# Final Evaluation Report

| Your Details | |
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| **Full Name** | Merrisa Naidoo |
| **Project Title** | Microplastic Pollution in the marine environment and biota of the Knysna Estuary. |
| **Application ID** | 26812-1 |
| **Grant Amount** | 5000 £ sterling |
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| **Date of this Report** | 31/01/2020 |

**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 |
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| Objective 1: Identify point sources of plastic pollution into the Knysna estuary | | | | A boat-based field trip was undertaken to identify the necessary incoming rivers, wastewater treatment works and areas of high human activity along the Knysna estuary was identified. The sources of microplastics was additionally identified by a German exchange student under the Knysna Basin Project which supported the approach that was implemented in the current study. The results obtained from this student's study represents a build-up of microplastic associated research in the Knysna Estuary. |
| Objective 2: Identify viable sampling sites where syngnathids are found co-occurring with eelgrass habitats | | | | |
| Objective 3: To determine if eelgrass beds are sinks for microplastic pollution | | | | |
| Objective 4: Assess the occurrence of microplastic ingestion in wild pipefish and wild fish larvae | | | | Juvenile as opposed to larval fish were assessed for the occurrence of microplastics. This change was made due to the difficulty in identifying larval fish to the highest taxonomic grouping. |
| Objective 5: Assess the perceptions of locals about plastic pollution in Knysna | | | | This objective had to be excluded from the current objectives of the study, due to time constraints. |

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

Some of the key challenges experienced during the project for the reporting period included the following:

*1) Limited logistical support and facility resources*

Having not been based within a university set-up but rather a small NGO facility, resources, equipment and logistical support did present challenges. However, throughout the course of conducting my research, I was able to improvise with the resources at hand and ensure ordering of additional resources was conducted timeously without compromising the aims of the project. In terms of logistical support, I was able to seek the services provided by the community.

*2) Unforeseen environmental issues on-site*

When sampling eelgrass habitats for microplastics, the distribution of eelgrass at certain sites were found to be patchy and not as dense as expected, in which case sampling had to be conducted in the available eelgrass beds at that time to the best of our ability. Replicates were effectively taken to minimise this affecting the density of microplastics sampled.

*3) Exclusion of the following objectives from the current project outline*

3.1) Expose pipefish to microplastic particles under experimental/laboratory conditions

In order to determine if pipefish take up microplastics an exposure experiment was conducted on pipefish prior to gut-flushing the individuals from natural populations. This was done as a verification that pipefish do actually ingest microplastics before sourcing additional samples from the wild. This experiment was unsuccessful as pipefish did not respond to the exposure of microplastics under laboratory conditions. This may have been due to stress under laboratory conditions or due to the type of plastic used. The fish were observed after 2 hours using GoPro cameras. The decision was taken to further extend the exposure time to 24 hours in which footage was still recorded with cameras. The gut flushing method did not yield any microplastic particles that may have been consumed. The way in which pipefish responded to live food being introduced into holding tanks were also recorded (using cameras) versus when plastic particles were introduced (in isolation) in which they were observed to be more responsive. Therefore, the results of this experiment have been omitted from the final thesis write-up and even though pipefish were not shown to ingest microplastics under lab conditions the decision was taken to still source additional pipefish from the wild to determine the occurrence of microplastics in natural populations.

3.2) Objective 5 of the original application is also no longer part of the current project i.e. the aspect that involved assessing the perceptions of locals about plastic pollution in Knysna. Excluding this aspect was due to time constraints as the project followed a strict timeline considering that it was conducted in a different province away from the home university which would have made obtaining clearance for this specific work time-consuming. Additionally, social science expertise was required to ensure that reliable results would have been obtained to meet the requirements of this objective.

*4) Comparing findings with historic information on plastic pollution in the Knysna estuary*
No historic data exists for plastic pollution levels in the Knysna estuary which makes comparisons and conclusions about the current state of plastic pollution in this system challenging. Additionally, comparing the results of this study to that of other studies was challenged by global lack of standardised sampling approaches, extraction protocols and units for reporting microplastics abundances.

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

All results have been analysed and presented in the first thesis draft during October-November 2019. The outcomes are as follows:

(1) Microplastics are ubiquitous distributed in the Knysna Estuary.

(2) Sites in proximity to high human activity and development were found to contain high microplastic abundances.

(3) Eelgrass habitats were found to not act as potential sinks for the accumulation of microplastics, however eelgrass habitats in sites receiving effluent and nutrient inputs were found to contain the highest frequency of total microplastics sampled.

(4) Biota from the Knysna Estuary are vulnerable to microplastic contamination especially from synthetic fibres and microplastic particles were found in significantly higher orders of magnitude across all biota sampled compared to that of most other studies.

(5) Successful application of a novel and non-destructive method for the assessment of microplastics in syngnathids.

(6) conference presentations and national science communication competitions as well as the successful completion of an MSc.

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

| **Science awareness (including awareness campaigns, debates, interactive events, public participation actions, profile raising etc)** | |
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| **Objectives** | During plastic free campaigns in July 2018, an eco-friendly company (Metelerkamps) held a formal presentation session in which members of the Knysna community were invited to. I was given the opportunity to communicate the focus of my study including issues surrounding the current marine plastic pollution crisis. |
| **Delivery mode and content** | A Powerpoint presentation was held and presented in a simplistic yet meaningful manner for the intended general community members. The content covered included: the objectives of the current study, the relevance of the study for the Knysna community and its marine realm, the history of the plastic manufacturing sector, the plastic pollution global crisis, sources and sinks of marine plastic pollution, consumer recycling information, the negative impacts of plastic pollution of various marine life and realistic amelioration strategies. |
| **Engagement experiences** | Some of the key highlights of this presentation included: a more knowledgeable audience post presentation (many members of the audience left with responses of being better informed about the seriousness of marine plastic pollution), and positive question and answer feedback session. One of the challenges met with was not being able to reach lower income groups as this presentation was held in an upmarket area in town. |
| **Intended audience** | General community members from Knysna. |
| **Actual number reached** | 40 people. |
| **Broader impact** | This presentation inspired a businessman from the audience to start a no plastic campaign in which boat owners purchase a sticker with the slogan no plastic to adorn their boats to raise awareness.<br>Proceeds from this drive go to the research NGO in Knysna. |
| **Education and training interventions (including both formal and informal education-based initiatives)** | |
| **Objectives** | In November 2018, I was given the opportunity to conduct an informal presentation and microplastic water sampling with South African High School students hosted by a Swiss research vessel (Fleur De Passion) that docked in the Knysna Lagoon. |

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| | These students were part of a Youth at sea Project (https://www.capenature.co.za/aboardyouth-sea-project/) initiated by Cape Nature, providing youngsters to experience life at sea and learn more about the marine environment. The Fleur De Passion sailboat is currently on a 4-year journey around the world to measure the impact that humans are having on the ocean. The ocean mapping expedition is led by Geneva-based non-for-profit Foundation Pacifique. |
| **Delivery mode and content** | An informal talk was given to the selected students aboard the Fleur De Passion, this also included members of the crew and scientists aboard the vessel. The talk was filmed by an onboard cameraman.<br>Once again plastic pollution was the primary focus of the talk and an introduction to microplastics formed part of the content covered which included aspects such as the sources of marine microplastics, its negative impacts and a call to action in terms of solutions was provided. The day in a life of a marine biologist was also highlighted to inspire the youth present as a potential career option to take on. |
| **Engagement experiences** | Being involved with such a proactive group of people that conduct clean-ups every week without fail was a key highlight of this initiative. However, one of the challenges faced despite the implementation of the new data sheets were that volunteers were still recording data according to their old methods on the new sheets which made electronic data capturing tedious. |
| **Intended audience** | Volunteers attending weekly clean-up organised by members of the Dirty Dozen clean-up committee. |
| **Actual number reached** | The number of people reached varied weekly according to attendance at the clean-ups. |
| **Broader impact** | The data collected from these clean-ups will be able to contribute to the waste management data base and waste management solutions in the larger Knysna area. |
| **Science communication (public engagement including use of media, art, theatre, science journalism & training, exhibitions etc)** | |
| **Objectives** | In September 2018, I had the opportunity to introduce my study in the form of a 5-minute speed presentation at the Wild Oceans Stewards Science session.<br>On the other hand, in November 2018, I presented my work including preliminary findings |

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| | at The Conservation Symposium with the main objective of disseminating my research and its findings to a scientific audience. In 2019, these same conferences were attended, and final results were presented. |
| **Delivery mode and content** | On both accounts, the presentations conducted followed the formal scientific format for presentations, however, at the science session the presentation was required to be a 5-minute speed presentation and at The Conservation Symposium a 15-minute presentation. The content covered was based solely on aspects of the current research topic which included aims and objectives of the study, methodology used, preliminary findings, future project goals and the project in a bigger picture. |
| **Engagement experiences** | Key highlights of both presentations included: 1) presenting before established scientists in the field, 2) attaining necessary exposure as a young scientist, 3) forming integral networks with like-minded people and 4) receiving constructive criticism to improve on aspects of the current project. |
| **Intended audience** | The scientific community and attending university students. |
| **Actual number reached** | At the science session that was an audience of at least 60 people and at the conservation symposium I presented to approximately 30 people due to other sessions being concurrently run. |
| **Broader impact** | Science dissemination and knowledge acquisition form part of the broader impacts of presenting at both these symposiums |
| **Science communication (public engagement including use of media, art, theatre, science journalism & training, exhibitions etc)** | |
| **Objectives** | In September 2018, I participated in the FAMELAB SA training session and heats that took place during the Wild Oceans Science Session. The main focus of this competition places emphasis on communicating science or a scientific concept in an effective and creative manner to a general audience in 3 minutes. I was placed first among 28 other participants and will move on to the national heats in March 2019. FAMELAB SA is in partnership with the NRF, SAASTA and Jive Media. |
| **Delivery mode and content** | The format of this competition included presenting your project topic in 3 minutes without the use of visual aid or notes in the form of Powerpoint presentations or thumb cards, however props were allowed. |
| **Engagement experiences** | The most valuable take-away from participating in this competition was gaining |

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| | effective time-management skills, presenting science in a user-friendly way and engaging with audiences on a more personal and intimate level that removes social, economic and educational barriers and norms. It was also prestigious for me to win this competition and go on to the National heats in which I will compete with candidates from around South Africa and attend a 2-day presentation masterclass with a UK academic. |
| **Intended audience** | University students, academia and a few professionals from other working disciplines such as social science, etc. |
| **Actual number reached** | Approximately 50 to 55 people including participants. |
| **Broader impact** | By being afforded the opportunity to present my science at national level will allow me to gain greater exposure and generate awareness around my research and the growing marine plastic pollution problem. |
| **Science awareness (including awareness campaigns, debates, interactive events, public participation actions, profile raising etc)** | |
| **Objectives** | In March 2019, the Touw River Conservancy hosted the Knysna Basin Project (the NGO under which I conducted my masters research). The main objective of this event was based on conversations in conservation. In this regard the Knysna Basin Project team and myself facilitated discussions on marine plastic pollution problem and the relevance of my study in the Knysna Estuary which happens to be one of South Africa's most important estuaries in terms of conservation. |
| **Delivery mode and content** | We had a stand in an open space and shared the research and conservative work that we were undertaking. A plastic filled turtle was one of the items on display to start conversations with visitors about the impacts of marine plastic pollution. |
| **Engagement experiences** | The most fulfilling part of this engagement was being able to start meaningful conversations with members of the public about local conservation and gauge their perceptions and knowledge on the plastic pollution crisis. One of the challenges met with was not being able to reach younger people. |
| **Intended audience** | Members part of environmental organisations. |
| **Actual number reached** | 50 people. |
| **Broader impact** | People that visited the stand left the event well-informed about various topics in ocean conservation, research and the many threats that affect the Knysna Estuary (including |

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| | plastic pollution) and the ways in which they can contribute to local conservation and waste management. |
| **Community engagement projects (collaborative work with communities or community groups to address identified issues)** | |
| **Objectives** | In April 2019, I had the opportunity to participate in the Garden Route walking festival with the Knysna Basin Project. Members of the community were educated and inspired about life on the rocky shore after taking them on a guided tour of the rocky shores at the Knysna Heads. The objective of this outing was to inspire and motivate the community to care for and protect the ocean as well as appreciate various life forms. |
| **Delivery mode and content** | Informal talks and guided tours of the rocky shore. Topics covered included: life on the rocky shore, threats to the animals on the rocky shore including plastic pollution and adaptation strategies of rocky shore animals. |
| **Engagement experiences** | Some of the key highlights included being able to motivate younger kids to learn about the ocean and its various life forms and engaging and answering important questions that people had. The attendance of the event was poorly responded to despite adequate advertisement. |
| **Intended audience** | Members of the general public. |
| **Actual number reached** | 15 people. |
| **Broader impact** | Being able to inspire and educate community members about the marine space can be considered a broader impact of this science engagement activity. |
| **Education and training interventions (including both formal and informal education-based initiatives)** | |
| **Objectives** | In June 2019, I participated on the month-long training expedition, SoNoAT 2019 on board RV. Polarstern (PS120) from Stanley (Falklands) to Bremerhaven (Germany). During the training expedition modules in climate systems, oceanography, remote sensing of ocean and atmosphere, microplastics, statistics and science communication and outreach was facilitated. This program was dedicated to the testing of onboard equipment ahead of the upcoming MOSAIC expedition with a strong focus leaning towards the physical assessment of the climate system, international climate negotiations and data analyses of the various water bodies along the transect. |
| **Delivery mode and content** | Whilst onboard the R.V Polarstern, I developed a research proposal on effective ways to use the onboard communication platforms to educate youth in different countries |

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| | about plastic pollution. |
| **Engagement experiences** | Key highlights included gaining experiential knowledge in scientific and climate research and learning how to use science communication platforms whilst onboard a research vessel. The science communication module taught us how to effectively prepare blogs and news articles, educate school kids from different countries on ocean related topics via skype and key presentation skills. |
| **Intended audience** | Youth that communicated with us via skype. |
| **Actual number reached** | 100-300 school-going children. |
| **Broader impact** | Having been a part of this training meant and still means that I wake up every day knowing that I have been and will continue to be part of a network that is making every effort to catalyse positive change in an ever-changing climate. This programme has encouraged me to become more involved in the global climate crisis by constantly staying updated and interacting in youth debates and marches surrounding this issue. Other broader impacts included being able to take my research to an international audience and generate awareness around the global plastic crisis. |
| **Education and training interventions (including both formal and informal education-based initiatives)** | |
| **Objectives** | In August 2019, the Knysna Basin Project team hosted a student from Knysna High school as part of the student's personal interest in job shadowing marine researchers. I had the privilege in contributing towards the student's understanding of the ins and outs in the daily life of a marine researcher. |
| **Delivery mode and content** | The delivery mode of this training intervention was informal and included giving the student tips on subjects to study at school to become a marine scientist as well as explaining to the student the type of research I was conducting and its relative importance. We also answered questions that formed part of the student's survey which will be reported to her school. |
| **Engagement experiences** | The student left the job shadowing session more inspired, better informed and positive about the desired career path he/she will choose. |
| **Intended audience** | A high school student. |
| **Actual number reached** | 1 |
| **Broader impact** | I hoped to have encouraged the student to further his/her studies in the field of marine |

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| | science considering the scarcity of students entering this field at South African institutions and would hope that this student will contribute positively to South African marine science research in the future. |
| **Education and training interventions (including both formal and informal education-based initiatives)** | |
| **Objectives** | In August 2019, I had the opportunity to share my experience as a marine researcher with high school students at their career day and positively engage with them about ocean conservation matters and their future career paths in marine biology. |
| **Delivery mode and content** | A PowerPoint presentation was conducted for each group of learners in subjects matters such as a day in the life of a marine biologist, my research, subjects to take at school in order to be accepted at a tertiary institute to study marine biology and job opportunities in marine biology. |
| **Engagement experiences** | Students positively enquired about marine biology as a prospective career choice. Some students made the commitment of choosing this career path and wanting to contribute to the protection of the marine space. |
| **Intended audience** | High school students from grade 8 to grade 12 |
| **Actual number reached** | At least 120 students |
| **Broader impact** | On a larger magnitude engaging with young malleable minds of our country on matters that matter has the potential to not only inspire them as a future generation to call to action in protecting and conserving our marine space but to take up jobs in this field and contribute to South Africa's growing economy and scientific research. Talking with youth about career paths in marine science and critical issues that affect the marine environment is pivotal in changing mindsets and building a knowledge base that is exchangeable. |

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

Yes, there is, an Honours student is currently assessing microplastic pollution in eelgrass habitats sub-tidally.

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

Thus far the results of my study have been disseminated at informal and formal community talks, festivals, school career days, the Knysna Basin Project's annual reports and newsletters as well as various conferences and science communication competition. However, efforts like these will continue to be made in the near future and the results of my research will be published in formal publications and shared with the Rufford Foundation.

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

The grant has been used from February 2019 when allocated and a portion to attend conferences and symposiums in 2020 will continue to be utilised. The utilisation of the grant occurs within the timeframe of the final submission of the dissertation which is due to be submitted by early May 2021.

**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 |
|---|---|---|---|---|
| Storage boxes for samples and acid washing | 29 | 12 | -17 | |
| Saline solution expenses | 15 | 12 | -3 | |
| Filtering tower for vacuum pump | 189 | 241 | +52 | |
| PVC Pipes (3m x3) (DIY sieves) | 16 | 6 | -10 | |
| Nitric Acid | 189 | 8 | -181 | |
| Seine net | 216 | 433 | +217 | |
| Travelling (Flight Expenses) | 431 | 67 | -364 | |
| PES Membrane Filters | 42 | 118 | +76 | PES membrane filters were selected for use and not glass fibre filters as per the original application due to issues of |

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| | | | | quality and consistency to other studies |
| Garmin Hand-held GPS | 189 | 232 | +43 | |
| Building materials for the construction of a DIY trawl (LADI) | 81 | 144 | | |
| Aquaria glass tanks (Holding capacity of 20 L) (x 16) | 485 | 142 | -343 | |
| Miscellaneous lab items (Syringes, foil, storage vials) | 27 | 114 | +87 | |
| Vacuum pump | 161 | 694 | +533 | The cheaper alternative as quoted in the original application was not feasible for the required protocol |
| Printing Costs | 81 | 21 | -60 | |
| Attendance of statistics workshop | 178 | 178 | | Please note that these funds were claimable after the course in 2018 |
| Nylon mesh for sieves | 86 | 82 | -4 | |
| Travelling for sampling trips | 296 | 50 | -246 | |
| Attendance of symposiums and conferences | 216 | 419 | +203 | 2 additional Conferences will be attended in 2020 |
| PVC sampling jars | 8 | 8 | | |
| Glass beakers | 107 | 36 | -71 | |
| Pipefish experiment equipment for aquaria (Stop valves, Aeration tubing, Fish air tubing T piece, Fish filter internal bio sponge, Fish air pump, fish pump via aqua, submersible pumps, clove oil) | 267 | 209 | -58 | |
| Potassium Hydroxide | | 3 | +3 | Alkaline digestion proved more effective than nitric acid to digest fish |
| Brine Shrimp (Artemia eggs) | | 36 | +36 | Used to sustain pipefish in an aquaria environment |
| Fishing Gut | | 5 | +5 | Used to expose to pipefish to a source of nylon microplastic fibres after sheering |
| Courier Costs (Samples and equipment repairs) | | 30 | +30 | |

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| Hard Drive | | 59 | +59 | Required to store large go-pro footage of pipefish during plastic exposure experiments |
| **TOTAL** | **3309** | **3359** | +50 | 1 £ sterling = R 18.56 as per original application, all figures are in £ sterling |

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

The most important steps looking ahead would be to successfully submit my dissertation for external examination in April 2021. Thereafter focus on disseminating my research in the form of publications, conferences and community and multi-stakeholder engagement.

**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 was acknowledged at all times in text during oral and poster presentations at conferences attended, however the logo was not used. Rufford will also be acknowledged in the final thesis submission and in publications.

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

My project team consists of two qualified academia (viz. **Dr Louw Claassens** and **Dr David Glassom**) that have attained their doctorates respectively in the population ecology of the Knysna seahorse and the reproductive ecology and biology of corals. They form part of my supervision panel and belong to separate institutes in South Africa. Dr Louw Claassens has worked with the seahorse species (*H.capensis*) for the past 4 years and received her doctorate in the study of this species ((Thesis title: Aspects of the Population ecology, habitat use and behaviour of the endangered Knysna seahorse (*Hippocampus capensis* Boulenger, 1900) in a residential marina estate, Knysna, South Africa: implications for conservation). Four peer reviewed publications resulted from her PhD research- all published in international journals. She is also a part of the project team researching the critically endangered estuarine pipefish (https://www.researchgate.net/project/Estuarine-pipefish-conservation), and a member of the IUCN Seahorse, Pipefish and Seadragon specialist Group. She has supervised Honours students doing a project on *H. capensis* and is continuing her own research on the species in the Knysna and Keurbooms estuaries. Dr Claassens oversees most research projects run under the banner of the Knysna basin project (an NGO whose primary aim is to manage the conservation of the Knysna estuary and surrounding catchments). On the other hand, Dr David Glassom is a lecturer at the School of Life Sciences at the University of KwaZulu-Natal in the discipline of biology. He has supervised numerous Honours, Masters and PhD students and produced various peer-reviewed publications. I have also had the assistance of a volunteer (**Mark Hodgson**) who has his Honours degree in Biological science as well an exchange student from Germany (**Jonas Haller**) that

is currently studying towards a degree in Marine Sciences and whose work will be combined in a publication together with mine.

**12. Any other comments?**

Please note that my master's thesis should be submitted at the end of April or early May 2021.