

Final Evaluation Report

Your Details	
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Project Title	Compliance campaigns and genetic monitoring to foster sustainable fisheries in the Rift Valley lakes of north-central Tanzania
Application ID	28683-2
Grant Amount	£6000
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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
To assess the extent of genetic connectivity among the threatened Manyara tilapias in saline lakes of north-central Tanzania				We extracted genomic DNA and amplified fragments (627 base pairs) of the mitochondrial cytochrome oxidase subunit I gene (COI) from 109 samples of Manyara tilapias (<i>Oreochromis amphimelas</i>) from five saline lakes in north-central Tanzania namely, Lake Manyara, Kitangiri, Singida, Kindai, and Sulunga. The sequences showed significant evidence of genetically distinct stocks of the threatened Manyara tilapia. It was revealed that the fish from Lake Manyara are genetically different from those of other lakes. Hierarchical AMOVA and phylogenetic analysis showed that the Manyara stock is very divergent from the rest, suggesting that it could constitute a cryptic species which should be investigation further using other markers. Apart from that, the findings show that Lake Manyara contains a unique stock of Manyara tilapias which do not interbreed with fish from other saline lakes; hence this stock should be conserved and managed as a separate stock.
To reduce illegal fishing through awareness raising				Questionnaires and interviews were used to collect data regarding the drivers of illegal fishing in Lakes Kindai and Singida. It was revealed that the majority of the fishers use beach seine nets which are prohibited by the law. Many fishers had the opinion that due to the increased salt concentrations in the aforementioned lakes, the Manyara tilapias are increasingly becoming smaller to be trapped in fishing nets of legal mesh size. Hence, the current mesh size limit should be revisited to

				account for this important opinion of the fishers. Thus, assessment of the appropriate mesh size limit for the Manyara tilapias is crucial for guiding decision makers on the matter. Apart from that, pieces of training were conducted in the fishing communities in the two lakes to raise awareness of the impacts of illegal fishing on the threatened Manyara tilapias.
To assess the extent of genetic hybridization between the Manyara tilapias and Nile tilapias in north-central Tanzania.				We extracted genomic DNA from 120 Nile tilapia and 120 Manyara tilapias from Lakes Manyara, Kitangiri, Kindai, and Sulunga. Eight microsatellite loci were amplified from each DNA extract. Microsatellite genotyping and data analysis is underway to reveal the extent of genetic hybridisation between the two species. Generally, it was observed that the Nile tilapia has already colonised most saline lakes inhabited by the endemic Manyara tilapia except Lake Singida. But since Lake Kindai which is already colonised by Nile tilapias is in close proximity to Lake Singida, there is a very high chance for the Nile tilapia to enter Lake Singida.

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

The COVID-19 outbreak was a major problem which delayed the implementation of some of the project activities. In 2020, the university was closed for months; hence we had to re-schedule some of the laboratory activities because we could not access the labs for some time. Additionally, due to the disease outbreak, the supplier could not deliver lab consumables as planned because they were ordered from foreign countries. So, we had to reschedule most of the project activities. We are very thankful to The Rufford Foundation for giving us an extension to accomplish most of the planned activities.

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

- Improved understanding of the stock structure of the Manyara tilapias in saline lakes of north-central Tanzania. This study revealed evidence of genetically separate stocks of Manyara tilapias in the rift valley lakes of north-central Tanzania. It was revealed that the Manyara stock is genetically distinct from the stock in other saline lakes, suggesting that it should be managed as a separate stock. The observed extent of genetic divergence between the Manyara stock and the stock in other saline lakes is very high, indicating that these stocks could

constitute cryptic species. Since the lowest genetic diversity was measured in the genetically distinct Manyara stock, efforts should be taken to conserve this unique stock. This information will be shared with the local authorities and published in a reputable journal by the end of this year.

- Increased awareness of the stakeholders regarding the drivers of illegal fishing and the impacts of illegal fishing. The findings of this study show that poor enforcement of regulations and lack of a separate mesh size limit for Manyara tilapias are the main drivers for illegal fishing in the study area. Apart from that, awareness rising was conducted in fishing villages surrounding Lakes Kindai and Singida. By the end of the project, the fishers were aware of the impacts of illegal fishing on fish stocks and are willing to use legal fishing nets, but they had the opinion that the authorities should determine and enact a separate mesh size limit for the Manyara tilapia. This is crucial because most fishers have the opinion that fishing nets of the current legal mesh size limits cannot effectively trap Manyara tilapias because they are increasingly becoming small due to increase in salt concentration in the lakes
- Increased awareness of the existence of Nile tilapias in most saline lakes inhabited by the endangered Manyara tilapias. Studies show that the Nile tilapia has already invaded many inland waters in Tanzania and has a potential to hybridise with many other *Oreochromis* species. The findings of this study confirm that the Nile tilapias have already invaded the lakes Manyara, Kitangiri, Kindai, and Sulunga. However, we did not observe any Nile tilapia in Lake Singida. Yet, due to its proximity to Lake Kindai, there is a very high chance for the fish to invade lake Singida. When genetic analysis is complete, the extent of genetic hybridisation between Nile tilapias and Manyara tilapias will be documented. This information will be communicated to managers and disseminated to other stakeholders by the end of the year.

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

The local communities were engaged through out the implementation of this project. At least 30 individuals including fishers and village leaders in two fishing villages surrounding the Lakes Kindai and Singida were engaged during questionnaires and interviews. These were followed by pieces of training which were organised in fishing communities surrounding the above-mentioned lakes to raise the awareness of fishers regarding the impacts of illegal fishing. The training involved fishers and school children in two fishing villages surrounding each lake. Additionally, the collection of fin clip of fish in the five sampled lakes was done in collaboration with the local fishers.



Figure 1: A group picture with some of the local fishers in a fishing village near Lake Kindai. © Rumisha C., 2019



Figure 2: Local fishermen using the banned beach seine net to catch fish in Lake Singida, Tanzania. © Rumisha C., 2019



Figure 3: Juvenile and adult Manyara tilapias *Oreochromis amphimelas* trapped in an illegal fishing net in Lake Singida, Tanzania. © Rumisha C., 2019



Figure 4: Collection of fin clip samples for genetic analysis. @ Rumisha C., 2019



Figure 5: The threatened Manyara tilapias *Oreochromis amphimelas*. © Rumisha C., 2019

5. Are there any plans to continue this work?

Yes. We plan to extend this work to address two important aspects that were beyond the scope of this project: (i) to determine the appropriate mesh size for the Manyara tilapias and communicate this information to the authorities; and (ii) confirm the existence of the observed discrete stocks of Manyara tilapias in Tanzania using microsatellites or SNP markers. The determination of the appropriate mesh size is very crucial for guiding decisions on the matter. Additionally, confirmation of the observed stock structure will provide useful information on conservation of the fishery.

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

The findings of this project have already been shared with different stakeholders in the region. Furthermore, we have prepared one journal article which will be published in a reputable journal by the end of this year. Additionally, a total of 109 sequences of the cytochrome oxidase subunit I gene were submitted to the GenBank nucleotide database for publication. GenBank will publish these sequences in its database and make them freely accessible to stakeholders when the aforementioned journal article is published online. Lastly, the findings of the project will be presented at a scientific conference and published in conference proceedings by the end of this year.

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

The grant was used between October 2019 and February 2022. The actual length of the project is more than 24 months. This is due to the fact that the project was extended beyond its duration due to COVID-19 related delays in implementation of some project activities. The project funds were used for fieldwork, procurement of lab facilities, and DNA sequencing of samples. Up to now over 95% of the project activities have been conducted. An additional 3 – 4 months are anticipated for completion of data analysis and the preparation of manuscripts for publication.

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
Institutional overhead (10% of the total budget)	546	273	-273	The fee was reduced to 5% of the total budget. The difference was used for other activities
Two multiplex PCR kits (at £ 208 each)	416	416		Used as planned
interviews, publication of magazine articles, T-shirts and posters	350	250	-100	The difference was used for other project activities
Costs for organising stakeholders' meetings	200	300	+100	The difference paid from other activities
Lodging and food for 3 days for two researchers during compliance campaigns	270	270		Used as planned
Postage charges for the PCR products to a commercial company for fragment analysis	150		-150	Postage charges were paid by the sequencing company. The difference used for other activities
DNA sequencing of six plates (at £ 220 per plate)	720	1320	+600	Deficient covered by the difference from other activities
Laboratory consumables (pipette tips, PCR tubes, oligonucleotide primers, electrophoresis reagents, and tissue sampling tools)	1532	973	-559	The difference used for other activities

DNA extraction kits (two)	516	1034	+518	Deficient covered by the difference from other activities
Car fuel and car maintenance during fieldwork	250	250		Used as planned
Labourers for the 10 days of fieldwork	150	150		Used as planned
Lodging and food for 10 days for two researchers during fieldwork	900	850	-50	The difference used for other activities
TOTAL	6000	6086	+86	

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

Since we detected significant evidence of a distinct stock of Manyara tilapias in Lake Manyara, there is a need to confirm these findings using microsatellites or SNPs makers. If confirmed this stock should be conserved and managed as a separate stock because it is genetically distinct (unique) from the stock in other saline lakes. Furthermore, assessment of the appropriate net mesh size for the Manyara tilapia should be conducted to inform the authorities about the appropriate and acceptable mesh size limit for the fish.

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?

Yes. The logo was printed on t-shirts, fliers, and the questionnaires which were distributed to some local people during social surveys and pieces of training. Additionally, the foundation is acknowledged in the manuscript which will be published online by the end of this year.

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

Mr. Fanuel Ernest	He participated in social surveys, pieces of training, and the collection of fin clip samples of fish. Also, he was involved in analysing the collected sociological data.
Mr. Jofrey Samwel and Ms. Lucy Jacob	These were the two interns who were recruited to do their bachelor dissertations in the framework of this project. The candidates worked very closely with the PI during social surveys, collection of field samples, and laboratory analysis of samples. Actually, DNA extraction of all sampled tissues was performed by these candidates.
Fisheries officers	We worked with three fisheries officers from Manyara, Singida, and Kitangiri. They helped us during social

	surveys and the collection of tissue samples
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12. Any other comments?

We are very grateful to The Rufford Foundation for funding this project. The project gave us an opportunity to visit all saline lakes inhabited by the endangered Manyara tilapias to raise awareness of stakeholders and contribute to the conservation of this endemic fish. Links established with stakeholders in the study area will be very crucial for our career. Additionally, the collected data will be published online and disseminated to stakeholders by the end of this year. This information will help to guide decisions on conservation and management of the fishery.