FELLOWSHIP SUMMARY REPORTS

Prof Nicholas COOPS
University of British Columbia

Theme 1: MANAGING NATURAL CAPITAL: - Forests.

Host Collaborator: Justin Morgenroth
University of Canterbury, Christchurch, New Zealand

15 December 2022 to 15 June 2023.

I consent to this report being posted on the Co-operative Research Programme's website, or alternatively, a short paragraph about your fellowship which could be used anonymously.

1. What were the objectives of the research project? Why is the research project important?

The objectives of the project were to develop new spectral and structural index indices which are specifically calibrated to conifer tree types, to estimate both physiological changes in tree condition (due to short term climate variations) as well as longer term structural attributes including volume and taper.

This is important as these remote sensing indicators can be used to inform which trees are more productive and climate resilient thereby ensuring a more sustainable seed source stock for future plantations.

2. Were the objectives of the fellowship achieved?
Or are they on the way to being achieved?

Yes, objectives were met. The first component of the research examined the density of drone -based LIDAR point clouds acquired in conifer environments, and compared across a range of growth stages and ages.
The second component developed comparison data for individual tree extraction focused on expansion of native NZ beech forest and the third on new approaches to fuse multi spectral sensors such as ground based and drone based LIDAR over a variety of ecological benchmark sites in native NZ forest.

3. What were the major achievements of the fellowship? (up to three)

- We acquired common datasets for analysis both at UBC and University of Canterbury for future data processing, and data analysis allowing comparisons of data workflows and protocols.
- Visits of UBC graduate students and researchers to University of Canterbury to undertake field work in New Zealand forest and collect data for international cross comparisons
- Development of new tools and scripts to display and analyse high density drone based points clouds.

4. Will there be any follow-up work?

- Is a publication envisaged? Will this be in a journal or a publication? When will it appear?

Yes, 3 publications anticipated. Analysis is already underway. Journal publications anticipated in late 2023 and 2024.

- Is your fellowship likely to be the start of collaboration between your home institution and your host?

Yes, additional visits are likely as well as international visits by other faculty and graduate students to both institutions.

- Is your research likely to result in protected intellectual property, novel products or processes?

No

5. How might the results of your research project be important for helping develop regional, national or international agro-food, fisheries or forestry policies and, or practices, or be beneficial for society?

We urgently need to identify and deploy new technologies to assess high performing trees, and to examine their responses to climatic extremes like drought and frost tolerance. This will involve a suite of complementary tools to gather data and should be rapid and inexpensive to enable visits to multiple trial sites at a sub-annual resolution, i.e., to evaluate phenology over a growing season. With advances in remote sensing technology, the potential to derive a suite of more targeted, accurate and broadly applicable set of indices in order to inform upon attributes such as volume, growth characterisers, as well as responses of the foliage to climate extremes is possible and has the potential to revolutionise the way tree breeding trials are measured and analysed. The results of this project with the analysis and gathering of the new remote sensing data, the sharing of scripts and code, the development of common processing pipelines and development of new validation techniques will further efforts to build rapid phenotyping technologies removing barriers to achieving the full potential of existing genomics information and would lead to significant additional value through multi-trait selection for volume and adaptive traits.

6. How was this research relevant to:

- The objectives of the CRP?

As discussed in Theme 1 of the fellowship guidelines, Forests, when sustainably managed, provide both wood biomass and carbon to society in addition to a range of ecological goods and services. Critical to our management of forests, especially establishment and regeneration silviculture, is the use of the best seed, in the right place. Tree improvement is specifically listed as a goal within the Forests sub-theme of managing natural capital theme, recognising that tree improvement and forest genetics are key to ensuring sustainable and resilient forest ecosystems. Measuring key tree attributes such as volume, in tree breeding trials, is currently difficult due to the size and slow growing nature of trees. As a result, we use diameter which is a very limited metric to inform on growth potential and resilience. This project is highly innovative as it applies new technologies, such as drone based remote sensing, to tree breeding programs to inform on realised gain, and breeding value, as well as providing insights into the resilience of genotypes to climatic extremes like drought and frost tolerance.

- The CRP research theme?

The fellowship research plan was highly innovative, bringing together the fields of tree breeding, remote sensing, 3D image analysis, and forestry. We demonstrated the applicability of remote sensing-based technologies to help assist forestry inventory and breeding programs. The fellowship is at the leading edge of new remote sensing technological advancements and allowed Coops to visit and work at a new institution will ensure the time and resources needed to investigate three key aspects currently limiting future development of this area.

7. Satisfaction

- Did your fellowship conform to your expectations?

Yes

- Will the OECD Co-operative Research Programme fellowship increase directly or indirectly your career opportunities? Please specify.

NA

- Did you encounter any practical problems?

No

- Please suggest any improvements in the Fellowship Programme.

Very happy with the program.

8. Advertising the Co-operative Research Programme

- How did you learn about the Co-operative Research Programme?

From Colleagues

- What would you suggest to make it more “visible”?

Continue to promote the program as you are currently doing.

- Are there any issues you would like to record?

No.