MASTS VISITING FELLOWSHIP
Project summary

Natalie Millán Aguiñaga (MASTS fellow)
Home institute: Universidad Autónoma de Baja California. Facultad de Ciencias Marinas. Ensenada, Baja California, México.
Visiting Institute: University of Strathclyde, Strathclyde Institute of Pharmacy and Biomedical Sciences. Glasgow, Scotland.

Dr Katherine Duncan (Host)
University of Strathclyde, Strathclyde Institute of Pharmacy and Biomedical Sciences. Glasgow, Scotland.

"Assessing the biotechnological potential of Antarctic and sub-Arctic sediment cores - a new resource for sustainable antibiotic drug discovery".

This MASTS fellowship support was used to bring Dr Natalie Millán Aguiñaga, a professor from Universidad Autónoma de Baja California, México to the University of Strathclyde, to work as an academic visitor in collaboration with Dr. Katherine Duncan at the Strathclyde Institute of Pharmacy and Biomedical Sciences (Glasgow, Scotland). This collaboration was in two visits: for the period of 9th December 2016 - 20th January 2017 and 19th June 2017 to 11th August 2017.

Dr. Millán-Aguiñaga worked on the project entitled "Assessing the biotechnological potential of Antarctic and sub-Arctic sediment cores - a new resource for sustainable antibiotic drug discovery". This project had three scientific objectives:

Dr. Millán-Aguiñaga successfully completed all three objectives within the laboratory over the course of her visiting fellowship. Currently the last of the data processing steps from objectives 2 and 3 are underway.

Results

1) Establish a rare actinomycete culture collection from Polar sediment cores

Dr. Millán-Aguiñaga initially visited The Scottish Association for Marine Science (a collaborator on the MASTS fellowship) in Oban, to collected sediment cores from the Arctic and Antarctic collection (Fig. 1). The samples were processed and bacteria were isolated using a selective isolation approach with targeted media and pretreatments for biotechnologically useful actinomycete strains. A collection of 45 bacterial strains was recovered from this culture-dependent work from 12 sediment cores. The majority were actinomycete strains (Fig. 2), known for the production of bioactive compounds with biotechnological potential. This Polar culture collection was taxonomically identified at the species level using 16S rRNA gene sequencing, thus completing objective 1 of the proposed research.

Figure 1. A sediment cores sampled for this research.

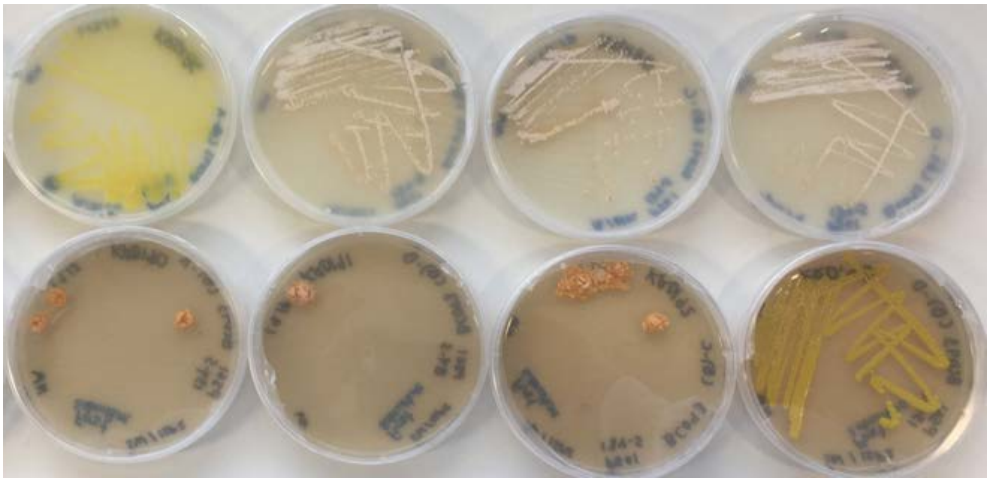

Figure 2. Bacterial strains isolated from marine sediment cores.

2) **Investigate bacterial community composition and functional analysis of sediment cores using next-generation sequencing**

To investigate the bacterial community composition of these Polar sediment cores, Dr. Millán-Aguiñaga isolated environmental DNA from all 12 sediment cores. Five high-quality DNA samples were then subsequently sequenced using cutting-edge MinION sequencing technology. A further three DNA samples are in the progress of being sequenced, to expand the dataset and provide a larger comparison of both the bacterial community composition and the functional gene annotations within each core.

3) **Understand the isolated bacteria as a chemical and biotechnological resource**

The third objective was achieved by selecting 15 strains based on taxonomic and phylogenetic analysis to ferment. The metabolites produced by these strains were then chemically extraction using a resin-based metabolite extraction protocol. Chemical profiling, using liquid-chromatography tandem mass spectrometry was preformed on all 15 strains. Currently comparative metabolomics analysis is being completed.

4) Research dissemination and networking opportunities

This manuscript resulting from this research is currently in draft-version, with the aim to submit to a high impact peer-reviewed journal due the novelty (Polar bacteria) and design (microbiology, molecular biology and chemistry).

Besides spending intensive laboratory hours over the duration of this project, Dr. Natalie Millán-Aguiñaga was invited to give a talk about this research at the Chemistry and Biology of Natural Products Symposium XI at the University of Warwick (UK) on 29th and 30th June, 2017. Dr Millán-Aguiñaga was also invited to give a special seminar at the Marine Biology seminar at Scripps Institution of Oceanography, University of California, San Diego on January 12th, 2018. On March 3rd, 2018, this work will be presented at the prestigious Gordon Research Conference on Marine Natural Products held every two years in Ventura, California, providing an excellent platform for dissemination.

Significance and further impact

This research has successfully created a culture collection of Polar rare-actinomycetes for further investigation. Dr Duncan (PI) has been awarded a Carnegie Trust Collaborative Research Grant (2017-2018) with researchers at Glasgow University (Co-I) and Aberdeen University to complete the whole genome sequencing of select strains.

The work here provides a rare insight into the chemical and biological potential of organisms that, due to sampling logistics, are poorly studied in these ecosystems. Dr Duncan plans to lead further grant applications in this area as a result of both the chemical and molecular data generated from objectives 2 and 3.

Dr Millán-Aguiñaga and Dr Duncan are currently pursuing further co-led research proposals to continue collaborating, including further visits between Scotland and Mexico, including potential future student exchanges. As a result of this MASTS fellowship Dr Millán-Aguiñaga has a greatly expanded Scottish/UK research network and will draw on this for future research collaborations and grant applications.