

Final Report: Stiftung Artenschutz 2016

Project Title

Predictive Modelling of Amphibian-Environment Interactions: Responses of Amphibians to Climate Change at the Micro-Habitat Level.

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Project Background and Objectives

In 2001 the Global Amphibian Assessment (GAA) was launched in order to document the conservation status of amphibians worldwide. By 2004 the GAA had reported that one third of all described amphibian species were categorised as threatened, with habitat loss, climate change and *Batrachytridiomycosis dendrobatidis* (Bd) high on the list of drivers behind species declines.

Madagascar is one of the world's foremost biodiversity hotspots and demonstrates one of the highest degrees of amphibian endemism in the world, with at least 247 recognised species, and if predictions are correct, as many as 465 species. However, due to the number and intensity of threats the need for biodiversity conservation in Madagascar remains high and should be classed as a priority.

Mantella aurantiaca (golden mantella) are endemic to the Moramanga district in Madagascar with three distinct population clusters in Ambatovy, Mangabe and Torotorofotsy, with the latter being the most isolated population. This species is Critically Endangered (CR) due to its small area of occupancy, declining numbers and level of threat to individuals, habitat and breeding ponds posed by collectors, mining companies and forest removal. In order to save the species from extinction in the wild a number of conservation initiatives have been undertaken. Local conservation organisations are able to have the greatest and most rapid impact on the protection of this species by either working with local communities who gain direct benefits from protecting habitat or, in some cases, working with large companies involved in the removal of the forests to mitigate or offset the results of forest clearance. However, much of the future mitigation and habitat protection work will be based upon scientific evidence provided by both *in* and *ex-situ* studies focussed on specific habitat requirements. The current project is the first of its kind on this species anywhere, designed to test and provide information on a number of different habitat and environmental scenarios which may then be related to changes in observed behaviour. Results from the study will be used to inform in-country biologists and conservation managers on the optimum habitat requirements of the species and could then be applied whether protecting existing habitat or providing new or restored areas as part of biodiversity mitigation or offsets.

Our results and objectives are summarized;

1. Determine microhabitat use for *Mantella aurantiaca* using a combination of experimental (*ex situ*) and observational (*in situ*) approaches.
2. Determine the range and potential habitat use of the species a) habitat alteration (changing land-use) b) habitat management (reintroduction) and c) prolonged climatic alteration.
3. Determine and recommend appropriate conservation interventions appropriate to species survival

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using results from *in-situ* and *ex-situ* data. 4. Capacity building and training of in-country (Madagascar) conservationists and local communities. 5. Dissemination of results to key stakeholders (i.e. Malagasy government/ANGAP, Ambatovy, Association Mitsinjo) - Use of data to assist habitat management for the species and build awareness among stakeholders. 6. Production of peer-reviewed publications. 7. Building awareness of amphibian conservation issues with public audiences both within the EU and Madagascar i.e. via production of materials for use at Paignton Zoo, Project Mitsinjo, ATASS Respect, and Durrell Institute of Conservation and Ecology, University of Kent.

General Framework/Preliminary Research

This research began in October 2013 and is scheduled to continue until September 2018. in the amphibian bio-secure facility at Paignton Zoo Environmental Park. Eight custom made tanks were constructed on site, each measuring 1m x 780mm x 1.2m with a viewing/access window at either end. Each tank was fitted with a small camera connected to a digital video recorder set to record 24 hours per day. Two rooms within the amphibian bio-secure centre were used to house 4 tanks each, the rooms were kept at 19°C (room 1) and 24°C (room 2). We then introduced 12 golden mantellas to each tank with a 2:1 male to female ratio.

Our first priority was to ascertain the diel activity patterns of the frogs by recording continuously for 24 hours each day over a period of 10 consecutive days. We then reviewed the recorded material via instantaneous scan sampling on hour and half hour intervals noting frog number presence/absence, behaviour, area of tank and with which type of substrate they were associated (leaves or coconut mat). Statistical analyses were carried out using SPSS™ and R™ (Analytical software). Our next priority was to look at *M.aurantiaca* habitat preferences under present and projected climate change scenarios for Madagascar. The project longer term will also involve building awareness of amphibian conservation issues with public audiences both within the UK and Madagascar and the dissemination of results to key stakeholders (i.e. Malagasy government/ANGAP, Ambatovy, Association Mitsinjo) alongside the production of peer-reviewed publications.

Planned activities and measures

Preliminary trials had been helpful in smoothing out any initial problems with either obtaining or construction and maintenance of the tanks, recording schedules and equipment, data collection, ethograms, methods and techniques. This phase completed, I then manipulated habitat/environmental settings and recorded habitat preference data. In-situ data continues to be collected by our Malagasy partner organisations, I also plan to join them again in collection and analysis of data in the near future.

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Participating Organisations /persons

UK Partners: Mike Bungard (Curator of Lower Vertebrates and Invertebrates, Paignton Zoo), Professor Richard Griffiths (University of Kent), Dr Lee Brady (University of Kent), Dr Gerardo Garcia (Curator of Lower Vertebrates and Invertebrates, Chester Zoo).

Madagascan Partners: Julie Razafimanahaka (Director of Madagasikara Voakajy) Christian Randrianantoandro (Manager at Madagasikara Voakajy) and Devin Edmonds (Director of Association Mitsinjo), an outline of their mission statements and aims is given below.

Madagasikara Voakajy is an NGO based in Antananarivo and was founded in 2005 by collaboration between the universities of Kent, Aberdeen, Antananarivo and Toliaro with the aim of training Malagasy scientists and others in conservation techniques. A staff of over thirty people now oversee a number of important research, outreach, training and educational programs. Their aim is to use practical conservation biology methods in partnership with community based initiatives in order to protect endemic Madagascan wildlife.

Association Mitsinjo is an NGO with a staff of around 10 people based in Andasibe, Madagascar. Founded in 1999 their primary purpose is to promote and oversee conservation projects and sustainable practices throughout Madagascar by working closely with local communities and overseas organisations. Mitsinjo is linked internationally to a number of *ex-situ* establishments and universities including the University of Antananarivo, Durrell Institute of Conservation and Ecology at the University of Kent, Durrell Wildlife Conservation Trust and Chester Zoo to name but a few. Their primary aims are conservation based training, ex-situ breeding and reintroductions, husbandry, research and knowledge sharing between partner institutions. Association Mitsinjo is currently working with Ambatovy Minerals S.A. and Madagasikara Voakajy in order to maintain an assurance population of *M. aurantiaca* at their bio-secure amphibian breeding facility in Andasibe

Description of expected results

Once the climatic envelope and habitat requirements of the species is known, further surveys and habitat assessments can be carried out to identify areas for habitat creation and management for the species, as well as the potential for assisted colonisation. Our project partner at Mitsinjo is already producing captive-bred mantellas suitable for reintroduction, and the research from this project will ensure that appropriate release sites are identified in accordance with the new IUCN guidelines. The results will also feed into the golden mantella action plan and the ongoing IUCN action plan for Malagasy amphibians.

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Summary

M.aurantiaca is a specialist tropical montane species, without a deeper understanding of its specific habitat needs we are currently unable to determine the optimum habitat to save, create or translocate it to in order to allow its persistence in the wild. Without studies such as this future actions will remain best guess, a scenario which is unacceptable. We have at Paignton Zoo a unique facility which we aim to use to bridge the *in-situ* and *ex-situ* divide. The Froggotron system we are using is designed to gather important data under simulated conditions, a task that would be impossible in the wild; this will be combined with field data and used to build species distribution models that can delimit the range and potential areas for reintroduction, if this is needed. In this way the research can lead logically to a strong conservation outcome - improved conservation status in the wild!

Report: Stiftung Artenschutz funded fieldtrip 2015

Duration of Madagascar Visit: 14th January 2015 –January 28th 2015

Team

1. Wayne Edwards BSc MSc PhD Candidate, DICE University of Kent and Paignton Zoo Environmental Park.
2. Ben Baker, Amphibian and Reptile Department Team Manager at Chester Zoo.
3. Louiza Passos, PhD Candidate, University of Manchester and Chester Zoo.
4. Eddie Fanantenana Rakotondrasoa, Head of Fieldwork, Madagasikara Voakajy.

Ben Baker's role was to follow up on donations and community projects supported by Chester Zoo. Louiza Passos's role was to collect data on *M. aurantiaca* population numbers by way of capture-mark-re-capture techniques, marking was achieved by injecting frogs with fluorescent elastomer. Eddie Rakotondrasoa was present to guide and oversee fieldwork as well as provide a direct link between ourselves and Madagasikara Voakajy whilst in-country.

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Aim of visit for the group and benefit to zoo research

- To assess the latest field research and habitat restoration/mitigation and status of *M. aurantiaca* both in the wild and *ex-situ* establishments in Madagascar.
- To advise in-country conservation organisations and local communities as to the next most effective steps and where to focus conservation efforts for *M. aurantiaca*.
- To advise local conservation organisations on their continued negotiations with others involved in habitat destruction and degradation.
- To visit and assess existing, potential and restored breeding ponds and habitat.
- To determine future research needs in-situ and timescale thereof.
- To see the target species in the wild and get a better idea first hand of the kind of conditions the frogs require.
- To take a number of habitat data including Air, surface and frog temperatures as well as humidity, light and UVB levels to compare and set up *ex-situ* research at Paignton Zoo.
- The data collected informed research using the Froggotrons based at Amphibian Ark. Results from in-situ analyses will also be compared with results obtained from the Froggotrons over the last 12 months.
- Direct contact and sharing information with Madagasikara Voakajy and Mitsinjo who currently lead research and conservation efforts in Madagascar.
- To obtain as much species distribution and historical data as possible on *M. aurantiaca*.
- To raise the profile of conservation and research efforts being conducted for this species at Paignton Zoo.
- To determine future fieldwork to be carried out and timescale thereof.

My aim was also to carry out surveys in three different forests surrounding *Mantella aurantiaca* breeding ponds. Data were collected via 5m x 5m quadrats on UV, LUX, frog temperature, surface temperature, ambient temperature, humidity, canopy cover, leaf litter depth and coverage, presence of water and altitude. The position of each quadrat was recorded by GPS. Much of the equipment I had bought with funding from the German Zoos Organisation was then donated to Malagasy field research teams.

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Findings

- We found that the monitoring of breeding ponds and surrounding habitat are still being carried out during the rainy season (November – February) by both Madagasikara Voakajy and Association Mitsinjo. During monitoring a number of environmental data are taken such as temperature, humidity, leaf litter depth and canopy coverage and number of frogs as well as pond temperature, light level and the presence or absence of tadpoles.
- We found that 8 clusters of breeding ponds are being, or are to be, destroyed as they fall within the footprint of Ambatovy Nickel and Cobalt mine. The mine is currently funding the Mitsinjo breeding facility and any individual frogs caught are transferred to this facility before, or as, ponds are destroyed (it should be noted that they only capture a sample before the habitat is completely destroyed).
- Madagasikara Voakajy are in negotiations with the mine to provide funding for work on 24 new or restored breeding ponds to 'offset' the 8 lost. So far the mine has promised to provide funding for the work to be carried out by local people with the areas to be decided after further analysis.
- There seems to be a healthy population of *M.aurantiaca* based in Mangabe but further surveys need to be conducted.
- The Torotorofotsy population appears to be much lower in number, but again further surveys are needed for confirmation and to determine future conservation actions.
- On the whole the conservation effort is complicated but moving in the right direction, in order to move to the next level more monitoring and survey work is required as well as in depth analysis of habitat and environmental variables.

Conclusion

The trip provided an opportunity to collect much needed data for the PhD study at Paignton Zoo; it also provided an ideal chance to network with other *in-situ* and *ex-situ* organisations. I think in a time when emails are so easy to send, receive and discard out of hand, actually meeting our Malagasy partners directly and discussing conservation strategies is invaluable in promoting trust and a good working relationship. I intend to repeat the fieldwork aspect of the study either in November this year or January next year (dependant on funding). The results from this *in-situ* and *ex-situ* PhD research will be used by organisations in Madagascar to inform future management of the species, the methods and techniques I use could be adapted for other species too.

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Breakdown of expenditure for research trip to Madagascar

Funds were needed for fieldwork in Madagascar to collect the crucial microhabitat data that would then be used to programme the Froggotron system with more accuracy. Without those data, it would be difficult to know whether our simulated climates/habitat preference work was appropriate. This important aspect of the project could not have gone ahead without funding.

Equipment purchased for Madagascar	£'s	
EL-USB-2 Temperature and Humidity Data Loggers (X9)	461.36	
Aluminium Flight Case Box 460x330x150mm Divides, Tool Panel	20.8	
Smart Weigh GEM20 High Precision Digital Milligram Scale 20 x 0.001g	19.99	
Rolson 27279 Infrared Thermometer	31.34	
Rolson 27279 Infrared Thermometer	31.34	
Pocket Light Meter - CEM DT-1300	39.99	
Pocket Light Meter - CEM DT-1301	39.99	
8" / 200mm Digital Vernier Calipers	24.95	
Zoo Med UVB Dig UV Radiometer	232.25	
Zoo Med UVB Dig UV Radiometer	232.25	
Zoo Med UVB Dig UV Radiometer	187	
Waterproof Case for Samsung Galaxy S3/S4	9.99	
Garmin Protective Carry Case	13.99	
Garmin Carabiner Clip for Handheld GPS	7.39	
Garmin Belt Clip for Handhelds	6.99	
Hard Spectacles Case	4.25	
Garmin GPSMAP 62 Handheld GPS Worldwide	212	
Plasma Ultra Compact +3C Sleeping Bag	39.95	
Chartwell Watershed Waterproof Book	7.4	
Chartwell Watershed Waterproof Book	7.4	
Berghaus Twentyfourseven 30L Backpack	34.04	
Lifesystems Adventurer First Aid Kit	13	
Regatta Water Resistant Walking & Working Cargo Combat Trousers	16.98	
Regatta Water Resistant Walking & Working Cargo Combat Trousers	16.98	
5 Pairs Hiking Socks	7.99	
Rechargeable Wind-Up Torch - USB Charging Function	16.83	
Petzl Tikkina Headlamp	18.91	

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Freeplay Energy - wind-up radio	24.95	
Powermonkey Extreme 5V and 12V Solar Portable Charger	90.95	
Berghaus Men's Explorer Ridge Leather Gore-Tex Waterproof Walking Boots	79.99	
Vango Banshee 200 Tent	91	
Inflatable ground mat	16	
Anti Malarials	8.78	
Pack a pillow	3	
Batteries	8.99	
Batteries	5.5	
Plasters	5.68	
Mosquito repellent	7.25	
Sun screen lotion	12	
Total	2109.44	
Miscellaneous	£55	
Krusell 95329 Sealabox Waterproof CASE	£10.99	
Flight change	£35.00	
Baggage	£48.00	
Total	£148.99	
Hotels, camping, transfers and evening meals	£'s	Date
1 x night Novotel Roissy CDG	84.16	14/01/2015
Transfer from airport to accomodation, Antananarivo	15.23	15/01/2015
1 x night Maison du Pyla Guesthouse, Antananarivo	20.31	15/01/2015
1 x night Maison du Pyla Guesthouse, Antananarivo	20.31	16/01/2015
1 x night Maison du Pyla Guesthouse, Antananarivo	20.31	17/01/2015
1 x night Maison du Pyla Guesthouse, Antananarivo	20.31	18/01/2015
1 x night Espace Diamont Hotel, Moramanga	8.88	19/01/2015
6 x nights camping, fieldwork and return transfer to site	140.64	20/01/2015
1 x night Maison du Pyla Guesthouse, Antananarivo	20.31	26/01/2015
Transfer from accommodation to airport, Antananarivo	15.23	27/01/2015
Hotel Evening Meals	31.73	
Total	£397.42	
Cash withdrawal in Paris	£203	
Total		
£2,109.44	equipment	
£148.99	Miscellaneous	
£203.00	Cash withdrawals	
£397.42	Travel and Accommodation	

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Grand Total		
£2,858.85		

Explanation

Originally I had planned that a large percentage of the funding would go towards return flights to Madagascar, however the University of Kent were able to supply the funding for these which meant I was able to put the Stiftung Artenschutz funding towards much needed field research equipment. On occasion it was necessary to purchase more than one of the same item, I did this so that I could provide a local Malagasy research team with extra/needed equipment to monitor habitat variables. Other equipment (such as camping equipment etc.) was also passed to our guides or helpers from local communities.

Summary

Worldwide, amphibians are in trouble, with more species under threat than either mammals or birds. Madagascar's amphibians follow the general trend with climate change, habitat loss, invasive species, disease, pollution, and people taking species faster than they are able to replace their own numbers continuing to exact a heavy toll. I believe there are many reasons to conserve biodiversity, but ultimately I think where damage has been done to another species, its environment or food source, we have a duty of care to put it right. My work is part of Paignton Zoo's contribution toward meeting that obligation and is an excellent example of how collaboration between zoos, universities and field conservationists can provide real added value for conservation. The importance of the Malagasy fieldtrip, with significant funding by Stiftung Artenschutz, should therefore not be underestimated. It allowed the collection of environmental and habitat variable data which was then used back at the zoo to set environmental parameters within the Froggotrons (climatically controlled tanks) to simulate those of the forest floor. The trip also promoted a good working relationship with our Malagasy partners, and they continue to send data sets for mantella distribution and population numbers as well as further surveys of forest floor variables (using the equipment we left for them).

Progression

Chapter one of my PhD Thesis is written, chapters two and three are near to completion. I intend to publish a number of the finished chapters and will of course acknowledge *The Amphibian Conservation Fund of German Zoo Associations and private participants in the German-speaking region, as well as Stiftung Artenschutz and Verband Zoologischer*

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Gärten e.V. as being important contributors. I am presently completing my PhD part time due to being self-funded, however I will be seeking an intermission (gap year) very soon. Hopefully this will allow me to raise the funds/sponsorship I need to return and concentrate solely on the last year of write up and study. I shall send you a copy of my PhD On completion, as well as any published papers or publications in which you are acknowledged. Finally, I would like to say thank you so much to everyone at Stiftung Artenschutz for supporting my research and this project, it was very much appreciated.