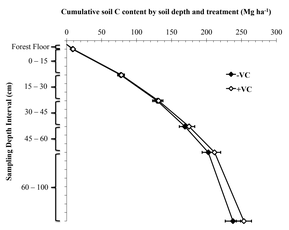
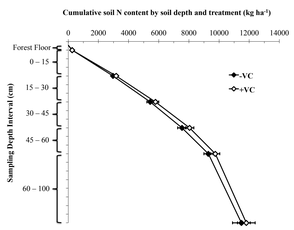
Effects of Vegetation Control and Harvest Intensity on Deep Soil Carbon and Nitrogen

R. Harrison, J.James, C. Dietzen, K.Littke, S. Holub, and M. Ciol
University of Washington

Why study deep soils?

- Soils contain a substantial store of carbon, more than the world's biomass and atmosphere combined, yet are currently under-represented in both forest management and carbon cycling literature.
- Research on the effects of silvicultural treatments on deep soil carbon and nitrogen has been particularly lacking.
- Effective soil depth is an important predictor of site productivity.
- Trees root deeply- the maximum rooting depth of Douglas-fir trees can be greater than 3 meters, indicating that deep soils are ecologically active and play a role in hydraulic distribution.



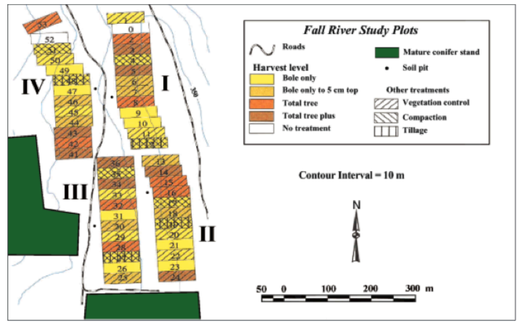


- Knight et al. found that differences in soil carbon and nitrogen between biomass removal treatments at Fall River were greatest deep in the soil profile, primarily below 0.6 m.

Experimental Design

- Four replicates of 12 treatments in a complete, randomized block design
- Our research will focus on three of the treatments:

1. Commercial bole only removal with vegetation control by annual herbicide application (BO+VC)
2. Commercial bole only removal without vegetation control (BO-VC)
3. Total-tree plus removal with vegetation control (TTP+VC)



- Bulk density samples will be taken to a depth of 3.5 meters at 9 depth intervals using an AMS soil auger and split-core sampler from 24 plots (2 replicates per treatment, per block) .
- *Hypotheses:* C and N concentrations will depend on both the treatment and the depth of a given observation.

Preliminary Results

Initial results from 2 plots indicate significant amounts of total C and N stored at the 200-300 cm depth in addition to large differences in amounts stored between treatments:

TTP+VC (Plot 24):
33.04 Mg C/ha
0.77 Mg N/ha

BO-VC (Plot 31):
131.54 Mg C/ha
6.31 Mg N/ha

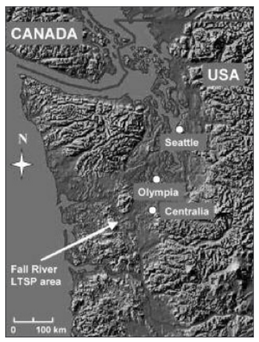
Large pockets of charcoal were found below 2 m in some plots

Further analysis to be completed: Samples will be analyzed to determine soil C and N concentrations. Carbon and nitrogen content on an areal basis will be determined by multiplying the bulk density by concentration and sample depth interval. Samples will also be analyzed to determine cation exchange capacity, anion exchange capacity, and short-range order mineral content, which previous studies have suggested may play a role in soil C and N retention.

Fall River Long Term Soil Productivity Site

- This project builds upon previous research by Erika Knight at the Fall River Long-term Soil Productivity Site located in Western Washington.
- The Douglas-fir stand was established in 1999

Figure 6—Typical soil profile of the Boistfort series at the Fall River research area. Every division of the measuring device is 10 cm.



- This site has a deep, well-drained soil with few rocks, which developed from weathered basalt and is classified as an Andisol of the Boistfort Series.
- These soils are representative of the most productive soils in the Pacific Northwest.

Progress to Date

- Validated split-core vertical bulk density sampler with punch corer samples.
- 9 out of 24 plots sampled to a depth of 3.5 meters.
- A majority of those samples have been analyzed for bulk density and carbon and nitrogen content.

Expected Deliverables and Benefits

- This project will generate data documenting:
  - Change in soil C and N content from initial post-harvest stocks
  - Change in total soil C and N between treatments
  - Change in soil C and N with depth
  - How soil C and N relate to chemical & mineralogical soil properties including AEC, CEC & amorphous minerals
- The primary deliverables will be data and statistical analyses of the effects of forest management practices on both surface and subsurface soil C and N.
- Sampling deep soil across treatments will provide the most complete understanding of soil C and N pools at Fall River to date, as well as a baseline for resampling deep soil pools in the future.
- Our results will shed long-needed light on the impacts of silvicultural treatments on deep soil, informing sustainable management practices in high productivity Douglas-fir plantations.