Acoustic monitoring of the Scops owl and other threatened species on Príncipe Island

Project Report for African Bird Club

Bárbara Freitas

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Project description

Location of the project
Príncipe Island, São Tomé and Príncipe, Africa

Project start and end dates
01-09-2021 to 31-12-2021

Team members
-Bárbara Freitas (National Museum of Natural Sciences, Spain & Laboratory of Evolution and Biologic Diversity, France)
-Dr. Martim Melo (Research Center in Biodiversity and Genetic Resources, Portugal & Natural History and Science Museum of the University of Porto, Portugal & FitzPatrick Institute, DST/NRF Centre of Excellence, South Africa)
-Mr Yodiney Santos (Fundação Príncipe, São Tomé and Príncipe)

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Introduction

Effective biodiversity conservation depends on the availability of systematic data on species distribution, population trends, community composition and ecosystem structure (Collen *et al.* 2013). However, monitoring of rare or declining species can be problematic due to detectability or survey constraints – such as when these species are elusive and/or live in remote, difficult to access, locations. This problem can often be minimized, or even entirely circumvented, in the case of vocal species.

Passive acoustic monitoring (PAM) is a non-invasive method for data collection of animals emitting detectable acoustic signals by using automated recording units (ARUs) deployed in the field (Browning *et al.* 2017). They can be used either for multitaxa assessments or can focus on particular species by programming the frequency range to be recorded (Hill *et al.* 2019). Furthermore, they allow for the systematic collection of large data volumes and the creation of standardised and permanent datasets, which can be repeatedly analysed and validated by different researchers (Abrahams & Geary 2020). Although the studies using PAM generate a massive amount of data and may create data storage and management constraints (Abrahams & Geary 2020), this can be overcome with automatic recognition approaches. This type of post-processing method has been improving, as reflected in the growing number of software available (e.g., Aide *et al.* 2013, Bas *et al.* 2017, Marsland *et al.* 2019).

Príncipe island, located in the Gulf of Guinea, is a biodiversity hotspot due to the large number of endemic species (Jones 1994). This island is recognised for having a high concentration of extant endemic birds, and it is also an important centre of endemism of angiosperms, amphibians and reptiles, mammals, coral-reef fishes, land snails, butterflies, and mosquitoes (e.g. Jones & Tye 2006, Ceríaco *et al.* 2018, de Lima & Melo 2021). The 136 km² island of Príncipe and its marine environment has been declared a UNESCO Biosphere Reserve, and the Príncipe Natural Park (PNP) covers around a third of its land area, including all remaining old-growth forest.

Although birds are the best-studied group of the island, the presence of an undescribed Scops-Owl in Príncipe was only recently confirmed on the island (Verbelen *et al.* 2016). Extensive surveys indicated that the species is restricted to the remote old-growth forests, inside the PNP, and that most likely will classify as Endangered or

Critically Endangered in the IUCN Red List for Threatened Species (Freitas 2019). As a member of the *Otus* genus, it is protected under CITES Appendix II. Monitoring this species is a priority, but as it is rare, nocturnal, and it is restricted to remote areas that are difficult to access, the effort required to monitor the Príncipe Scops-owl is prohibitive in terms of human and funding resources.

Nevertheless, a pilot study using an entirely automatic workflow showed to be a precise and efficient method to survey this species. This workflow made use of AudioMoth automatic sound recording devices (Hill *et al.* 2019) to automatically record the owl and TADARIDA (a Toolbox for Animal Detection in Acoustic Recordings Integrating Discriminant Analysis, Bas *et al.* 2017) to automate the detection of recordings with the owl's vocalizations. With this method, it was possible to obtain almost identical data to that of the much more costly and demanding observer-based surveys, both on the distribution of the Príncipe Scops-Owl and on the number of individuals per sampling point (Freitas *et al*. in prep.).

The automatic workflow can immediately be applied to monitor the Scops-Owl, and despite it had been developed specifically to monitor this owl, it can be adapted for other species as well. The Príncipe Thrush is an endemic bird also restricted to these forests, and bi-annual monitoring of this species has been established (Fauna & Flora International (FFI) 2019), but sightings prove too rare to determine population trends (Fundação Príncipe pers. comm.). Adapting this method for diurnal surveys could provide an invaluable contribution to the ongoing monitoring efforts for this Critically Endangered species. This method can also be used to monitor the three endemic species of frog, for which the distribution information is scarce, especially in the south of the island, where the Scops-Owl occurs. The periods of activity of the frog species overlap with those of the owl, so they can be recorded concurrently. As all these five species inhabit the PNP forests, the application of the automatic workflow will allow simultaneous surveys, greatly reducing efforts and costs of field work. Given the facility in obtaining distribution data through this method, it could be used to reassess species under Red List category A, B and C (distribution and population trends), thereby contributing information for the long-term conservation strategy for these species.

Aims

This project aimed to build local capacity for this automatic workflow, by training local NGO staff and Natural Park rangers to implement all steps of the method – from the deployment of the automatic recorders to data retrieving - to be used as a monitoring tool for this likely threatened species, as well as other vocal species. In this report we describe the completed project activities and outputs.

Project activities and outputs

General description of activities

October 2021

4-5 - Presentation of the Principe Scops-owl and pilot project using the automatic workflow; Workshop 1st part: introduction to automatic recording and benefits for long-term monitoring, how to use AudioMoths and what to do before to go to the field.

6-8 - Fieldwork: deployment of AudioMoths along two different transects, nocturnal observer-based surveys to train identification of the Principe Scops-owl song and count its presence along the transects.

9-10 –Retrieve recordings from AudioMoths, backup of data, formatting SD cards, organize data.

11-12- Workshop – 2nd part: What is TADARIDA software? How to use it for automatically identify the Principe Scops-owl songs and other species?; Analysis of data obtained during fieldwork.

Public presentation

The Principe Scops-owl was only recently confirmed (Verbelen *et al.* 2016). Since then, there has been an effort to collect information on this very little known species, not only to allow its formal description, but also to know its ecological status.

The first activity of the project was a presentation on the Principe Scops-Owl (see Appendix 2.1) based on the work developed previously. We explained how this owl was discovered, how it is related to other species of the same genus, and its characteristic morphology and very distinct vocalization. Besides, we presented its

most updated map of distribution and density estimates, which resulted from a thorough observer-based survey along the entire island (Freitas 2019). This map showed that the owl seems to be restricted to the remote old-growth forests, inside the Natural Park. Having into account its density estimates, it most likely will classify as Endangered or Critically Endangered in the IUCN Red List for Threatened Species. Additionally, we discussed about potential threats to this species, such as introduced species and disturbance of its habitat.

Finally, we showed the successful results of the pilot study on the acoustic monitoring of the Principe Scops-owl and introduced to the working team the methods used for both the automatic recording of the songs and it automated detection. Then, the benefits of this method and applicability for other species were exposed.

Collaboration and capacity building of local technicians and natural park wardens

Workshops

During the workshops, we trained 10 people with the aim of ensuring the persistence of skills and knowledge on the application of the automatic workflow in Príncipe so that the method can keep being used for a long-term monitoring plan. This included local staff members from Fundação Príncipe and Natural Park, some local and international volunteers (see https://fundacaoprincipe.org/pt/blog-noticias/blog-noticias/curso-monitorizao-acstica-do-kitoli).

These workshops were divided in two parts, corresponding to tasks that must be done before and while doing fieldwork (first part), and after fieldwork (second part). The first one was dedicated to explain how to use AudioMoths, all the components needed for its normal operation, and how to adapt its settings to specific aims (see appendix 2.2). During this part, the working team configurated the AudioMoths that we used in the field on the following days (Figure 1; see fieldwork section).

The second part of workshops consisted in practicing the retrieval of the recordings from the Audiomoths, organizing data and datasets, and to understand the importance of having data backups (see appendix 2.3). This part was also dedicated to train the use of TADARIDA software to automatically obtain information on the

presence of the Príncipe Scops-owls form the recordings obtained in the field, and the procedures needed to adapt this method for other species (see appendix 2.4). Results from this analysis revealed two new points in which the Principe Scops-owl was detected by the software (see appendix 3).

Figure 1. Working team setting AudioMoths.

Fieldwork

In order to practice and apply the methods explained during the workshop, we spent two nights at Boca do Inferno, an area where the owl is known to be present. We set two transects, one in each night. Within each transect, point counts were spaced at least 150 m apart, totalling 13 points. We attached an AudioMoth to the nearest tree of each point count using a cable tie (Figure 2), at approximately 1.70 m above the ground and these devices were programmed to record from 20:00 h to 04:00 h, in cycles of 1 min recording followed by 4 min pause. The schedule and cycle were chosen based on results obtained from the pilot study. AudioMoths set in the first

transect were recording for two nights and the ones set in the second transect were recording for one.

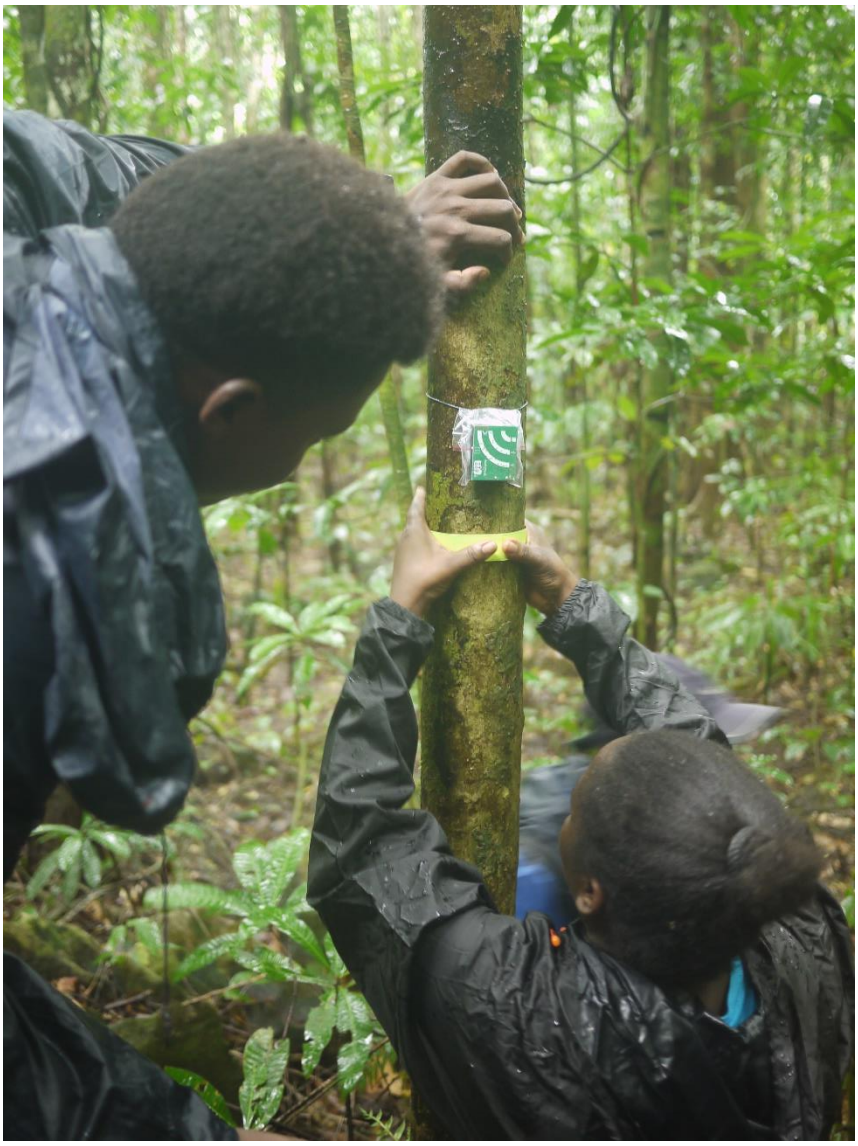

Figure 2. Deployment of AudioMoths in the field.

Figure 3. Working team during fieldwork at Boca do Inferno, Príncipe Island.

Data

Recordings obtained during this project, as well as all the material used for the workshops were shared between the project members, archived in the hard drive and uploaded on OSF repository (https://osf.io/b76nk/), which was not possible due to size constraints. To get further information please contact Bárbara Freitas (barbarabfreitas6@gmail.com) and/ or Yodiney Santos (yodi.santos@fundacaoprincipe.org).

Monitoring protocol

Based on previous work, on the information provided in the workshops, and on the training period, it is possible to prepare a monitoring protocol for the Príncipe Scops-Owl. This should include the methodology to deploy the AudioMoths and the automatic detection by TADARIDA, as well as the establishment of sampling priorities. This document can also detail the process needed to adapt the automatic workflow to other species, such as the Príncipe Thrush and the three species of frogs of Príncipe.

Challenges

During the project, we faced some difficulties, which halted the progression of the project as planned. Nevertheless, these challenges have been identified and can be improved upon in future work:

-Stock of AudioMoths and protection cases - we realized that this equipment was sold out and we would have to wait until 2022 to buy them. After discussing this situation with Fundação Príncipe and funders, we all agreed on proceeding with the trip and planned activities with the ten AudioMoths that Fundação Príncipe had by then. In 2023, Fundação Príncipe bought the needed AudioMoths and cases to keep going with the monitoring project following the procedures explained during the workshops.

-Timetable modifications – due to a flight cancellation (from São Tomé to Príncipe) and unavailability of AudioMoths, we had to readjust the time dedicated to presentations and workshops, and time spent in field, respectively. The presentation of the Príncipe Scops-Owl was done just before the workshop about the use of the AudioMoths and not as an isolated event. As there were not enough AudioMoths to implement a monitoring protocol, we decided to use fieldwork as a training opportunity and transfer of practical knowledge. Thus, we only went to one field location and so fieldwork lasted three days instead of seven. We retrieved the AudioMoths on the last day and analysed the data from those two nights on the two following days. Finally, we did not publicly present the Príncipe Scops-Owl in São Tomé and Príncipe since the formal description was not published yet (it was published in November 2022). Nevertheless, we are in contact with BirdLife International and BirdLife São Tomé members that can promote this presentation when best suited.

Conclusion

This work constituted an important step on the monitoring of the Príncipe Scops-Owl and potentially other endemic species of the island as well. By benefitting from an entirely automatic workflow (automatic recording + automated detection), this method will allow to increase the extension of coverage area and frequency of the

surveys, and to obtain detailed information of population fluctuations, in time and space, with much less human-effort and at a lower cost. Therefore, it can play a central role in the long-term conservation strategies developed for Príncipe island.

Acknowledgements

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Appendices

1.Financial report

The total amount requested to ABC was £4,980. A summary of expenditure is provided below. Full receipts are available on request.

Flights for Bárbara and Martim were supported by Portuguese National Funds through the project NORTE-01-0145-FEDER-000046, supported by Norte Portugal Regional Operational Programme (NORTE2020), under the PORTUGAL 2020 Partnership Agreement, through the European Regional Development Fund (ERDF).

The official local currency is the Santomean dobra (STD), but large payments are usually made in Euros (conversion rate: 1€ = 0.86 GBP, since they have a fixed exchange rate (1 € = 24,500 STD).

Description	Budget €	Budget GBP	Spent GBP	Justification
Flights (2 people; not requested)	2000	1728	1728	
Visa, Covid-19 test and medication (2 people)	310	268	182	Visa=34; Covid tests=128; Medication=20
Fuel (for NGO's cars and boat)	400	346	60	Field site changed so boat was not needed.
Accommodation	520	449	449	
Camping food	300	259	~150	Field trip was shorter than planned
Local staff (4 people)	950	821	821	
Meeting space in Príncipe and São Tomé (not requested)	320	276	0	Arribada Initiative allowed us to use their meeting room for our presentations and workshops for free.
Hard drive 2TB	70	60	58	
AudioMoths (18) + cases (30)	2637	2278	3064.5	These were bought later (due to lack of stock) at a different price than budgeted
USB cable (2)	8	7	5.2	

Memory card (30)	480	415	113	We only bought 12. The other 18 will be bought by Fundação Príncipe as soon as the new AudioMoths arrive.
Batteries	90	78	96	There was a need for more batteries than it was planned.
Waterproof reflective tape	Not budgeted	Not budgeted	13	Used to mark the transects so that they are easy to follow during the night.
Memory card reader SD/MicroSD	Not budgeted	Not budgeted	6	
Plastic Zip Bags	Not budgeted	Not budgeted	5	Plastic Zip Bags were used to protect Audiomoths as the waterproof cases were not available to buy in time of this trip.
TOTAL REQUESTED	5,765	4,980		
TOTAL	8,085	6,984	5,022.7	

2.Power-point presentations:

2.1-Principe Scops-owl presentation (00-PrincipeScopsOwl.pptx)

2.2-How to use Audiomoths (01-Audiomoth.pptx)

2.3-How to retrieve recordings from AudioMoths and organize data (02-Guardar_audios.pptx)

2.4- What is TADARIDA software? How to use it for automatically identify the Principe Scops-owl songs and other species? (02-TADARIDA-Otus_outrasEspecies.pptx)

3.Fieldwork sheet with presence records obtained through the automated workflow:

AudiomothID	CartaoID	Config	GPS	N.GPS	Lat	Lon	Elevação	DataIN	DataFIM	Notas	Equipa	Leader	Presença
FP003	CM-003	Kitoli01	460	Trex-2	1.60464	7.40209	304	20211006	20211008		Tordo	yodi	Não
BM002	CM-002	Kitoli01	461	Trex-2	1.60520	7.40085	314	20211006	20211008	kitolí ouvido no ponto	Tordo	yodi	Sim
BM006	CM-003	Kitoli01	462	Trex-2	1.60521	7.39934	327	20211006	20211008	ruído continuo na gravação	Tordo	yodi	Não é possivel saber
BM003	CM-004	Kitoli01	463	Trex-2	1.60649	7.39857	364	20211006	20211008	O Adiomoth gravou pouco, com problema	Tordo	yodi	Não
FP004	CM-005	Kitoli01	464	Trex-2	1.60728	7.39741	368	20211006	20211008	audiomoth recolhido com agua dentro do saco	Tordo	yodi	Não é possivel saber
FP011	CM-006	Kitoli01	465	Trex-2	1.60611	7.39640	378	20211006	20211008	kitolí ouvido no ponto	Tordo	yodi	Sim
FP007	CM-007	Kitoli01	466	Trex-2	1.60355	7.39952	286	20211007	20211008		Tordo	yodi	Não
FP010	CM-008	Kitoli01	467	Trex-2	1.60197	7.39925	305	20211007	20211008		Tordo	yodi	Não
FP009	CM-009	Kitoli01	468	Trex-2	1.60072	7.39786	330	20211007	20211008		Tordo	yodi	Não
FP005	CM-010	Kitoli01	469	Trex-2	1.59980	7.39662	381	20211007	20211008		Tordo	yodi	Não
FP008	CM-011	Kitoli01	470	Trex-2	1.59828	7.39636	400	20211007	20211008		Tordo	yodi	Não
FP001	CM-012	Kitoli01	471	Trex-2	1.59721	7.39736	405	20211007	20211008		Tordo	yodi	Não
FP002	CM-013	Kitoli01	472	Trex-2	1.59568	7.39766	423	20211007	20211008		Tordo	yodi	Não