2020 Project Summaries
Boreal Ecosystem Recovery & Assessment
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Remote Sensing Team: Coarse Woody Debris Can be Mapped Effectively Over Large Areas

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Project Summary
Forest managers and ecologists can benefit from large-scale high-accuracy maps of coarse woody debris (CWD) over complex boreal environments. I tested the effectiveness of a geographical object-based image analysis (GEOBIA) workflow with random forest classification for mapping CWD (logs and snags) across a 4300-hectare study area near Conklin, Alberta. The models mapped (up to 93.4% completeness and 94.5% correctness) and estimated volume of CWD (0.623 R2, 0.224 RMSE) with very good accuracies. Single-band LiDAR improved the distinction between logs and snags in CWD maps (~6% better distinction; significant at α 0.05) and multispectral LiDAR data improved the estimation of CWD volume occluded by superimposed vegetation (~ 0.1 higher R2 and ~0.018 lower RMSE).

Management Implications and Lessons Learned
Site managers, ecologists, and foresters can use workflows developed in this research to map CWD accurately and efficiently over large areas. Specific lessons learned include the following: The main lessons learnt through development of this project were:

1. Machine learning proved a valuable tool to detect CWD on orthophotos. Given a large training sample, the artificial intelligence was able to achieve high accuracies with relatively little efforts from the user.
2. CWD estimations in the surrounding forest are more challenging than on disturbances (e.g. seismic lines), but achievable through sophisticated modelling. Field measurements are instrumental for obtaining good estimates where CWD is invisible from orthographic view.
3. Multispectral LiDAR is an emerging technology which has immense potential especially for forest mensuration purposes. However, technical challenges remain.

Publication(s)
Lopes Queiroz, G. 2019. Remote Sensing Boreal Coarse Woody Debris [Master's thesis]. University of Calgary, Calgary, AB.

Lopes Queiroz G., McDermid G.J., Castilla G., Linke J., Rahman M.M. 2019. Mapping Coarse Woody Debris with Random Forest Classification of Centimetric Aerial Imagery. *Forests*. 10(6):471.

Lopes Queiroz G., McDermid G.J., Linke J., Hopkinson C., Kariyeva J. 2020. Estimating Coarse Woody Debris Volume Using Image Analysis and Multispectral LiDAR. *Forests*. 11(2):141.