoring biodiversity and the environment', *Methods in Ecology and Evolution* **9**(5), 1–13.

Kalan, A. K., Mundry, R., Wagner, O. J. J., Heinicke, S., Boesch, C. & Kühl, H. S. (2015), 'Towards the automated detection and occupancy estimation of primates using passive acoustic monitoring', *Ecological Indicators* **54**, 217–226.

## Approval

Dr Cristina Banks-Leite

26/04/19