Claudia Santori
Anuran biodiversity project, Mariarano, Madagascar

This report follows the successful field work and subsequent write-up of my dissertation which I carried out this past summer thanks to the Travel Grant awarded to me by the Royal Society of Biology. My dissertation was awarded a Distinction by my MSc programme's examiners.

I left to Madagascar on 17th June 2016. I flew to Antananarivo and then travelled to the Mahamavo forest, via Mahajanga, a beautiful coastal town on the West of the country. Upon arrival at the forest, I decided which areas were going to be my study sites by consulting with people who had worked on amphibians in previous years: I chose 10 permanent water bodies where I could study the local frog communities as well as test different monitoring techniques. The equipment I used regularly was a portable recorder Roland R-05, zip-lock bags which aided the collection of frogs, and callipers and Pesola scales to collect morphometric data of each captured individual.

I visited my 10 study sites four times. At each visit, I performed two types of frog survey: an acoustic survey, during which I recorded the soundscape for 20 minutes with the Roland recorder, and a capture-encounter survey (CES), where I looked for frogs and captured as many as possible right after the recording or at least an hour later. If a frog escaped the capture but was identified, it was still counted. Both surveys yielded a species list for the site: for the CES this was straightforward. For the acoustic survey, I used the recording in two ways: firstly, I listened to it and listed all calling frog species – a process which yielded a species list for each visit, to compare to the one gathered from the capture-encounter survey. Then, I used the recording to test the programme Sound-ID, a sound recognition software – the potential future of amphibian conservation.

Sound recognition software offers the opportunity of making frog recognition more precise and quick by automating the identification process: once call templates are created, the programme can scan a long recording and determine whether similar sounds to the templates are present. I wanted to test whether it would be possible to introduce Sound-ID as a tool in amphibian monitoring in the Mahamavo forest in the future. To assess this, I created templates for all the frog species I recorded calling, and then tested whether the software would correctly identify the species by using them to scan a recording which contained the target species and a recording which did not contain it (a potential source of false positives). I completed my field work by the end of July 2016, and returned to the UK for analysis and write-up.

My analysis went relatively smoothly for the most part. I described the frog communities found at each study site, and determined whether human disturbance influenced the community characteristics. Then, I determined whether capture-encounter or acoustic surveys were the better method to use overall, and also at a species-specific level. Then, through the calculation of occupancy models, I also determined whether a particular survey method was better than another for detecting the species present. With occupancy models, I could also give advice for the design of a future monitoring programme at a local level.

The most challenging part was assessing the potential of the Sound-ID software to correctly match the templates created to frog calls from the field recordings. Mostly, it was difficult to build very good templates due to the recordings' quality. This was due to the fact that the calling frogs were often very far away from the recorder, because of the size of the water bodies within which they were found, resulting in a low sound to noise ratio. Finally, I compared my finding with historical records of frogs collected yearly in the area since 2012, to see whether the species richness changed over time.

This is my conclusion, reported exactly from my dissertation write-up:

"The permanent water bodies sampled were an intriguing system which is inhabited by a variety of species. The surveys conducted throughout this field season brought new insights on both the composition of the

anuran communities at the visited sites, and on the calling behaviour of the species present. There seemed to be small differences in species compositions between the water bodies, however human disturbance wasn't a factor affecting this. Future visits to these sites should be performed also during the wet season, during the day time, and collecting habitat data to investigate what could be driving the variation noticed.

CES were overall a more effective method to survey anurans in Mahamavo during the dry season, possibly due to the inactivity of some of the species at this time of year (Glos, 2003). However, by using both raw species counts and detection histories, this study supported that acoustic surveys are more effective than CES for particular species. Three species were indeed more detectable by their calls; therefore, acoustic methods should be incorporated in future monitoring programmes in this area to increase the chances of detecting them. Furthermore, the proportion of sites occupied by each species tended to be higher when calculated accounting for imperfect detectability, emphasizing the value of this exercise in studying species distributions and designing a monitoring programme.

I demonstrated that SoundID has the potential of correctly identifying a frog species by its call, even if with a very low matching rate. This confirms that this software has the potential of being used to build presence/absence matrices and inform future occupancy models (Campos-Cerqueira, 2016). However, more work needs to be done for building more robust templates to achieve higher accuracy, in order for SoundID to be reliable and identify calls in every circumstance. A test with different recording equipment, improving the templates' library, as well as approaching new techniques which may be more valid in noisy environments are all worthwhile future directions.

Finally, the historical surveys supported the validity of this year's surveys, as well as confirming that human disturbance has not been impacting the anuran communities. However, they pointed out that there was not complete correspondence between species composition at each site throughout the years. This confirms that a sound long-term monitoring programme is needed to capture the nuances of this system. Through the occupancy models this study brought recommendations for a future design which should be followed to reach the most effective output. As reported by D'Cruze *et al.* (2009), monitoring efforts in Madagascar need to improve and diversify, especially in non-protected areas. This project is an important step towards the design of a modern long-term monitoring programme in Mahamavo, which has the potential of being a very successful endeavour."

Thank you ever so much again for supporting this project. It was overall a success, and it definitely paves the way to future research in this field.

References

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