

## Final Project Evaluation Report

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We ask all grant recipients to complete a project evaluation that helps us to gauge the success of your project. This must be sent in **MS Word and not PDF 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 – remember that negative experiences are just as valuable as positive ones if they help others to learn from them.

Complete the form in English and be as concise as you can. Note that the information may be edited before posting on our website.

Please email this report to [jane@rufford.org](mailto:jane@rufford.org).

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Your Details	
<b>Full Name</b>	Vincent Shacks
<b>Project Title</b>	Measuring the recovery of the previously exploited crocodile population in the Okavango Delta
<b>Application ID</b>	17868-B
<b>Grant Amount</b>	8950 GBP
<b>Email Address</b>	vshacks@gmail.com
<b>Date of this Report</b>	September 2017

**1. 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
Population growth/decline				A full nocturnal spotlight survey was conducted of the Okavango River. This survey allowed us to produce an accurate population estimate which is comparable to the baseline survey carried out in 2008.
Nesting effort				An aerial survey of crocodile nest sites was carried out along the Okavango river as well as a ground truth exercise of a portion of the channel at the end of the nesting season to confirm nest sites.
Growth rates in the wild				The estimation of growth rates can only be done if individual crocodiles from each size class are recaptured. None of the crocodiles captured were recaptures and thus no concrete growth rate can be established yet.
Success of CITES farm release programme				The population survey carried out revealed very useful data which will allow us to change and adapt future release programmes for them to be as successful as possible.

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

Botswana implemented a permit system for the use of Unmanned Aerial Vehicles (UAV) or drones. To avoid unnecessary administration and permit costs, it was decided to not purchase a UAV. Fortunately, one of our research team members was able to join an aerial survey that was taking place in the region by a combined group of wildlife researchers. This allowed for the counting of crocodile nests during these aerial transects. To ground truth results from the air, a sample portion of river

was selected and a ground survey carried out to confirm the presence of nests identified from the air. The ground survey was conducted by boat and on foot.

A temporary research permit freeze was implemented by the Botswana government in February 2017 (<http://www.mmegi.bw/index.php?aid=66322&dir=2017/february/02>). It was hoped that our research group would be able to renew our research permit by August 2017 to complete our second spotlight survey, but unfortunately this suspension has been prolonged to December 2017. This temporary suspension of research has had an extremely negative effect on research in the region. The research group continue to work closely with the relevant government department as they attempt to improve the terms and regulations for independent research in the country.

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

Important Outcome 1: Population Growth.

Our project was able to do produce a comparative study on population trends over an 8-year period (2008 – 2016). The comparative study was done by conducting a repeat full length spotlight survey of the Okavango Panhandle using standardised methodology and a correction factor established by earlier research on this population (Bourquin, 2008). The results of the survey clearly showed that this population is recovering from an intense period of exploitation in the past (Bishop et al, 2009) and that while this recovery is slow, the trends indicate that the crocodile population is steadily increasing.

This result shows that the monitoring, conservation and educational strategies of the recent past have been successful and that the crocodile population is responding positively to this change. By permitting long term population monitoring on the species, the Government of Botswana has allowed researchers to carefully assess this population in enough detail to be able to provide long term population trends such as this. This population monitoring represents some of the best long term wildlife monitoring data on any species in Botswana.

This population data has been submitted to the IUCN Crocodile Specialist Group (CSG) in order to carry out an updated IUCN Red List assessment for Botswana. The population data was also included into “easy to read” infographics which have been shared with a range of stakeholders in the region and globally through social media. The population trend infographic is shown below:



## Crocodile Spotlight Survey Results

Distance covered

**260km**



2008	TREND	2016
Crocodiles Encountered	↑	Crocodiles Encountered
<b>402</b>		<b>433</b>
Crocodile Population Estimate (Seronga - Shakawe)	↑	Crocodile Population Estimate (Seronga - Shakawe)
<b>1793</b>		<b>1931</b>
Crocodiles per km of River	↑	Crocodiles per km of River
<b>1.52</b>		<b>1.63</b>



Figure 1 - 4: Nocturnal spotlighting and capturing of crocodiles.

References:

- Bourquin, S.L. (PhD 2008). Population ecology of the Nile crocodile, *Crocodylus niloticus*, in the Panhandle region of the Okavango Delta, Botswana.
- JM Bishop, AJ Leslie, S Bourquin, L Badenhorst, C O'Ryan. 2009. Overexploitation and the declining effective population size of a top predator. *Biological Conservation*, Vol 142, Issue 10: 2335-2341.

Important Outcome 2: Current Farm Release Methodology Needs to Change.

The current method used for the release of wild collected- farm raised crocodiles is to hold the newly hatched crocodiles at the farm facility until they are around 1.3m in total length. The crocodiles are then released in large batches in specific regions of the Okavango Panhandle which allows for easy access from the farm by boat. That particular size class (1 – 1.5m) would be better suited to the Okavango Delta seasonal swamp but unfortunately this area is much less accessible and would require long travel times from the farm.

The assessment of the success of the CITES farm release programme (2008 – 2010) indicates that the current method of releasing sub-adult crocodiles in the Panhandle is very likely, not effective. At this stage, we are only able to make this assumption based on encounters rather than confirmed survivorship. The data from the spotlight survey indicates a 74% decline in sub-adult encounters (not necessarily a decline in this size class of the population). This decline could suggest either a total decline of sub-adults in this region or it could mean that the presence of sub-adults in the Panhandle fluctuates (for several natural or unnatural causes).

The release of juveniles and sub-adults into unfavourable habitat will likely require the crocodile to move long distances to find new and suitable habitats, a process which may be too stressful for newly introduced, farm raised crocodiles. The very low numbers of sub-adults encountered during this survey clearly indicate that this region and habitat is not stable or suitable enough for this size class. Earlier studies (Wallace & Leslie, 2008; Bourquin & Leslie, 2011) have indicated that this permanent river system is not ideal habitat and that juveniles and sub-adults will prefer seasonal rivers/pans and floodplain environments. This is due to several factors but we know that diet plays a big role in this.

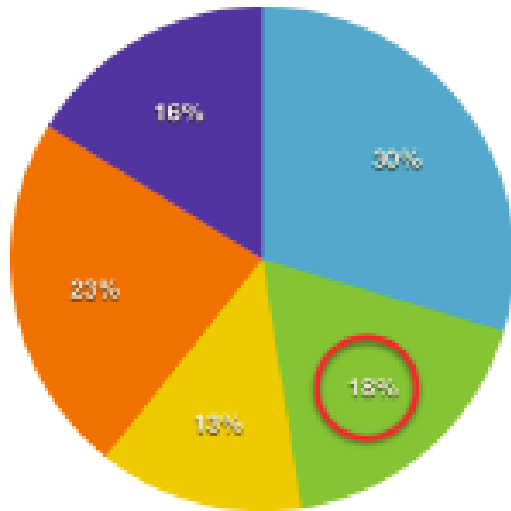
Our data from the spotlight survey provides significant information to validate our assumption that the panhandle is not the best habitat for these release efforts. We also believe that the survivorship of the animal would be improved if the release was done earlier in the life cycle of the crocodile (yearling) to avoid excessive time in a farm environment which will lead to fitter animals with better flight and feeding behaviours.

It is our recommendation that any future farm release programmes aim to release wild collected, farm raised crocodiles as yearlings instead as this will improve their ability to hunt in the wild (less time spent in a farm environment) and the Okavango Panhandle will provide a much more suitable habitat for this size class. This adjustment will likely improve the survival of these released animals as they will be less tame and will have a greater flight response to attacks and will also be released into a habitat which is suitable for this size class.

Marked Decline in Sub -Adult Crocodiles Encountered

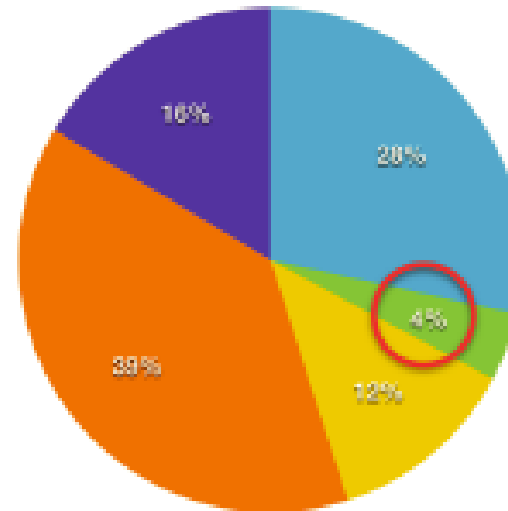
2008

● ADULT ● SUB-ADULT ● JUVENILE ● YEARLING ● HATCHLING ● UNKNOWN



2016

● ADULT ● SUB-ADULT ● JUVENILE ● YEARLING ● HATCHLING ● UNKNOWN



74% DECLINE IN SUB-ADULTS ENCOUNTERED



1.3m - 2.3m



SUB - ADULTS

References:

- Wallace KM and Leslie AJ. 2008. The Diet of the Nile Crocodile (*Crocodylus niloticus*) in the Okavango Delta, Botswana. *Journal of Herpetology* Vol 42, No 2, pp 361-368.
- Bourquin SL, Leslie AJ. 2011. Estimating demographics of Nile crocodile (*Crocodylus niloticus* Laurenti) in the panhandle region of the Okavango Delta, Botswana. Blackwell Publishing, *African Journal of Ecology*.

Important Outcome 3: Nesting Effort by Female Crocodiles in the Panhandle is Stable.

The Okavango Crocodile research group (2002-2006) and monitoring programme (2007-2017) have carried out a total of eight nesting surveys over the period of 2002 – 2016. The monitoring programme has made use of nesting numbers from the Phillippo channel, a major channel on the Okavango River, for comparative purposes. This channel has been used for these comparisons as it represents the longest stretch of undisturbed nesting habitat in the Okavango Panhandle (Shacks 2006). Disturbances along the Panhandle are created by tourist boats, grass cutters, grazing cattle and fires. While this channel is affected by fires, the burning of this area is consistent each year in terms of timing and this has allowed our team to plan surveys accordingly.

The graphic below indicates the nest numbers counted in the Phillippo channel over the study period. While the exact numbers do fluctuate slightly each year, we believe these fluctuations follow a long term and stable cycle. For the 2016 survey, an initial aerial survey was flown over the channel by light aircraft (Cessna 182) using predefined transects. The aerial survey identified five nesting sites in the Phillippo Channel and this represented an undercount which was probably due to the distances between transects. A ground truth exercise of the aerial points was carried out by boat and on foot. The boat survey is carried out by travelling along the channel and investigating all crocodile "slides" which are recently used paths that run from the main water channel to the adjacent reed beds. These slides are used by female crocodiles to move between the nest site and the river channel and are an excellent indicator of a nest site.

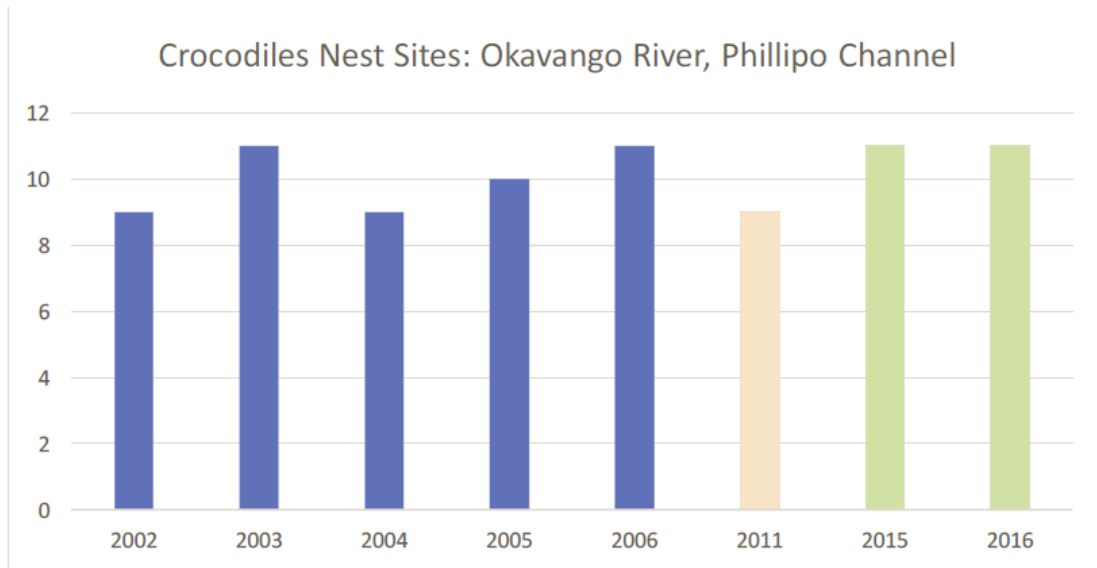
The 2016 nesting success survey was carried out in January 2017 which allowed the team to confirm nest sites easily as more than 95% of the nests in this channel will have hatched by the first week in January. All nests encountered were confirmed either by the presence of an excavated nest chamber with associated egg shells or in some cases, the hatchlings were still present at the nearby crèche site. A total of 11 nests were counted on the survey which is the same number as was counted in a 2015 survey.

The results of the nesting survey show that nest numbers in this region are stable which is promising for this previously exploited adult crocodile population. While nesting numbers for the entire length of the Okavango Panhandle is still low when compared to nesting numbers from the 1980's (50% decline), the fact that numbers are not declining is a good indicator of long term recovery.





Figure 5-6: Previously hatched nest sites allow the researchers to confirm the presence of eggs at each nest.



References:

SHACKS, V. (MA, 2006). A habitat suitability model for the Nile crocodile, *Crocodylus niloticus*, in the Okavango Delta, Botswana.

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

Problem Animal Control (PAC)

The monitoring team carried out the safe capture and relocation of three adult crocodiles from village areas back to the protected wildlife areas of the Okavango. One of these crocodiles was a large adult that had moved 2 km from the river to a cattle post where it has consumed three goats in 2 days. With the assistance of the local community members, this crocodile was safely captured and relocated from Toteng Village into the NG 32 wildlife concession of the Okavango. During these captures and relocations, local community volunteers as well as officers from the Wildlife Department are trained in methods of capture, sample collection and transport of crocodiles.

The village of Maun now has an ably trained group of community volunteers as well as wildlife officers who are able to safely capture and relocate problem crocodiles without the assistance of the research team. The relocation work is ongoing in and around the village areas of the Okavango Delta.

Environmental Education

The research team have carried out and continue to carry out our Keystone Predator education talk at Primary Schools along the Okavango Panhandle. These activities include a short informative lecture to the students from the researchers about the role that crocodile play as keystone predators in the aquatic food chain. A specifically designed food chain poster was designed for this lecture and a poster is left with each school that we visit. Two teachers have been given training on how

to conduct this lecture and will be continuing with these talks in the Shakawe region of the Panhandle.



Figure 8: Department of Wildlife and National Parks (DWNP) staff being trained in problem crocodile capture and relocations.



Figure 9 - 10: This adult crocodile was captured from a village cattle post and relocated to the wildlife area of the Okavango Delta. This crocodile had killed 3 goats in 2 days.

As part of these school talks, the research team bring a live crocodile to the classrooms to give the students an opportunity to closely inspect the animal and get more information about biological and physical adaptations. The feedback from the teachers at the schools has been very positive and the research team have

received requests to hold the talks more often. Our intention is to work on the development of a structured Environmental Education programme for this region, in close collaboration with other wildlife researchers in the Panhandle.

We believe that our primary school visits in the region over the last 14 years have significantly changed perceptions about the value of crocodiles both with children and adults in the surrounding communities. Our environmental education efforts are not only focussed on the pupils but also on the teachers of the schools. Our team have included detailed briefing sessions with teachers at all the schools we have spoken at and ensure that the concepts of the talk are fully understood and able to be repeated. We believe that pupils in the region as well as the teachers and parents of the pupils have shifted their perception of crocodiles which has led to an improved tolerance of these reptiles and is also, in our view, one of the reasons we are seeing a recovery of this population.



Figure 11-12: The crocodile top predator lecture and live crocodile presentation at a local primary school.

Two work books were produced for Grade R and Grade 1 learners. These work books include lessons and activities around water conservation. Lesson plans have been printed and handed over to teachers in the region for use with their classes.

Educational efforts are also taking place on social media through two separate Facebook pages. The first page (Okavango Croc) is a general Facebook page on the work that our research group is carrying out in the region but the page also shares updates on problem crocodile locations and incidents in the village of Maun. Posts created on this page are also shared on a community forum page (Maun Bulletin Board) which has over 6000 members, most of which reside in the town of Maun. This page has allowed for very productive engagement with the local community around problem crocodile management and awareness. Results of the progress made through social media was also shared at the 2016 Crocodile Specialist Group meeting in Skukuza South Africa.



Okavango Crocodile Monitoring Programme

Activity	Learning Area covered in this activity	Learning Outcomes covered in this activity	Assessment Standards covered in this activity
1. Listening, answering questions and colouring in.	Languages	<p><b>Learning Outcome 1: Listening:</b> The learner will be able to listen for information and enjoyment, and respond appropriately and critically in a wide range of situations.</p> <p><b>Learning Outcome 2: Speaking:</b> The learner will be able to communicate confidently and effectively in spoken language in a wide range of situations.</p> <p><b>Learning Outcome 4: Writing:</b> The learner will be able to write different kinds of factual and imaginative texts for a wide range of purposes.</p>	<ul style="list-style-type: none"> <li>Demonstrates appropriate listening behaviour by listening without interrupting, showing respect for the speaker, and taking turns to speak.</li> <li>Participates confidently and fluently in a group.</li> <li>Recounts own personal experiences.</li> <li>Experiments with writing; manipulates writing tools like crayons and pencils.</li> <li>Copies print from the environment.</li> </ul>
2. Introduction to two of the three phases of water (liquid and solid).	Natural Sciences	<p><b>Learning Outcome 1: Scientific Investigation:</b> The learner will be able to act confidently on curiosity about natural phenomena, and to investigate relationships and solve problems in scientific, technological and environmental contexts.</p>	<p><b>Does:</b> Participates in planned activity;</p> <ul style="list-style-type: none"> <li>Follows simple instructions with assistance.</li> <li>Explains what is being done.</li> </ul> <p><b>Reviews:</b> Thinks and talks about what has been done.</p> <ul style="list-style-type: none"> <li>Uses simple words, pictures or other items with assistance to explain what has been done.</li> </ul>
3. Drama exercise drawing on previous two activities, personal experience and imagination.	Arts and Culture	<p><b>Learning Outcome 1: Creating, Interpreting and Presenting:</b> The learner will be able to create, interpret and present work in each of the art forms.</p> <p><b>Learning Outcome 2: Reflecting:</b> The learner is able to reflect critically and creatively on artistic and cultural processes, products and styles in past and present contexts.</p> <p><b>Learning Outcome 3: Participating and Collaborating:</b> The learner will be able to demonstrate personal and interpersonal skills through individual and group participation in Arts and Culture activities.</p>	<p><b>Dance:</b></p> <ul style="list-style-type: none"> <li>Through play, co-ordinates simple gross and fine motor movements, including crossing the mid-line.</li> </ul> <p><b>Dance:</b></p> <ul style="list-style-type: none"> <li>Talks about own dancing using action words.</li> </ul> <p><b>Drama:</b></p> <ul style="list-style-type: none"> <li>Thinks about and shows how people and animals move.</li> </ul> <p><b>Dance:</b></p> <ul style="list-style-type: none"> <li>Responds to movement instructions that cover space without bumping or hurting others when moving backwards and forwards.</li> </ul>
4. Designing and building simple boats by following instructions and choosing between a range of materials.	Technology	<p><b>Learning Outcome 1:</b> The learner will be able to apply technological processes and skills ethically and responsibly using appropriate information and communication technologies.</p>	<p><b>Designs:</b></p> <ul style="list-style-type: none"> <li>Chooses from a given range materials or substances that can be used to make simple products.</li> </ul> <p><b>Makes:</b></p> <ul style="list-style-type: none"> <li>Makes simple products from a range of materials provided.</li> </ul> <p><b>Evaluates:</b></p> <ul style="list-style-type: none"> <li>Expresses own feeling about the products made.</li> </ul>
5. Just for fun - water and water-related poems and rhymes.	-	-	-

Figure 13: Example of the Grade R lesson plan developed for Primary Schools.

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

It is our intention to conduct a third spotlight survey and nesting survey in 2019 again. Our Problem Animal Control work and training is ongoing as well as our primary school environmental education work. Together with fellow wildlife research NGOs in the region, it is our intention to assist with the development of an Eco-Schools (Foundation for Environmental Education) programme in the Okavango. This structured schools programme will allow researchers to create relevant wildlife educational material and have it implemented at several schools through a measurable and reward based educational system. Through the Wildlife and Environment Society of South Africa (WESSA) we aim to also raise funds for the training of primary school's teachers for the implementation of the Eco-Schools programme at their schools in the Okavango.

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

The work of our research team is featured on the Okavango Croc Facebook page. Through this platform several images and videos are shared to promote our work and crocodile conservation in general.

A popular press article about the spotlight survey was written by Vince Shacks for South Africa's longest running wildlife and environment magazine, African Wildlife and Environment. The article titled "Recovering the Nile crocodile population of the Okavango" featured in Issue 65 (Autumn 2017).

A detailed report on our spotlight survey results was featured in the IUCN Crocodile Specialist Group newsletter.

- Bourquin, S.L and Shacks, V.A. 2016. Population trends in a previously exploited Nile Crocodile population in the Okavango Panhandle, Botswana. Crocodile Specialist Group Newsletter, Volume 35, no 4.

Data from the survey has also been submitted to the latest revision of the IUCN Red List for the Nile Crocodile. This Red List assessment is still currently in progress.

A report on our social media efforts to raise awareness and engage community's participation was presented at the IUCN Crocodile Specialist Group conference in July 2016. The report reference below.

- Shacks V.A. (2016). Human Crocodile Conflict in the Okavango: The use of social media to educate and communicate with small communities. Public Education and Community Participation (PECP) in crocodylian conservation – A report for the Crocodile Specialist Group PECP Groups, 23rd Meeting, Skukuza, South Africa.

It is our intention to have a full research article written and published in a peer reviewed scientific journal in 2018.

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

The RSG was used over the period August 2016 – August 2017. While it as possible to carry out the surveys required to present a comparative study between the 2008 survey and this one, it was our intention to fit in a second consecutive survey in August 2017. This was not possible due to the unfortunate research permit freeze implemented by the Botswana government. While these intensive surveys only take place when funding allows, the Problem Animal Control efforts and training of wildlife scouts and community volunteers continues.

**8. Budget: 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. It is important that you retain the management accounts and all paid invoices relating to the project for at least 2 years as these may be required for inspection at our discretion.**

Item	Budgeted Amount	Actual Amount	Difference	Comments
Flight	1200	1465	-265	Unforeseen increase in flight costs
Capture equipment	350	292	58	Favourable exchange rate
Storage trunks & containers	500	243	257	Over budgeted amount required for metal storage trunks
Accommodation	560	729	-169	Increased amount of survey days in the field required additional accommodation at a commercial camp site
Boat & vehicle fuel	750	790	-40	Increased survey days for nesting
Food & Subsistence	650	729	-79	Increased survey days for nesting
Laptop	850	805	45	Favourable exchange rate
Protective gear	250	243	7	Favourable exchange rate
Tents & gear bags	400	426	-26	Favourable exchange rate
UAV drone	640	0	640	A UAV drone was not purchased due to the new UAV permit regulations that were put in place. The cost of this permit was seen to be exorbitant and was also not budgeted for. A research team member was able to join a planned aerial survey taking place in the study area in order to locate potential nest sites. This was a fortunate donation and allowed us to complete an aerial assessment which we had hoped the UAV would assist with
Binoculars	120	116	4	Favourable exchange rate
School educational book	150	182	-32	Increased printing costs
Postage & permits	60	0	60	The tissue samples collected

				have not yet been couriered to the lab. Our aim is to build up a larger stockpile before sending the samples. All tissue samples sent out of the country require a CITES permit and wherever possible we aim to limit the amounts of permits we apply and pay for by increasing the number of samples sent in a batch. We aim to have all the samples posted in early 2018
Infrared camera	750	729	21	Favourable exchange rate
Plastic tarp	200	152	48	Favourable exchange rate
Electric deep freeze	650	608	42	Favourable exchange rate
Tools	120	61	59	Favourable exchange rate
Electric power system	750	578	172	Favourable exchange rate
TOTAL	8950	8149	801	A large proportion of the under expenditure is due to the UAV drone not being purchased (640 GBP). The exchange rate used was 16.45 BWP to 1 GBP. A large majority of the equipment was purchased in South Africa due to a wider available selection and better pricing. A favourable exchange rate between the Botswana Pula and the South African Rand over the period when purchasing was carried out meant that expenditure was lower than budgeted for and a saving was made on many items. The remaining funding will be used for fuel costs for the ongoing problem crocodile relocations taking place at a number of villages in the southern Okavango region. It is also our intention to conduct a nesting survey in January 2018 (research permits pending) and the remaining funding will contribute to the fuel costs of that survey.



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

As a long-term conservation programme, we are in the fortunate position to now have a good idea of the population status and trends in the Okavango. Our efforts have now moved to a closer focus on human – wildlife conflict and community education and awareness. Our research team will be assisting with the development of an eco-schools programme in the Okavango which will focus on the themes of wildlife and biodiversity. Education and awareness efforts are long term investments into the conservation of wildlife species and no research work should take place without a strong parallel education programme in place.

It has also come to our attention that this crocodile population is facing risks upstream in the Okavango in Angola. The Okavango catchment falls within three countries who all share the resource and are responsible for the health of this incredible system. Angola are coming out of a 30-year civil war and the southern portion of the country, which holds the two major feeder channels for the Okavango, is facing threats from aggressive development projects. The crocodile population has already faced extreme pressure from populations who have been killing them for food and the latest pressure will be on the aquatic habitats of these two important channels, the Cuito and Cubango rivers. It is our intention to carry out baseline population work on this upstream population as well as implementing environmental education activities at villages along these two channels. The crocodile populations of these two channels have never been studied and currently there is no available data on the status of this population. The research team carried out two provisional surveys of these channels in 2012 and 2013 and would like to now focus on a full length population survey.

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

The RF logo appeared on all environmental education material submitted to schools. The logo also appears permanently on our research boat and vehicle.

**11. Please provide a full list of all the members of your team and briefly what was their role in the project.**

**12. Any other comments?**

The Okavango Crocodile Monitoring Programme would like to thank and acknowledge the RGS for the support provided to our monitoring efforts since 2007. This significant comparative study would not have been possible without the generous funding received from the RGS. The work carried out by our conservation group has managed to fill the common gap found between scientific research projects and government implementation on the ground. This work has benefitted the Okavango crocodile population significantly after many years of severe exploitation in the past.