**The Evergreen State College**

**Graduate Program on the Environment**

### Thesis Prospectus

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**STUDENT AGREEMENT:**

**SIGNATURE: \_\_\_Raquel Sejour\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ DATE\_\_\_12/8/2020\_\_\_\_**

**FACULTY READER APPROVAL:**

**SIGNATURE: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ DATE\_\_\_12/11/2020\_\_\_\_**

**MES DIRECTOR APPROVAL:**

**SIGNATURE:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ DATE\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

1. Provide the working title of your thesis[[1]](#endnote-1).

An Analysis of a Reduction in Animal-Vehicle Collisions as a Result of the Washington state COVID-19 Stay-at-Home Order

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

Every year more than 400,000 animal-vehicle collisions are reported in the US (Setiadi, 2018). These collisions cost more than eight million dollars annually. Most of those costs can be seen in car repairs, road repairs, insurance claims, and medical expenses for injured or killed humans. Human injury and death are another impact of animal-vehicle collisions. While 95% of these collisions do not result in injury or death, that number changes drastically when collisions occur with big game like deer and elk (Federal Highway Administration, 2020). The final major impact of animal-vehicle collisions is the impact these collisions have on traffic jams, and indirect loss of time and money as a result.  
Road ecology and habitat connectivity are two complimentary fields of study that seek to explain the relationships that animals and wildlife share with roadways in order to reduce animal-vehicle collisions and their negative impacts. A complex mosaic of variables like animal species, traffic volume (when measured against other variables), and habitat connectivity corridors, all have an effect on rates of animal-vehicle collisions (Bissonette & Kassar, 2008). When a large shift in one of these variables occur, we can expect to see a large shift in the number of animal-vehicle collisions occurring, for better or for worse. Examples of big changes that might affect animal-vehicle collisions include wildfires, volcanic eruptions and other natural disasters, and large drops in traffic volume due to quarantine measures.

1. State your research question(s).

How did the Stay-at-Home orders put in place in Washington state at the beginning of the COVID-19 pandemic in March 2020 affect the frequency of animal vehicle collisions in the state?

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

R oad ecology and habitat connectivity are two complimentary disciplines with similar goals. Both disciplines seek to keep wildlife restrained to habitats that are suitable to them while also providing easy access between habitats. The result is fewer animals on the road and, therefore, fewer animal-vehicle collisions.   
In theory the relationship between number of animal-vehicle collisions and number of cars on the road is nonlinear. When there are fewer vehicles on the road compared to typical trends, animals can grow complacent and comfortable with crossing the road (Hurley, Rapaport, & Johnson, 2009). These types of trends can be mapped across various changes in both human and animal behavior. One such change is the statewide decision made by humans to stay at home starting in March of 2020. Because we know that the great reduction in traffic caused by the coronavirus quarantine would not have caused a linear reduction in animal vehicle collisions, it is important to understand exactly what kind of changes in animal-vehicle collisions we did see, whether or not those changes occurred on a species level, and how much money and how many lives these changes in traffic may have saved.

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?

For road ecologists, an abrupt decline in traffic like the one seen at the start of the pandemic is a rare opportunity to study the relationship between traffic and animal-vehicle collisions more closely. Nonlinear trends, and the factors that may explain them, should be brought into a starker light by the uniqueness of the situation being studied. This research, using arguably the most robust state data available for animal-vehicle collisions, could bring a new understanding to the relationship between these two variables as they pertain to specific species in Washington.  
Many researchers have begun to extrapolate just how much time, money, gasoline, and carbon emissions were saved by the national and international quarantine orders put into place as a result of COVID-19. These researchers have made it very clear how working from home can benefit the climate and the environment. I believe that a road ecologist’s perspective may further drive that point home by extrapolating a similar savings model based around animal-vehicle collisions that did not occur as a result of reduced traffic. With more evidence provided in favor of work from home policies state legislators would be encouraged to adopt them post-COVID. An environmentally progressive state like Washington could use this type of state-specific evidence to justify incentivizing private businesses to continue work from home policies post-COVID with tax cuts and grants.

1. Summarize your study design[[2]](#endnote-2). 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 data sets come from two different sources that seek to paint a complete picture of the number of animal-vehicle collisions occurring in Washington.

The first set of data comes from WSDOT via animal-vehicle collision reports made that did not involve the removal of an animal carcass. This data has already been transformed into a percent change in animal-vehicle collisions by me. These collisions are, to an extent, a dependent variable. In this research, they depend on traffic and the Stay-at-Home order.  
 The second set of data comes from the WSDOT Carcass Removal Database. This databased includes temporal and spatial information, mapped by me, about all animal-vehicle collisions that resulted in the removal of an animal carcass. This information is dependent on the number of collisions, among other things.

Other potential dependent variables will include things like number of animals killed, potentially broken down to a species level, estimations of amount of dollars saved as a result of any change in animal-vehicle collisions, and number of humans’ lives saved as a result of these changes. While this is a basic layout of my research design, the dependence and independence of the variables being studied here is not black and white, and will need further explanation in a discussion chapter. These variables make up a mosaic of possible causal reactions.

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[[3]](#endnote-3).

The data used in this thesis, as described in the previous question, is existing data that was collected by myself and my predecessors on behalf of WSDOT. I have been given permission to use this data for this thesis project. The data in the Carcass Removal Database is collected by WSDOT employees across the state during incident responses. This data was not collected directly by me, but it is monitored and maintained by myself as well as others on my team. I have been given permission to use this data for the sake of a thesis project as well.

1. Summarize your methods of data analysis. If applicable, discuss specific techniques that you will use to understand the relationships between variables (e.g., interview coding, cost-benefit analysis, specific statistical analyses, spatial analysis) and the steps and tools (e.g., lab equipment, software) that you will take to complete your analyses.

One portion of data analysis that I intend to use that has already been partially completed is the spatial portion. I have used GIS to map data from the Carcass Removal Database in order to offer a visual representation of where animal-vehicle collisions are taking place in Washington.

The other independent variable: the percent change in animal-vehicle collisions over time, has also already undergone statistical analysis by me. This data in its raw form included numbers of animal-vehicle collisions at 180 different intersection across the state of Washington during the two analogous time periods of March 2019 – June 2019 and March 2020 – June 2020. In comparing these data points, I was able to determine a percent change over time for each week during the time periods, at each of the 180 intersections monitored, as compared to the same week during the following year.

The remaining data, whether or not it is used, and how it is used will depend on the final scope of my project. The Carcass Removal Database tends to only include larger animals, as carcasses for smaller animals are rarely removed from the road by WSDOT employees unless they are determined to be causing a distraction. There is potential for a species-level breakdown of this data, but it would not be comprehensive. Instead this data would focus on big game, primarily deer and elk collisions, as they make up the majority of carcass removals in Washington state. Statistics on the average amount of money spent on an animal-vehicle collision exist, sometimes also to the species level. This data would need to be statistically analyzed in order to make any real extrapolations about money saved due to a reduction in collisions.

I will be using basic statistical software, Excel and R Studio.

1. Address the ethical issues[[4]](#endnote-4) 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 do not anticipate any specific people will be put at risk by this thesis project. Whenever spatial wildlife data is used there is always a risk to the safety of the animals, however my spatial data focuses specifically on animals that already deceased, eliminating the possibility that they be poached as a result of their locations being shared.   
In analyzing the potential benefits of the Stay-at-Home order as it pertains to reduced collisions I plan to ultimately recommend more remote work options. It is important to acknowledge that not everyone has the privilege of working from home, staying at home more often, or carpooling and using public transportation. It is very easy to make recommendations from a scientific and research standpoint without regard for the realities that many low income and essential workers face in Washington. Ethically I can’t recommend that Washingtonians impede their own access to labor for the sake of reducing animal-vehicle collisions.

1. List specific research permits[[5]](#endnote-5) or permissions you need to obtain before you begin collecting data (e.g. landowner permissions, agency permits).

No official permits are necessary for me to use the data sources listed in this prospectus, including the Carcass Removal Database and the percent changes in animal-vehicle collisions across the state intersections. Simple written permission from a supervisor is all that is needed for me to make use of this data in a strictly academic setting. For publication outside of Evergreen further permits would need to be obtained. For use of data that includes specific injury reports further permits would need to be obtained. These are both options that I am considering but do not necessarily need,

1. Reflect on how your positionality as a researcher could affect your results and how you will account for this in the research process[[6]](#endnote-6).

For more than a year I have been working as a Habitat Connectivity Intern at WSDOT. In that time I have been promoted to Lead Intern and trained a number of others in the finer workings of my position and road ecology. That has given me a real sense of ownership when it comes to this data. In addition, I spend many of my working hours going over images and videos of wildlife from across Washington. These images are taken on cameras that I drive and hike out to and then personally maintain. Early on I began to recognize individual animals across the state and I began to care about them.   
As a professional I have been trained to seek solutions to reduce the destruction of wildlife on Washington’s roads which has given me a considerable bias towards encouraging any behaviors that I believe will achieve this goal. As an individual that bias is even stronger; I do not want to see any animals dying on the road, ever.   
Peer review and regular proofreading from my thesis reader, John K., should help to keep my biases in check. Once I have determined which statistical tests are best suited for my data I will pick a significance level before completing my statistical analysis. Whether or not this data has any statistical significance will be determined by that pre-set significance level.

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

There are no costs associated with this thesis project. All data has been collected by me or previous WSDOT interns for free use by WSDOT employees such as myself. Software used for statistical analysis is Microsoft Excel and R Studio and does not require any additional purchasing. All analysis is statistical and will be done by me, from my home. This is an independent research project requiring nothing more than time and patience.

1. Provide a detailed working outline of your thesis.

[Jump to Outline](#_Thesis_Outline)

1. Provide a specific work plan and a timeline for each of the major tasks in the work plan. Be as realistic as you can, even though you will probably need to alter this schedule as you complete the tasks. Remember that faculty readers take time to return your drafts and that the final polishing and formatting of your thesis for binding will take longer than you ever imagined.

For each major section of writing I have given myself two weeks of writing time, excluding the Literature Review which has been allotted around five weeks of writing time. For the remaining pieces of statistical analysis to be done (for species level breakdowns of collisions as well as analysis of potential monetary savings) I have given myself three weeks for each dataset for analyzing data. After that I have given myself four weeks to create cohesive visuals and graphs for all data analyses performed. These writing and statistical analyses timelines overlap. Once all major portions mentioned are complete I have given myself four weeks of “buffer” time to catch up on any parts of the thesis that need extra work and to allow for any postponed deadlines along the way, before a complete draft is due in the spring. After the complete draft is submitted I have dedicated all remaining time to presentation preparation and revisions.

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| **Quarter & Week** | **Month & Date** | **Task** |
| Fall: Week 9 | Nov 30 – Dec 4, 2020 | Literature Review: first draft (End: Dec 18) |
| F: 10 | Dec 7 – 11 |  |
| F: Evaluations | Dec 14 – 18 |  |
| Winter Break | Dec 21 – 25 | Personal time (End: Dec 26) |
|  | Dec 28 – Jan 1, 2021 | Round out data timeframe (End: Jan 8) |
| Winter: Week 1 | Jan 4 – 8 | Review Literature Review (End and draft to reader: Jan 15) |
| W: 2 | Jan 11 – 15 | Brainstorm species analysis methods (End: January 15) |
| W: 3 | Jan 18 – 22 | Write Introduction (End and draft to reader: Jan 29)  Analysis of species breakdown (End: January 29) |
| W: 4 | Jan 25 – 29 |  |
| W: 5 | Feb 1 – 5 | Write Methods (End and draft to reader: Feb 12)  Brainstorm monetary analysis methods (End: Feb 5) |
| W: 6 | Feb 8 – 12 | Analysis of monetary breakdown (End: Feb 19) |
| W: 7 | Feb 15 – 19 | Write Results (End and draft to reader: Feb 26) |
| W: 8 | Feb 22 – 26 | Create graphs and visuals (End: March 19) |
| W: 9 | March 1 – 5 | Write Discussion & Conclusion (End and draft to reader: March 12) |
| W: 10 | March 8 – 12 |  |
| W: Evaluations | March 15 – 19 | Buffer Zone (End: April 9) |
| Spring Break | March 22 – 26 | Personal Time (End: April 2) |
| Spring: Week 1 | March 29 – April 2 | Optional: Field days for taking photos of intersections used in data collection (End: April 2) |
| S: 2 | April 5 – 9 | Complete Draft Due: April 9 |
| S: 3 | April 12 – 16 | Create presentation (End: April 30) |
| S: 4 | April 19 – 23 |  |
| S: 5 | April 26 – 30 |  |
| S: 6 | May 3 – 7 | Send presentation for peer reviews (End: May 7) |
| S: 7 | May 10 – 14 | Presentation TBD |
| S: 8 | May 17 – 21 | Presentation TBD |
| S: 9 | May 24 – 28 | Revisions (End: June 11) |
| S: 10 | May 31 – June 4 |  |
| S: Evaluations | June 7 – 11 | Final Thesis Due: June 11 |

1. Who, beyond your MES faculty reader, will support your thesis? Indicate support both within and 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.

My direct superior at WSDOT, Glen Kalisz, is a wildlife expert who was directly involved in the collection of some of the data that I will be using for my thesis project. He and the rest of the team at WSDOT stand to benefit from any information or insights gleaned from this thesis project. In addition to giving me permission to use WSDOT data he has offered to mentor me as I work on this project, providing proofreading and brainstorming sessions when needed. As an expert in the field he is a valuable asset when it comes to maintaining accuracy and professional terminology.

1. List the 3-5 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. For each annotated reference, explain how your project specifically connects to the source by extending, challenging, or responding to the conclusions, methods, or implications. For any other sources cited in this document provide a complete bibliographic citation.

A Reprieve from US Wildlife Mortality on Roads during the COVID-19 Pandemic (Shilling, 2020).

This source is the springboard for my thesis project. As a contributing author to this paper I analyzed the above-mentioned percent change in animal-vehicle collisions data. That data was presented in this Shilling paper, along with some of Shilling’s own statistical transformations for the sake of comparing that data to other states. I also mapped collisions from the Carcass Removal Database, which is unique to Washington state. That data was not used in this Shilling paper. Shilling examined general trends in percent change across the nation. My research is novel because I will focus on Washington state and expand my dataset, using more than just percent change in vehicle collisions, to get a bigger picture of how COVID-19 affected wildlife mortality and economic loss during 2020. I don’t believe my work will challenge the results of this Shilling paper, rather I intend to simply narrow my scope and look into the finer details of Washington state’s affected species and specific traffic fluctuations.

Wildlife Vehicle Collision Reduction Report to Congress (Huijser, M.P., P. McGowen, J. Fuller, A. Hardy, A. Kociolek, A.P. Clevenger, 2007)

While dated, this paper is a one of a kind national report on the phenomenon of wildlife vehicle collisions in the US. It provides extensive national statistics, which are not compiled often, if ever. At 280 pages, this report also gives basic background information on road ecology, habitat connectivity, and many related subjects that provide the theoretical framework for my thesis. This report continues to be widely referenced across the industry. I don’t believe my work will challenge anything in this report, aside from providing the insight of time. I intend to reference this report heavily in my introduction chapters as a way to explain the basic theories and assumption that I am working with in constructing my research design.

Locations of Deer-Vehicle Collisions are Unrelated to Traffic Volume or Posted Speed Limit (Bissonette & Kassar, 2008)

This research provides insights into to just how many confounding variables come into play when studying animal-vehicle collisions. It also makes assertions that may challenge my research model, although this remains to be seen. For that reason alone, I feel that it is an important reference to include, especially in a discussion chapter. These researchers show that annual average daily traffic flow (AADT) is not a good predictor of deer-vehicle collisions specifically. While I am not using AADT data in my study, I am making similar assumptions about traffic volume leading to any significance (or lack of) in the percent change in animal vehicle collisions data in my project. I want to further explore this source so that I can make implications with my results that are accurate and not presumptuous.

Utility of Expert-Based Knowledge for Predicting Wildlife-Vehicle Collisions (Hurley et al., 2009)

The mosaic of variables that I have describe which effect animal-vehicle collisions and their frequencies is given one explanation by the modeling used in this paper. Using an analytical hierarchy process (AHP) hypothesized which variables they believe are most relevant, what kind of weight each variable should be given in a modeling scenario. While a model developed by ecologists for widespread use may not be precisely tailored to the situation in Washington state during COVID-19, I believe it does provide a useful baseline in understanding how many variables are at play here, and why they may carry a specific weight during different scenarios. I cannot say yet whether or not my research will challenge the conclusions of this paper.

# Thesis Outline

1. Thesis Introduction
   1. Title Page
   2. Signature Page
   3. Table of Contents
   4. List of figures
      1. GIS Map(s) of collisions
      2. Graph(s) of percent change in animal-vehicle collisions
   5. List of tables
      1. Table of percent change data (shortened)
      2. Species breakdown
      3. Comparison of two-three data years
         1. Monetary estimations
   6. Acknowledgments
      1. WSDOT and incident response road workers
      2. Glen Kalisz, Kelly McCallister
      3. Frasier Shilling
2. Written Introduction
   1. Topic Introduction
      1. Road ecology and animal-vehicle collisions
         1. Habitat connectivity
      2. Non-linear relationships between traffic and animal-vehicle collisions
      3. Stay-at-home order and traffic reductions
         1. How did the Stay-at-Home orders put in place in Washington state at the beginning of the COVID-19 pandemic affect the frequency of animal-vehicle collisions in the state?
   2. Positionality Statement
      1. Direct relationship to the data and the wildlife it represents
      2. Uneasy feelings surrounding animal mortality, roadkill
3. Literature Review
   1. Introduction
      1. Thesis Statement
   2. …
   3. Conclusion
4. Manuscript: “A Reprieve from US Wildlife Mortality on Roads during the COVID-19 Pandemic,” Shilling, F., et al.
5. Methods
   1. Roadmap
   2. Site Description(s)
      1. GIS map of carcass removals
      2. Pictures of some of the intersections used to determine percent change in animal-vehicle collision statistics
   3. Rate of animal-vehicle collisions in Washington
      1. Rationale
      2. Description
      3. Benefits and limitations
      4. Disclaimer
   4. Carcass removal database
      1. Rationale
      2. Description
      3. Benefits and limitations
      4. Disclaimer
   5. Statistical Analyses
      1. Test #1: Percent-change in animal-vehicle collisions from 2019 to 2020
         1. Description and rationale
         2. Method used to answer main research question: how did the Stay-at-Home order put in place in Washington state at the beginning of the COVID-19 pandemic affect the frequency of animal-vehicle collisions in the state?
         3. Limitations and Utility
      2. Test #2: TBD
         1. Description and rationale
         2. Method used to answer: how much money was saved by the reduction of collisions seen as a result of the Stay-at-Home order put in place in Washington state at the beginning of the COVID-19 pandemic?
         3. Limitations and utility
         4. Reference to research on the monetary cost of animal-vehicle collisions
6. Results
   1. Introduction and roadmap
   2. Data / sample collection details
      1. What went wrong
         1. Continued fluctuations in traffic as COVID-19 restrictions change
      2. What went right
         1. Very large sample
   3. Summary of all data produced
      1. Tables
         1. Table of percent change data (shortened)
         2. Species breakdown
         3. Comparison of two-three data years
            1. Monetary estimations
      2. Figures
         1. GIS Map(s) of collisions
         2. Graph(s) of percent change in animal-vehicle collisions
      3. Statistical tests and results
         1. Percent change in animal-vehicle collisions
7. Discussion and Conclusion
   1. Introduction and roadmap
   2. Summary of key results
   3. Interpretation
      1. Correlation between traffic changes and animal-vehicle collisions
         1. Causation?
      2. What was unexpected
      3. Conclusions
   4. Connecting results to framework
      1. Typical relationships between traffic and animal-vehicle collisions based on prior research
      2. Relationship that I saw between traffic and animal-vehicle collisions in *this context*
      3. Conclusions based on agreements/disagreements with prior research and what I saw in this context
   5. Final Conclusions
      1. Big picture meaning and implications
         1. Work from home
         2. Habitat connectivity
         3. Dangers of continued fluctuations in traffic
      2. Directions for future research
         1. Continued monitoring of fluctuations in traffic as quarantines change over time
         2. Effect of traffic reductions on habitat fragmentation/connectivity
8. References
   1. Mendeley list
   2. Raw data
      1. Percent change in animal-vehicle collisions (full)
      2. Table of raw spatial data from GIS map of animal-vehicle collisions (partially redacted)

References

Federal Highway Bissonette, J. B., & Kassar, C. A. (2008). Locations of deer – vehicle collisions are unrelated to traffic volume or posted speed limit. *Human–Wildlife Interactions*, *2*(1), 122–130.

Huijser, M.P., P. McGowen, J. Fuller, A. Hardy, A. Kociolek, A.P. Clevenger, D. S. & R. A. (2007). Wildlife Vehicle Collisions Reducation Study: Report to Congress. In *US Department of Transportation, Federal Highway Administration*. https://doi.org/10.4135/9781544377230.n128

Hurley, M. V., Rapaport, E. K., & Johnson, C. J. (2009). Utility of Expert-Based Knowledge for Predicting Wildlife–Vehicle Collisions. *Journal of Wildlife Management*, *73*(2), 278–286. https://doi.org/10.2193/2008-136

Setiadi, W. (2018). NICB ForeCAST Report: 2014-2017 Insurance Claims - Wildlife Collisions. In *National Insurance Crime Bureau* (Vol. 2).

Shilling, F. (2020). Biological Conservation A Reprieve from US Wildlife Mortality on Roads during the COVID-19 Pandemic. *Biological Conservation*, (Under Review).

1. You are not locked into this title; its purpose is to help you identify the main point or topic of your thesis at an early stage. [↑](#endnote-ref-1)
2. You might discuss selection of case studies, sampling methods, experimental design, and/or specific hypotheses you will test. You should also address any specialized knowledge or skills that are necessary to complete the research. [↑](#endnote-ref-2)
3. If you are planning to use existing data, explain the specific source, contact information, arrangement with collaborating agencies, and expectations about use of data and final products of your research. If you are planning to gather new data, describe specific methods, time, place, and equipment that will be required. [↑](#endnote-ref-3)
4. If you’re not sure where to start, consult a ‘Code of Ethics’ or other similar document from an academic society in an applicable field of study. [↑](#endnote-ref-4)
5. If you are collecting ANY samples or data, even observational data, on public lands (city, county, state and/or federal) it is your responsibility to find out the permit requirements BEFORE you collect data. Conducting research with tribal members/on tribal lands will have different and additional requirements. [↑](#endnote-ref-5)
6. Your *positionality as a researcher* refers to the fact that one’s “…beliefs, values systems, and moral stances are as fundamentally present and inseparable from the research process as [one]’s physical, virtual, or metaphorical presence when facilitating, participating and/or leading the research project…” (The Weingarten Blog 2017). [↑](#endnote-ref-6)