Final Evaluation Report

Your Details	
Full Name	Olaniran Hamed Odountan
Project Title	Biomonitoring of Lake Aheme, Benin, using macro-invertebrate diversity: state of the art & policy implications for sustainable management
Application ID	26531-1
Grant Amount	£4,990
Email Address	oolahamo@gmail.com hamed.odountan@capebio-benin.org
Date of this Report	20-10-2020

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
Investigate the environmental characteristics of Aheme Lake			▇	Although this 1-year sampling is a good starting point to explore spatial and temporal variation of environmental characteristics of Lake Aheme, many years are required to know well environmental features of aquatic ecosystem as they dependent on unpredictable external factors like land use changes.
Evaluate the qualitative composition of macroinvertebrate community of Lake Aheme			▇	However, 1-year sampling cannot reveal the real biodiversity of the ecosystem.
Assess structure of macroinvertebrate community of Lake Aheme in relation to environmental features			▇	
Contribute to development of biomonitoring routine tools for conservation and sustainable management			▇	
Environmental education with local community and decision-makers.			▇	

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

There were a few unforeseen difficulties that arose during the project. However, these difficulties were tackled.

- As expected, identification of organisms to species level was nearly impossible. There was no identification key and comprehensible checklist dedicated to our study area. As such documents provide consistent taxonomic and nomenclatural framework for biodiversity studies and biomonitoring, we have summarised with other collaborators a checklist of West African gastropods. This document will be useful for ecologists and conservationists within our region. We focused on molluscs, since they have societal interest for local communities. We are currently working on another group.

- The sad toll of 12 dead and four injured from the boat that capsised on August 5th, 2019, around 3 pm on Lake Aheme, caused commotion and sadness, especially within local communities. For more than a month, it was not possible to sample with our driver who was still traumatised by the drama. As result, we had to postpone the sampling by 1 month.

- The sanitary cordon established from March 30th to May 11th, 2020 in the south of Benin, did not include the municipalities crossed by the lake in the traffic area. As result, our environmental education activity was disturbed, especially with school groups and the involvement of certain stakeholders. We delayed this activity until the reopening of classes, which fortunately coincides with final period of the project. Meantime we invested in data analysis and the production of a policy brief that summarises key conservation recommendations.

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

Increased taxonomic information and macroinvertebrate diversity
West African lagoons are among the least explored and understood aquatic ecosystems in tropics. These standing habitats harbour many species of aquatic macroinvertebrates. During this study, 50 families from eight classes were recorded: 15 Insecta, 12 Malacostraca, one Thecostraca, one Arachnida, eight Gastropoda, seven Bivalvia, two Oligochaeta and four Polychaeta among which unidentified Arachnida. Based on individual numbers, Bivalvia (Corbulidae) were dominant. Generally, collected taxa showed spatial and seasonal variation in abondance and occurrence. Mollusca (Gastropoda and Bivalvia) were dominant during dry seasons especially at southern sites whereas Insecta were abundant during wet seasons especially at northern sites.

Highlighted physico-chemical variables structuring macroinvertebrates
This project provided relevant information regarding the spatial and temporal variation of physico-chemical variables and how some variables are responsible for structuring macroinvertebrate communities of the lake. This is one of the few studies contributing to our knowledge of ecology of most important aquatic ecosystems of southern Benin. This step is a prerequisite and essential for the development of biomonitoring tool/index as well as predicting model of anthropogenic disturbances and climate change impact on aquatic biodiversity. Our findings suggested that seasonal and hydroclimatic changes, as well as anthropogenic activities were the overriding factors affecting physicochemical variables investigated. From the investigated variables temperature, water transparency, dissolved oxygen, conductivity, salinity, pH, nitrate and nitrite were the most important physico-chemical variables structuring aquatic macroinvertebrates throughout the study period. However, the physico-chemical factors responsible for shaping the distribution of individual taxa varied per taxa. As to important habitats, mangroves sites showed highest diversity especially in aquatic insects, which serve as food source for higher trophic levels organisms. According to an FAO report on mangroves of Benin, the area of these habitats is expected to decrease. Therefore, the conservation of mangroves habitats is of paramount interest for biodiversity and

humans. Moreover, it is well known that mangroves are a unique type of coastal habitat, which play an important role in ecosystem services such as food and water provisioning, nutrient cycling, environment purifying, carbon sequestering and climate regulation, as well as cultural services. Comparing freshwater sites, the one under traditional dredging showed lowest diversity.

Contributed to the lake sustainability through environmental Education
We carried out two awareness campaigns with 100 persons (from local communities, especially Sèdomè) around the lake at the final period (August – September 2020). Talks were related to knowledge of degradation status and other threats for the lake resources, as well as good fishing practices and actions contributing to its sustainability and conservation. We also had shared with three selected school groups about the freshwater fauna and bio monitoring. As future decision makers, care about lake resources conservation by school children will guarantee its sustainability. The produced policy was shared with decision makers.

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

The communities involved in the project (mainly communities of Sèdomè) have greatly participated in the developed talks related to conservation of Lake Aheme and biodiversity. The main benefit of these communities has been the increasing of awareness and knowledge referred to conservation of local biodiversity. The communities have also benefitted with better fishing practices, informed about impact of unregulated sand dredging and how to protect the surrounding soil. We think that the most important benefit achieved by the communities is to contribute to a better lifestyle inside the communities involved in the project.

5. Are there any plans to continue this work?

This study intended to provide a good understanding of what habitats are more polluted in Lake Aheme, and about which sites are most in need of conservation, using aquatic macroinvertebrates. With the field and laboratory works that were conducted, we have successfully concluded this study. However, further research on this lake is essential for its sustainability. Therefore, after this first experience, we plan to continue the work. The main objectives will be training and environmental education relating to Lake Aheme conservation. We intend to reach more persons involved directly or indirectly in the lake exploitation or management (e.g. more schools, communities, women and local authorities) and enhance their knowledge on the threats and their effects on the ecosystem services provided. Moreover, we will act for the Lake Aheme mangroves habitats conservation which showed high diversity and known to provide many ecosystem services and minimise negative impacts of climate change.

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

The main practical findings of this study were already shared in several activities. We offered during August – September 2020, talks with local communities and school groups. These talks were also emphasised on the challenge of conserving Lake Ahémé and important habitats such as mangroves. An informative policy brief was prepared and shared. Moreover, I have co-authored (as first author) one paper published in ZooKeys 942: 21–64 (2020). The CAPE BIO NGO website will contain the achieved results of this project. Currently, I'm working on one manuscript, which is expecting to be published in 2021 in peer-reviewed international journals and shared in international conferences.

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

Most of the time was spent on fieldwork (sampling of macroinvertebrates, physicochemical variables monitoring) and the rest for data processing and environmental education. Despite the Covid-19 pandemic and the unexpected sad event of August 5th, 2019, we generally succeeded in respecting the planned timescale of the project by completing it in 19 months, compared to the 18 months suggested early.

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
Pirogue transport for sampling, Hands of occasional works (transportation of bottles and aid in sampling), fuel	215	235	+20	Because of changes of fuel price and £ exchange rate we spent more money for transport than we planned to.
Brochures 500 for awareness campaign	400	50	-350	As conservationist, we finally used posters to avoid printed papers and to contribute indirectly to forest and trees protection.
Workshop lunch and refreshments (tea and coffee) for 30 participants speakers and sound system	340	340		
Survey and overnight stays	300	300		

Reagent for nitrites, nitrates, orthophosphates, kjeldahl nitrogen and total phosphorus and BOD	1000	1000		
Posters to present the final result and workshop	65	15	-50	We reduced size and number of posters to save money here for transport extra charges.
Transportation from Abomey-Calavi to Lake Aheme	450	500	+50	Because of changes of fuel price and £ exchange rate we spent more money for transport than we planned to.
Ethanol, bottle	200	200		
Hach GE DR2800 portable spectrophotometer (for water analyses)	2020	2350	+330	It was necessary a larger amount for the purchase of the equipment, to support duties and transfer charges since it was bought from France (Grosseron company). I used extra money from brochures.
Totals	**4990**	**4990**		**Exchange rates were 1 GBP = 720 – 742 Franc CFA (XOF).**

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

In line with our aim to contribute to sustainability of Lake Aheme, after this study, the most important steps are:

- Continue educating the local communities on the threats to the lake sustainability and their effects on the ecosystem services provided. It is important because many cultural and societal local considerations are not favourable with environmental protection. Therefore, we need to change the paradigm.
- Act for the mangrove habitat conservation which showed high diversity and known to provide many ecosystem services and minimise negative impacts of climate change.
- Continue with the biomonitoring of the lake to monitor the success of the ambitious planned dredging project and have a large and heterogenous dataset to develop biotic index.
- Develop with local communities and authority, lake resource management plans, including zonation of Lake Aheme highlighting most important habitats were conservation actions are required.

- Develop partnerships with interested groups (students, fishermen, women, and other local communities), to promote citizen science approach to support biodiversity inventory and conservation.
- Complete a taxonomic inventory of the lake using innovative approaches such as eDNA, which has little impact on biota, less time consuming and more accurate to reach lowest taxonomical level.

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 Rufford Foundation logo was used in all public presentations on the results of this study, including the environmental education activities and the project presentation in Kenya (2019) during a citizen science workshop held by Tropical Biology Association and funded by Cambridge University. It was also used in the policy brief that was produced. The Rufford Small Grant was acknowledged in the paper published in ZooKeys.

The RF received publicity throughout the project in one way or another. Prime example is its enumeration among our partners on the website of CAPEBIO NGO (www.capebio-benin.org). I notified other aquatic ecologists about RF funding for projects dealing with conservation, which resulted in three of my colleagues applying for the grant with already one success at the first time. Finally, the Rufford Small Grant will be acknowledged in all forthcoming publications.

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

Isabella Olodo and **Nambil Adjibade**, mainly contributed to physicochemical variables measurement and environmental educations.

Nadjib Sidi O. I. Massara and **Cosme Koudenoukpo** contributed to field works, laboratory analyses as well as environmental educations.

Jean-Hugé, has contributed to preparing policy briefs on biodiversity conservation.

12. Any other comments?

I would like to extend my gratitude to the Rufford Small Grants Programme which has helped me to collect for the first-time large amounts of data on the macroinvertebrate community of Lake Aheme. These data will serve as baseline for sustainability of the lake. The foundation has also helped me reinforce my capacities and knowledge in biological conservation. As I recently told the British Ecological Society, RF is the funding that has given me the biggest boost in conservation. This project allowed me to participate in symposia and training in Kenya and to interact with other African young conservationists. It is a great pleasure to be today member of CISCA (Citizen Science in Africa) Programme. The spectrophotometer provided by the RF is much appreciated as it will help us in routine biomonitoring activities.

Left: Spectrophotometer. Right: Sampling with Eckman grab.

Environmental education with School groups

Environmental education with local communities