Final Evaluation Report

Your Details	
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Project Title	Multi-taxon biodiversity survey of threatened ecosystems along a climatic gradient: educational and citizen science approaches in biodiversity conservation
Application ID	39397-B
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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 differences in biodiversity attributes in climatically distinct threatened ecosystems				Overall biodiversity was high (78 tree species, 49 arthropod taxa) in the Essan-Apam Forest Reserve, followed by the Atewa Range (59 tree species, 42 arthropod taxa), the Akwamu Gorge Conservation Area (33 tree species, 28 arthropod taxa) and the Tain II Forest Reserve (27 tree species, 28 arthropod taxa). Essan-Apam Forest Reserve was characterised by a higher abundance of arthropods including *Polyglochin percullaris* (moss katydid), and Zoncerus variegatus (variegated grasshopper). Atewa Range was characterised by arthropods including *Argemma maesseni, Mylothris atewa*, and *Papilio antimachus*. *Melanitis leda, Cephetola maesseni* and *Papilio antimachus* were commonly associated with the Akwamu Gorge Conservation Area while *Henotesia elisi* and *Ypthima vuattouxi* characterised the Tain II Forest Reserve.
To identify major threats to biodiversity in the different ecosystems				Major threats identified include wildfires, indiscriminate logging activities, unsustainable mining practices, farming, urbanisation, and land-use conversions. The impact of each of these threats

				to biodiversity however differs depending on the conditions of the ecosystem assessed. For example, because of the diverse and abundant commercial tree species in Essan-Apam Forest Reserve, illegal logging activities by community members fringing the forest were rampant leading to a reduced stock of tree species. Similarly, the characteristic annual wildfire events of the Tain II Forest Reserve were a major threat to biodiversity. Furthermore, a mono-cultural plantation with *Tectona grandis* (teak, an exotic species) in the Tain II Forest Reserve, seems to be changing the historic vegetation structure of the native tree communities in the area. This hence resulted in the presence of few specialist arthropod groups, highlighting the limits of monoculture plantations in offering essential resources (food and habitat) for species to thrive. In the Atewa Range, indiscriminate mining activities across the entire range were the major threat. This was noted to affect tree communities which provide essential habitat and food resources for arthropods. Because of the proximity of the Akwamu Gorge Conservation Area to major towns and villages, resident relied heavily on the forest for all their energy (fuelwood) needs. In addition, a

				lot of illegal farming activities were also observed in the area.
To train citizen scientists in basic biodiversity assessment and develop adaptive strategies for conserving and maintaining species in threatened ecosystems.				Citizen scientists were trained in all aspects of biodiversity assessment. This includes training in identifying the hotspots of mammals using wildlife cameras, sampling arthropods using pitfall traps, malaise traps, sweep nets and the beating tray, and identifying birds based on sounds and the use of binoculars. Furthermore, they were trained in identifying tree species based on their leaves, stem structure, branching patterns, fruits, etc. and further trained in assigning local use categories (food, fuelwood, medicine, etc.) to each identified tree. Additional training provided includes measuring the diameter of trees with the diameter tape/Vernier calliper as well as estimating height with the clinometer. In developing adaptive strategies for species conservation, citizen scientists geographically mapped ecologically significant habitats such as riparian areas, and seedling germination patches as off-limits to be monitored constantly. Degraded areas (through mining, wildfire, logging etc.) were also restored with native tree species including *Terminalia ivorensis, Ceiba pentandra, Khaya ivorensis, Triplochiton scleoxylon*.

2. Describe the three most important outcomes of your project.

a). An important outcome of this project was the training of citizen scientists in overall biodiversity assessment. After receiving the training, they were involved in the field biodiversity assessment of the various ecosystems. Citizen scientist engagement included plot demarcation for sampling, trap installation (pitfall and malaise traps), arthropod catch harvesting, sorting catch samples into taxonomic groups for further identification to species and labelling and preservation of catch samples. Through this, participant's interest in science was ignited as well as raising their awareness on conservation issues.

b). Another important outcome is the creation of a database with species (trees and arthropods) lists for each ecosystem and a highlight of their conservation status (based on IUCN Red List Categories: Least Concern, Near Threatened, Vulnerable, Endangered, Critically Endangered, Extinct, Not Evaluated). This database also includes the habitat characteristics of each ecosystem as well as some identified potential threats. Species distribution modelling for some selected species highlighting their range based on a set of climatic factors, land use, and soil parameters are under construction (This will be highlighted in a future publication).

c). Another important outcome of this project is the creation of a multipurpose indigenous tree nursery which is frequently used to reforest degraded sections of the various ecosystems. Besides the ecosystems, some of the seedlings are also given free of charge to community members who want to plant trees in their backyards, and schools who want to plant shade trees on their school yards.

3. Explain any unforeseen difficulties that arose during the project and how these were tackled.

No major issues arose during the project. The only issue was the fact that more participants (more than what we planned) wanted to volunteer for the project which wasn't possible because of time and other factors. Those who couldn't participate were noted and will be given the opportunity next year when we repeat this citizen science project. Another issue was the fact that the rains delayed thereby delaying our tree planting activities. At the seed nursery sites, we relied on nearby boreholes for water to irrigate our seedlings.

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

The project was a citizen science project; hence it was community centred. Community members and school children were trained in basic biodiversity assessment protocols after which they translated the skills and knowledge gained into assessing the various ecosystems fringing their communities. Aside their involvement in field research, they also offered indigenous explanations as to why we have certain

kinds of species in certain ecosystems. In addition, their involvement was also seen in joining the various conservation campaigns thereby creating awareness of the unique biodiversity of their region as well as soliciting support from their fellow community members in forest protection.

Schoolchildren also benefited from first-hand scientific field and laboratory experiment involving arthropod sampling from the field and identification of samples in a mobile laboratory workstation we created. This exposure is hoped to guide them in deciding on conservation careers in future.

Furthermore, the indigenous tree model nursery we established is currently serving as a community seedling bank where any community member can procure seedlings for planting in their backyards, farms, and other community spaces. This initiative will increase the coverage of green space in the various towns and villages.

5. Are there any plans to continue this work?

In other to achieve a lasting impact on communities and school children, we plan to repeat this citizen science programme annually. Nurturing school children is a continuous process that requires repetition, effort, and commitment. Continuing this project will offer us the opportunity to train more school kids to love and care for nature and to be environmental stewards. More communities expressed interest in participating in this informally scientific research which they never had the opportunity to experience. Unfortunately, we couldn't engage all because of time and resource constraints. We therefore plan to continue this programme next year so we can engage as many communities as possible in this informal scientific research.

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

The results of this project have already been presented in some seminars and workshops. I had the pressure of presenting the unique species and the involvement of citizen scientists in biodiversity conservation during this year's Career Fair organised by the University of Environment and Sustainable Development, Somaya, Ghana. The database of species from the various ecosystems will be hosted on an online platform where researchers and people with interest can freely assess for their projects. Furthermore, a manuscript highlighting the involvement of citizen scientists in conservation projects in Ghana and the underlying factors driving species distribution in the various ecosystems is currently under preparation for possible publication in a high-impact open-access journal. The publication of the results will help circulate the biodiversity attributes of the various ecosystems which have been researched by our esteemed citizen scientists.

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

The next important stage will focus on continuous mentoring of citizen scientists (school children) in the conservation sphere so the knowledge and skills acquired can remain with them in addressing immediate environmental issues in their vicinity. Regular visits and further engagements with the schools and communities will be our priority. The community tree species nursery will continue to be maintained as a seed

bank to supply seedlings to schools and people interested in planting trees in the backyards.

From the unique biodiversity data obtained would be reports and publications produced to further disseminate the results of this citizen science project to local, national, and global audiences. Dissemination channels would include presentations at seminars and workshops, publications in local NGO websites and newsletters or posters of the projects with key conservation points distributed to people as a form of awareness creation.

Since this project is planning to be an annual event in selected communities across the country, we will carry out feasibility assessments in several regions and landscapes to preliminary select schools and communities for future projects.

8. 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 has been displayed on all presentation materials since the award was granted. The logo was also displayed on t-shirts we used for the campaign and awareness creations in Ghana. It is also displayed on the cover page of other technical reports and shall again be displayed and acknowledged in future presentations.

9. Provide a full list of all the members of your team and their role in the project.

Members	**Roles**
Dr. Mrs. Felicity Bentsi-Enchil	Helped in the training of citizen scientists in basic techniques in biodiversity assessment.
Mrs Nana Yeboah Opuni-Frimpong	Facilitated the selection of participants, and capacity building during the various phases of the project.
Mrs Betty Boante Abeyie	School children's engagement and demonstration.
Eli Hopson Estra	Participant and community selection, campaign lead
Daniel Kwame Debrah	Teaching citizen scientists in arthropod sampling, sorting and taxonomic identification
Charles Yaw Agyakwa	Training of citizen scientists in basic techniques in biodiversity assessment
Raymond Ayepah	Advising on the model nursery establishment, and tree species selection for planting
Adofo Ernest	Community education and awareness creation on the importance of forest
Kwabena Adu-Bonnah	Lead the team in restoring degraded ecosystems with indigenous tree species

Dr. Collins Nsor Ayine	Offered guidance on sampling arthropods and data analysis
Dr. Daniel Acquah-Lamptey	Arthropod sorting and identification
Prof. Edawrad Debrah Wiafe	Local host, facilitated the permit acquisition to use the various ecosystems, and provided guidance on sampling.
Prof. Klaus Birkhofer	Project supervisor, provided guidance on plot demarcation, sampling, and data analysis

10. Any other comments?

We are extremely grateful to The Rufford Foundation for supporting this citizen science programme in Ghana. This support enabled school children and community members to experience real-time scientific experiments for the first time. I look forward to future collaboration where we can engage and train more citizen scientists in similar informal scientific research across the whole nation.

Field pictures

Figure 1: Citizen scientists conservation walk.

Figure 2:Tree diameter at breast height (dbh) measurement.

Figure 3: Linear measurement demonstration.

Figure 4: Linear measurement of distance between trees.

Figure 5: Diameter measurement.

Figure 6: Wildlife camera set-up.

Figure 7: Malaise trap set-up demonstration.

Figure 8:Tree planting activity on degraded landscapes.

Figure 9: Tree planting exercise.

Figure 10: Bird watching.

Figure 11: Interactions with citizen scientists.

Figure 12: Field day out

Figure 13: Interactions with citizen scientists.

Figure 14: Citizen scientists group picture