Ecogenomics

Ecological Genomics & Wildlife Conservation

UNIVERSITY OF JOHANNESBURG

National Research Foundation

SANAP

Bettine van Vuuren (SANAP PI)

Biodiversity is being lost at unprecedented rates. Factors such as climate change, habitat fragmentation and environmental degradation (including alien species) are influencing the distribution and abundance of species, often in ways that are impossible to predict.

The focus of our work is to document genetic patterns in various species, and to link these spatial patterns to biotic and abiotic drivers. For example, how do the histories of islands shape spatial genetic patterns (climatic and geological histories, local landscapes and environmental conditions, geological features, and ruggedness of the local landscape)? How do species respond (in terms of adaptations and / or gene expression) to local changes? How do the islands shape marine biodiversity (the island-effect)?

For more information on our work, please visit www.molzoolab.co.za

Our work is multi-disciplinary and links strongly to the work by Peter le Roux and Michelle Greve (University of Pretoria) (plant ecology), David Hedding (UNISA) and Werner Nel (UFH) (geomorphology and landscapes), Linda Basson and Gerhard De Jager (UFS) (island effect), and Charlene Janion-Scheepers (UCT) and John Terblanche (SUN) (adaptation and transcriptomics). We also have strong ongoing collaborations with researchers at Rhodes University, in Australia, and in the UK.

There are a few highlights on our academic calendars ever year - but foremost for us is the SANAP Symposium. The SANAP community is not only a group of researchers (including students) doing great work "down south", but also a group of friends that have worked together for many years (in some instances), that know each other well, and that have seen the worst but also the best of each other. Our symposium is equal to a family-gathering, a mile-stone birthday; an opportunity to meet people that are important in not only our science lives, but also in our every-day lives.

Morgan Raath-Krüger
(Postdoc)

By using molecular tools in conjunction with an engineering model of wind flow we are able to understand species' range expansion rates and the drivers of observed ecological and genetic patterns. Marion Island has experienced rapid climate change over the last 50 years, and consequently, species' altitudinal distributions have changed, with most, but not all, plant species' upper altitudinal limits expanding. This project will involve building on a long-term dataset to document how plant species' ranges have changed (between the early 1970s, 2008 and 2021) and links gene expression to ecological data across altitudinal gradients, accounting for the impact of biotic interactions. This work is in collaboration with Peter le Roux (UP).

Harini has developed microsatellite libraries for indigenous and introduced springtail species which will be used to study and compare the spatial genetic structure of these species across Marion Island. To date, she has published two complete mitochondrial genomes. She is in the process of assembling the full genome, to the scaffold level, of one of her species. This genome will then be used to compare the loci under selection of indigenous and introduced species (linking to Shilpa Parbhu, see below) and determine the driving factor for adaptation to the harsh conditions on Marion Island. This work in collaboration with Rosemary Dorrington (RU) and Charlene Janion-Scheepers (UCT).

Harini Jagatap (PhD)

Shilpa Parbhu (PhD)

Since the 1960s to the early 2000s meteorological data has indicated that Marion Island is getting warmer and drier, driving the flora and fauna on the island to adapt quite rapidly to this ever-changing environment. A springtail was accidentally introduced to Marion Island in the late 1970s and has since thrived on the island. Using transcriptomes (the RNA expressed by cells under specific environmental conditions) we aim to study the genes and metabolic pathways involved in local adaptation and pinpoint the biochemical mechanisms that facilitate adaptation to the diverse stressors that may co-occur in cold environments. This work in collaboration with Charlene Janion-Scheepers (UCT) and John Terblanche (SUN).

The Marion Island landscape is exceptionally heterogeneous, architected by repeated glaciations and volcanic episodes. Previous work shows that distinct genetic groups are present, which loosely corresponds to broad-scale landscape features and barriers on the island. In contrast, the importance of the habitat matrix in shaping local-scale movement of individuals has received little attention. My work aims to understand how the landscape matrix shapes the local-scale dispersal abilities of Marion Island springtails (how individuals perceive and move within their environments). This work is in collaboration with David Hedding (who will provide bearing directions and a ruggedness index between each sampling point) and Peter le Roux (to provide wind model data).

Daniela Monsanto (PhD)