The Rufford Foundation
Final Report

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.

Thank you for your help.

Josh Cole, Grants Director

Grant Recipient Details	
Your name	Dr Tamie J Jovanelly
Project title	Critical, immediate, and necessary improvements to endangered antelope habitat through water quality assessment
RSG reference	15823-1
Reporting period	August 29, 2014 to August 29, 2015
Amount of grant	£4997
Your email address	tjovanelly@berry.edu
Date of this report	August 27, 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
Complete a site assessment to determine contamination sources.			X	Contamination sources were determined by conducting a detailed site assessment within park boundaries. Animal keepers and the senior warden helped to identify major watering holes and habitat grounds used by the Sitatunga antelope that were affected or down gradient of the contamination.
To designate suitable vs, hazardous drinking water sources for Sitatunga antelope at Impala Sanctuary.			X	From visual inspection I quickly determined contaminated drinking water sources. This was confirmed by water quality analysis. The major drinking water holes were immediately fenced off and replaced by a temporary clean water source.
To test eight physical parameters important to water quality at multiple sites within the park to establish a representative water quality index value.			X	Over the course of 3 months I was able to test six relevant sample sites twice weekly. The data collected for the individual parameters were compared to standards designated for livestock. Additionally, this data was analysed and computed to form monthly water quality index values that represent the (poor) health of the drinking water sources. This analysis will continue weekly for the next year by KWS research scientist, Stanley Munji.
To train KWS research scientist, park warden, and senior park warden in water collection and analysis for continued long- term investigations.			X	Through a series of hands-on demonstrations and field experience I successfully trained the KWS scientist (Mr Stanley Munji), KWS senior park warden (Ms. Christine Boit), and KWS Impala Sanctuary park warden (Ms Nancy Akinyi).

To share information on the importance of water quality and water conservation during monthly demonstrations at Impala Sanctuary that are free to park visitors.			X	At the front gate of the park I set up an information table with working demonstrations for passers-by. The goal was to share information about water quality within the park, their challenges, and to talk about sustainability and conservation. Additionally, there was a group of 15 university students taking a 3-month short course at Impala Sanctuary on conservation who shadowed me in the field on three occasions.
Meet with Wildlife Clubs of Kenya (WCK) youth members to discuss water sustainability and challenges to the Lake Victoria watershed.				The park boundary is adjacent to WCK. I was able to participate in three monthly meetings by leading a discussion about conservation, giving an equipment demonstration, and leading a serendipitous field trip in the park to talk about surface water and ground water resources.
Organic dye tracer test to outline groundwater flow				Shipping of the needed Rhodamine dye was prohibited in Kenya. Moreover, the chemical is not available for sale in East Africa.

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

Two of three of my initial contacts from Impala Sanctuary on the grant were transferred to different parks within the Kenyan Wildlife Service before my arrival. However, the research scientist (Mr Stanley Munji) that was my main collaborator remained. Fortunately, he is well respected within the park service and his new warden (Ms Nancy Akinyi) and senior warden (Ms Christine Boit) both welcomed the project.

Obtaining a research permit is always challenging in East Africa. It took a full week of meetings/introductions and a trip to Nairobi for signatures before I was cleared to start collecting data. Once I had proper documentation the research project continued flawlessly.

Additionally, I planned to stay in a banda at the adjacent facilities run by the Wildlife Clubs of Kenya. Although I had a reservation from February 2015, I was bumped by a large school group who took up the entire complex. As I was not made aware before my arrival, I had to quickly find a substitute living arrangement that was safe for a female mzungu (white person). The new accommodation was more expensive and in town centre which was not a walkable distance.

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

1. Through several months of site assessments, data collection, and analysis we determined that most of the open water sources for the endangered sitatunga antelopes are severely contaminated. Field testing for eight physical and chemical parameters (pH, dissolved oxygen, nitrates, phosphates, faecal coliform, biological oxygen on demand, turbidity, and temperature) allowed us to calculate a water quality index value for each of the sample sites (Mitchell and Williams, 2000; Brown et al., 1970). The WQI is a unit less number ranging from 1 to 100 that reflects the overall health of a system by assigning weighted values to the aforementioned parameters. A higher WQI number is indicative of better water quality (100-90 is deemed excellent water quality, for example). After 3 months of continual monitoring, a baseline WQI (that represents seasonal variability) was established for each sample site in Impala Sanctuary. We found that the water quality ranked from 46 to 57% (bad to medium). Moreover, only two of the six sample sites met the minimum criteria determined by numerous livestock researchers (Adams et al., 1995; Beede, D.K. 2006; Linn and Raeth-Knight, 2010) for faecal coliforms, nitrates, phosphates, and turbidity. The remaining four sites were exponentially contaminated with some levels reaching 10 times recommended values for water health. Although water quality testing will continue for the next year, we have already substantiated that contamination is coming from up gradient sources including luxury hotels and residential complexes.

2. With help from the animal keepers, and approval by the senior warden, we were able to fence off a major watering hole for the s itatunga antelopes that was found extremely contaminated with nitrates, phosphates, and faecal coliform. This watering hole was temporarily replaced by a hose that was turned on in the mornings to flood a nearby papyrus swamp. Some of the antelope adjusted to this new drinking water location. However, infant antelope who are not strong enough to navigate the swamp were found drinking from other contaminated water sources. The arching challenge is that the pollution problems are widespread throughout the park boundary as a leaking sewage pipe has been compromised by an increase in usage. Additionally, we found that the pollution is widespread throughout the park during the rainy season. The long-term solutions include fixing infrastructure, drainage, and education of near-by park neighbours.

3. A key component to this project was to train KWS scientists, wardens, and staff how to both use the field instrumentation and to have a thorough understanding of how to interpret results. This was done through a series of workshops, demonstrations, and field experiences. Additionally, I used a tiered-teaching approach whereby I taught the KWS park scientist who then taught the senior warden. The senior warden then taught the park warden. With several people now comfortable with the instrumentation I am confident that together they can trouble shoot problems and have discussions about their results. Undoubtedly, employing the help and support of KWS to conduct long- term WQI monitoring is essential to project success. Through long-term monitoring of the eight parameters Impala Sanctuary will be able to identify improvement or degradation to watershed health based on comparisons to new and old WQI values.

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

The Impala Sanctuary borders the regional Wildlife Clubs of Kenya which is the country's largest environmental conservation group that engages youth (8-17) in participatory events. I was able to attend three monthly meetings (June, July, and August) where I gave lectures relating to water quality, water sustainability, and groundwater/surface water interactions. Not only are these topics particularly important to the health of Impala Sanctuary, but the City of Kisumu borders Lake Victoria.

Additionally, there was a group of 15 university students taking a 3-month short course at Impala Sanctuary on conservation who shadowed me in the field on three occasions.

5. Are there any plans to continue this work?

Yes, it is our intention to apply for a second Rufford Small Grant. The goals of the second project phase include:

1. **Data collection**. Continued throughout the year (2015-2016) with equipment purchased for the pilot study. Monthly Skype meetings will be held with KWS research scientist, Mr Munji. Additionally, Mr Munji will be sending updated spreadsheets for my review. Moreover, Mr Munji will work closely with KWS animal keepers throughout the year to ensure s itatunga antelope health and to provide them with clean water sources as needed. This is particularly challenging during the rainy season where the pollution from up gradient is widespread.

2. **Stakeholders meeting**. Culturally in Kenya infrastructure change must include the participation, and input, of all relevant stake holders. Next summer we hope to host a meeting to present our water quality data, the challenges with water pollution at Impala Sanctuary and the threat to the sitatunga antelopes, and potential long-term solutions to infrastructure. Because WQI combines parameters into a single rank value (poor, moderate, etc.), the WQI will serve as a straightforward way of communicating changes in watershed health to forest communities adjacent to reserves. Moreover, it can serve as a tool for conservationists and park managers to monitor and protect valuable tree and papyrus swamp resources.

   We plan to invite the following stakeholders and allow them time to reflect, and discuss, the water pollution problems at Impala Sanctuary: Lake Victoria Environment Program II (LVEMP II), Natural Environmental Management Authority (NEMA), Kisumu County Ministry of Environment, Kisumu Water and Sewage Company (KIWASCO), Water Resources Management Authority (WRMA), Lake Victoria Water South Board Services, Chief Water Engineer Kisumu City, Water Resources Uses Association (WRUA), Kenya Wildlife Service (relevant Impala Sanctuary staff), Wildlife Clubs of Kenya, Sunset Hotel Management, Parkview Hotel and Apartments, and local environment groups such as Dunga Beach Environment Group and Nyalenda Environmental Group.
3. **Alterations to park drainage and free-roaming areas**. Large-scale changes to broken sewage lines, leaking septic tank systems, and waste disposal will take community effort that will be encouraged through the aforementioned stakeholders

meeting. With some small funding, however, Impala Sanctuary can make landscape alterations to improve the dire conditions. In discussions with the Impala Sanctuary KWS scientists, wardens, animal keepers, and staff, we have concluded that the installation of a French-drain will help to mitigate, reduce, and control immediate pollution problems within the park boundaries. A French-drain is a trench filled with gravel that redirects surface water away from an area. Additionally, it encourages seepage of sewage into the soil where it can be broken up naturally by microorganisms before entering the groundwater table. The 1 m deep French-drain would be installed along 600 m of the fence line and continue down-gradient away from sitatunga habitat. Through the channelisation of the wastewater the sanctuary will be able to secure clean surface water viable for the sitatunga antelope and other free-roaming park animals.

4. **Daily monitoring of Sitatunga antelope health**. Currently there are 18 free-roaming sitatunga antelope within the Impala Sanctuary park boundaries. Although they had four fawns born in 2014, only one lived. The cause of deaths have not strictly been determined, however, animal keepers report that the fawns became weak, lethargic, and sickly within 2 months of maturing. Higgens & Agouridis (2010) and Swistock (2012) report on similar symptoms retained by livestock who are accessing poor drinking water. As water assessment in the park continues over the year the animal keepers plan to journal daily on the eating, drinking, and resting habits of the herd. This will provide valuable data to validate waterborne illnesses.

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

The data collected throughout this study is shared at weekly Friday meetings of the KWS Impala Sanctuary park staff. Additionally, the KWS scientist, Mr Munji, writes a monthly report about the water quality assessment that is forwarded to the KWS Nairobi headquarters. Currently, I am drafting a formal publication that will be submitted to a relevant conservation journal. I plan to present this data in the form of a talk at the South Eastern Geological Society of America conference during Spring 2016. Perhaps, most importantly, with subsequent funding we hope to present the entire data set at a stakeholders meeting in July 2016. We are confident that this staggering data set will motivate concern and change in wastewater management.

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

Project funding was received in August 2014. Over the course of my academic year I was able to purchase field equipment and make preparations for my arrival during June of 2015. I lived in Kisumu, Kenya through August whereby obtaining research permits, conducting site assessments, observing antelope habitat and behaviour, establishing sample sites, collecting/analysing water samples, training KWS staff for long-term water quality sampling and analysis, and facilitating a series of discussions about drainage/waste water management solutions. After my late-August departure, the KWS staff remained with the water quality field instrumentation purchased with this grant. For the next year, Mr Munji will send me via email weekly water quality updates and excel data. Mr Munji and I have already established our monthly Skype meetings to discuss progress, changes, and challenges.

We are happy to announce that the research team has exceeded all of our project goals and kept

strictly to the timeline presented to the Rufford Foundation in our initial proposal.

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
Round trip airline ticket for Jovanelly (ATL, GA to Nairobi, Kenya)	900	1033.52	-133.22	Airline ticket cost was more than expected
Jovanelly airline Ticket Nairobi to Kisumu	180	97.10	+82.9	Ticket on Kenya airways was less than expected. I waited to purchase it while in country from local office
Lodging for Jovanelly (6 weeks at $35 USD/day or 18 British pounds)	845	950	-105.00	Over budget because I could not stay at Wildlife Clubs of Kenya bandas.
KWS Research permit	400	129.47	+270.53	In correspondence with Rufford Foundation review committee we discussed the cost of a research permit. It was the feeling that if a researcher is working in a park, then they shouldn't have to pay for a permit. Unfortunately, the KWS Nairobi office wants documentation for such activities and a permit must be issued. Because the new senior warden once worked in Nairobi, we were able to receive a "discount"
Vehicle hire with gas	200	200	0	Three-day rental to explore all of the park and to set up field equipment
Vivitar camera	60	213.63	-153.63	I decided because we were sampling during the rainy season that a waterproof camera was more appropriate and a better long-term investment for the park
SD cards	9	25.89	-16.89	Three 16GB SD cards were purchased
TI-inspire calculator, ph. sensor, dissolved oxygen probe, turbidity probe	900	853	+47.00	I was able to purchase last year's model which was a bit cheaper.

HP pavilion laptop	120	226.55	-106.55	The laptop was more expensive because it came with the installation of Microsoft Word.
LaMotte nitrate/phosphate chemicals	351	165,36	+185.64	Under budget
E. coli membrane filters	351	450.88	-99.88	Over budget
Misc. office supplies	30	30	0	
Opaque sample bottles	60	26.48	+33.52	Under budget
GPS unit	60	64.60	-4.60	Over budget
Cell phone, modem, air time, SIM cards	96	96	0	
Organic Rhodamine Dye	95	95	0	
Shipping/luggage fees	240	240	0	Although some of the equipment was shipped, the majority I brought as checked luggage to ensure its safe arrival.
Meals (launch luncheon, Meeting warden/senior warden, closing luncheon, tea for animal keepers)	100	100	0	As part of Kenyan culture, it is expected that the visiting researcher host opening/closing meals.
Total	4997.00	**4997.48**		

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

After submitting this final report to the Rufford Foundation I will prepare a proposal for a second Rufford Foundation grant to support the stakeholders meeting, installation of a French-drain drainage system along 600 m of park boundary, and the continued monitoring of water and antelopes populations.

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?

I have not yet used the Rufford Foundation logo, but I plan to use the logo on my power point presentation at the South-eastern Geological Society of America meeting in Spring

2016. I have, however, mentioned the support of this grant to my equipment sponsor (North Face), to the Recreational Equipment Incorporated (REI) Advisory Committee members, to my college (Berry College), and to the Geological Society of America.

11. Any other comments?

I am very hopeful of the continued success of this project. The KWS are very supportive of this opportunity to improve the water quality within the park and welcome the collaboration.

Left: Dr Jovanelly shakes the hand of the Impala Sanctuary senior warden. Right: Dr. Jovanelly talks to Kenyan Wildlife Service Senior Warden, Christine Boit (left), and other KWS wardens about the project in Impala Sanctuary at the opening of the research launch gathering.

Left: Dr. Jovanelly introduces the field equipment purchased by the Rufford Foundation for the water quality assessment at Impala Sanctuary. The equipment remained at KWS for weekly sampling throughout the 2015/2016 year. Right: Capturing the research launch party closing. The two white gentlemen are Berry College undergraduate environmental science students who had the opportunity to shadow the project for two-weeks.

Left: KWS research scientist, Stanley Munji, and KWS senior park warden, Christine Boit, learn how to use the field equipment and analysis. Right: Investigating Situatunga trails, foot prints, and scat.

Left: Dr. Jovanelly prepares the field equipment. Right: Dr. Jovanelly works with KWS research scienctist, Stanley Munji, on selecting the field locations. This was primarily determined on Sitatunga antelope habitat and roaming behavior patterns discussed by the animal keepers.

Left: Some of the contamination entering the park boundaries was obvious. Above, you will notice a broken PVC sewer pipe on the opposite side of the electric fence (park boundary). We determined both point-source and non-point source contamination. Right: Training park staff is an integral part of the Rufford Foundation grant. Here, Dr. Jovanelly begins to explain the field equipment in detail and measures needed to calibrate and care for the equipment.


Left: Free-roaming impalas also share similar habitat to the Sitatunga antelope, however, the Sitatunga antelope are way more camera shy and difficult to capture in the wild. Right: Dr. Jovanelly and Stanley Munji pose near the Situatunga antelope watering source. They can be seen in the distance.


Left: Dr. Jovanelly is here with the group of college student interns who are learning about conservation management at Impala Sanctuary. She taught them about sustainable water practices. Right: Dr. Jovanelly poses with KWS animal keepers in the field as they monitor the Sitatunga antelope in their natural habitat.