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PhD Candidate: Erin Ross-Marsh

Grant Name: FILAMO Mobility Grant Report

Report: Experience at the University of St Andrews, Scotland.

In June 2022, I was given the opportunity to visit the University of St Andrews to receive training for my PhD project from Dr Ellen Garland at the Sea Mammal Research Unit (SMRU) which forms part of the Scottish Oceans Institute (SOI). The SMRU and the SOI are world class institutions in the marine mammal science field, and I was beyond privileged to be able to visit the institution for a month. My time at the university and with Dr Garland has been invaluable to the future success of my doctoral research. Dr Garland has taught me techniques and analyses that will form a vital part of my thesis, but beyond that, has given me a more wholistic understanding of the importance and uses of bioacoustics research in marine mammal science.

Thanks to the FILAMO grant, I was able to form a good working relationship with Dr Garland, a co-supervisor for my PhD, as well as meet many incredible scientists working with marine mammals from all over the world. I am very excited for the next phase of my research and working closely with Dr Garland for the next few years, hopefully visiting the university again sometime in the future.

My Research

My doctoral research is dedicated to the study of the singing behaviour of humpback whales (*Megaptera novaeangliae*) in South Africa. Humpback whales (*Megaptera novaeangliae*) are highly vocal, producing a wide repertoire of sounds; often organised into song produced by males. Song is prolific at breeding sites but has also been documented along migration routes and at feeding sites. Males within a population will converge on a single song type within a breeding season, which is likely mediated by vocal production learning and cultural transmission. Gradually over time the specific song type will evolve as changes are introduced. These changes in song provide insight into the occurrence, movement patterns and interchange between populations of humpback whales over time and space as similarity or dissimilarity of song types between populations can indicate whether populations are in contact.

In South Africa, two populations of humpback whales are found along our shores, those on the west coast, breeding stock B (BSB) whose breeding grounds are near Angola and Gabon and who feed in the Southern Benguela, and those on the east coast, BSC who migrate to their breeding grounds around Mozambique and Madagascar. These two populations are recognised as genetically distinct with only occasional movement of individuals between them and little overlap between migration routes. However, recent evidence suggests that the Southern Benguela feeding ground may be used by both BSB and BSC. The waters of the

Southern Benguela feeding grounds are nutrient rich and an unknown proportion of the population feed there throughout the summer months. Occurrence of these groups has increased over the past 20 years and since 2011, aggregations of hundreds of whales have been documented forming tightly knit 'super-groups' of 20-200 individuals. Song has been recently recorded in this area during these aggregations. The presence of song, through comparison and structure analysis, could provide a tool to elucidate the potential point of connection that this area might provide between the two populations. This in turn could prove extremely important to our understanding of the stock structure and distribution of humpback whales along the South African coastline.

What I learnt at the University of St Andrews

The sole purpose of my research visit to the University of St Andrews was to learn specific techniques and analyses that will form an essential part of my thesis once the data have been collected and collated. Dr Garland instructed me in several different areas, the first and most important being song coding. Song coding is effectively breaking up a whale song into individual units. Each unit is coded (a, b, c, d etc.) and logged into a spreadsheet. This is done for an entire song and allows researchers to analyse the structure and make up of a specific song. This is an essential first step in being able to determine the population's song repertoire and to be able to eventually compare different songs to determine similarity. This forms an integral part of my doctorate research as one of my main research questions asks whether the songs sung by the humpback whale populations on the west coast of southern African sing the same song as those on the east. Song similarity between these two populations would indicate cultural learning of the songs between the two populations, indicating some form of prolonged contact. Once that training was done, we tackled statistical analyses, specifically those analyses that would validate the coding done in the song. These analyses, Random Forest, Levenshtein Index and Dice similarity index, show two important things, firstly, that the repertoire coded in the initial stages is accurate and consistent (i.e., sound type 'a' is consistently coded as sound type 'a' and not mistaken for another sound type too often), and secondly that two songs are similar or dissimilar. Dr Garland was incredibly knowledgeable, having been working in the field of bioacoustics, and humpback whale bioacoustics specifically, for more than a decade, and really helped to understand the nuances of these analyses. It was a wonderful experience not only to form a good working relationship with Dr Garland, but to also get to know others working at SMRU, being exposed to different studies and ways of thinking. While I was at the SOI, I also had the opportunity to present my work in humpback whale bioacoustics so far to students and colleagues, which was great practice for delivering my proposal presentation in the next few months at the University of Stellenbosch where I am currently enrolled.

I am incredibly grateful for the support from the FILAMO grant for making this opportunity possible and will take this experience with me, and the knowledge I gained during it, into the next three years for my project, knowing that it will have a major impact on my success.