SUMMER RESEARCH 2024/25
PROJECT ABSTRACT

THE UNIVERSITY OF WAIKATO
Te Whare Wānanga o Waikato

PROJECT # 53

SUPERVISOR/S:	AProf Chris Lusk & Melanie Ooi
PROJECT TITLE:	Is climate change affecting the spread of Nothofagus in North Island upland forests?
FIELD:	Ecology
DIVISION/SCHOOL:	HECS - Te Aka Mātuatua School of Science
PROJECT LOCATION:	Hamilton
EXTERNAL PARTNER:	Royal Society of New Zealand

PROJECT ABSTRACT:

Carbon and nitrogen dynamics differ substantially between ectomycorrhizal and arbuscular mycorrhizal forests, the former on average storing more soil carbon and showing stronger growth responses to elevated atmospheric CO2. Forests dominated by ectomycorrhizal Nothofagus comprise about half of New Zealand's remaining native forests, the remainder comprising arbuscular mycorrhizal conifer-broadleaf forests, and mixed forests including elements of both. Twentieth century researchers reported that the distribution of Nothofagus in New Zealand was still undergoing post-glacial readjustment, invading conifer-broadleaf forest at rates of 6-12 m per century in some districts. The documented effect of ectomycorrhizal symbiosis on forest carbon storage makes it pertinent to ask if rising temperatures are altering the rate of Nothofagus expansion. We will address this question the in the northwestern Ruahine range, where research in the 1980s indicated Nothofagus expansion into upland conifer-broadleaf forest on the Mangaohane plateau. We will test for temporal change in the rate of Nothofagus expansion by comparing the extent of outlier Nothofagus stands on aerial photos taken in 1953 and 1980, and on 2024 satellite photos. We will use 21st century satellite images to train a convolutional neural network algorithm to distinguish between Nothofagus and conifer-broadleaf stands on grayscale images, and then apply the algorithm to delineate Nothofagus stands on historical grayscale aerial photos. The aerial imagery will be orthorectified to ensure faithful spatial correspondence with recent satellite photos. We will visit the Mangaohane plateau to characterize the current structure and composition of Nothofagus and conifer-broadleaf stands. We will determine the effects of Nothofagus expansion on soil carbon and nutrient dynamics by analysing soil samples, and by using Plant Root Simulator probes to measure nutrient availability beneath replicated Nothofagus stands and neighbouring mixed conifer-broadleaf stands, and at the ecotone between the two forest types. A manuscript based on the results will be submitted to an international journal of ecology.

STUDENT SKILLS:

- Physical fitness compatible with fieldwork in remote locations, including long hikes with a pack.
- Must be available for 4-5 day fieldtrips, and willing to travel by helicopter.
- Basic knowledge of terrestrial ecology, such as that imparted by BIOEB202.
- Teamwork skills.
- Basic Python programming.
- Code reuse from Github.
- Please contact Chris Lusk if you're unsure about any of these skills/requirements, or if you'd like to know more.

PROJECT TASKS:

1. Fieldwork to install Plant Root Simulator probes in Nothofagus and conifer-broadleaf forest on Mangaohane plateau (access to Ruahine Corner hut by helicopter: https://www.google.com/maps/place/Ruahine+Corner+Hut/@-39.6311594,176.1718655,2687m/data=!3m1!1e3!4m6!3m5!1s0x6d6a192a6f2c3777:0x4679bd324ac82ecc!8m2!3d-39.6311594!4d176.1718655!16s%2Fg%2F1hfny6z86?entry=ttu)
2. Measure forest structure and composition by plot sampling in both forest types.
3. Use AI to colourize historical aerial photos of the study area, and orthorectify photos to correct parallax error.
4. Compute rates of Nothofagus expansion by comparing areas of Nothofagus outlier stands in 1953, 1980 and 2023.
5. Access Ruahine Corner on foot to extract soil samples, and to retrieve Plant Root Simulator probes.
6. Clean and submit probes to laboratory for analysis.
7. Prepare poster based on results. Prepare manuscript for submission to an international journal.

EXPECTED OUTCOMES:

- Student's Research Poster (as per clause 6 of the Scholarship regulations)
- The student will acquire skills in image processing and photogrammetry.
- The student will acquire field skills in forest mensuration, and soil sampling.
- The student will develop their data analysis and writing skills.
- The student will produce a final research poster.
- We will submit a manuscript to an international journal of ecology.