

## Project Update: September 2021

My second season of field work was conducted from 18<sup>th</sup> August to 3<sup>rd</sup> September 2021 in Tapir Mountain Nature Reserve (TMNR), Belize. University of Southampton team member Dr Jake L. Snaddon assisted me in fieldwork, and with the on-site logistics of the workshop described below. I conducted the following activities:

1. On 24<sup>th</sup> August 2021 I ran the 1-day workshop 'Soundscape ecology, acoustic sensing and use of AudioMoths for monitoring biodiversity and forest threats', covering basic concepts on acoustic theory, conservation technology, and configuration, use and deployment of AudioMoth acoustic loggers in the field, and on acoustic data analysis. The workshop was given to 10 members of the conservation community of Belize. These included undergraduate and PhD students, NGO staff, forest rangers, and academics, from the University of Belize, The Belize Zoo, Panthera Belize, Belize Karst Habitat Conservation, and Pook's Hill Lodge (Fig. 2). The Belize Forest Department, and main local NGOs (Friends for Conservation and Development, Belize Audubon Society), were not present in the workshop due to schedule clashes, however they all showed interest in obtaining training by us in the future. The workshop was very well received, and attendees showed interest in using AudioMoths to monitor local birds, frogs, and for the PhD thesis of an attendee studying bat ecology and conservation in the area.

The workshop was carried out at Pook's Hill Lodge. One AudioMoth acoustic logger was donated to each attendee, to encourage and facilitate the adoption of acoustic technology within the conservation community of Belize for monitoring their local biodiversity.

At the end of the workshop, attendees were invited to answer a short questionnaire about on-the-ground knowledge of general hunting habits in relation to habitat and topography. Results will inform our full deployment of acoustic loggers in the area, to prioritise likely hunting hotspots.



Figure 1. Evidence of an illegal hunting encampment in Tapir Mountain Nature Reserve (left). One of our AudioMoth acoustic loggers, retrieved from the forest in 2021, after two years of deployment (right), and near the hunting encampment shown in the photo on the left.



Figure 2. Workshop given on acoustic monitoring to the conservation community of Belize.

2. We conducted field tests with AudioMoth acoustic loggers coupled to GPS, to improve synchronisation of the devices' in-built clocks, thereby to maximise accuracy of our published algorithm for gunshot localisation. This will allow us to locate individual hunting events in space and time, using hyperbolic navigation, based on millisecond time-lags between devices in detection of the gunshot audio signal. We identified and rectified a previous issue we had in 2020 in Belize, involving build-up of humidity inside the case, which caused malfunctions of several devices.
3. We retrieved 20 AudioMoth acoustic loggers which we had deployed in TMNR in 2019 and 2020, including three supplementary sensors in the western part of the reserve, where we have identified persistent evidence of frequent hunting (Fig. 1). We aim to analyse data from those devices within the next year. Our full deployment of 40 AudioMoths throughout TMNR, on near-optimal locations of devices described in [Piña-Covarrubias et al \(2019\)](#) is currently pending due to ongoing COVID-19 restrictions, which has depleted the numbers of rangers on the ground, who we depend on to conduct our full deployment.

### **Variations to schedule due the COVID-19 pandemic**

The ongoing global COVID-19 pandemic has impacted my original plan to conduct fieldwork mainly in the following ways:

1. *Workshop*: I had originally scheduled the above-mentioned workshop for early-April 2020. However, during my first visit to Belize (late-February to early-March 2020), the COVID-19 pandemic reached the country. Thus, I had to leave Belize before the government closed its borders. I was not able to come back until August 2021, since all international travel before then was prohibited by the University of Southampton. I organised and ran the workshop at the very first opportunity I had since this happened.
2. *Deployment of 40 AudioMoths throughout TMNR*: Originally scheduled for mid/late February 2020, this has not yet been possible. The deployment of these 40 devices within TMNR need the assistance of forest rangers. Currently, and since the COVID-19 pandemic began in early 2020, there have not been rangers appointed on the ground to assist me. I have spoken to local authorities, and they deem this possible by summer 2022.

### **Variations to budget**

1. *Travel arrangements*: Travel between my base at the University of Southampton UK and the field site in Belize was achieved by routing via Mexico due to COVID-19 restrictions to enter the USA from the UK. The return flight was taken from Belize City.

I have added to my expenditures two mandated COVID-19 tests to enter and leave Belize, and one test to enter the UK. Accommodation and daily expenses were not funded by Pook's Hill Lodge; however, they almost completely waived costs of running the workshop, which resulted in an overall reduction of budget expenses.

2. *Equipment purchase*: I bought 15 AudioMoth detectors @ £60 x 10 (including MicroSD cards, USB-A to micro-USB cables), which were donated to the attendees of the workshop. Although this had not been included in the original budget, I believe that the donation of these acoustic loggers will help disseminate knowledge more effectively in the area.