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The Effects of Climate Change on Tradeoffs in Forest Ecosystem Services

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Abstract

The Effects of Climate Change on
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This sample dissertation is an aid to students who are attempting to format their theses with L^AT_EX, a sophisticated text formatter widely used by mathematicians and scientists everywhere.

- It describes the use of a specialized macro package developed specifically for thesis production at the University. The macros customize L^AT_EX for the correct thesis style, allowing the student to concentrate on the substance of his or her text.¹
- It demonstrates the solutions to a variety of formatting challenges found in thesis production.
- It serves as a template for a real dissertation.

¹See Appendix A to obtain the source to this thesis and the class file.

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GLOSSARY

ARGUMENT: replacement text which customizes a \LaTeX macro for each particular usage.

BACK-UP: a copy of a file to be used when catastrophe strikes the original. People who make no back-ups deserve no sympathy.

ACKNOWLEDGMENTS

I want to thank all those that contributed to my earning this degree.

DEDICATION

To ma femme and my family

Chapter 1

ASSESSING CHANGES IN TRADEOFFS AMONG ECOSYSTEM SERVICES IN THE DESCHUTES NATIONAL FOREST

1.1 Introduction

Forests are crucial to global ecological, social, and economic processes. They provide ecosystem services such as carbon storage, purification of water and air, wildlife habitat, recreation opportunities, and generate raw materials for goods such as food and lumber [9]. Many forests are actively managed, either by public or private entities [39]. These managing entities prioritize the ecosystem services to be provided by the land. The extent to which forests can provide these services depends on management practices. The ultimate goal in forest planning is to ensure the sustained provision of these ecosystem services.

Similar to all other ecosystems, forests are predicted to undergo complex changes as a result of the changing climate. We anticipate new spatial distributions of tree species [18], increased sediment delivery to streams [16], and increasing disturbance regimes such as wildfires, drought, and insect infestation [38]. As this transformation occurs, forests ability to provide ecosystem services will change. For instance, increased frequency of wildfires will impact forests ability to store carbon [3] and provide habitat for wildlife [25]. Water supplies that rely on forests filtration capabilities may be impacted by the rising sediment levels predicted by [16].

As forest management often plans decades into the future, proper planning must include the effects of changing climate. Under new climatic conditions, decisions that once would have resulted in levels of optimal achievement of ecosystem services may no longer do so. Without proper correction we may be managing forests in a way that restricts their potential

to provide ecosystem services most effectively. To determine which management practices will be optimal in the future, we must first understand how climate change will impact forests ability to provide ecosystem services. For example, how many tons of carbon dioxide will the forest be capable of storing? How many acres of forest will still qualify as suitable habitat for a particular species? Many studies have considered these questions but address ecosystem services in isolation.

Because forests provide these ecosystem services in concert with one another (see, for example, [36]), we must also understand how climate impacts the tradeoffs that exist among them. Consider the simultaneous provision of wildlife habitat, carbon storage, and resistance to wildfire. How does an increase in any one service alter our ability to acquire an amount of another? Relationships such as a marginal sacrifice in one objective for substantial improvement in another may no longer be as advantageous under a new climate. To properly adapt management decisions and ensure the sustained provision of ecosystem services, we must understand how these tradeoffs evolve as a function of climate.

1.2 Methods

In this thesis the typist refers to the user of L^AT_EX—the one who makes formatting decisions and chooses the appropriate formatting commands. He or she will most often be the degree candidate.

This document deals with L^AT_EX typesetting commands and their functions. Wherever possible the conventions used to display text entered by the typist and the resulting formatted output are the same as those used by the T_EXbooks. Therefore, `typewriter type` is used to indicate text as typed by the computer or entered by the typist. It is quite the opposite of *italics*, which indicates a category rather than exact text. For example, `alpha` and `beta` might each be an example of a *label*.

1.3 Results and Discussion

This sample thesis was produced by the L^AT_EX document class it describes and its format is consonant with the Graduate School's electronic dissertation guidelines, as of November, 2014, at least. However, use of this package does not guarantee acceptability of a particular thesis.

1.4 Conclusion

Here's a conclusion.

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Appendix A

WHERE TO FIND THE FILES

The uwthesis class file, `uwthesis.cls`, contains the parameter settings, macro definitions, and other T_EXnical commands which allow L^AT_EX to format a thesis. The source to the document you are reading, `kullman_thesis.tex`, contains many formatting examples which you may find useful. The bibliography database, `kullman_thesis.bib`, contains instructions to BibT_EX to create and format the bibliography. You can find the latest of these files on:

- My page.

`http://staff.washington.edu/fox/tex/uwthesis.html`

- CTAN

`http://tug.ctan.org/tex-archive/macros/latex/contrib/uwthesis/`

(not always as up-to-date as my site)