

FILAMO Masters mobility grant report

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Grant: Master's mobility grant

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Host institution: Norwegian Polar Institute, Tromsø, Norway

Period of visit: (06 July – 24 August 2022)

I am doing a Master's dissertation in Statistical Ecology at the University of Cape Town. I am analysing a large empirical dataset of the at-sea foraging behaviour of two closely related Antarctic penguin species (Gentoo penguin (*Pygoscelis papua*) and Chinstrap penguin (*Pygoscelis antarcticus*)), who are breeding sympatrically at two sites in the Antarctic Peninsula. Specifically, I am investigating the within-individual and between-population plasticity in the foraging behaviour of both penguin species breeding on islands in the Antarctic Peninsula. I am also investigating the three-dimensional (horizontal and vertical) and temporal niche partitioning at sites where the two species are breeding sympatrically.

The reason that I applied for the FILAMO Mobility Grant was to visit my co-supervisor, Dr Andrew Lowther, a Senior Research Scientist at the Norwegian Polar Institute. My aims for the visit were to gain hands-on training to expand and develop my current expertise in modern animal movement modelling and spatial analysis techniques and to learn about oceanography in the context of my master's research. Dr Lowther has experience with programmes specifically dedicated to visualising high-resolution animal movement in a geospatial context and oceanographic datasets relevant to my project (e.g., programmes such as QGIS and Ocean Data View and the PostgreSQL database).

Report on my overall experience:

Overall, I enjoyed my time visiting my co-supervisor, Dr Andrew Lowther at the Norwegian Polar Institute in Tromsø, Norway. I got to experience a new research environment at an institute where work is driven by government-mandated research that leads to important decisions (e.g., how the krill fishery is managed in the Southern Ocean) being made by national governments and international associations. I was able to broaden my knowledge when speaking to students and staff involved with different projects taking place in other areas of the world (e.g., the Arctic) and hear about their field and research experiences.

Week 1 & 2:

- I was happy to finally meet my co-supervisor, Dr Lowther at the Norwegian Polar Institute in person, whom I have communicated with for the past year during my studies. I only had a brief meeting with him in the first week, after I had an unplanned six-day delay (flight cancellations) during my first week.
- Later, I presented and discussed some of my linear mixed-effects model results with both my supervisors that I previously obtained just before my research trip started. It was valuable to me to get their input on what they thought of the preliminary results. We talked about how I would be able to discuss the results in my chapter, before moving on to working on the second chapter, which I wanted to do while I was on my research visit. From the first meeting and for the rest of the research visit, it was so beneficial to have face-to-face meetings and receive quick feedback on small aspects of the work as we could make decisions a lot quicker which made the work a lot faster.
- From the first discussions about my project, we realized that we needed to make clear separations between my project's two chapters. A lot of time went into creating new, improved project outlines and research questions with clear workflows and a timeline with dates of when I want to have certain tasks done during the rest of the year. This was an important aspect of the research visit to ensure that I have clear ideas when going forward with the data analysis. Dr Lowther and I worked through the new research chapter outlines and proposed timeline and discussed expected figures and tables to be included in my dissertation. We also discussed expectations from me, as the student and them as supervisors for the rest of the year and the

expected outcomes (publications) from this study. My supervisors and I are all satisfied with the new chapter outlines, and excited to see what the outcomes of the project will be.

Week 3 & 4:

- A lot of time was spent on data exploration to see if we could include high-resolution temperature data in my second research chapter. I also spent time trying to identify any irregular weather patterns during the data collection process using high-resolution data. After extensive data exploration, we could, unfortunately, see that the high-resolution data that we have available, would not be suitable to use in the rest of the project. I felt quite upset and disappointed after realizing that I will not be able to use a large amount of the work that I have spent a lot of time on. However, I did learn a lot of geospatial skills from this work, so I do not see this as a negative. This meant that we had to shift the focus of the second research chapter. The outline of the second chapter is now interesting but concise, ensuring that I will be able to finish my project in time because most of the methods and scripts for this chapter were already worked out.
- Dr Lowther and I had valuable discussions where I learnt a lot about the oceanography of the two study sites, which was one of the main aims of the research visits. An important point that came out of these discussions was to include remotely sensed salinity as an additional environmental variable to identify important water masses. Salinity is proving to be one of the most important environmental variables to characterise the environments in this study. I quickly learned how to use the Ocean Data View, a programme to analyse and visualise oceanography data. Using Ocean Data View, I can now easily visualise and interpret temperature-salinity plots for my study areas and have already identified the important water masses that characterize the study areas.
- I have realised that my data wrangling, exploration, and visualisation skills in the R programme have greatly improved during the past few weeks. When I needed to formulate a few new ideas and shift the focus of research chapters, I was able to quickly code and visualise new ideas using the already processed data. I presented the new ideas to my supervisors during discussions, and they especially liked the fact that I was able to visually illustrate my ideas to them, while also being able to cite the existing literature. I have also learned the importance of having your files and data organized and labelled clearly and logically so that when you quickly need to revisit a script or a data file, it is easy to find it.
- During our weekly discussions, Dr Lowther often used QGIS and Quantarctica to show me how the two environments differ on both islands (e.g., to visualise the bathymetric features). I realised yet again how efficient it is to be able to work in QGIS and to use the Quantarctica programme (developed by the Norwegian Polar Institute) for studies conducted in the Southern Ocean. For the next few weeks, we had a few sessions in QGIS and R. Dr Lowther introduced me to QGIS and showed me how beneficial the program would be for my project (specifically focusing on data visualisation) and how important it is to keep your input data files organized. Following the introductory QGIS session, we went through the steps from how to go from the raw GPS data that we downloaded from the deployment tags to processing the animal movement data and converting it into shapefiles using geospatial R packages. Then how to import the shapefiles (representing the animal movement tracks) into QGIS. He showed me how to work with the shapefiles to create high-quality maps in QGIS, which I can use for quick data visualisation and publication. These sessions ensured that I could do all the data processing steps independently so that I can be confident to say that I can use QGIS in a project. We also discussed the benefits of using the new database, PostgreSQL, where you can store QGIS projects and shapefiles. He helped to set up my own PostgreSQL database that I can use for QGIS. I used the rest of my time to familiarise myself with the PostgreSQL database and QGIS. I have been able to create a few preliminary plots to illustrate the movement tracks of both species that I can now use in my dissertation.

Week 5 and 6:

- We want to characterise and compare the environments within which species move around an island during incubation and chick-rearing. After feedback from previous weeks, I needed to improve how I characterize the

environmental envelope for each island and my supervisors encouraged me to try out a few different methods. I was able to improve how I used the remotely sensed variables. I created species-specific utilisation distribution polygons, which I overlaid over a raster layer of each environmental variable. I was able to extract the spatiotemporally matched remotely sensed environmental variables associated with each cell of the polygon. I am now able to compare the environments of both islands during different phases of the breeding season. Instead of using density plots to compare the environments, my supervisors think that I should also compare the environments using a Principal Component Analysis to see if the islands cluster out separately using the environmental variables, which I will look into when I am back in South Africa.

- Following the small changes in the research chapters, it meant that I had to go back to some of my previous data analyses to update the scripts so that I only use specific data in the rest of my data analyses. The following two weeks required a lot of hard work to update all the R scripts that I used to process data to ensure that I am using the most up-to-date data throughout the remainder of my project. For example, I had to update the R code to classify dive types using an expectation maximization algorithm. I also updated the remote-sensed environmental variables to include the newest fine-resolution sea surface temperature data and fine-resolution gridded bathymetry data that was released earlier in the year. I also spent some time updating my methods document to explain how and why we use certain variables.

I am grateful that I got the opportunity to go on a research visit to meet my co-supervisor, Dr Lowther. The visit also gave Dr Lowther the chance to catch up with my project and to also feel more involved with the project. Before my visit, we, unfortunately, did not have a lot of time to discuss my project as he spent a lot of time in the field with limited internet access. Throughout the visit, he provided me with a lot of valuable insights into why we are getting certain results and what results we can expect to get from further analysis. He made important suggestions on how to improve my project as he knows where the research gaps are in our field of research as he has been involved in the industry and research for several years. As an experienced researcher, who supervised many students before, he advised me that I needed to make some important decisions and set myself some deadlines for this project so that I can finish my project in time, which is advice I definitely needed to hear.

I got to experience the nature-loving culture of people who live in Northern Norway, who appreciate nature so much during summer when the midnight sun is ever present. I got incredible opportunities to go hike in and around Tromsø on my days off and spent a lot of time in nature, which I enjoyed. I truly feel like I explored all around the city, learned about the history, and experienced the daily culture and the lives of people residing in Tromsø. This has truly been a once-in-a-lifetime experience filled with opportunities to learn, challenge myself and improve my skills as a researcher. The trip came with a few difficulties (transport and technical), but through all the problems, I was able to always stay calm and have a positive outlook on the situation. It was unfortunate that I had a six-day delay at the start of the trip (due to SAS airline strikes) because I think if I had a few more days in Tromsø to work, I would have seen even more progress. But I am now motivated to progress with my research and to hand in my dissertation in due time. I am forever thankful to Dr Andrew Lowther for inviting and hosting me at the Norwegian Polar Institute during my research visit. Thank you to the FILAMO Funding committee for granting me the opportunity to go on this memorable mobility experience.