Cone Collection Behaviors of Red Squirrels on Concordia Campus

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Introduction

Concordia College is abundant with local squirrels, and during the fall season these squirrels begin to collect their food source as to get them through the winter. Squirrels are known to habitually collect acorns as their source of food, but since trees on Concordia's campus don't shed acorns, the squirrel population resorts to the collection of pine cones and harvest them for the seeds that are inside. A certain female squirrel that inhabits Concordia's campus has previously been observed in her collection of pine cones, as she creates a large pile of cones underneath a pine tree toward the north end of campus. Once the seasons begin to change, it's been noted that a large pile appears underneath this tree to provide a food source for the squirrel during the winter. The purpose of this study is to determine the general size, in mass, of pinecone collected by the squirrel. The study is going to analyze whether or not mass and size of the pine cone has any effect on its chance of being chosen by the squirrel. Previous studies conducted to measure relationships between squirrel habits and collection of food source found that squirrels tend to prefer cones with high seed counts (Steele 1998). The optimal foraging theory discusses how an animal behaves when it is searching for food and is a factor of natural selection. If foods of higher value are available to an animal, foods of lower value will be rejected no matter the abundance of that food source (Lacher et al. 1982).

The hypothesis being tested is, pine cones being collected will have a higher amount of seeds, but still not be too heavy for the squirrel to transport.

The null hypothesis is, the mass of pine cone has no effect on whether or not it gets chosen.

Methods

Three piles were observed, a pile near Fjelstad building, a pile located on the east side of Normandy, and a pile located on the north end of Ivers. A 1 meter diameter was measured out from the trunk of the tree to account for any cones around the tree that might have been brushed aside by elements. A random sample of 10% of cones was collected from each pile. Cameras were set up adjacent to the trees to observe each location. The length (mm), diameter mm), and mass (g) of each cone was measured and categorized according to mass. A caliper was used to measure the width of each cone and the length, and a scale was used to measure the mass. The smallest and largest mass measurements were found in order to get a representation of the range for the categories. Food coloring was used to distinguish between each categorized group; Blue represented masses 5-10g, Red 10-15g, Green 15-20g, and Purple 20-25g. When placing cones back, 20 other random selected cones (10 from the Fjelstad pile and 10 from the Normandy pile) were painted with orange food coloring and placed in random locations around the tree to observe whether or not the squirrels would place the cones back into original piles. This was replicated twice.

We carried out a T-test on each individual pile and across the three piles and used the p-value derived from the tests to determine if a correlation exists between cone mass and cone diameter, alluding to seed count.

Figure 1 & 2: View of the cone pile outside of Fjelstad where a sample of 70 cones was collected and one of the lights collected by the squirrel.

Figure 3: Food coloring was used to categorize the cones into their respective weight distributions. Blue represented 5-10g, red 11-15g, green 16-20g, and purple 21-25g.

Results

The results of the t-tests indicated a significant correlation between cone area and mass (Fjelstad: 0.0001, Lorentzen: 0.0001, Normandy: 0.0248, total sample: 0.0001). These results allowed comparisons between cone mass and number of seeds the cone potentially holds. While observing, there was an apparent relationship between the mass of cone and its likelihood of being chosen. The cones with a mass from 10-15g were collected at a higher frequency, while others were collected at a lower frequency. This foraging technique is optimal for the squirrels because they are collecting cones with a moderately high seed count that are also easily transported to their respective piles, allowing them to collect a higher number of cones. Fig. 4 and Fig. 5 indicate the area of the cones has a direct correlation to their mass. Squirrels were more likely to collect cones with a mass between 10-15g (51%). The null hypothesis can be rejected as cones were collected according to their mass.

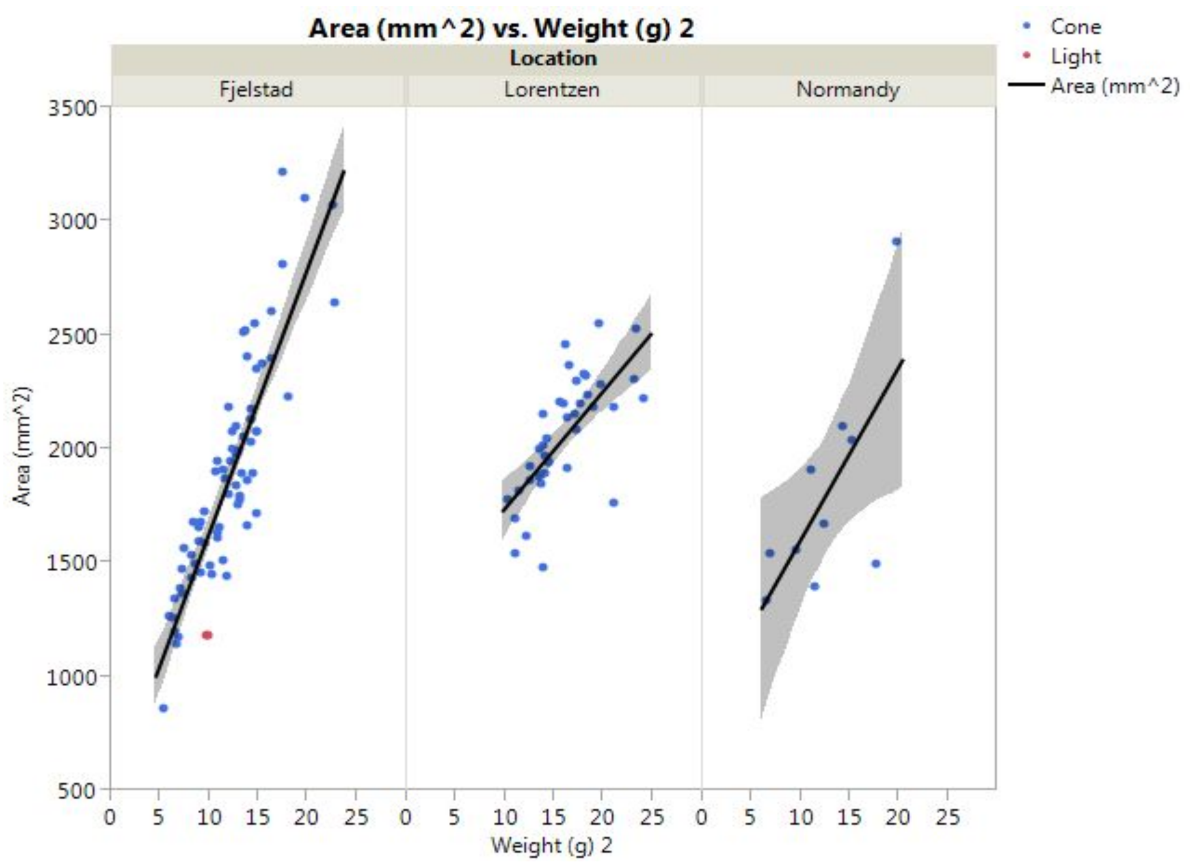

Figure 4: Shows positive correlation between area (mm^2) and weight (g) of collected samples for each individual location being observed. The red points plotted in the Fjelstad location represent two cone-shaped lights that were found in the pile and the blue points represent cone samples.

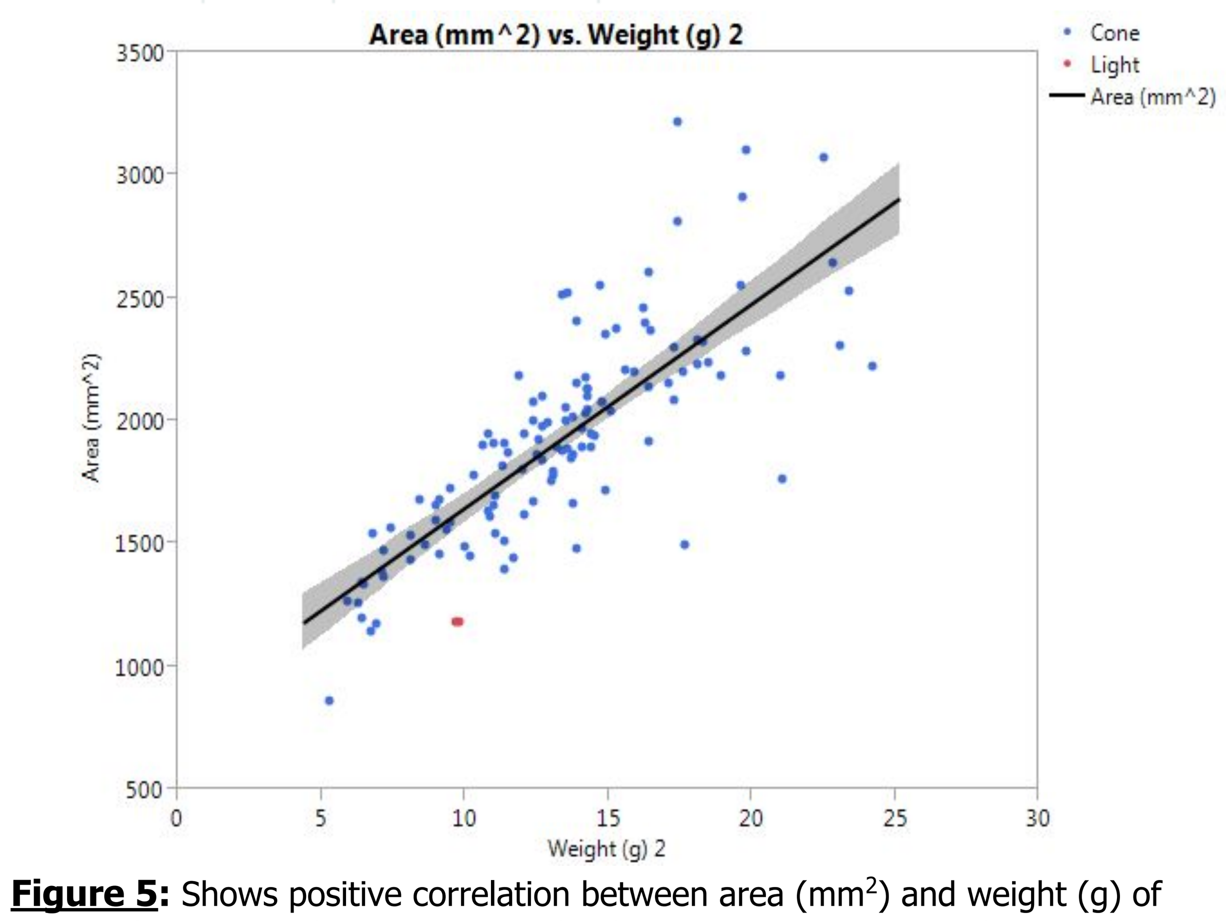

Figure 5: Shows positive correlation between area (mm^2) and weight (g) of collected samples. The points plotted in blue represent cones and two red points represent two small lights that were found in the Fjelstad pile.

Discussion

As the hypothesis that is being tested is as the number of seeds increases and the weight of the pinecone stays within a range that is allows the squirrel to easily transport the pinecone, the more likely that it will be collected and burrowed for the winter. The null hypothesis would be that the number of seeds in the pinecone and the weight of the pinecone will have no effect on whether or not it is collected. This experiment resulted in the acceptance of the hypothesis that the weight and area of the pinecone affects whether or not it is collected.

Based on other works that were experimenting with similar variables, many of the experiments studied and found different results. One example is called "Seed Mass And Mast Seeding Enhance Dispersal By A Neotropical Scatter-Hoarding Rodent" by Patrick Jansen, Frans Bongers, and Lia Hemerik, the study looked at the size of the pinecones and its seeds compared to how far and the abundance of their dispersal. Noticing how they measured their pinecones and how many seeds in each will be very valuable to this experiment. Also, one thing that should have been researched prior to this experiment is the availability of cones on Concordia campus and the average size of these cones. This information could lead to why this experiment concluded that medium-sized cones were most abundantly collected if they were originally most abundant on campus. After removing some pinecones from the pile and placing them around the pile at random, the squirrel always returned them back to the pile.

Some problems that may arise during this experiment include weather and climate change, methods of data collection, and analysis. As the weather and climate continues to cool and come closer to frosting over completely in northern Minnesota, this experiment becomes more and more risky, as these changes in temperature could cause a radical change in the life of the squirrel that collects the pinecones and may cause the squirrel to burrow the pinecones before the data can be fully collected. Also, one day of data collection had rained so the results of the weight of the pinecones may have been affected. In addition, as many separate locations are needed in order to draw a solid conclusion, this could cause another issue to arise as the number of piles of pinecones created by squirrels on Concordia campus may be limited and with only having three in our data collection, this could restrict the variation in our data. Finally, the data analysis can become a problem as the site is on campus and can be tampered with by the staff and students of Concordia College.

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