Spatial patterns of forest floor pH, nitrate, and ammonium associated with bigleaf maple and Douglas-fir in conifer forest

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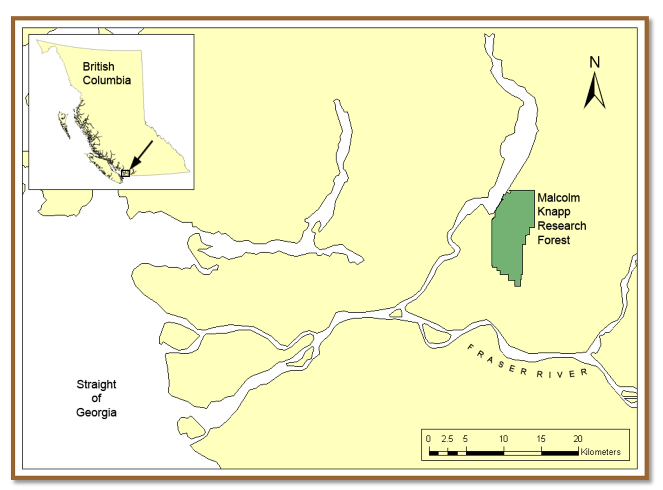
Introduction

Bigleaf maple (*Acer macrophyllum* Purch.) is a large deciduous tree that occurs naturally in conifer forests of southwestern British Columbia (B.C. Ministry of Forests 1999). The spatial influence of individual stems of this species has not been fully characterized yet. The objective of our study was to characterize and compare the spatial structure of forest floor pH, NO_3, and NH_4 associated with bigleaf maple and Douglas-fir. We hypothesized that bigleaf maple canopy and stem have significant impact on forest floor and this would be expressed in the spatial distribution of pH, NO_3, and NH_4.

Materials and Methods

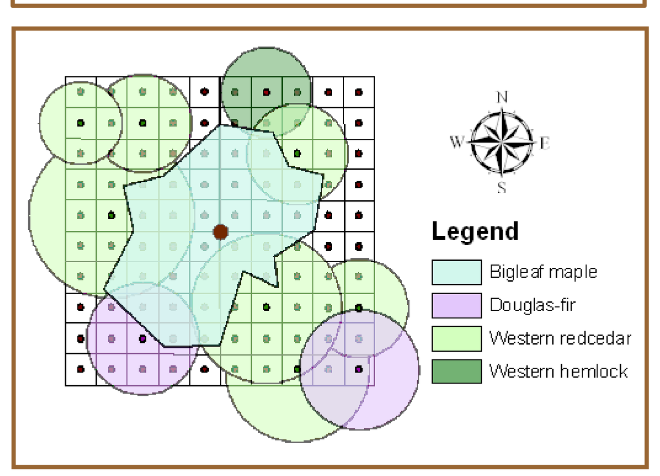
The study site is located within UBC's Malcolm Knapp Research Forest, Maple Ridge, British Columbia (49º21'N, 122º31'W).

A single dominant bigleaf maple was located and matched with a Douglas-fir having similar site characteristics. Both trees were centred within a 20 x 20 m plot. Plots are located on a midslope. Forest floor was sampled across a regular grid every 2 m centered at each plot. The locations of all tree stems and canopies on both plots were mapped. At each sample location forest floor was collected. Isotropic Moran's *I* correlograms were used to give a global measure of spatial autocorrelation over the sampled regions. Kriging was used to visualize forest floor pH, NO_3, and NH_4 across plots.

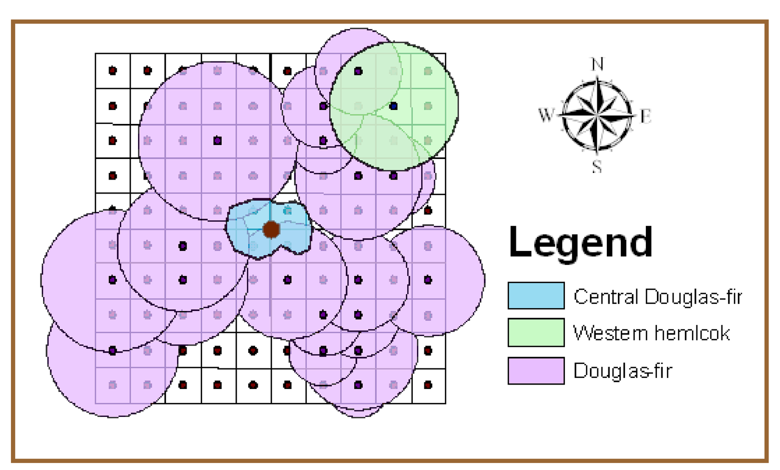


UBC's Malcolm Knapp Research Forest

Bigleaf maple leaves



Canopy extent of bigleaf maple central tree



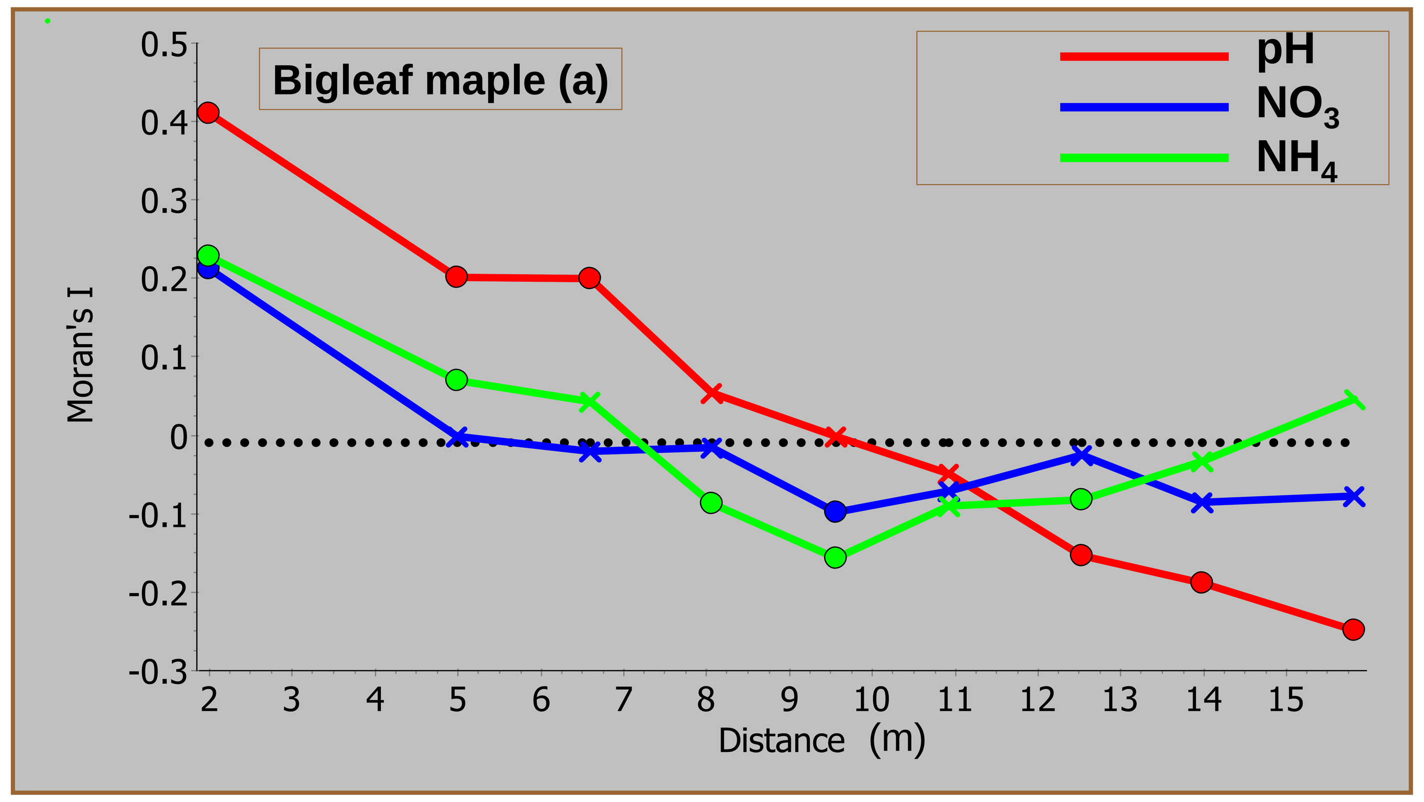
Canopy extent of Douglas-fir central tree

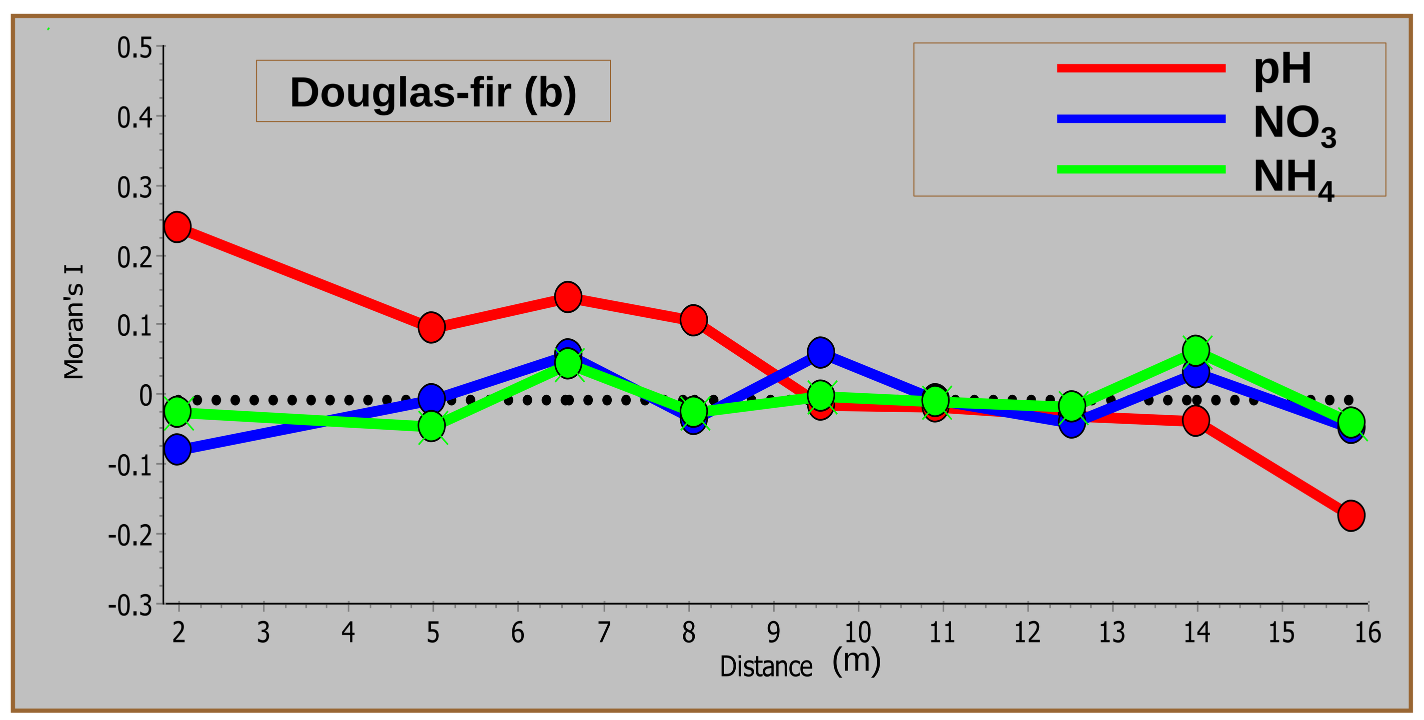
Results

Isotropic correlograms for bigleaf maple plots showed strong spatial autocorrelation for both forest floor pH and NH4. The shapes indicated presence of a spatial gradient and patchy structure respectively. Contrary to this, correlograms for Douglas-fir showed random patterns for NO_3 and NH_4 and a gradient spatial pattern for pH.

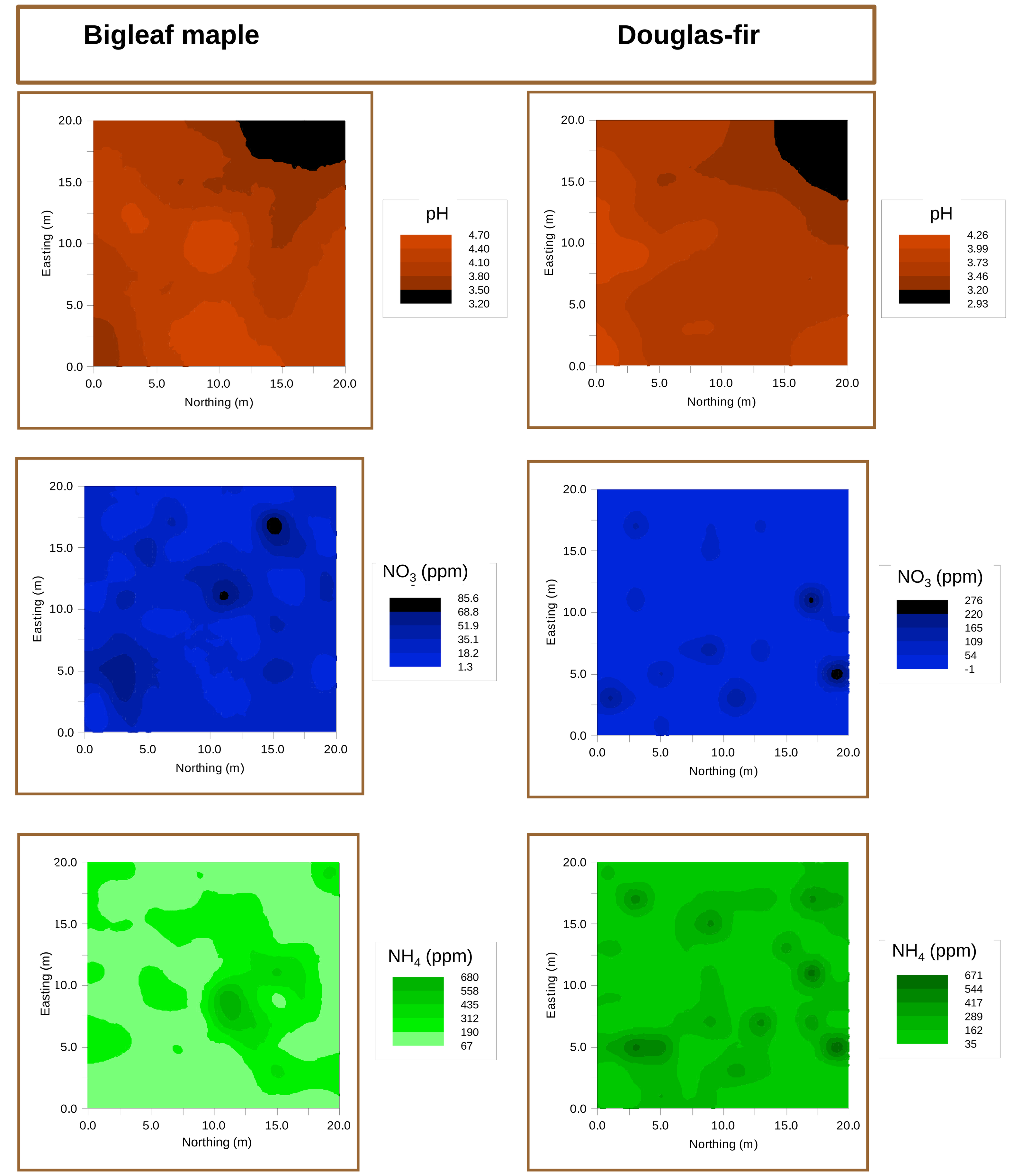
Kriging maps showed that bigleaf maple forest floor pH seemed to have distinct concentric patterns near the stem, and pH had higher values in locations adjacent to the bigleaf maple trunk. In addition, it detected a spatial gradient in the 135º direction (low values at the upper left corner and high values at the lower right corner of the map). Similarly, Douglas-fir forest floor pH showed a spatial gradient in the same direction.

Bigleaf maple NO_3 and NH_4 Krig maps confirmed the patchy spatial structure indicated by Moran's *I* correlograms while Douglas-fir forest floor NO_3 and NH_4 showed random patterns.





Isotropic correlograms of forest floor pH, NO3, NH4 for bigleaf maple (a) and Douglas-fir (b). Circle indicates a significant level, cross indicates non-significant



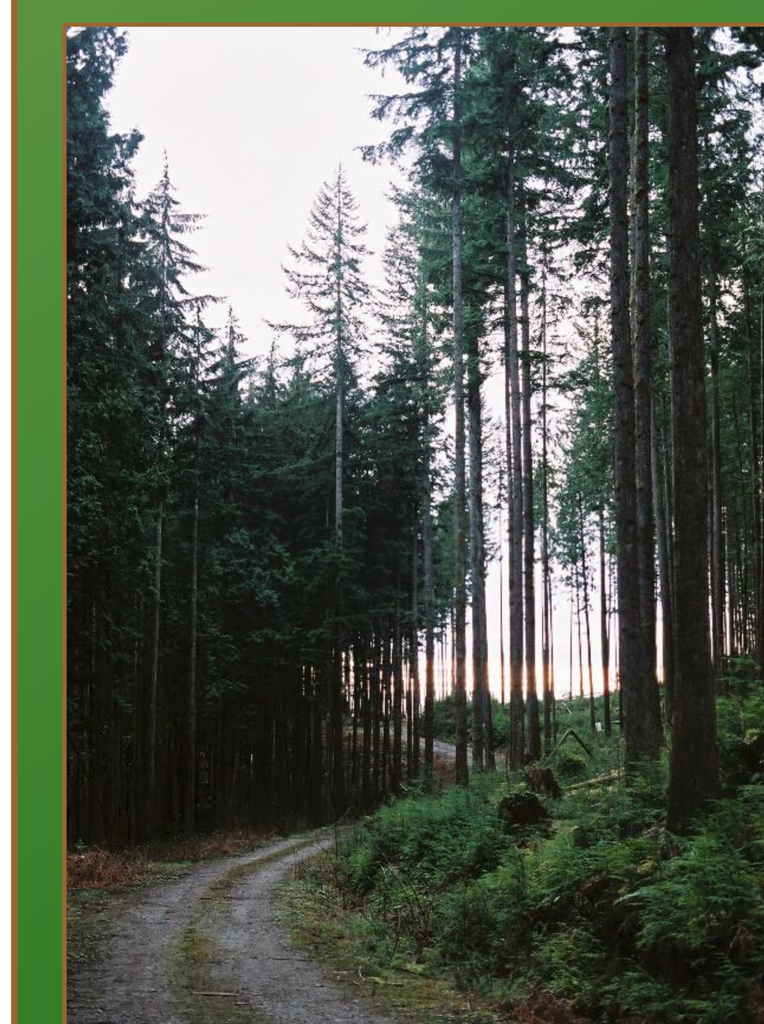
Conclusions

Bigleaf maple has a stronger influence on spatial patterns of forest floor pH, NO_3 and NH_4 as compared to Douglas-fir. This stronger influence could be partially explained by the larger canopy extent of bigleaf maple and possible masking of the influence of Douglas-fir by surrounding conifers.

The canopy and stem impact could be explained by processes such as the nutrient enriched litter (Zinke, 1962), throughfall and stemflow.

Site topography seemed to influence forest floor pH but not NO_3 and NH_4.

The results suggest that bigleaf maple may produce a microhabitat suitable for the growth of microorganisms that enhance N mineralization within the vicinity of the tree stem.



References

B.C. Ministry of Forests. 1999. Bigleaf Maple Managers' Handbook. Government of Canada, British Columbia.

Zinke, 1962. The pattern of individual forest trees on soil properties. *Ecology* 43 (1962), pp. 130–133.

Acknowledgments

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