

AN ABSTRACT OF THE THESIS OF

Joseph A. Student for the degree of Master of Science in Radiation Health
Physics presented on January 1, 2013.

Title: An Analysis of Something

Abstract approved: _____

Jane D. Professor

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An Analysis of Something

by

Joseph A. Student

A THESIS

submitted to

Oregon State University

in partial fulfillment of
the requirements for the
degree of

Master of Science

Presented January 1, 2013
Commencement June 2013

Master of Science thesis of Joseph A. Student presented on January 1, 2013.

APPROVED:

Major Professor, representing Radiation Health Physics

Director of the School of Nuclear Engineering and Radiation Health Physics

Dean of the Graduate School

I understand that my thesis will become part of the permanent collection of Oregon State University libraries. My signature below authorizes release of my thesis to any reader upon request.

Joseph A. Student, Author

ACKNOWLEDGEMENTS

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Chapter 1: Introduction

1.1 Objective

The Douglas-fir forests of the coastal Pacific Northwest are among the most productive globally (???). Maintaining forest productivity of this region is important for the continued viability of the Pacific Northwest timber industry, as well as for its potential to regulate atmospheric carbon in the ongoing climate crisis. This productivity is due to a combination of high soil nitrogen (N) and climate that is favorable to tree growth. Whereas the majority of forests worldwide are N limited due to low N availability, the coastal Douglas-fir forests have undergone centuries of N saturation due to historic presence of the symbiotic N-fixing red alder (**Alnus rubra**) in the region (?). When soil N availability comes to exceed tree requirements, tree growth commonly becomes limited by other nutrients required in high quantities to sustain growth, such as P, Ca, K, and S (???Radwan and).

When soil N supply exceeds ecosystem N demand, N saturation is known to occur (?). Highly N saturated soils undergo enhanced soil nitrification and subsequent coupled nitrate-base cation leaching (?). Nitrification particularly accelerates calcium (Ca) and magnesium (Mg) losses from soils (?). As Ca is required in higher quantities by trees than Mg, and is known to be distinctly limiting in forests predisposed to highly acidic and weathered soil conditions (??Bigelow and Can-

ham, 2007), it is more likely that Ca deficiency is to develop in the higher N soils of the Oregon Coast Range (OCR) rather than other base cations. In contrast to accelerated leaching losses, chronic N saturation and nitrification can stimulate accelerated mineral weathering (??). However, over millennia, the source of ecosystem Ca supply in the OCR has shifted from mineral to atmospheric in soils with either sedimentary or basaltic soil minerals. This implies either a depletion or an inaccessibility of the weatherable pool of nutrient cations at N saturated sites (??). Despite a large disparity between potential base cation supply between soil minerals in OCR soils, chronic N saturation may nevertheless lead to base cation limitations all forests.

Although ecosystem nutrient cycling processes are sufficient in supplying Ca in many unaltered forests (?Hilton, 1987), a large portion of Douglas-fir in the OCR is specifically grown for the harvest of timber. Removals of tree nutrients through harvest is a primary cause of ecosystem nutrient losses in managed forests (?), and may quickly lead to soil Ca depletion and subsequent forest productivity losses in Ca deficient forests (??). Intensive forest-harvest practices, such as whole-tree-harvest (WTH), are known to be the major cause of nutrient losses in a range of forest plantations in comparison to moderate practices, such as bole-only (BOH) harvest (?). Recent intensification of forest management to improve economic returns has led to shorter rotation schedules of 40 years and lower (?), with potential to accelerate nutrient removals substantially. It is estimated that high N Douglas-fir forests under WTH will reach soil Ca depletion within 50 years of continued harvest, whereas the application of BOH can extend this to 400 years

(?). However, it remains unknown how many short-rotation harvests must occur to cause nutrient depletion under a variety of soil nutrient conditions. In Coastal Douglas-fir forests, it is likely to depend on the interaction of harvest intensity and how forest N saturation influences Ca supply from mineral weathering and exchangeable nutrient supply.

As an analysis of nutrient depletion in the OCR requires the observation of soil nutrient conditions from 40 to 500 years in the future (?), a dynamic modelling approach is used to observe the potential for soil N saturation and harvest to drive nutrient depletion in soils. Relatively few dynamic models of forest nutrient cycling contain sufficient chemical detail to evaluate interactions between nitrogen cycling and calcium supply from mineral weathering. One such model is called “Nutrient Cycling in Forest Ecosystems”, or NutsFor. NutsFor is one of several dynamic process-oriented models that was developed to simulate forest-soil chemical responses to harvest and acidic deposition (van der Heijden et al., 2017). It is a hybrid of the Nutrient Cycling Model (NuCM), the ForSAFE model, and the PROFILE model, which have been used to study base cation nutrient depletion due to acidic deposition and harvest intensity (Verburg et al., 2001; van der Heijden et al., 2011; Liu et al., 1991). NutsFor has adopted NuCM’s exchange site simulations and N-transformation processes, while adding the PROFILE soil mineral weathering model (van der Heijden et al. 2017). NutsFor’s ability to link soil N transformations to soil acidification, mineral weathering, forest management, and exchange site depletion of base cations makes NutsFor well suited to the study of nutrient cycling and depletion in the biogeochemically diverse, intensively managed

coastal forests of the PNW.

In this study, we report how extreme soil N enrichment affects long-term nutrient retention in OCR forests under repeated harvest. We further describe how bedrock type interacts with soil N to supply base cation nutrients to forests. We studied the effects that soil N extremes (low to high) have on nutrient limitation on forests sites overlying either sedimentary or basaltic minerals, over a range of harvest intensities to answer the following questions: Q1: How does soil N saturation affect nutrient losses (especially Ca) in coastal Douglas-fir stands? Q2: How do different stand rotation lengths and harvest types change the rate at which nutrient depletion occurs? Q3: How do different kinds of bedrock (basaltic versus sedimentary) and associated soil minerals influence the rate of nutrient depletion? Q5: When (after how many harvests) do nutrient losses cause biomass accrual rates to slow?

1.2 Background

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Chapter 2: Literature Review

2.1 First Section of Lit Review

Frogs are weird...

Table 1: Simulated Lysimeter Fluxes by Depth (2005-2006)

Depth	YEAR	kg/ha									
		Ca	Mg	K	Na	NO3	NH4	SO4	Cl	P	DOC
2	2005	9.7	7.1	6.4	29	0.37	0.71	3.3	24	0.13	19
2	2006	11.5	8.4	6.9	20	0.26	0.72	3.4	30	0.13	19
8	2005	10.0	9.5	4.3	32	0.21	0.39	5.2	42	0.061	6.3
8	2006	8.8	8.4	3.9	30	0.12	0.42	5.2	30	0.062	6.1

Figure 2.1: Frog pic...

Here is a reference to the from pic: Figure 2.1.

2.2 Just another section of this chapter.

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Chapter 3: Materials and Methods

3.1 Primary Methods

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3.2 More Methods

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Table 3.1: Types of stuff you put in a table

Header 1	Header 2
Item 1	something
Item 2	something else
Item 3	more things
Item 4	and more
Item 5	last thing

Table 3.2: Thicker horizontal lines above and below the table.

	Treatment A	Treatment B
John Smith	1	2
Jane Doe	—	3
Mary Johnson	4	5

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Chapter 4: Results

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$$MDC = \frac{3.29 * \sqrt{(Bkgcpm * C_t * (1 + \frac{C_t}{BkgC_t}))} + 3.0}{2.22 * E * C_t * V * decay * A * R * DF * I} \quad (4.1)$$

Where:

- C_t = Sample count time
- $BkgC_t$ = Background count time
- $Bkgcpm$ = Background counts per minute (cpm)
- E = Counting efficiency
- V = Sample volume or weight
- $decay$ = isotopic decay (if applicable)
- A = Isotopic abundance (if applicable)

- R = Recovery (if applicable)
- DF = Dilution factor for liquid scintillation (if applicable)
- I = Additional decay or ingrowth factors (if applicable)

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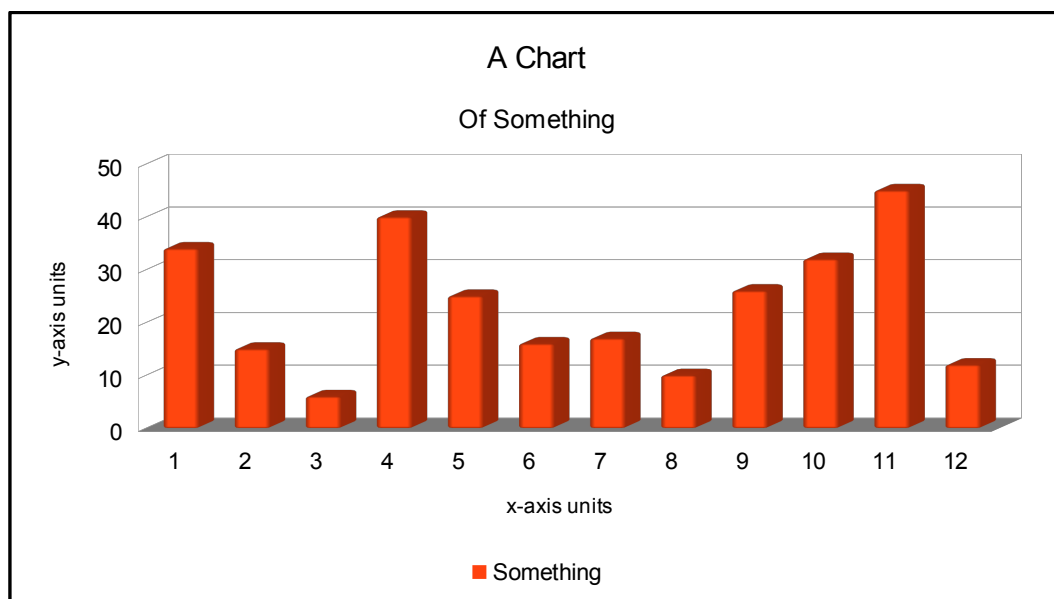


Figure 4.1: A Chart.

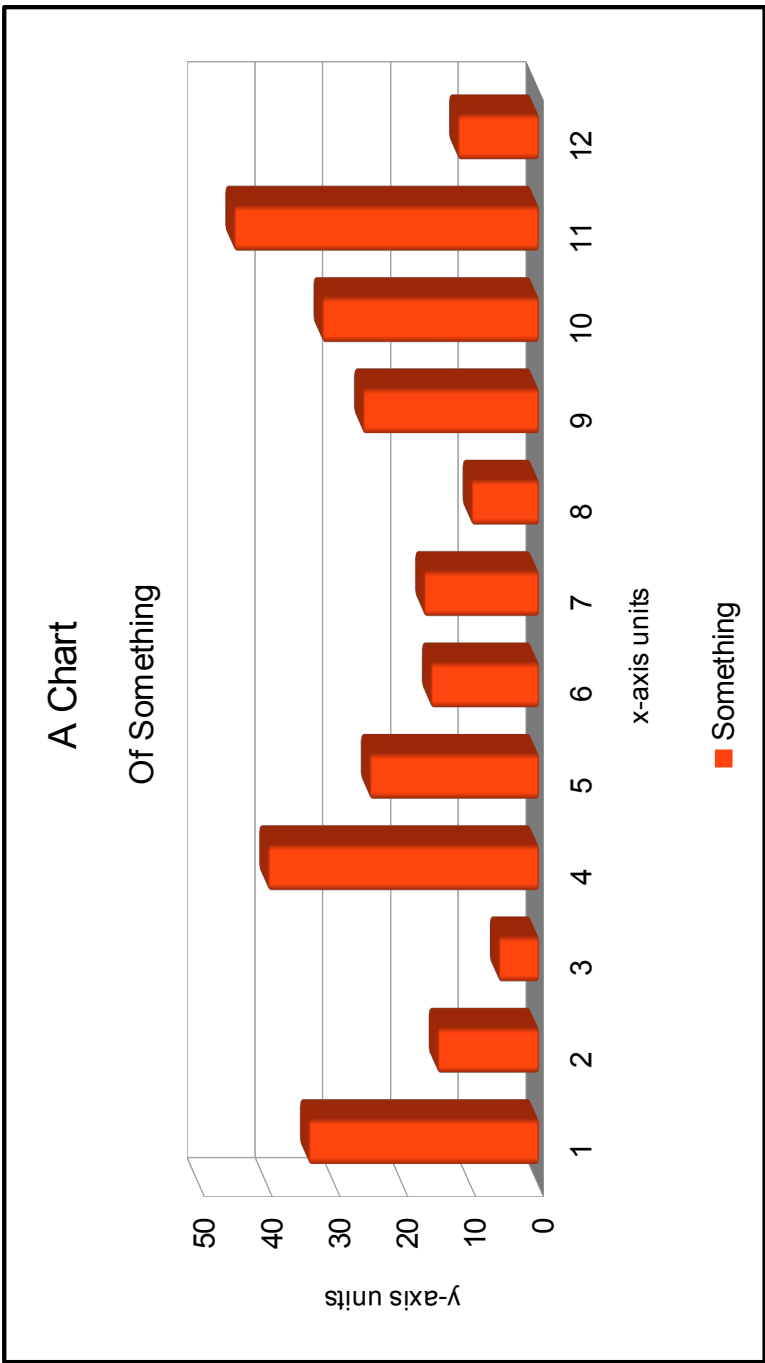


Figure 4.2: Same chart, but using sidewaysfigure.

Chapter 5: Discussion

5.1 First Subsection

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$$A(t) = A_o e^{(-\lambda t)} \quad (5.1)$$

Then Equation 5.1 is integrated to become:

$$\tilde{C} = \int_0^t A(t) dt = \frac{A_o}{\lambda} (1 - e^{(-\lambda t)}) \quad (5.2)$$

Where:

- $A(t)$ = original exponential function
- A_o = the peak activity at day 0 (Bq per mass or volume)
- \tilde{C} = Integrated Activity Concentration (Bq-days per mass or volume)

- $t = 28$ days
- $\lambda =$ removal constant (day^{-1})

5.2 Another Subsection

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Finally, a table with a footnote...

Table 5.1: Some table values					
Sample	A_o ¹	λ	\tilde{C}	Something	Total (units)
Item 1	1	.55	3	125	70
Item 2	1	.55	3	125	70
Item 3	1	.55	3	125	70
Item 4	1	.55	3	125	70
Total					280

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¹some kind of footnote from a table, which doesn't work without the tablefootnote package

Chapter 6: Conclusion

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Bibliography

- Seth W. Bigelow and Charles D. Canham. Nutrient limitation of juvenile trees in a northern hardwood forest: Calcium and nitrate are preeminent. *Forest Ecology and Management*, 243(2):310–319, May 2007. ISSN 0378-1127. doi: 10.1016/j.foreco.2007.03.027. Describes species-specific growth responses of Northern Hardwood trees to Ca and N additions over a fertility gradient. Generally, the study shows that different species respond to soil nutrient conditions differently, but that some northern hardwoods (saplings) specifically show slow growth responses to Ca limitation. This opens up the possibility for soil N saturation and acidic rain to drive successional changes in natural forests via soil Ca depletion.
- J. G. Bockheim, E. A. Jepsen, and D. M. Heisey. Nutrient dynamics in decomposing leaf litter of four tree species on a sandy soil in northwestern Wisconsin. *Canadian Journal of Forest Research*, 2011. doi: 10.1139/x91-113.
- Guy Hilton. Nutrient cycling in tropical rainforests: Implications for management and sustained yield. *Forest Ecology and Management*, 22(3):297–300, December 1987. ISSN 0378-1127. doi: 10.1016/0378-1127(87)90114-9.
- M A Radwan and H Brix 1986 . Nutrition of Douglas-fir. page 12.

APPENDICES

Table 1: Sources of Parameterization

Parameter	Source
Example Parameter	Bockheim et al. (2011)
Example 2	3
4	5

Appendix A: Things

Appendix B: More Things

