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	
Your name	Armindo da Silva
Project title	Elephant Conservation Planning and monitoring in the Mozambiique Central Ecosystem using GIS and Remote Sensing
RSG reference	51.07.07
Reporting period	April 2009
Amount of grant	£4621
Your email address	ndo.silva@yahoo.com
Date of this report	01.06.2009

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
1- Determine, by use of transects, GPS, kernel density and home range, the Elephant spatial distribution				Direct observation (pre-field, field and post-field) of elephant did not only show the distribution of elephant in communal land but also the activities in course in sites used by elephant. Field survey also allowed the team to test to which extend GIS can be used to predict species distribution.
2- Map, by use of satellite imagery NDVI, GPS, quadrats, Shannon index; the habitat diversity spatial distribution				Habitats diversity understood by means of plants survey using quadrats combined with satellite imagery data along different altitudinal gradients is time consuming but it offers good measures for habitats description and differentiation, important information need for full interpretation of Elephant ecology
3- Examine, by use of statistics and spatial correlation analysis, the relationship between habitat types and Elephant spatial distribution				Understanding the join between elephant and its habitats does not need a simply overlay of the two types of maps but also we need to justify to which extent both variables are related. This required, of course, the researchers to produce maps, verify the relationship in the field and validate the association using statistical tests. Validating the degree of association in the field was somehow dangerous to the team since required to observe (closely) what elephant was doing at that place documented on the map. This undermined the life of some fellows.
4-Determine, by use of coefficient of determination, the key variables that explain the seasonal habitat selection or avoidance by elephant				A good explanation of why elephant use some areas frequently than others needed a huge geodatabase. A gigantic spatial database (in ecosystem) depends on increased sampling efforts and this needs time. However, strategically the project coordinator placed 3 research stations in the field, which was not planned before. Although these efforts, the team still not satisfied by the current factors affecting elephant habitat use since

				the impact of legislation need an exceptional attention.
5- Design, by use of queries, scores-ranking, numerical clustering analysis, quantile method, kriging geostatistics, satellite imagery derived NDVI, the candidate habitats for Elephant conservation				The promising areas for future elephant conservation are shown on the map. Investors are truly invited to use this knowledge for elephant circuits design and game viewing. We emphasise that good profit of these areas depend on timely monitoring process, which was missed on this study due to the lack of time series data.

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

Elephants of Mozambique central ecosystem are assassins (they destroyed more than 2 cars when we were in the field).

Bull elephant running after one of our research team car (17:05 pm)

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

1. Kernel spatial movement analysis was used to access elephant distribution. Elephant core home range was primarily (48.54%) found in community land comparatively to hunting blocks (35.00%) and national parks (16.45%).

2. The analysis of habitat distribution diversity and availability by means of Landsat ETM+ NDVI imageries, Shannon Winner Index and General Linear Model-GLM long-established that NDVI performance differed significantly (*p = 0.000*) between the habitats, expressing the larger effect size variability between them (Partial Eta= 0.952; *p=0.000*). Further, NDVI increases with altitude (r=0.945, *p= 0.001*) and decreases with plant richness (r= -0.416; *p= 0.727*). This had implications to elephant habitat use.

3. Spatial correlation between elephant distribution and habitat types denoted that Elephant foremost (53.54%) utilized the semi-arid plateau of *Combretum* spp and *Colophospermum mopane*; reasonably (34.92%) used the degraded lowlands of Urema and Zambezi

floodplains and relatively avoided (11.54%) the moist evergreen afro-montane of *Brachystegia spiciformis*. Repeated ANOVA has shown that elephant habitat use differed significantly (*p = 0.003*) between habitats. Semi-arid plateau was 118.51 times more utilized than the moist evergreen afro-montane.

4. Spatial Model for Landscape Elephant Conservation-SMLEC identified that habitat use by elephant was detrimental to water availability (40.2%; *p=0.000*), human activities (36.80%; *p=0.000*) and vegetation diversity (35.00%; *p=0.000*). Aridity index mostly (8.3%; *p=0.000*) determined the factors influencing elephant habitat use at different landscape units, confirming the hypothesis that elephant survivor at the ecosystem was any strategy of adaptation to the impacts of climate variability.

5. Elephant Habitat Prediction Model-EHPM based on kriging analysis of ranking scores of elephant critical factors and NDVI, prioritized elephant conservation sites, which were almost found outside protected areas with more prominence in Chivuli (22.23%), Nhamassonge (17.66%), Nhacafula (5.19%) and Chiramba (3.46%) communities. Unfortunately, the habitats are water limited during 8 months.

6. Kriging and NDVI geostatistics induced to the prioritization of future elephant conservation habitats. Kriging was mostly applicable to macro scale prediction while NDVI denoted smaller site details. However it's highly recommended the use of geostatistics for elephant conservation priority setting particularly in developing countries where the rate of habit loss is more likely hasty than preservation strategies.

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

- field survey: local communities have been involved in our project as guiders on their lands in Chivuli, Macossa and Gorongoza

- camping fee: in Mussangadze community, the unique place for hosting was previously prepared by the local assembly management and we enjoyed the local guest houses

- ancestral recognition fee: before entering in the bush, a ceremony for acknowledging the ancestral was early done by the *regulos* (traditional authorities) of all visited villages

- project results dissemination: the *regulos* are used in this project as focal points in results dissemination. Also through these figures, local people know where they are vulnerable to lose their agricultural production due to crop raiding elephant.

5. Are there any plans to continue this work?

Yes.

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

- the abstract of this work has been now accepted by the Scientific Commission of Eduardo Mondlane University to be published in form of an article in October 2009

- campaigns are in course with traditional authorities in order to convince people in order to quit areas vulnerable to crop raiding by elephant; to wisely use fire in their lands. The lack of

transport is somehow limiting great focus on these activities. Also materials need to be translated in local languages

- we also hope to publish our films on TV
- a community radio dealing with issues related to elephant in changing climate is planned to be used on this results dissemination action
- if we had a grant we would like to participate in the 7th wildlife conference annually held in Tanzania Wildlife Research Institute (TAWIRI)

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

The RSG was very useful during 9 months of project life. The RSG was applied in the first 3 months for data and field equipment acquisition. It also supported our 5 months of field survey distributed in the following: 15 days pre-field survey; 105 days field survey and 30 days field verification and validation. During this time we had to budget fuel, communication, guiders and lodging. The RSG also helped on printing the report for appreciation by different stakeholders.
Comparing the anticipated use, it was not far of what we expect. If we had some shortage was due to the increase of the study area extent, which reflected on the increase of satellite imagery data and the sampling effort.

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
Landsat ETM+ Satellite imageries -previous planned (5000 sq km) -actual area (49342.96 sq km)	£ 1130.4	£ 2050.69	£ -920.29	The difference was due to the increase of the study area size.
Climate data	£763.04	£500.00	£+263.04	Since we acquired a huge data they decided to make some discounts.
Topographic maps	£ 348.17	£ 719.02	£- 370.85	Increase of the study area size.
Socio-economic data	£ 70.7	£0.00	£0.00	Although the increase of study area size required an increase in data costs, this did not happen since we involved one stakeholder of the National Statistic Institute
Field Survey	£1837.1	£2655	£-817.9	We planned 60 days but we had to stay for 150 days. Also the number of guiders increased since

				we were indebted to change in each District.
10% of costs cover Printings	£420.13 £52	£420.13 £52	£0.00 £0.00	
TOTAL	£4621.6	£6344.84	£-1845.71	

Exchange rate 1£ equal to 32 MTn during the of the study

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

- Project results dissemination (also hope to translate all dissemination materials to local languages)
- Monitor elephant habitats gains, loss and persistence
- Evaluate the implications of habitats change in elephant feeding behaviour
- Assess and mitigate the effects of climate change on food availability and feeding preferences of elephants
- Influence politicians to declare the area as an important elephant corridor
- Found a nature association affiliated to Rufford Small Grants Organization

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. Our field survey car had the logo of RSGF.
- During results dissemination we are using the logo on our maps, reports, leaflets.
- We had two radio meetings to introduce project results at National, Provincial and District levels. The entry in these meetings was the RSGF initiative
- We are printing the final report with RSGF logo to distribute in all Agricultural Activities District Directors. All researches and investors, at District level, will be accessing this report.

11. Any other comments?

No.