### Thesis Prospectus 2023-24

**Name: Kate Hall**  **ID Number: A00432164**

**Email:** **Katherine.hall@evergreen.edu**

**Student Final Submission (date): 2/24/2024**

**Faculty Reader Approval (date):**

**MES Director Approval (date):**

1. Working title of your thesis.

Recreation Trail Analysis on Social Trails in Forest Habitats

1. In 250 words or less, summarize the key background information needed to understand your research problem and question.

 Recreational trails are a great resource for people to enjoy the outdoors. However, if not maintained or built properly, these trails can do major harm to the surrounding vegetation and soil. The top three recreation activities are hiking, horseback riding, and biking. Hikers trample vegetation which has been found under light traffic to reduce vegetation height, biomass, and seed development (Marion et al., 2016). High usage of the trail leads to soil compaction, soil erosion, and water alteration. This further impacts the surrounding vegetation as it impedes plant seed germination since the soil is compacted. (Marion et al., 2016). Horseback riding amplifies trampling damage seen by hikers. Horses exert 2000-4000 g/cm2 of ground pressure, shearing and deepening the trail. This significant trampling destroys vegetation along the trail path (Price, 1985). Lastly, bikers tend to make social trails, disturbing plants further away from the trail edge. Improper building of these trails amplifies this damage as it increases soil erosion, trail braiding, and trail widening (Marion and Leung, 2004). It is clear recreation damages the local vegetation and soil. Most trail research has been done on formal trails. The studies that have compared social vs. formal trails have found social trails reduce tree canopy while formal trails do the most damage during construction (Ballantyne et al., 2015a). More research needs to be done on the environmental impacts of different recreational trail types. This study will help close this knowledge gap by studying social trails in forest habitats.

1. State your research question(s).

How do social trails impact the vegetation and soil in the forest of Evergreen Street College?

1. Situate your research problem within the relevant literature. What is the theoretical and/or practical framework of your research problem?

There are more than 50 years of research findings on how recreational trails impact the surrounding environment yet there are still many gaps in the research of recreation ecology (Ballantyne and Pickering, 2015a). Trail science is a small network that doesn’t get a ton of spotlight in tourism literature (Marion, 2023). Furthermore, land managers tend to lean on experience rather the hard science. Management publications rarely discuss trail sustainability and rarely site any trail science. Land managers tend to fund trail assessment over trail science (Marion, 2023). With the lack of interest in trail science these gaps prevail after 50 years of research in this topic. Most research has only been done in U.S. or Australia. 50% of research on this topic has focused on only three biomes (Ballantyne and Pickering, 2015a). One knowledge gap is how informal trails and trail infrastructure impact the surrounding vegetation and soil (Ballantyne and Pickering, 2015a). My research question will aid in closing this gap with the specific focus on social trail impacts on forest habitats. It is important to understand how forest habitats handle recreation disturbance so maintenance can make informed decisions on trail planning and future maintenance.

1. Explain the significance of this research problem. Why is this research important? What are the potential contributions of your work? How might your work advance scholarship?

Trails provide one of the top ways people access outdoor recreation, providing a social, cultural, and physical connection to our environment. Nature-based tourism has been on the rise after the COVID pandemic. During the 2019 COVID pandemic there was a significant drop in international tourism due to the risk of traveling. Interestingly, as international travel fell, domestic travel started to rise and there’s also a noticeable trend that people were choosing more outdoor activities (Obradovic and Teslin, 2022). Obradovic and Teslin found before the pandemic, people chose nature-based tourism for vacation 73.9% of the time. During the pandemic, people choosing nature-based tourism for vacation rose to 95.8% (Obradovic and Teslin, 2022). Trails became a positive outcome and a safe solution for people trying to escape from the lockdown. However, the increase in people has greatly impacted the environment surrounding the trails. Trails if not created properly or maintained properly can cause great damage to the local environment. People and pack animals trample vegetation, compact the soil, and transport invasive seeds latched onto clothing or furs. This may look minimal but can have lasting damaging effects to the surrounding environment. With the increase in people using trails we shall see major environmental consequences if trails aren’t maintained to minimize damage. The solution is not to remove people because protective areas rely on money inflows from recreation activities for part of their funding (Marion, 2023). The solution is to find a balance between restoration and recreation. My research question will bring to light how social trails impact deciduous forest habitats. This work can help managers plan restoration longevity of their trails and better understand recreational impacts.

1. Summarize your study design. If applicable, identify the key variables in your study. What is their relationship to each other? For example, which variables are you considering as independent (explanatory) and dependent (response)?

My study area will be the 1,000-acre forest surrounding The Evergreen State College campus. These trails are rarely maintained and most of the trails are social trails. I will perform a trail analysis to better understand how these trails are possibly impacting the surrounding vegetation. The first step will involve locating all the social trails and mapping them in ArcGIS. Dylan Ficher, a facility member of the school has kept an updated map of the more popular trails used. I will use his map as a baseline to find the rest of the social trails. I will be focusing on the social trails that branch off the beach trail maintained by the school. If I have enough time, I will analyze the social trails that branch off the farm trail that is maintained by the school. Many studies have found the size of the trail influences the damage caused to the environment and in forested habitats in general, trails tend to reduce tree density. This study will focus on this topic by calculating the buffer zone of distance between the trail edge and where the closest trees are to the trail. The trail edge is defined as an area cleared of vegetation and obstacles so one may walk through (USDA, 2007). This study will also analyze tree width, to understand if the tree size is influenced by the trail width. If there is time, this study will also analyze the soil compaction along the trail path to better understand recreational impacts to the soil.

1. Describe the data that will be the foundation of your thesis. Will you use existing data, or gather new data (or both)? Describe the process of acquiring or collecting data.

First phase: Using the map created by Dylan Fischer I will start with the trails on the map as a starting point to find all the social trails along the maintained beach trail and if time, along the maintained farm trail. I will use the GPS tracks app on my phone to record my walk on these social trails which will be downloaded and mapped on ArcGIS.

Second Phase: Starting at one end of the trail GPS coordinates of the starting point will be recorded. Every 10m I will stop and collect data. GPS coordinates will be recorded for each collection site. Trail width will be collected by using a tape measure to measure the distance between the edges of the trail. The edges of the trail will be defined as where bare ground ends and vegetation begins. Using judgment of sight, the closet tree to the trail where I’m collecting data will be determined. For possible tree density loss, I will be using the method Ballantyne and colleagues (2015b) used to determine forest loss. A tape measurer will be used to get the distance between the trail edge and that tree. This will be done on both sides of the trail. The tree width of the tree selected will also be collected by placing a tape measurer around the truck at my chest level height. If time allows for soil collection the penetrometer tool will be used to measure soil compaction. For soil compaction I will take three measurements. One at the center of trail, and one inch away from the trail edge on both sides. Data will be collected every 10m from one end of the trail to the other end of the trail. GPS coordinates of the end trail will be collected.

1. Summarize your methods of data analysis. If applicable, discuss any specific techniques, tests, or approaches that you will use to answer your research question.

I will use ArcGIS to map out all the social trails on campus. Trail width will be averaged for all trails. Trails will then be categorized as small (0-2m), medium (2-4m), or large (4-7m). I will then calculate the average length of distance between the trail edge and the closet mature tree for all trails. This will be mapped in ArcGIS to display the buffer zone of possible vegetation loss, specifically trees, between trails and the locations of the trees. One-way ANOVAs and turkey post hoc tests will be conducted to determine the difference between trail widths and the tree distances. Average tree width will be calculated for each trail in this study. One-way ANOVAs and turkey post hoc tests will be conducted to determine the difference between trail widths and tree width. Both sets of tests will be a correlation analysis.

1. Address the ethical issues raised by your thesis work. Include issues such as risks to anyone involved in the research, as well as specific people or groups that might benefit from or be harmed by your thesis work, perhaps depending on your results. List any specific reviews you must complete first (e.g., Human Subjects Review or Animal Use Protocol Form).

I need to be respectful to people using the trails and make sure any pictures I take won’t have any people to respect their privacy. I need to be mindful when I go off the trail to minimize the trampling damage I might do to the vegetation. No review forms need to be completed.

1. List specific research permits or permissions you need to obtain before you begin collecting data (e.g. landowner permissions, agency permits).

I won’t need any land permission as I’m a student from the college and I will not be removing any vegetation or soil from the trails.

1. Reflect on how your positionality as a researcher could affect your results and how you will account for this in the research process.

I love hiking and using recreational trails, so I have a basis on seeing recreational trails as a positive resource for people. I’ve worked in recreation my whole life and have seen how destructive people can be firsthand. Due to my background, I’m assuming more people, and more time equals more invasives. I will account for this in my research by doing formal trail assessments and being accurate with my data collection. Data will bring new perspectives that might be different from my assumptions, and I will listen to these new perspectives carefully.

1. Provide at least a rough estimate of the costs associated with conducting your research, if any.  Provide details about each budget item so that the breakdown of the final cost is clear.

My research study won’t cost any money. All the supplies I need can be borrowed from the school and I won’t have any lab costs. If anything, I will have to pay for gas to get to the school.

1. Provide a detailed working outline of your thesis.

I will be using the traditional thesis outline.

**Abstract**

This section will cover a brief introduction and significance to my topic. I will then discuss a brief overview of my methods along with the most important findings in my results. Ending this section with the most important conclusion statement and how research should move forward.

**Table of Contents**

**List of Figures**

**List of tables**

**Acknowledgements**

Will acknowledge my parents and my spouse.

**Chapter 1- Introduction**

 This chapter will provide an overview of the project. I will highlight important points from the literature review and my research question. This section will go over current knowledge gaps and maintenance setbacks to highlight the significance of this research.

**Chapter 2- Literature Review**

1. *Introduction*

Discuss the significance of trails and the increase of people recreating after COVID. Describe how trails can damage the environment if not created or maintained properly. Make it clear what I’m researching and provide a roadmap on what will be discussed in the literature review.

1. *Recreational impacts on vegetation*

Recreational activities impact the environment differently. This paper will discuss the top three recreational activities: hiking, horseback riding, and biking. Hikers damage the environment through trampling and transporting invasive seeds on their clothing. Horses and other pack animals transport seeds on their fur and through their dung. Pack animals damage the soil which stresses the nearby vegetation. Bikers create social trails damaging more vegetation and transport invasive seeds that latch onto the bike and the biker’s clothing.

1. *Maintenance*

Trail planning and building have been more on experience than science. Furthermore, most trails have been inherited by old roads that weren’t built for recreation. Poor planning and building leads to soil erosion, trail widening, and loss of vegetation. This section will discuss how poor trail building leads to soil and vegetation damage.

1. *How different plant species handle human disturbance.*

Plants react differently to anthropogenic disturbance due to different morphological characteristics, environmental conditions, and different thresholds. This section will discuss how vegetation in Evergreen State College handles these three conditions to determine how resistive the vegetation is to recreation disturbance.

1. *How soil handles recreation disturbance*

Certain soil types are better for trails because of their ability to handle repeated compaction without eroding or doesn’t get muddy immediately when wet. This section will discuss what soil types are best for trail design and why.

1. *Conclusion*

This section will highlight important points in the literature review and provide possible solutions to the maintenance setbacks. This section will also go over research gaps in this topic and how important it is to close these gaps.

**Chapter 3- Methods**

 This chapter will go over details of my study site: location, climate, and history. I will discuss the recreational activities performed on these trails, how most of these trails are social trails, and the little maintenance done in this area. I will go over in detail how I plan to do a formal trail analysis and how I plan to collect my data on the vegetation and soils.

**Chapter 4- Results**

 This chapter will show all my one-way ANOVAs and turkey post hoc tests with figures displaying my findings. This chapter will also display the map I created for all the social trails and the map displaying the buffer zones for the mature tree vegetation analysis.

**Chapter 5- Discussion**

 This chapter will discuss the figures in chapter 4 and any patterns that can be found from my data collection and analysis. Overall, forming conclusions from the data analysis in chapter 4.

**Chapter 6- Conclusions**

 To end my thesis, I will discuss overarching themes, the significance of this project, and the overall findings of my research. I will end this paper with the encouragement for more people to invest in recreation ecology as it’s important to find a balance between recreation and restoration during these times of uncertain climate change.

**Bibliography**

1. Provide a specific work plan and a timeline for each of the major tasks in the work plan. Be as realistic and specific as you can at this point, including the deadlines for Spring quarter.



1. Who (if anyone), beyond your MES thesis reader, will support your thesis (in or outside of Evergreen)? Be specific about who they are and in what capacity they will support your thesis. If you are working with an outside agency or expert, be specific about their expectations for your data analysis or publication of results.

I hope the facility will see this alteration of my original thesis as a better fit. My original thesis had many complications, to the point that my thesis reader expressed great concern and recommended a change.

1. Provide the 5 most important references you have used to identify the specific questions and context of your topic, help with issues of research design and analysis, and/or provide a basis for interpretation. Annotate these references with notes on how they relate to/will be helpful for your thesis. For any other sources cited in your prospectus in other answers, provide a complete bibliographic citation here as well.

Ballantyne, M., & Pickering, C. M. (2015a). The impacts of trail infrastructure on vegetation and soils: Current literature and future directions. *Journal of Environmental Management*, *164*, 53–64. <https://doi.org/10.1016/j.jenvman.2015.08.032>

 This research article reviewed 50 years of research on what has been studied in terms of recreational trail impacts and where there are still research gaps. This article will help me narrow my research question on a problem that hasn’t been worked on yet or a problem that needs more research to advance possible solutions.

Marion, J. L. (2023). Trail sustainability: A state-of-knowledge review of trail impacts, influential factors, sustainability ratings, and planning and management guidance. *Journal of Environmental Management*, *340*, 117868. <https://doi.org/10.1016/j.jenvman.2023.117868>

 This review article collected all the research done on recreational trails damaging the environment. This article will give me a general overview of my topic and a gateway to other sources that could be more specific to my problem.

Ballantyne, M., & Pickering, C. M. (2015b). Differences in the impacts of formal and informal recreational trails on urban forest loss and tree structure. *Journal of Environmental Management*, 159, 94–105. <https://doi.org/10.1016/j.jenvman.2015.05.007>

 This study compares formal and informal trails to overall forest loss. This is very similar to my work and will be a guideline to my methods and data analysis.

Pickering, C. M., & Norman, P. (2017). Comparing impacts between formal and informal recreational trails. Journal of Environmental Management, 193, 270–279. <https://doi.org/10.1016/j.jenvman.2016.12.021>

 There have been many studies on how trails impact vegetation along the edge of the trail, but few studies compare different types of trails and how these trails impact vegetation differently. Pickering and Norman emphasize comparison of trails as important information to management as formal and informal trails impact the environment differently. My research site mainly consists of informal trails. This gives me information on what damages I might see during my research.

Pickering, C. M., Hill, W., Newsome, D., & Leung, Y.-F. (2010). Comparing hiking, mountain biking and horse riding impacts on vegetation and soils in Australia and the United States of America. *Journal of Environmental Management*, *91*(3), 551–562. <https://doi.org/10.1016/j.jenvman.2009.09.025>

 This research article compares the different impacts recreation activities have on vegetation and soils. This article will help me narrow down the scope of my understanding general impacts people have on vegetation and soils to specific impacts specific activities have to the environment.

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