

## The Rufford Foundation Final Report

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

We ask all grant recipients to complete a Final Report Form that helps us to gauge the success of our grant giving. The Final Report must be sent in **word format** and not PDF format or any other format. 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. Please note that the information may be edited for clarity. 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](mailto:jane@rufford.org).

Thank you for your help.

**Josh Cole, Grants Director**

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Grant Recipient Details	
Your name	Morris Gosling
Project title	Area-wide conservation of mountain zebra in Namibia
RSG reference	13585-B
Reporting period	January 2014 – October 2015
Amount of grant	£11,988
Your email address	l.m.gosling@ncl.ac.uk
Date of this report	13 October 2015

**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
Developing population estimation techniques			✓	Important advances have been made in estimation techniques – especially in showing numbers can be predicted using rainfall variation and the numbers seen in previous years.
Helping monitor GSNL mountain zebra populations			✓	Populations and satellite tagged individuals have been monitored in two protected areas and neighbouring farms in this landscape scheme and data passed to conservation managers.
Improving understanding of mountain zebra population dynamics			✓	Basic patterns of age-specific survival have been established and shown to be strongly rainfall dependent.
Advancing study of hybridisation between plains and mountain zebra		✓		This key issue is now being taken forward by a senior MET scientist who has registered at Witwatersrand University to study the problem for his PhD.
Giving advice about conservation management			✓	Information about monitored populations, and advice about conservation action has been passed to conservation managers of protected areas.
Contributing to IUCN reassessment of mountain zebra conservation status			✓	The reassessment of mountain zebra includes an estimate of the national population and is almost complete.

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

The main difficulties are the usual problems of field research in remote areas and of a useful but ageing 4x4 research vehicle. Good garages are available in Windhoek although they take a while to find. Camera traps are a continual challenge and need detailed attention to ensure adequate sampling.

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

(a) Advances in Gondwana Canyon Park (GCP) monitoring

I have now worked in GCP since 2005 and have accumulated a useful database of known individual zebra and population changes. Over the period of the recently completed Rufford grant I have established a basis for predicting HMZ numbers in any current year and the proportion of the 'source population' (see below) that is in the park at any one time. The analysis is based on the numbers of individuals identified in past years (mainly from camera trapping), prediction based on responses to variation in seasonal rainfall and comparison with GCP ground counts.

Briefly, once the number of individual animals identified in a year has been established, we can use regression analysis to predict three components in the annual total of the following year: (1) the proportion of the animals identified in a year that will be identified in the following year; (2) the proportion of the animals identified in a year that are new; and (3) the proportion of animals which are not identified in a year but which become known either from earlier or later observations (these can be called 'uncatchables': animals that are temporarily outside the study area or too young to be identified). This development comes partly from the finding, using annual values from 2005 to 2012 (the period when these numbers are complete in my database), that once the first variable is in hand, the others (1-3 above) can be predicted with a high degree of reliability from their relationship with seasonal rainfall. The Pearson  $r^2$  values for the relationships between seasonal rainfall and the last three of these variables are respectively 0.50, 0.52 and 0.56 which shows what a massive influence this single independent variable has on mountain zebra dynamics in this arid system.

The numbers obtained by summing the results of the analyses outlined above give the *source population* in a year, that is, the animals that visit GCP at some time during the year (but are not all present at any one time). The best estimate of the numbers present at one time in the year comes from the annual ground counts carried out by Park staff and volunteers. The background time series analysis uses data from the northern part of GCP where we have been collecting individual based data since 2005. And so the comparable ground count data are from those sectors of the annual ground count that fall in the northern part of the park. When both source population and ground count data are in hand we can then calculate the proportion in the park at the time of the annual ground count and relate these to rainfall. Once again, this variable is significantly predicted by seasonal rainfall ( $r^2 = 0.50$ ):-

This means that once the number of known individuals in the previous year has been determined and the seasonal rainfall measured (when the season is over in April or May), the relationships in mentioned above can be used to estimate numbers in the current year. Thus, in 2015, the proportion of the source population that was in the park during the latest ground count can be estimated, following a season when rainfall was below average. The starting point is the number of individuals identified from camera trapping (and some normal photography) in 2014. This currently

stands at 697 individuals (in the north of the park). From relationship (1) mentioned above and the knowledge that the 2014-15 rainfall season was drier than average we can predict that about 86% or 599 of these will be seen in 2015. From relationship (2) above we can predict that 'new' animals will be about 31% of the animals identified in the year and so the total that will be identified will be about 874. We only started camera trapping in the south in 2014 but sampling was quite intensive and 394 were identified in that year. If the same relationships apply in the south of GCP as in the North we can calculate that the number identified in the south in 2015 (re-sightings plus new animals) will be about 494. The total for the animals that will be identified in the whole park is thus about 1,368. But this does not include animals that will not be identified in the year, the 'uncatchables'. The average for these in years following below average rainfall seasons is 30% of the source population and when these are included this suggests that the total source population of GCP in 2015 is about 1,965 animals.

With a source population of about 1,965 mountain zebra during 2015, and given the ground count estimate of 1,083, then about 55% of the source population was in the park at the time of the count. This value falls below the regression line (although within the error) for the relationship between rainfall and the proportion of the source population in the park, probably due to heavier rainfall to the west of GCP, in the Ai-Ais National Park, which led part of the population to depart in that direction. The 2015 ground count estimate gives an average density of 0.86 mountain zebra per km<sup>2</sup> within the 1,253 km<sup>2</sup> Park. If this density applied across the range of the source population then it can be calculated that it uses an area of about 2,274 km<sup>2</sup>. Although this calculation clearly operates on a number of simplifying assumptions (uniform density, etc.), it emphasises the point that the mountain zebra seen in any limited area are generally part of a larger population that needs a far larger areas in which to survive.

(b) Greater Sossusvlei-Namib Landscape (GSNL) monitoring – including sightings of satellite collared individuals

Monitoring of mountain zebra populations continued, and was extended, within parts of the 5,730 km<sup>2</sup> GSNL scheme. This area-wide conservation scheme is at a scale that should provide sufficient space for mountain zebra movements in response to patchy rainfall – at least so long as the removal of fences and creation of corridors goes as planned. Protected areas are a key part of the scheme and individual-based monitoring has continued in the NamibRand Nature Reserve and the Naukluft National Park. In the latter, the network of camera traps was expanded to sample the entire area. In 2015, 1,080 individuals have been identified so far. 476 (44.1%) of these were new, a proportion which should decline to about 10% per annum as the animals around the new camera trap positions are detected and IDs established.

Other study sites within the GSNL that are monitored include farms adjacent to the Naukluft NP and NamibRand. Zebra populations need free movement to and from such areas and in some cases – such as Geluk farm to the north-west of NamibRand NR - this has been achieved by the removal of fences between the farm and the protected area following agreement between landowners. The success of this removal has been monitored by the identification of known individuals as they move

between the two areas. Other farms see zebras as competing with their livestock and cut off such movements by strengthening their boundary fences. Hopefully such attitudes will decline as landowners see increased benefits from ecotourism in the GNSL when they support wildlife populations.

- (c) Extending Gondwana CP monitoring to the entire Park in preparation for area-wide monitoring across the Greater Fish River Landscape (GFRL)

As mentioned above the longest period of monitoring has been in Gondwana Canyon Park (GCP) and data from the north of the park has provided the data on which the most important insights about population processes are based. Over 2014 and 2015 the camera trap network in GCP has been extended to the south of the park in preparation for area-wide monitoring of the large areas to the west that, together with GCP, form the Greater Fish River Landscape scheme. There is thus a network of cameras extending throughout the entire 1,253 km<sup>2</sup> of GCP. The park has an elongated shape along a north-south axis and the camera network allows study of movements along this 70 km long axis. Up until the extremely dry conditions of 2015 (following the very low rainfall of the 2014-15 rains) these movements were very few. Less than 2% of the new animals detected in the south were shared with the north and most of these were males, suggesting movements dictated by searching and competing for mates rather than movements in relation to food and water. However there have been large scale changes in numbers in the park in recent years and these are suspected to be the result of seasonal migration along an east-west axis in response to variation in food and water. The latest drought appears to have caused additional movements with some animals moving north as grazing is locally depleted and with most of the population now individually known it has been possible to track these movements.

GCP lies at the eastern edge of a larger mixed-use conservation area, the Greater Fish River Landscape scheme which includes the Ai-Ais National Park and extends over an area of 7,621 km<sup>2</sup>. In the south this area adjoins the Richtersveld Park across the Orange River in South Africa and thus forms the vast Ai-Ais-Richtersveld Transfrontier Park. Mountain zebras exist throughout the Namibian sector of this huge area (they were eliminated in the Richtersveld and may need to be re-introduced) and their populations are slowly recovering following years of persecution by farming interests. Potentially, mountain zebra in this area will form one of the largest and most spatially unconstrained populations in existence but we know virtually nothing about numbers or movements or the critical population processes that will allow us to assess its long term viability.

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

The work carried out under this Rufford grant is designed to help scientifically-based conservation of mountain zebra both in their own right and as an economically valuable natural resource. The consumptive and non-consumptive use of mountain zebras supports local communities over large areas of Namibia and their economic value helps ensure their conservation. Mountain zebra are

Namibia's only large mammal endemic and are thus a flagship species that is especially important for a developing wildlife-based economy. Studies of flagship species such as mountain zebra contribute to the development of essential techniques for the management of a wildlife resource job creation and pro-poor national development.

In all of my study areas the use of land for wildlife and tourism has created major improvement in the local economy. In Gondwana Canyon Park for example, the change from farmland to wildlife and tourism has increased the number of jobs for local people from 20 to just under 150 since 1997. The change has resulted in a pro-poor contribution of over N\$19 per hectare per year compared to about N\$3 per hectare under farming. This is happening because of an increase in wildlife, particularly flagship species such as mountain zebra that are attractive for paying tourists. New products that take advantage of wildlife viewing opportunities are being developed all the time, for example, the introduction of mule hiking trails. Mountain zebras are one of the main species that tourists want to see on the trails. The diversification of activities and services provided in GCP requires a great deal of staff training. Over 10% of the wage bill comprises training and capacity building. The lowest paid staff receive 2.5 times the average agricultural wage for labourers. In addition, there are many career pathways and people with ambition receive training and rapidly begin to move into more senior positions with the associated benefits. In the absence of good wildlife and rangeland management to ensure healthy wildlife populations that attract tourists none of these benefits will accrue to local people. The development of techniques to monitor and manage mountain zebra populations described here are particularly important since fencing and the removal of some natural limiting factors (including lions and spotted hyaenas) means that most, perhaps all, wildlife populations may need careful intervention to ensure their long-term survival.

Key elements of the techniques needed to manage wildlife for consumptive and non-consumptive use are the numbers and biomass of key species in relation to rangeland quality and water availability. My research aims to develop monitoring techniques to provide a robust technique for estimating numbers so that this key species can be properly monitored. This is particularly important for all managed populations and for all local communities whose lives depend on wildlife, including those in the communal conservancies which are run by local people and which depend on well-managed wildlife for their income.

Flagship species are also particularly important in understanding and telling the story of wildlife and tourism as a competitive form of land use in arid areas. Namibia has been outstandingly successful in converting farmland to wildlife conservation and this movement depends on scientifically-based management and has had major benefits both for the national economy and for wildlife conservation.

## 5. Are there any plans to continue this work?

There are a number of critical issues that needed to be addressed (see 9. below) if the conservation management of mountain zebra populations is to be put on a sustainable basis and, subject to funding, I aim to address these over the next two years.

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

I have provided detailed feedback to conservation managers and landowners at all of the study sites – particularly on zebra numbers, the numbers using different water sources and on movements between different areas. Reports will be written for funding organisations (Rufford Foundation and the Montpellier Zoo) and for the Ministry of Environment and Tourism in Namibia. Material for pedagogic purposes has been provided to Montpellier Zoo for their educational programme. Updated reports will be added to the Mountain Zebra Project section on the Namibian Nature Foundation website and to the Environmental Information Service (EIS), Namibia. A paper on the individual recognition technique developed for this project is in the process of being submitted for publication.

## 7. Timescale: Over what period was The Rufford Foundation grant used? How does this compare to the anticipated or actual length of the project?

The grant was used over the period January 2014 to October 2015. The project was initiated in 2005 and it is planned to continue for at least two further years (see sections 5 and 9).

## 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
Return air flights x2	2,200	1,033	-1,167	I used other funds (income from lecturing) for one ticket.
Fuel for research car	1,532	1,046	-486	
Research car service and repair	1,427	1,731	+304	
Car insurance	810	652	-158	
Car licence	72	94	+22	
Camera traps, boxes and batteries	2,755	2,311	-444	
SD cards	225	173	-52	
Field equipment	280	321	+41	

Computing	250	0	-250	Purchased using other funds.
Accommodation	1838	1,348	-490	
Food	600	173	-427	
<b>Total</b>	11,989	8,882	-3,107	

### 9. Looking ahead, what do you feel are the important next steps?

There are a number of practical problems that needed to be solved if the conservation management of mountain zebra populations is to be put on a long term sustainable basis. Two issues in particular, the relationship between natural and human intervention in limiting populations and the role of large-scale biodiversity conservation schemes seem particularly important.

Events over the course of this grant have included discussions about intervention in key populations and whether or not to reduce numbers in the face of the drought following the failure of the 2014-15 rains. My research has started to quantify patterns of mortality in southern populations where the major predators, lions, spotted hyenas and wild dog, have been eliminated or reduced. It is clear that many animals die from natural causes, particularly when young and when dispersing from their natal social group; we need to know whether this mortality, plus increasing deaths due to senility and a component of density-dependent mortality on older animals will be sufficient to limit populations without intervention. More generally we need to understand what limits mountain zebra populations in the same way that there is an improved understanding of the role of predation in limiting plains zebra populations in recent years. Answers to this question will include comparisons between areas where different combinations of predators have survived and different forms of human intervention occur. Hopefully this comparison will lead to recommendations about what human intervention, if any, is needed to ensure viable populations for the future.

It is generally believed that the larger the conservation area, the better will mountain zebra and other wildlife be able to survive when rainfall and thus food and water is patchily distributed over large areas of semi-desert. The GEF-funded NAM-PLACE landscape schemes have the greatest potential to meet the requirements of wide ranging animals and to pioneer an exciting new form of biodiversity conservation in parallel with ensuring a sustainable broadly-based ecotourism industry that provides improved incomes for local people. The viability of mountain zebra as a flagship species is key for such areas and it is particularly important to know how their populations will fare in the two landscape schemes, the Greater Sossusvlei-Namib Landscape (GSNL) and the Greater Fish River Landscape (GRFL). Important questions include: the carrying capacities of these areas; to what extent do such multiple-use areas provide freedom of movement for mountain zebra foraging; how well do they survive extreme drought; and how are their populations limited? The work already carried out in Gondwana Canyon Park, at the eastern edge of the GRFL provides important groundwork for extension of the work westwards into the 7,621 km<sup>2</sup> area of this ambitious

landscape scheme. Many of the individuals identified in GCP range beyond its boundaries and hopefully some of them will be picked up if the study is extended to the wider area in the west.

Lastly, the issue of hybridisation between mountain and plains zebra remains a crucial threat. This problem is now being taken forward in a PhD by a senior MET scientist who is registered at Witwatersrand University in South Africa. Hopefully this work will provide ways in which conservation managers can address this potentially serious problem and I will continue to provide what help I can to support the study.

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

The Rufford Foundation logo features on the Mountain Zebra Project section of the Namibian Nature Foundation website and it is included with mention of the Foundation in the Acknowledgments in the many reports on the work. A talk was given on the project at the RSGF Southern African Conference in Cape Town in April 2015.

**11. Any other comments?**

I am most grateful to the Rufford Foundation for the Booster grant which has allowed this project to continue and to the people who have helped especially Josh Cole and Jane Raymond. Thanks also to Ian Little who organised such an excellent meeting in Cape Town; it was wonderful to meet so many people who have benefitted from Rufford funding and to see what a huge positive impact the RFSG scheme has made on conservation in Southern Africa. None of the work described here would be possible without collaboration of landowners and conservation managers in the sites where I work and without the support of the Ministry of Environment and Tourism.