

Final Evaluation Report

| Your Details | |
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| Full Name | Kunjulakshmi K |
| Project Title | Assessing the conservation priority of freshwater ornamental shrimps (Family: Atyidae and Palaemonidae) from the Central Western Ghats, India |
| Application ID | 39325-1 |
| Date of this Report | 27-03-2024 |

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 |
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| Diversity & Population of Ornamental shrimps | | | ✓ | This research explored the diversity of freshwater shrimp species found in the central Western Ghats region of Karnataka, as well as some areas of the southern Western Ghats in Kerala. Furthermore, we documented the variety of shrimp inhabiting the brackish downstream waters of Karnataka. |
| Questionnaire survey about ornamental shrimps | | | ✓ | The study utilised online platforms and WhatsApp groups of aquarists and hobbyists worldwide, as well as Google forms, to understand their attitudes and perceptions regarding freshwater shrimp. Surveys were also carried out at freshwater ornamental shrimp farms in the states of Karnataka and Kerala. Moreover, women actively involved in rearing and breeding freshwater ornamental shrimp were surveyed to understand the advantages and challenges they face in this business. |
| Identifying habitat for monitoring, conservation status and formulating management plans along with state forest | | ✓ | | The Netravati River, which flows through Mangalore and Nandhini river in Dakshin Kannada district have been recognised as habitats requiring continuous monitoring. These rivers are home |

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| department | | | <p>to a diverse array of shrimp species. However, they are under threat due to pollution, mining operations and construction activities in the area. These anthropogenic activities pose a significant risk to the river's ecosystems, leading to the exploitation of natural resources and endangering other freshwater species inhabiting these water bodies. We are still working on the ground to implement the location boundary, sorting out suitable sustainable methods in forthcoming year with the concerned authorities.</p> |
| Awareness | | ✓ | <p>We conducted conservation awareness to students and faculties of Vivekananda College of Arts, Science & Commerce, Karnataka. We were able to provide awareness and share our findings to youngsters, citizens and environmentalists in collaboration with Green Line, an NGO involved in conducting education-action programmes in schools, involving citizens in neighbourhood environmental initiatives in India. Delivered a class at the ICAR-NBFGR workshop titled 'Research Trends in Ornamental Aquaculture: Advancements in Breeding, Rearing, Genetics, Nutrition, and Health.' The workshop had participants from 18 distinct academic institutions across 13 states. It comprised theoretical lectures, practical sessions and</p> |

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| | | | | engaging field visits. Additionally, conducted an awareness webinar session at Bournemouth University. |
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2. Describe the three most important outcomes of your project.

- a) The project delivered a comprehensive inventory on the diversity and distribution patterns of freshwater shrimps in the understudied freshwater ecosystems of the Western Ghats. A thorough inventory was created, establishing baseline data on shrimp species inhabiting the Netravati-Gurupura river systems and their tributaries. Additionally, the project evaluated the impacts of anthropogenic activities on the conservation status of these shrimp populations.
- b) The project led to the discovery of previously unknown freshwater shrimp species from various locations of Western Ghats in Karnataka and Kerala, including the Nandhini River, Netravati River, Malaya Marutha Falls, Chikkamangaluru and Peechi Dam. Several of these discoveries represent first records of the species in India, while others are entirely new to science. We are currently working on ascertaining the taxonomic status of these species, with manuscripts submitted for peer review to formally describe and establish their scientific nomenclature.
- c) Through our diversity and population study, we assessed the conservation status and identified freshwater shrimp species with potential ornamental value. We successfully bred these shrimps in captivity, demonstrating that aquaculture of freshwater ornamental shrimp can serve as a sustainable alternative to wild collection. This approach meets the demand for highly desirable aquarium species while reducing pressure on wild populations.

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

- a) Sampling in water bodies within city limits posed significant challenges due to elevated pollution levels. Team members experienced issues such as skin allergies and encounters with hazardous materials like broken glass bottles, resulting in minor cuts and infections. To mitigate these risks, team members were provided with protective gear, including gum boots and plastic gloves during the sampling process.
- b) Owing to the nocturnal nature of some species, sampling was conducted at night. However, monitoring the sites during the night in the monsoon season proved challenging due to high water levels and safety concerns. To address

this, the team employed homemade minnow traps, which were deployed at the sites and inspected the following morning.

- c) During the questionnaire survey, few aquarists and farm owners declined to participate, potentially due to their involvement in illegal wildlife trading or operating pet shops without proper licensing.

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

Throughout the project, we actively involved and worked with local communities. Initially, we recruited local youth as volunteers to assist with field sampling activities. Their regular participation in field visits helped us identify potential sampling locations at fish landing centres, Netravati-Gurupura riverbanks and nearby ponds and streams. The volunteers also conducted informal interviews with local fishers, gathering their traditional ecological knowledge about the diversity and distribution of freshwater ornamental shrimps across the area.

The residents provided valuable assistance by sharing information about potential sampling sites, including tributaries and streams flowing through agricultural lands. Some landowners kindly granted us permission to access these water bodies for sampling. Additionally, the local community offered insights into anthropogenic activities such as drainage water discharge and sand mining operations, which could impact the aquatic ecosystems.

Interestingly, even young children contributed to the project by describing the shrimp species they had observed or caught while fishing in local water bodies. Their accounts provided an initial understanding of the potential aquatic species present in the area.

Through this collaborative approach, the project benefited from the local community's knowledge and support. At the same time, it fostered a sense of ownership and awareness among residents regarding the importance of preserving their natural resources. By involving the community in the process, the project helped cultivate an appreciation for biodiversity conservation within their local environment.

5. Are there any plans to continue this work?

We are already running a follow-up project to our initial initiative. From October 2023 we have extended our study location to other regions of the Western Ghats, especially the southern regions. This expansion is due to the Palghat Gap, a major geographical barrier that affects species composition before and after the gap, which is present in Kerala.

Our fieldwork has commenced in the Kali River, situated at the endpoint of Karnataka, aiming to assess the diversity at two contrasting extremes within the state (Mangalore & Karwar). Our expedition into the Kali River's tributaries revealed a significant presence of *Macrobrachium* diversity, which has been systematically collected for future examination. Encouraged by the relatively low pollution levels and abundant agricultural land, we also explored the neighboring district of Udupi and Dakshina Kannada with the assistance of local communities, providing us with some fundamental baseline data. We are eager to explore its ponds and rain-fed streams in search of further insights during the monsoon season.

Moreover, we have expanded our research scope by investigating a previously overlooked environment: wells. Given Udupi's landscape, mainly consisting of laterite soil and numerous wells, some dating back over a century, we decided to explore them. Employing various techniques, including homemade minnow traps baited with shrimp pellets and direct exploration within the wells, we made a notable discovery. Our exploration led to the identification of a *Caridina* species inside one of these wells, a finding hitherto undocumented from Indian waters. This expands our understanding beyond traditional habitats such as streams, rivers and ponds to include wells, enhancing our knowledge of *Caridina* species habitat preferences. Additionally, our future plans involve further exploration of numerous wells within the region to comprehensively understand the species diversity/richness present and investigate whether any morphological changes occur in these species due to adaptation to well environments or darker conditions.

Passionate youths interested in contributing to the project have sampled and couriered specimens to the laboratory facility at Sathyabama Institute of Science and Technology. They were provided with ethanol and vials for preserving the samples they caught and shared photos through social media platforms like WhatsApp, Facebook Messenger, Reddit, and Twitter. In exchange for native *Macrobrachium* specimens caught during sampling, some hobbyists provided us with samples of ornamental shrimps available in the trade.

The network and collaboration established during international conferences like the Association of Tropical Biology and Conservation and the Student Conference on Conservation Science helped connect us with researchers working on freshwater ecosystems. They were able to courier samples from Sri Lanka and east India, which aid in studying the in-to-India or out-of-India hypothesis of freshwater shrimps from Sri Lanka and the changing course of rivers in India over the years.

Moving forward, we plan to continue our RSG project. One of the key conservation issues identified is the lack of biodiversity literacy among local community members.

Thus, we aim to engage in biodiversity literacy programs that will increase conservation awareness in the communities surrounding our study areas.

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

Our work has been widely shared through WhatsApp groups, Reddit and Twitter regularly. Further, the study was shared with international participants through presentations, direct discussions, or as posters.

The work was selected for a poster presentation at the Student Conference on Conservation Science (SCCS) in Bangalore in 2023.

I also presented the ongoing project work at the Society of Molecular Biology and Evolution (SMBE) Everywhere Global Symposium on Genetics of Adaptation (GS6) held at the National Centre for Biological Sciences (NCBS), Bangalore.

The project was presented as a poster at the Annual Meeting of the Society of Molecular Biology and Evolution (SMBE) held in Ferrara, Italy.

The ongoing work was presented as a poster at the 59th Annual Meeting of the Association for Tropical Biology and Conservation (ATBC-2023) held in Coimbatore, India.

We will continuously organize education events annually at our centre to explain ornamental freshwater shrimp conservation to fishers and youth, in collaboration with the local education department.

The work has already been shared with the wider local community by publishing an article in a local newspaper (see link).

The obtained results will be compiled and submitted as a final report to The Rufford Foundation and the concerned authorities of the Government of India (Ministry of Environment, Forests, and Climate Change) and the Government of Tamil Nadu (Forest Department).

We are currently drafting a manuscript on the new species of shrimp from the downstream regions of the Netravati River. This manuscript will be published in an internationally peer-reviewed journal and will be publicly available to scientists, non-scientists, NGOs, and government agencies interested in understanding the diversity of shrimps in the central Western Ghats region.

Additionally, the data will be analysed using statistical tools and every objective will be transformed into a manuscript and submitted to national and international peer-reviewed journals for publication consideration.

All acknowledgments for funding support, including Rufford, have been duly mentioned during every presentation and publication. The results obtained from other project objectives, including population biology and population genetics, will also be compiled and submitted for publication in relevant scientific national and international journals.

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

Looking ahead, the crucial next steps for the project are as follows:

1. Developing enhanced conservation literacy programmes in schools and communities surrounding the focal study areas. Currently, there are no documentaries or picture books available for children about freshwater ornamental shrimps and native freshwater shrimps of the central Western Ghats. We aim to produce a high quality short documentary and picture book on the freshwater ornamental shrimps and their ecosystem with international expertise and collaborations. This will serve as an effective awareness tool in the local language. (A short documentary on freshwater ornamental shrimps of the central Western Ghats for local schools is in progress).
2. Initiating alternative livelihood programs for local community members and promoting women's empowerment by providing training for rearing and breeding freshwater shrimps in their backyards.
3. Recruiting 50 volunteers in the Western and Eastern Ghats to support the conservation efforts. Expanding surveys to comprehensively cover both the east and west ghat regions of India to gain population, biology and diversity data. Then to work on the molecular phylogeny of freshwater shrimps through DNA barcoding to clearly understand their evolutionary ecology relationships.
4. The collected species list will be compared with the IUCN listing, which will help identify vulnerable and endangered species involved in the trade. This, in turn, will lead to the establishment of species-specific action plans to reduce the pressure on wild collections.
5. After compiling all the data, a final report will be prepared and submitted to The Rufford Foundation. A copy of the final report will also be sent to the concerned authority, the Government of Karnataka, for detailed discussions

regarding the establishment of management and conservation strategies in the Central Western Ghat regions.

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?

Yes, we used the Rufford Foundation logo in the following:

1. On t-shirts used for field surveys and community-based conservation programmes.
2. On questionnaire survey sheets distributed among local volunteers and interns.
3. The logo was integrated into all our posters presented at the Student Conference on Conservation Science (SCCS) in Bangalore; Everywhere Global Symposium on Genetics of Adaptation (GS6) held at the National Centre for Biological Sciences, Bangalore; Annual Meeting of the Society of Molecular Biology and Evolution (SMBE) held in Ferrara, Italy; and the 59th Annual Meeting of the Association for Tropical Biology and Conservation (ATBC-2023) held in Coimbatore.
4. During all awareness presentations carried out as part of the project, the Rufford Foundation logo was conspicuously displayed on the opening and acknowledgment slides. Additionally, a compact identification guide featuring local shrimp species, emblazoned with the Rufford logo, was created and utilised during interviews and handed out to the hobbyist.
5. On Twitter, The Rufford Foundation was credited for supporting the work, with posts showcasing native freshwater shrimp species and their habitats captured during field visits.
6. In addition, one of my manuscripts entitled "A new species of shrimp from the genus Palaemon (Crustacea, Decapoda, Palaemonidae) from the Netravati River, Coastal Karnataka, India" has been communicated, and proper credit to the Rufford Small Grants, UK, as the funding organisation, has been mentioned in the acknowledgments.

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

Kunjulakshmi K contributed to mapping and GPS tagging of sampling locations for pre-monsoon and post-monsoon field work. I assisted with genetic studies and

identifying shrimp species using integrative taxonomy methods. I conducted a questionnaire survey in the southern Western Ghats regions. Presented the project's findings and raised awareness at national and international conferences. Instructing volunteers on pictorial data collection of habitat and live-shrimp samples.

Dr. S. Prakash made invaluable contributions as a co-founder of project concept and idea. His extensive knowledge of crustacean fauna was extremely useful as he closely worked with the team during field sampling and carefully identified all specimens collected from the wild. He capably coordinated volunteers according to the schedule. He gave informative awareness talks on the ornamental trade, inspiring and educating young researchers. His critical reviews of posters presented at national and international conferences maintained high academic standards, further increasing the project's impact and credibility within the scientific community.

Maclean Antony Santos was involved in volunteering, sample collection from Central Western Ghats regions, making of homemade minnow traps, discovered *Caridina* species in new habitats (well), training new volunteers who are interested to join the team, documenting pictures and videos, he gave webinars and talks on freshwater shrimps to international and national research and educational institutes.

Dr. Amit Kumar being an expert in molecular biology, has offered guidance on DNA barcoding to better understand the evolutionary ecology relationships of freshwater shrimps and their population genetics. He helped the team in preparing manuscripts, analysing data, and editing for publication in international journals. He also introduced the team to international events where we could present our work, ensuring the research met high quality standards. He also provided valuable assistance in drafting and conducting questionnaires as a Google form for distributing in online platforms.

10. Any other comments?

I am immensely grateful to the Trustees, Director and staff of The Rufford Foundation for their generous support of our project "Assessing the Conservation Priority of Freshwater Ornamental Shrimps (Family: Atyidae and Palaemonidae) from the Central Western Ghats, India."

I wholeheartedly appreciate the invaluable initial suggestions provided by the Rufford Small Grants team during the project's inception. Their guidance in narrowing our focus to a single major river was invaluable, as diverse perspectives are crucial for successful endeavours.

Beyond funding, I am truly thankful for the opportunity to receive direct observation and constructive suggestions from internationally experienced conservationists. This

enabled us to align our local efforts with a global conservation outlook, an opportunity made possible by The Rufford Foundation.

I am deeply grateful for the prompt responses and acknowledgments of periodical updates from Jane Raymond and Lisa Rogers, which facilitated seamless communication throughout the project.

My sincere thanks also extend to the referees, Dr. Rajeev Raghavan and Mr. Steve Lockett, for their endorsement of our project and for sharing the latest research developments in the field. Their expertise in freshwater biology proved to be an invaluable asset to our team.

I am extremely thankful to team members, volunteers, fishers and hobbyists who immensely helped with much enthusiasm. MAS is thankful to Anthony Paul, Vaishak Sanil and Eashan Manohar Naik for the sampling aids.

Words cannot express my gratitude for the trust placed in us by the Rufford Small Grants Programme. I look forward to providing updates on the remaining activities soon.