**Enhancing Seedling Detection in New Zealand Forestry: A Multi-Datastream Approach**

Early detection of seedlings is crucial for effective silvicultural practices and accurate mortality quantification in New Zealand plantation forestry. However, the presence of dense weed populations within the forestry cutover environment presents a significant challenge in the development of accurate detection models.

Recent advancements in consumer-grade multispectral UAV technology, such as the DJI Mavic 3 Multispectral, offer a cost-effective solution for capturing high-resolution RGB and multispectral imagery simultaneously. This study addresses the limitations of existing New Zealand UAV seedling detection models by developing mixed-resolution detection models using both high-resolution RGB and multispectral imagery.

Focusing on one-year-old Pinus radiata and Pseudotsuga menziesii seedlings across diverse site characteristics, five trial sites were selected in the Blue Mountains (Otago, New Zealand). These sites, totaling 143.8 hectares, encompass a spectrum of topographic, vegetative, and crop health conditions. At a flight height of 65m, high-resolution RGB imagery achieved a spatial resolution of 1.77 cm/px, while multispectral datasets attained 3.03 cm/px.

Within the mapped area, an estimated 140,870 seedlings are present for annotation. In addition to imagery annotation, ground-truthing using survey-grade GNSS receivers recorded the precise locations of 1,612 seedlings in regions with challenging detection conditions. Furthermore, the ground-truthing process included qualitative assessment of the health status of the seedlings.

This study was conducted under operational conditions, with the model generated from this study intended for direct operational use in New Zealand forestry management. We hope this nuanced approach, incorporating these multiple data streams, not only facilitates the generation of more powerful training data but also enables a more accurate assessment of model performance. By combining high-resolution imagery with precise ground-truthed seedling locations and health status, our methodology aims to enhance the robustness and reliability of seedling detection models.

This holistic approach not only improves the model's ability to accurately detect seedlings in difficult conditions but also provides valuable insights into its effectiveness across diverse environmental conditions, ultimately advancing our understanding and application of remote sensing techniques in forestry management.

Preliminary examination of the collected data instills confidence in the potential for improved detection accuracy, especially in heavily vegetated areas, through the integration of multispectral and high-resolution RGB imagery. While the research is ongoing and results are pending, initial observations suggest promising outcomes for advancing seedling detection methodologies in New Zealand forestry.