February 11, 2018

Anne-Marie Deitering
Associate University Librarian
121 The Valley Library
Corvallis, Oregon 97331

Re: LURA letter of nomination for Morgan Dally

Dear Selection Committee,

It is my pleasure to nominate Morgan Dally for the Library Undergraduate Research Award. Morgan was a top student in my Field Sampling class (FW 255) within the Department of Fisheries and Wildlife during the fall quarter 2017. A major component of this class is to conduct a field research project and communicate results through a scientific report. I believe that Morgan Dally's excellent report meets the criteria for the LURA award and I therefore nominate her for consideration.

A large portion of the field sampling class is to have students design and conduct a field research project. Morgan's field research project was carefully designed to evaluate rodent habitat preference at the Finely National Wildlife Refuge. I was very impressed with her research design and the amount of work she accomplished. In addition to collecting data, Morgan presented her project results in an oral presentation to the class and submitted a written report, both of which were of excellent quality.

I have taught this class many times over the past decade (multiple times per year) and occasionally receive reports that stand above all others at the 200-level. A major objective of the research project is to develop a hypothesis, conduct field-based research to test the hypothesis, and communicate the project as a scientific report. The report is written in the general scientific writing format including the following sections: Title, Abstract, Introduction, Methods, Results, Discussion, and Literature Cited. During the quarter I lecture on how to prepare and write a scientific paper. At the 200-level, most students have never written a thorough scientific paper. Morgan's research report was well-organized, followed the correct format, and was clear and concise.

The research report for the Field Sampling class is designed to determine the student's overall understanding of the course learning objectives. The course learning objectives are as follows:

- Understand concepts, practices, and limitations of sampling nature
- Understand various approaches to obtaining data through field sampling techniques in different environments
- Appreciate basic approaches to organizing and summarizing data
- Interpret data and observations in the context of the ecosystem
- Clearly communicate your results and interpretations

Morgan's research report was completely relevant to the course learning goals. In her report she displayed her understanding of the concepts and limitations of sampling nature and in her analyses of the data displayed a clear understanding of organizing, managing, and summarizing the data collected. In addition, Morgan clearly communicated her results in a concise manner as specified in the instructions for the project.

The main objective of the research report is to communicate the research to the scientific community. An important component to the research report is the Introduction section in which the author must explain the rationale behind the study and hypothesis. This is accomplished with logical thinking and involves the incorporation of research by other scientists. Morgan's report included an Introduction section which introduced her research question and rationale behind her hypothesis by including reference sources that were appropriate for the scope of the argument. Her hypotheses are clearly stated and include predictions about what she expected to find. The Discussion section of scientific reports is for the author to evaluate the results in light of past research and knowledge and explain what the study means. In Morgan's study, the results contradicted her initial hypothesis which meant that she had to explain why this happened. This is often challenging to students because they have to reflect on what may have gone wrong, how they might improve the study, and/or rationalize an explanation based on their knowledge of the system. Morgan did an excellent job of this by providing several reasons for why the results did not support the initial hypothesis. In addition, Morgan clearly stated potential errors in the study design and indicated ways to improve her study.

Morgan’s field research and report were consistent with standards used in the field of ecology and her work clearly followed the instructions for the assignment. Through her report she displayed an understanding of the written communication style used by scientists in this field. Most students struggle with the scientific writing format because they lack the experience writing in this specific format. Most students are more comfortable with a writing style more consistently used in literature reviews based on their experience in other classes. Morgan did not have this problem and was very successful at conveying her research in the assigned written report. For these reasons, I am nominating Morgan Dally for the Library Undergraduate Research Award. Please feel free to contact me if you need any additional information.

Sincerely,

[Signature]

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Morgan Dally

Reflective Learning Essay

My Research Project and How It Impacted My Learning

Every since I was a little girl, I have been fascinated by the outdoors and the wildlife that inhabit it. My love for nature lead me to discover and pursue many passions such as hiking, hunting, wildland firefighting, and now, a career in fish and wildlife sciences. I am interested in using my degree to become a fish and game warden; however, I also have a profound interest in research. In order to discover where I truly want to take my future, I have taken and will continue to take classes that explore all of my options. One such course that I took fall term of 2017 was Field Sampling Fish and Wildlife (FW 255).

In Field Sampling, I was taught about field research and how it is conducted. More specifically, I learned how to conduct my own research utilizing field sampling methods discussed in class, statistically analyze and organize data, and write a scientific research paper.

For the course, we were put into small groups and instructed to pick an area of study. My group and I chose to study small mammals, and so we designed a project in which we used quadrats to evaluate the density of rodent holes in different habitats within William L. Finley National Wildlife Refuge in Benton County, OR. Quadrats are a sampling method in which a specific area within a habitat is measured out and surveyed. In our study, my team and I used large quadrats to count rodent holes and hills in an attempt to figure out which habitats Gray Tailed Voles and Pocket Gophers prefered. If we found more holes and hills in one area over another, then we assumed that the rodents favored that habitat over the other. There were twelve quadrats total, three in each of the four chosen habitats of study. After we were done with our
research in the field, we analyzed out data and then each of us wrote our own paper on our results and the overall study.

I really enjoyed this class because it allowed me to combine real world experience with knowledge obtained in many of my other courses. The knowledge that I acquired from classes that I had taken prior to and during field sampling enabled me to have a richer and a more enlightened experience out in the field as I did my research. An example of this is when I noticed a fuzzy fungi protruding out of a rodent burrow that I was closely examining within a quadrat. Although my teammates didn’t see any significance to this discovery, I recognized that there was a symbiosis between the fungi and the rodents who created the burrows. This fungi, from the phylum Zygomycota, was actually growing on vole droppings, and it depended on the voles to aid in reproduction by spreading spores. I would never have stopped to analyze this important symbiotic relationship between these two organisms had I not been enrolled in Biology 211, where we were learning about such things.

Another example of applying prior knowledge to my research was when I was finding resources to aid in writing my scientific paper. I was struggling to find valid sources when I remembered something that I learned in my Ancient Roman Art and Architecture (ART 321) class. This class also had a research paper project, and in order to assist us in learning how to cite appropriate sources, my professor took us to the Valley Library to learn about its online scholarly journal search tools. A librarian went over Isearch, citations, and research guides for specific classes with us. Because of this helpful knowledge, I was able to find reliable resources for my field sampling paper, and I now know where to go for future assignments.
Overall, Field Sampling provided me with a hands on research opportunity and newfound skills that I can utilize in future classes and a future career. Further, I realized that many of my courses fit together and aided in the overall understanding of my research. This created a very powerful learning experience for me, and I will continue to use the knowledge obtained from past experiences to aid me in future ones.
Using Quadrats and GPS to Assess the Abundance of Rodent Holes in Different Habitats

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Abstract

In this study, pocket gopher and gray-tailed vole holes and hills were counted within four distinct habitats using quadrats and a gridding method over a period of five field days. The study was conducted to determine which habitat these small rodents favored for burrowing. The four habitats are located in William L. Finley National Wildlife Refuge in Benton County, OR and consist of lowland agricultural fields, lowland natural prairie/oak savanna, upland agricultural fields, and upland prairie/oak savanna. Statistical analysis through the use of parametric and nonparametric tests revealed that there was no significance in the data and that the abundance of small rodent holes was equivalent throughout all habitats; however, a number of factors not related to the favoritism of the rodents to certain habitats could have influenced these results.

Introduction

Gopher and Vole Background

The Pacific Northwest is home to a wide variety of burrowing rodent species. In this study, we focused on two species of burrowing rodents that inhabit William L. Finley National Wildlife Refuge— the pocket gopher (Thomomys bulbiferous) and the gray-tailed vole (Microtus canicaudus). Both species serve important ecological roles within their environments. Their burrows aerate the dirt, creating porous soil that soaks up water and is carbon rich. Pocket
gophers and gray-tailed voles also aid in the distribution of plant seeds and fungal spores. Their droppings and decomposing food remnants act as deep fertilizers for these organisms as well (Figure 1). Further, gophers and voles serve as a food source for many predators such as coyotes, owls, bobcats, hawks, and snakes. Their tunnels also create habitat for other creatures (Link, 2004; Dibble et al. 2014).

![Figure 1: Fungi from the Phylum Zygomycoota growing on vole feces.](image)

Although pocket gophers and grey-tailed voles positively impact their ecosystems in many ways, they are often seen as pests by gardeners and farmers. Holes, hills, tunnel systems, and vole runways displace and destroy crop rows and pastures while also causing sinkage and uneven ground. Gophers eat entire plants and voles consume their roots. Because of this, large populations of one or both of these rodents can cause crop sizes to diminish rapidly if unchecked (Pokorny, 2015). Further, holes can be hazardous to horses and livestock. These animals often trip in burrow openings and injure themselves.

The Purpose of Our Study
The purpose of our study was to determine if pocket gophers and grey-tailed voles preferred natural habitat over agricultural habitat. We had two hypotheses associated with our research. The first hypothesis was that small rodents (gophers and voles) prefer uncut, natural prairie and oak savanna habitat over agricultural fields. The second was that that the rodents prefer lowland locations for burrowing over upland locations. In order to test our hypotheses, we counted the number of rodent holes and hills in natural prairie and oak savanna habitat as well as in agricultural fields in both lowland and upland locations of William L. Finley National Wildlife Refuge located in Benton County, Oregon. If we found more holes in natural prairie and oak savanna, then we could assume that rodents prefer taller grasslands. Similarly, if we found more holes in lowland locations, then we could assume that rodents prefer lowland locations.

**Methods**

**Field Site Information**

Established in 1964 and a total of 5,325 acres, Finley National Wildlife Refuge (Figure 2) is home to many different habitat types that support a diverse community of plants and animals ("Habitats", 2014). As stated above, our study sites were located in upland natural prairie and oak savanna, lowland natural prairie and oak savanna, upland agricultural fields, and lowland agricultural fields. Below is a description of each as observed by the researchers in this study.
Figure 2: Finley National Wildlife Refuge. Red circles indicate areas of study.

Upland natural prairie and oak savanna consists of dry soil, knee high grasses, patches of blackberry bushes, poison oak, apple trees, and thorny shrubs. Further, and indicated by its name, this area is also dotted with Oregon white oak trees. Animal presence here is plentiful, with elk and deer scat, beddown, prints, and antler rub on trees observed.

Lowland natural prairie and oak savanna consists of loamy soil, waist to chest high grasses and shrubs, areas of dense vegetation, scattered trees, and tree litter. There was also a
noticeable increase in insect activity in this area; however, the observation of elk and deer presence decreased, likely due to the fact that denser vegetation made it harder to spot tracks and scat.

The upland agricultural field contained dry, compacted soil. Grass here was short and patchy, growing in distinguishable man-made rows. The field had slight dips and hills as well. Large animal presence here was sparse.

Contrary to the upland agricultural field, the lowland agricultural field had a continuous blanket of lush grass with dead mowed grass on top, formed in rows. The soil here was loamy and moist. Elk and deer tracks and scat were abundant here, and complex vole trail systems connecting burrow entrances were evident (Figure 3).

Figure 3: Above ground vole trail system with fecal matter. Small notebook for size reference.
Data Collection Materials and Methods:

- 30m fiberglass measuring tape
- GPS
- Phone (for pictures and compass readings)
- Data sheets
- Pen

In order to effectively sample our locations and collect data, our team constructed five meter by five meter quadrats in each location and used a gridding method to count the number of holes and hills within each quadrat. There were twelve quadrats total, three in each of our four habitats of study. Each plot area was randomly selected and its GPS coordinates, compass readings, and area description were recorded for easy relocation. Sampling began on October 10th 2017 and ended on November 7th, 2017. We went out once a week for three hours and attempted to reconstruct all our quadrats and sample them. On an average field day, we were able to sample six to nine quadrats.

During sampling we recorded our findings in appropriate data sheets for each location. These data sheets included the date, names of each observer, general habitat conditions and weather, and a chart for recording data (Table 1). Notes and trends were recorded in the margins of our data sheets.
Table 1: Example of data chart contained in a data sheet used to record research aspects such as: time, quadrat #, hole/hill #, species of burrowing rodent, presence of other animals, and the species presence/ signs.

<table>
<thead>
<tr>
<th>Time (24 hr)</th>
<th>Quadrat #</th>
<th>Hole/Hill #</th>
<th>Species</th>
<th>Presence of Other Animals?</th>
<th>Other Species Presence/ Signs</th>
</tr>
</thead>
<tbody>
<tr>
<td>12:55</td>
<td>1</td>
<td>24</td>
<td>Vole</td>
<td>No</td>
<td>N/A</td>
</tr>
<tr>
<td>13:06</td>
<td>2</td>
<td>7</td>
<td>Vole</td>
<td>Yes</td>
<td>Elk Prints and Scat</td>
</tr>
<tr>
<td>13:19</td>
<td>3</td>
<td>32</td>
<td>Vole</td>
<td>Yes</td>
<td>Elk Prints</td>
</tr>
</tbody>
</table>

Statistical Analysis

After each week of sampling, data from the physical sheets were transferred into Microsoft Excel. After completing our field study, we utilized these Excel files to do statistical analysis on our data. One-way analysis of variance (ANOVA) is used determine if there is any significant difference between independent groups of data (Lund, 2013). First, we ran a Levene’s test to test for equal variance within our data to determine if the assumption of equal variance, necessary for parametric statistics like the ANOVA, was met. To find out if the distribution of rodent holes was different across the habitats sampled, we used parametric and nonparametric tests when appropriate. Parametric T-tests were conducted to test upland vs. lowland regardless of habitat type, agricultural fields vs. natural prairie/oak savanna regardless of location, lowland agricultural fields vs. lowland natural prairie/oak savanna, and upland agricultural fields vs. upland natural prairie/oak savanna. A nonparametric Kruskal-Wallis test was conducted to determine if the distribution of rodent holes and hills were the same across lowland and upland locations, while multiple Mann-Whitney U tests were conducted to see if distribution was the
same across agricultural fields and natural prairie/oak savannas. For all statistical analyses a significance level of 0.05 was used.

Results

The mean number of holes observed were higher in the lowland habitats compared to the upland habitats (Figure 4). Each habitat had a mean number of holes and hills (Figure 4), standard deviation from the mean, and standard error (Figure 4). For upland agricultural field, the mean number of holes/hills from all five days in the field was 18.33. The standard error (SE) was .0872 and the standard deviation (SD) was 2.137. Upland prairie had a mean of 21, SE of 12.52, and a SD of 30.67. In the same order, the statistical data revealed that the lowland agricultural field had results of 47.67, 1.58, and 3.87. Lowland prairie/oak savanna was 45, 6.94, and 16.99 for the mean, SE, and SD.
Figure 4: Mean number of holes and hills with standard error (SE) in relation to each habitat type.

Our statistical analysis revealed that there was no statistical significance in any of the nonparametric tests that we ran because the P value was always above 0.05 (Table 2).

Table 2: Testing the null hypothesis. There is no significance in any category and so the null hypothesis is retained.

<table>
<thead>
<tr>
<th>Null Hypothesis</th>
<th>Test</th>
<th>Significance</th>
<th>Decision</th>
</tr>
</thead>
<tbody>
<tr>
<td>The distribution of holes/hills is the same across all locations (lowland and upland)</td>
<td>Kruskal-Wallis</td>
<td>0.563</td>
<td>Retain null hypothesis</td>
</tr>
<tr>
<td>The distribution of holes/hills is the same between ag. field and natural prairie in lowland locations</td>
<td>Mann-Whitney U</td>
<td>0.31</td>
<td>Retain null hypothesis</td>
</tr>
<tr>
<td>The distribution of holes/hills is the same between ag. field and natural prairie in upland locations</td>
<td>Mann-Whitney U</td>
<td>0.955</td>
<td>Retain null hypothesis</td>
</tr>
<tr>
<td>The distribution of holes/hills is the same across all locations (lowland and upland) regardless of habitat type</td>
<td>Mann-Whitney U</td>
<td>0.981</td>
<td>Retain null hypothesis</td>
</tr>
<tr>
<td>The distribution of holes/hills is the same across Ag. Field and natural prairie, regardless of location (upland and lowland.)</td>
<td>Mann-Whitney U</td>
<td>0.062</td>
<td>Retain null hypothesis</td>
</tr>
</tbody>
</table>

**Discussion**

**Interpretation**

According to the statistical analysis, the distribution and abundance of rodent holes/hills is the same throughout all habitats. The closest we got to significance was when we used a t-test to compare the agricultural fields to the natural prairie/oak savannah with no regards to the location (upland and lowland). This is interesting because if it had been significant, it could have meant that our hypothesis that small rodents prefer uncut, natural prairie and oak savanna habitat over agricultural fields could have been correct.

**Influencing Factors**

There are many factors that likely influenced our results. The first being that we only sampled five times, and in those five field days we were not able to sample all twelve quadrats. Limited and unequal data could dramatically skew data and cause inaccurate results. An example of this is when you look at the standard error of the means (Figure 4). The standard errors within our upland and lowland natural prairie/oak savanna were higher than those of the two agricultural fields because we sampled more in the natural prairies than in the fields. The second
factor was that our sample sizes were small. Larger sample sizes mean more data and thus more accurate results that are better at representing the entire habitat.

Errors

Errors could have also greatly influenced our study. One such error is failing to properly locate the exact quadrat plot. Although we wrote down our GPS locations, compass readings, and wrote notes describing our areas, we still had issues finding our exact quadrat areas again. This was partly due to the fact that the GPS has a limited accuracy of 3-7 meters and so even if the GPS coordinates matched the ones we wrote down from the previous week, our quadrats still could have been a few meters away from their original locations, causing our counts to be inaccurate and tainting our data. Another error was the possible misidentification of holes and hills. Deep elk and deer prints may have been counted as holes. Furthermore, if one of us did not count something as a hole during one of our samplings, another could have counted it as a hole when we went back to the area the following week resulting in inter-observer sampling errors. Finally, accurately counting holes proved to be difficult as well. The grid system was an effective way of counting holes and hills; however, overlap in gridding could have caused holes to be counted more than once. Additionally, merging hills caused confusion on how many hills there really were in a certain area.

Ways to Improve: A Look at a Similar Study

"Living on the edge": The role of field margins for common vole (Microtus arvalis) populations in recently colonised Mediterranean farmland is a study that focuses on the common vole, its agricultural habitats, and its invasive, pest-like tendencies. The research focuses on common vole habitat use in Mediterranean European farmland and compares it to vole usage in
Northern areas (Rodríguez-Pastor et al., 2016). As mentioned above, certain factors can influence data negatively. This study avoids these factors and by doing so, provides a great example of how a future study should be conducted to be more successful.

Like our research, this study looked at small rodent abundance in certain habitats and utilizes statistical analysis to organize and make sense of data collected. Unlike our research, however, the statistical analysis of this study proved significance. A research period of six years and a wide variety of research locations with large sample sizes contributed to accurate results that were trusted enough to be published into a scientific journal.

Conclusion

While our study provided insight on small rodent habitat usage, there were many things that could have been changed or controlled in order to make it stronger and more reliant. An additional study should provide for more time in the field and larger sample sizes. Perhaps increasing the number of quadrats to six in each habitat for a total of twenty-four quadrats and 150 square meters of land surveyed could aid in more accurate and useful data. Moreover, sampling three times a week for five weeks could greatly improve the variety of data collected.
Literature Cited


