24 August, 2022

Dr. Lynn Gillette
Provost and Vice President of Academic Affairs
Lake Superior State University

RE: Jason Garvon, PhD. - Report on Sabbatical Leave Activities for the Academic Year 2021/2022.

Dear Dr. Gillette,
I am happy to provide the following report on activities conducted while on sabbatical leave for the academic year 2021/2022.

Sincerely,
Jason M. Garvon, Ph.D.

Objective 1 – Learning R.
    I proposed to complete one course (R Programming A-Z: R for Data Science with Exercises) in R programming during the months of September and October. After completion I would begin working on the Blue-winged Teal dataset with R and prep for publication.

    In summary, while I proposed taking one course, I quickly learned that R is a vast topic and because I wanted to take my time and really learn it as well as I could, I ended up completing 5 courses. The first course was broken into 79 lectures with associated problems accompanying most lectures. R has a steep learning curve and the I recall the first exercise taking me 2.5 hours to complete only to see the solution was two lines of code and I had used way more than that. Without the time to devote all of my efforts to the course(s) I would not have gotten the full benefit of taking them.
    During the month of September, I completed the course "R Programming A-Z: R for Data Science with Exercises" and through the process learned that I had just scratched the surface and, indeed, was not comfortable with attempting to perform statistical analysis, or more specifically manipulating code needed to fine tune analysis, and looked for more courses. I first took a course in the graphing package of R (ggplot2). I had a brief tutorial in the first course and used it once. Taking the whole course was very beneficial and completed it by early October. With completion of a basic coding course in R and the graphing package I switched my attention to manuscripts.
    Near early November I realized that I was comfortable graphing in R and doing some basic coding, and while I could do basic statistics, I wanted to know more of the coding part of statistics rather than relying on what code I could find online. Running simple statistical tests took a bit of time as I had to look for code and then trouble shoot what could be wrong if things did not work. I enrolled in the course "Introduction to Statistics in R – A Practical Approach". I completed this by early December. While working through this course I completed analysis for the manuscript "Cathemeral Behavior of Piping Plovers Breeding along Michigan's Lake Superior Shoreline".

I began 2022 with another course in R, "Statistics in R – The R Language for Statistical Analysis". Between revising the plover manuscript and communicating with editors I completed this course in early February and felt fairly comfortable coding in R for basic statistics. At this point I was working in the lab and decided to complete one more course ("Statistics with R – Advanced Level") as I realized that I quite enjoyed coding. Between other activities, I completed the 5th course in late April.

The goal was for me to become proficient enough in R to help students complete data analysis for their senior thesis projects. I believe I have done this, and have already worked with, my and other faculty's, students to complete analysis and create graphs for presentations in the spring of 2022. In addition, I am scheduled to teach a course (NRES 250 – Quantitative Biology) in Fall of 2022 where I will introduce students to R and basics of programming and quantifying data using R.

Objective 2: Complete Manuscripts for Publication
I proposed to analyze data from three, but up to 5 data sets in R and to prepare manuscripts.

In summary, I felt I had data for three publications, with potential for an additional two. During the academic year 2021/2022 one paper was successfully published, one draft was completed and revised and is sitting with the co-author for editing, data for a third was re-run and awaiting detailed analysis from a co-author, and two data sets were analyzed but no manuscripts were generated.

In October after completion of the first course in R, I met with Dr. Kolomyjec to pick up data on Blue-winged Teal genetics that was completed by two undergraduates in 2019/2020. We located the data to find that it was incomplete, due to COVID shutdown it had been abandoned, and decided it best to re-run all samples. With sufficient DNA in the freezer I had to complete PCR reactions and fragment analysis. We looked at results from the undergraduates and selected the best 11 primer sets (of possible 18 we originally tried) and I began the process of ordering needed supplies.

While awaiting lab supplies, I switched my focus to my student Riley Waterman's senior thesis which I felt was good enough to publish. Throughout October and into November I alternated between R courses, re-running data analysis, and re-writing parts of the manuscript. In the end we submitted it to the international journal *Birds*. I spent the remainder of November and a bit of December editing, responding to editors and Riley, completing coursework in R, and got the paper accepted in January.

> Waterman, Riley & Garvon, Jason. (2022). Cathemeral Behavior of Piping Plovers (*Charadrius melodus*) Breeding along Michigan's Lake Superior Shoreline. Birds. 3. 72-83. 10.3390/birds3010006.

From December through January I completed 2,400 PCR reactions in total and began fragment analysis. The fragment analyzer broke in late January and took nearly a month to get repaired.

During later January and February, I worked on the second Piping Plover article – Incubation Behavior and Nest Disturbance of Great Lakes Piping Plovers Measured Using Trail Cameras. Statistics had been run in R but the code would not work for my co-author or myself. I used

information from courses in R to trouble shoot and was able to repair the code and to create some new graphs. The manuscript was passed back and forth throughout the spring but was not yet submitted at the end of the Spring 2022 semester.

I spent the remainder of the semester working on old data sets, and completing fragment analysis on my Blue-winged Teal samples. I had data from 5 years of deer shine counts that seemed promising from looking at paper data collection sheets. Once they were uploaded into a spreadsheet there were inconsistencies with how data was collected by various students over the years. Still, data was analyzed in R as an exercise and revealed no significant differences among the two sample periods. I then turned my attention to some data collected on methods of removing lice from duck carcasses and once data was entered and analyzed showed some differences among methodologies used. At the completion of the Spring 2022 semester I am still evaluating what might be an appropriate journal and if our very small sample size is sufficient.

During the Spring semester, with a shortage of faculty, I was asked to serve on two search committees for the School of Natural Resources and Environment. I was able to work this into my schedule but it did take time away from planned activities. One search was successful. I would not suggest faculty on future sabbatical leaves engage in such activities if at all possible. The shift from research/learning to faculty business as usual, as well as being on campus in the department was difficult and resulted in lower production.

Communication

Cathemeral Behavior of Piping Plovers (*Charadrius melodus*) Breeding along Michigan's Lake Superior Shoreline

Riley Waterman [ID] and Jason Garvon *

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Simple Summary: Many shorebirds are active throughout a 24 h time period, yet few comparisons of nighttime and daytime activity exist. Better understanding of nighttime activities could aid in conservation measures of endangered shorebirds. The Great Lakes population of piping plovers contains fewer than 80 breeding pairs. Within this population, a few pairs breed along Lake Superior in Michigan's Upper Peninsula. To better understand what leads to success or failure of these nests, we observed behaviors of plovers during both daytime and nighttime. We found they feed more at night than during the day, when their primary predators are active. Our findings give insight into the nighttime activity of these critically endangered birds and help to identify the need for management strategies that limit disturbance at night.

Abstract: Shorebirds commonly exhibit cathemeral activity and commonly forage throughout a 24 h period. Conservation of endangered shorebirds should then extend to protection at night, yet little data exists on overall time budgets of such species at night. The Great Lakes population of piping plovers (*Charadrius melodus*) is the smallest and most endangered, making each breeding pair an essential part of recovery. Intense monitoring of breeding individuals occurs during the daytime, yet we have little understanding of the time budgets of plovers at night. To gain better insight into the cathemeral behavior of plovers we recorded behaviors of 12 plovers from along Michigan's Lake Superior shoreline during both day and night in 2018 with the use of a night-vision-capable camera, and compared time budgets of plovers between daytime and nighttime. Overall, piping plovers spent more time and a greater proportion of their time foraging at night and more time devoted to being alert during the day. These differences were especially evident during the chick rearing phase. Limited observations suggest that copulatory activity may also be more common at night. Likely, the threat of avian predation on this population drives the increase in nighttime foraging, despite decreased efficiency. Recognizing the importance of decreasing potential for disturbance during the night should be considered in future management strategies regarding the recovery of this endangered species.

Keywords: Piping plover; foraging; behavior; cathemeral; nocturnal behavior; *Charadrius melodus*

1. Introduction

Cathemerality refers to animal activity throughout both light and dark phases of the 24 h cycle [1,2], and is commonly reported in primates, e.g., [3,4], and other mammals, e.g., [5,6]. It has not been widely used to describe bird behavior, despite numerous studies of both nocturnal and diurnal foraging of bird species, e.g., [7–9]. Shorebirds commonly exhibit cathemeral behavior [9–12], and may use different foraging techniques between daytime and nighttime (i.e., visual or tactile) [10,11,13], or forage in different areas between daytime and night time due to food availability, predation risk, and human activities [11]. Within the shorebirds, many plovers (*Charadridae*), including the piping plover (*Charadrius*