Antarctic Science Bursary

Final Report

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Habitat suitability and conservation of McMurdo Dry Valley soil biodiversity

Ashley Shaw[1] & Jasmine Lee[2,3]

1. Department of Biology, Colorado State University, Fort Collins, Colorado, United States
2. Centre for Biodiversity Conservation Science, University of Queensland, Brisbane, Queensland, Australia
3. Australian Antarctic Division, Kingston, Tasmania, Australia

The Antarctic Science Bursary supported a collaborative project for two early career Antarctic scientists, integrating the skillsets of both researchers. As well as improving understanding of Antarctic conservation needs, this research expanded the scope of both candidates' PhD projects, increased their research skills through peer-assisted learning, and produced a strong international collaborative partnership that will continue beyond this project's conclusion.

Project Overview

The McMurdo Dry Valleys (MDV) of Southern Victoria Land are Antarctica's largest ice-free area (>4,500km^2)[1] and contain soil biodiversity that has not been considered for conservation. Here, soil conditions vary substantially across the landscape, reflecting unique glacial, hydrologic, and climatic histories.[2-5] These soils form a heterogeneous habitat where environmental factors, including water and energy availability, temperature, and soil properties (e.g., salt and nutrient concentration), constrain species distributions and biodiversity.[6-12] This biodiversity consists of largely soil-inhabiting microbes, nematodes, rotifers, tardigrades, springtails and mites.[13,14] Climate-driven increases in biological and hydrological connectivity across the MDV landscape are expected to alter soil habitat through increased movement and distribution of soil water, carbon, nutrients, and salts, impacting biodiversity's distribution and abundance.[15,16] Given their vulnerability to such changes, including soils in conservation planning is critical.

We used our Antarctic Science Bursary to build a soil biodiversity database, develop habitat suitability models and identify areas of conservation concern for MDV soil biodiversity. In a collaborative exchange, we visited each other's institutions and combined our skillsets to achieve our objectives. In the project's first phase, Lee visited Diana Wall's soil biodiversity and ecosystem functioning lab at Colorado State University in August 2017, where Shaw's soil ecology expertise was used to coordinate compilation of MDV records and guide habitat suitability model development. Shaw next visited Aleks Terauds' biodiversity conservation group at the Australian Antarctic Division in September 2017, where Lee's spatial modelling and conservation planning experience was utilised to run the habitat suitability models and incorporate them into conservation planning.

Database

Nearly 30 years of biodiversity data and accompanying environmental variables were compiled into the first comprehensive database of soil invertebrate records for the MDV region. These records primarily come from the United States Antarctic Program, with most associated with the National Science Foundation Long Term Ecological Research (LTER) program. Early records from pre-LTER expeditions were also transcribed from field notes, using location descriptions to assign the record's coordinates in GIS software. Additional records for the MDV area were also obtained from Landcare New Zealand and the Scientific Committee on Antarctic Research's terrestrial biodiversity database. All historic records were generally stored as individual excel sheets and had not been previously

combined or formatted. We identified and cleaned all available data, standardising all records in a comprehensive database. More than 1060 individual data files were integrated, resulting in over 18,000 biodiversity records of 14+ taxa (Fig 1). The database and accompanying manuscript have been drafted as a data paper for submission. Given that the MDVs are one of the best studied Antarctic regions, this comprehensive, spatially explicit database will be very valuable to the Antarctic research community.

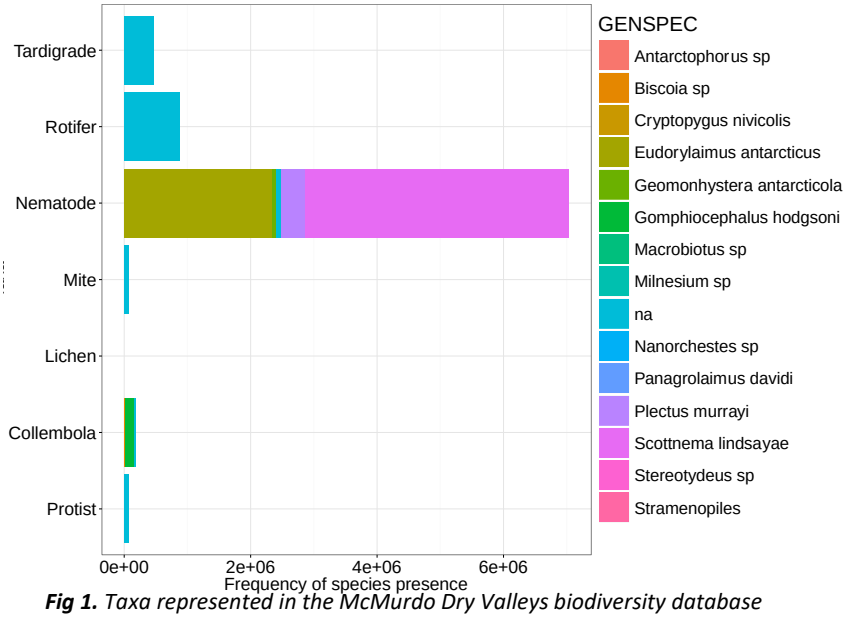

Fig 1. *Taxa represented in the McMurdo Dry Valleys biodiversity database*

Habitat suitability models and conservation planning

General Additive Models were used to model habitat suitability for taxa using eight environmental variables (salinity, elevation, degree days, pH, nitrogen, carbon, distance to coast, and melt). Habitat suitability varied between species, with a large amount of variation even within phyla. Among the nematodes for example, presence of *Scottnema lindsayae* was correlated with salinity, soil moisture and total nitrogen, while *Eudorylaimus* sp. correlated with organic carbon and distance to coast, and *Plectus* sp. correlated with summer degree days. Initial species distribution models were built to examine habitat suitability at sites where biodiversity has not yet been surveyed, although these will be further refined using new topographic soil maps produced by collaborators at Landcare New Zealand when available. Final models will be utilised in a systematic conservation planning process where valuable soil conservation sites within the MDVs will be identified using soil properties and habitat suitability. Once finalised we will submit the results to a scientific journal. Identifying sites of conservation value is important for managers and policymakers in the region, and soils are yet to be included in planning. We will ensure the information is made available to them, such as through an Information Paper submitted to the Antarctic Treaty Consultative Meeting.

Measures of success

- The need for a comprehensive MDV soil biodiversity database was recognised and communicated to key scientists, which resulted in shared data for database inclusion
- The first, comprehensive database of MDV soil biodiversity and environmental variables was assembled, which includes over 18,000 records
- A manuscript describing this dataset is being finalized for submission
- Habitat suitability models for inclusion in soil conservation planning were developed, with a planned manuscript in preparation, to be submitted after updated soil maps are available
- Professional career development was achieved via a skill exchange, where Lee increased her soil ecology skills, while Shaw developed modelling and conservation planning skills
- Professional networks were expanded via exchanges and introductions to colleagues
- Results were shared with the scientific community via an oral presentation at the POLAR2018 conference in Davos, Switzerland

Publications

Shaw EA, Lee JR, Terauds A, Wall DH. 2018. Habitat suitability and conservation of McMurdo Dry Valley soil biodiversity. POLAR2018, Davos, Switzerland. Available at: https://www.scar.org/science-meetings/osc/open-science-conference-abstracts/5075-polar2018-abstracts/file/ pp. 2387

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