

The Rufford Small Grants Foundation

Final Report

Congratulations on the completion of your project that was supported by The Rufford Small Grants Foundation.

We ask all grant recipients to complete a Final Report Form that helps us to gauge the success of our grant giving. We understand that projects often do not follow the predicted course but knowledge of your experiences is valuable to us and others who may be undertaking similar work. Please be as honest as you can in answering the questions – remember that negative experiences are just as valuable as positive ones if they help others to learn from them.

Please complete the form in English and be as clear and concise as you can. We will ask for further information if required. If you have any other materials produced by the project, particularly a few relevant photographs, please send these to us separately.

Please submit your final report to jane@rufford.org.

Thank you for your help.

Josh Cole, Grants Director

Grant Recipient Details

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| Your name | Michelle Bradshaw (née du Toit) |
| Project title | Feasibility study of ultrasonic acoustic telemetry of penguins |
| RSG reference | 12009-1 |
| Reporting period | Nov 2012 – Jan 2014 |
| Amount of grant | £5320 |
| Your email address | mdutoit@bayworld.co.za |
| Date of this report | 31 January 2014 |

1. Please indicate the level of achievement of the project's original objectives and include any relevant comments on factors affecting this.

| Objective | Not achieved | Partially achieved | Fully achieved | Comments |
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| Training of staff in research techniques | | | Achieved | I conducted three research training workshops at Bayworld for all Oceanarium staff – including curators, animal keepers, general assistants, volunteers and interns – outlining the value of captive animals (in particular African penguins) in their contribution to conservation-related research and the importance of collecting accurate data on each individual animal. This RSG-funded project was used as an example throughout. The workshops were well received and it was decided to have feedback sessions during similar workshops. This will enable further training of interested staff members, while improving the standard of data collection and research contribution, providing ongoing input from both the researcher and the animal keepers' perspectives. The closer link between the research and live animal departments within Bayworld will result in improved standards of record keeping and data collection, as well as enabling the Oceanarium staff to provide feedback to the public during their daily presentations. |
| Assess behavioural response of African penguins to an active and inactive VEMCO 69 kHz transmitter in air | | | Achieved | The resident penguins at Bayworld were exposed to a transmitter (alternately active and inactive) placed on a pole in the colony. Behavioural observations were conducted from a suitable vantage point during 10-minute sessions every hour from 08.30 to 16.30 over multiple days, and supplemented by GoPro photographs taken at 10 second intervals. The penguins did not respond differently to active and inactive transmitters in terms of walking, swimming, preening or aggressive behaviour. |
| Assess behavioural response of African | | | Achieved | This aspect of the study was delayed, while renovations to the Oceanarium |

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| <p>penguins and Cape fur seals to an active and inactive VEMCO 69 kHz transmitter in water</p> | | | | <p>were conducted. The new penguin enclosure (completed in September 2013) includes a large pool suitable for testing their reaction to underwater sounds. The response of African Penguins to active and inactive VEMCO 69 kHz transmitters underwater was recorded.</p> <p>GoPro footage was used to record the behaviour of all birds in the water while observers recorded the behaviour of specific birds in the water (focal animal sampling).</p> <p>In contrast to the behaviour of the birds in response to an audible sound (clanging two metal pieces together) – when all the birds climbed out of the penguin pool – the birds did not change their behaviour in response to an active transmitter underwater.</p> <p>Similarly, Cape fur seals (known predators of African penguins) did not change their behaviour in response to an active transmitter.</p> |
| <p>Design and build a penguin model for testing various aspects of feasibility study</p> | | | <p>Achieved</p> | <p>A penguin model was successfully designed and built according to the following specifications:</p> <ul style="list-style-type: none"> ▪ Flippers (from taxidermy specimen) to stabilise model to float in natural swimming posture at surface. ▪ Attachment for towing model behind boat or mooring at sea during tag range testing. ▪ Air-filled balloons incorporated to simulate lungs and air sacs (collapsible at depth). ▪ Taxidermy penguin skin and feathers, with interlocking feathers trapping air. ▪ Foam/silicone simulating the density of flesh – designed to soak up water so that there's no air trapped. ▪ Balloon simulating stomach, with tube to enable filling with water of different temperatures. |
| <p>Range testing of acoustic tags conducted at sea</p> | | | <p>Achieved</p> | <p>The attachment and position of a transmitter (tag) on a penguin may have an impact on the detection distance of the transmitted signal at sea. In addition, various environmental factors may</p> |

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| | | | <p>reduce or improve the distance at which a hydrophone (VEMCO VR2 listening station) can detect an acoustic tag. Range testing of these tags at sea is therefore an important aspect of the feasibility study and was conducted during October and November 2013. Six listening stations were moored 100 m apart at sea at 15 m depth. Various tag attachment positions were tested using the penguin model, at varying distances from the listening stations and during different weather conditions. A penguin carcass was also used to provide a comparison with the model. The number of pulses recorded by each listening station provides an indication of the range at which the transmitter is detectable. This allows for an investigation into the influence that air sacs and the air trapped in the feather layer have on the detection range of tag positions. The range tests were concluded over several sea trips, after which the stations were retrieved and the data downloaded. Internal placement of the tag resulted in zero pulse transmission through the feather layer, but external tag placement is feasible provided that the tag is below water level when the penguin is in swimming posture.</p> |
| <p>Tag attachment techniques</p> | | <p>Partially achieved</p> | <p>One aspect of the project entails trialling tag attachment methods in order to refine techniques and minimise the impact of acoustic tags on penguins. In order to minimise the extent of tag attachment trials on live birds, the results of the tag range tests were used to establish which tag attachment positions are feasible for ultrasonic telemetry. Since internal placement of the tag results in zero pulse transmission through the feather layer, it is not necessary to subject live birds to internal tag attachment trials. However, external tag attachment trials (with the tag below water level when the penguin is swimming at the surface) are currently</p> |

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| | | | | underway at both Bayworld and SAMREC (South African Marine Rehabilitation and Education Centre), and the results so far are promising. Following the method outlined in Wilson <i>et al.</i> (1997), dummy acoustic tags are attached to the birds' feathers using waterproof Tesa Tape. We will assess how long this type of attachment lasts, as well as the best position and tag size. |
| Stomach temperature telemetry | Not achieved | | | Since the air trapped in the feather layer prevents the transmission of the signal to the surrounding water, surgically implanted tags will not transmit sensor data to the moored hydrophones. This technology is therefore not appropriate for internal tagging of penguins (unlike fish and sharks), so cannot be utilised for stomach temperature telemetry. Further advances in acoustic telemetry and new tag designs may overcome this obstacle in future; however, such developments are beyond the scope of the current study. |
| Listening station array placement design for future studies | | Partially achieved | | The remainder of the project funding was utilised to purchase VEMCO acoustic transmitters for tagging of penguins released after rehabilitation. These data will be collected during the course of 2014. This information will be used to assess the extent to which the current listening station array within and beyond Algoa Bay can be used for tracking penguins, and aid in designing an ideal array for acoustic telemetry of African Penguins. |

2. Please explain any unforeseen difficulties that arose during the project and how these were tackled (if relevant).

Some aspects of the study were delayed while the penguins were housed in a temporary enclosure for 6 months during renovations to the Oceanarium. Behavioural studies of the birds' response to an active transmitter in air could still be carried out but not their response underwater because a deep pool was needed for this underwater study. As soon as the birds moved back to their revamped enclosure, the project continued. This delay also resulted in other aspects of the study (notably tag attachment trials) being delayed, as we first needed to ascertain whether the birds could hear the transmitter underwater before continuing with the next step of the investigation.

3. Briefly describe the three most important outcomes of your project.

This study tested various aspects of acoustic telemetry and its feasibility for tracking African penguins. This was the first study conducted using ultrasonic telemetry in monitoring penguin behaviour. Important outcomes include the following:

- 1) African penguins do not change their behaviour in response to an active 69 kHz transmitter in air or in water, indicating that this frequency could be used in acoustic telemetry of this species. Cape fur seals, known to prey on African penguins, also do not respond to the transmitter underwater.
- 2) The use of a penguin model while assessing the detection range of transmitters proved valuable in confirming our suspicion that the air within the feather layer – possibly in combination with internal air sacs – prevent transmission of an internally-placed transmitter's signal to a mobile or a moored hydrophone. To test whether the model itself was influencing tag transmissions, experiments were also undertaken using a penguin carcass from a dead stranding.
- 3) The external attachment of transmitters (tags) to the feathers of penguins using waterproof TESA tape so far seems promising as a method to track the birds; however, we have yet to confirm how long the attachment lasts. Externally attached tags will be lost during the bird's annual moult but as yet it is unclear whether they will also be lost as a result of preening and interactions in nature.

4. Briefly describe the involvement of local communities and how they have benefitted from the project (if relevant).

Bayworld Oceanarium employs various people from local communities, as well as providing internships and volunteer opportunities. All of the staff (curators, animal keepers, and general assistants), interns and volunteers at the Oceanarium took part in three research workshops outlining the value of captive animals (in particular African penguins) in their contribution to conservation-related research, and the importance of collecting accurate data on each individual animal. This RSG-funded project was used as an example throughout, and the participants assisted with observing the birds as well as attaching transmitters for the tag attachment trial. They have benefitted through learning valuable skills in data collection, how to design a research project, participating in a research project, as well as being able to communicate research results to the public during their daily penguin presentations. The thousands of visitors (especially school groups) that visit the Oceanarium every year also benefit through learning about the declining conservation status of the African penguin, and how research such as this RSG-funded project can aid in our conservation efforts.

In addition, staff and volunteers at SAMREC (South African Marine Rehabilitation and Education Centre) are assisting in the tag attachment trials, and rehabilitated penguins will be released from SAMREC with active transmitters purchased with RSG funds. A display in the SAMREC foyer will showcase the project, and will be included in the daily tours conducted at this facility, further exposing visitors and local communities to the project.

5. Are there any plans to continue this work?

Yes. External tag attachment trials are currently underway at both Bayworld and SAMREC, whereby dummy acoustic tags are attached to the birds' feathers using waterproof Tesa Tape. We will assess how long this type of attachment lasts, as well as the best position and tag size.

Acoustic transmitters purchased with the remainder of the funding received for this project will be attached to SAMREC's rehabilitated penguins prior to release. During the course of 2014, data will be retrieved from listening stations in Algoa Bay (and further afield) and form a continuation of this feasibility study.

Additional aspects of tag detection range testing will be carried out to supplement data collected during the current project.

Further funding will be sought (possibly via RSG) to purchase additional acoustic transmitters to tag rehabilitated birds – this will provide both a valuable source of information on the survival and movement of rehabilitated penguins, as well as give an indication of the suitability of this technology to track birds in the wild.

Following a thorough investigation into the feasibility of acoustic telemetry to track penguins at sea, a project will be launched to tag wild penguins with transmitters, as well as to supplement the current array of listening stations in order to obtain valuable information regarding the at-sea behaviour of this endangered species.

6. How do you plan to share the results of your work with others?

The results of this work were shared with Oceanarium staff through three research workshops held throughout the study period. Further such workshops are planned for 2014, as well as seminars at Bayworld and Nelson Mandela Metropolitan University.

I gave a presentation of this work at the National Conference of the Marine and Coastal Educators Network in January 2014, and it was very well received.

The results of this work will also be shared with penguin rehabilitation facilities, as they will play a crucial role in enabling this work to continue. In addition, a display in the SAMREC foyer will showcase the project, and will be included in the daily tours conducted at this facility, further exposing visitors and local communities to the project.

I will also be compiling a research paper on the feasibility study, as well as the range test results for publication in peer-reviewed journals. Popular articles in local and national magazines may also be a good platform for disseminating the results of this study.

I will be submitting a report of this work to the Canadian developers of the acoustic telemetry technology, as well as to my employer.

7. Timescale: Over what period was the RSG used? How does this compare to the anticipated or actual length of the project?

The RSG grant was approved on 25 October 2012, and the funds released on 14 November 2012. The project itself only started in January 2013, and was completed in January 2014; however, tag attachment trials are still ongoing, and additional at-sea range tests and detections of tagged birds released after rehabilitation will continue during 2014 to contribute data to this project.

8. Budget: Please provide a breakdown of budgeted versus actual expenditure and the reasons for any differences. All figures should be in £ sterling, indicating the local exchange rate used.

| Item | Budgeted Amount | Actual Amount | Difference | Comments |
|---|-----------------|---------------|------------|---|
| GoPro to record penguin behaviour before, during and after tag attachment | 300 | 404 | 104 | Micro SD card, spare battery and stopwatch purchased in addition to GoPro camera |
| VEMCO V9TP Fixed time-off acoustic tags | 1150 | 916 | -234 | Unspent money in this budget item was used to purchase additional VEMCO acoustic tags |
| Laboratory costs for monitoring health of penguins involved in research | 200 | 217 | 17 | Expenditure closely matches budget. |
| Boat trips for tag range tests | 1280 | 1200 | -80 | Discount received for 9 boat trips |
| Rope, shackles, buoys, mooring weights, cable ties, waterproof tape | 700 | 524 | -176 | Unspent money in this budget item was used to purchase additional VEMCO acoustic tags |
| VR2 listening station batteries (4 x R350 each plus shipping) | 100 | 0 | -100 | Batteries borrowed from another project. Unspent money in this budget item was used to purchase additional VEMCO acoustic tags. |
| Construction of a penguin model for lab and range testing of tags | 200 | 53 | -147 | Model was cheap to construct. Unspent money in this budget item was used to purchase additional VEMCO acoustic tags. |
| i-buttons (temperature loggers) | 160 | 198 | 38 | Dual Input Thermocouple Data Logger purchased instead of temperature loggers. |
| Veterinary assistance & penguin anaesthesia for trialling internal tag placement techniques | 350 | 167 | -183 | Penguin anaesthesia unnecessary as internal tagging was not pursued. Unspent money in this budget item was used to purchase additional VEMCO acoustic tags. |
| Dissection equipment & supplies (gloves, scalpels, blades, tweezers) | 300 | 312 | 12 | Expenditure closely matches budget. |
| Miscellaneous / Unforeseen expenses | 160 | 24 | -136 | No unforeseen expenses. Miscellaneous includes Bank's Inward Foreign Exchange Charge. |
| Administrative fee BCRC (7.5%) | 420 | 399 | -21 | Expenditure closely matches budget. |
| Additional VEMCO acoustic transmitters | | 906 | | Additional VEMCO acoustic transmitters purchased with remainder of funds – for tagging rehabilitated birds when they are released back to sea. |

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| TOTAL | 5320 | 5320 | 0 | Note: Exchange rate of received funds: ZAR13.503 = 1£ |
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9. Looking ahead, what do you feel are the important next steps?

Further funding will be sought (possibly via RSG) to purchase additional acoustic transmitters to tag rehabilitated birds – this will provide both a valuable source of information on the survival and movement of rehabilitated penguins, as well as give an indication of the suitability of this technology to track birds in the wild.

10. Did you use the RSGF logo in any materials produced in relation to this project? Did the RSGF receive any publicity during the course of your work?

Yes. The RSGF logo was used during Research Workshops, as well as at the MCEN National Conference where this work was presented. The RSGF will also be acknowledged in all publications resulting from this project.

In addition, a display in the SAMREC foyer will showcase the project, utilising the RSGF logo, and will be included in the daily tours conducted at this facility, further exposing visitors and local communities to the project as well as to RSGF.

11. Any other comments?

I would like to thank the RSG Trustees for awarding me this grant, as well as for allowing me flexibility in the project duration in order to complete important aspects of this feasibility study. I hope that I will be eligible for a 2nd Rufford Small Grant in order to continue this study and contribute to the conservation of the Endangered African penguin.