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Seed Choice and Optimal Foraging: Investigations on Bird Feeding Preferences in Cariboo, BC

Abstract

The diverse family of Aves, or commonly known as birds, have been observed to make conscious food decisions. Within British Columbia, many birds commonly feed on bird feeders that consist of an array of different seeds of varying nutritional content. This study investigated bird preference over four different seed types as modelled by the abundance of birds at the control (black oil sunflower seeds) and each treatment group (nyjer, millet, and safflower seeds) in an observational study in Quesnel, BC. The researchers hypothesized that birds would prefer seeds of higher protein content and therefore, would observe the greatest average abundance of birds at the safflower treatment group. A statistical analysis was conducted by a one-way ANOVA and determined $p = 0.55$ for Trial 1 and $p = 0.010$ for Trial 2. The results of this study were significant in Trial 2 where after an additional Tukey-Kramer test, a distinct preference for black oil sunflower seeds was determined. This study concluded that bird preference for black oil sunflower seeds was most likely an outcome of seed familiarity rather than the occurrence of food availability or protein content.

Introduction

Meeting nutritional dietary needs is necessary among all species of animals—Aves, or commonly known as birds, are no exception. Researchers have long been fascinated with bird feeding behaviour as this diverse family feeds on an array of different diets consisting of seeds, invertebrates, and vegetation, to name a few (The Cornell Lab of Ornithology, n.d.; Jones & Reynolds, 2008). Interestingly, birds have been observed to make conscious decisions on food choice where they select food with the greatest profitability (Meire & Ervynck, 1986). Profitability is defined by the energy gained from the food item and is divided by the handling time, or processing time, of the food item.

Within British Columbia, birds often feed on bird feeders. Such feeders consist of different seed types that often include sunflower, millet, safflower and nyjer seeds (The Cornell Lab of Ornithology, n.d.). In order to determine nutritional content, this experiment will focus on protein percentage within each seed type. Proteins are essential amino acids that help maintain daily bodily function in birds and thus, are an important component of nutritional value. The protein content within each seed type is reported as follows: safflower seeds (22% to 24%), nyjer seeds (18%), black oil sunflower seeds (15%), and millet seeds (12%), respectively (Nosheen et al., 2016). This would exhibit that safflower seeds are of greatest protein content.

The researchers involved in the present experiment are not aware as to whether conscious food choices are being made based on nutritional content within birds that feed on bird feeders. Therefore, our experiment will aim to determine whether birds that typically feed on bird feeders make conscious food decisions based on nutritional content or rather, food availability.

Our null hypothesis states that if birds do not make conscious food decisions based on nutritional value (protein), then the abundance of birds between each seed type will not significantly differ. Conversely, our alternate hypothesis states that if birds make conscious food decisions based on nutritional value (protein), then safflower seeds will have the greatest average abundance of birds over the 4-day period.

Methods

To determine whether Cariboo BC birds prefer seeds of higher nutritional value, we used four different seed types of varying protein content. Our experimental groups included black oil sunflower seeds, millet seeds, safflower seeds, and nyjer seeds. Since the local Cariboo BC birds have been routinely fed black oil sunflower seeds within their environment, this seed type will serve as the control group during our experiment to make comparisons between treatments.

We placed each of the four treatment groups into identical deep oven pans (11 inch x 9 inch x 1.5 inch) on the edge of a forest clearing in Quesnel, BC. To ensure that each seed type was distributed equally, we measured one leveled cup (250 mL) of the control seed (black oil sunflower) and treatment seeds (millet, safflower, and nyjer) and added it into each pan, resulting in four treatments (Fig 1.). We then used a measuring tape and placed laminated markers with labels 1, 2, 3 and 4, that were one metre apart from each other in a square formation (Fig 2.). Using a random number generator, we placed each seed type into a pan according to the number drawn. From a nearby window, we set up a camera approximately 3.4 metres from the sample area (Fig 2.). We conducted the recordings in 2-hour segments beginning from 10:00 AM to 12:00 PM over a 4-day period. A second trial was then conducted 4 days after the conclusion of the first trial with identical methods as described above. We then uploaded the recordings to YouTube for data collection.

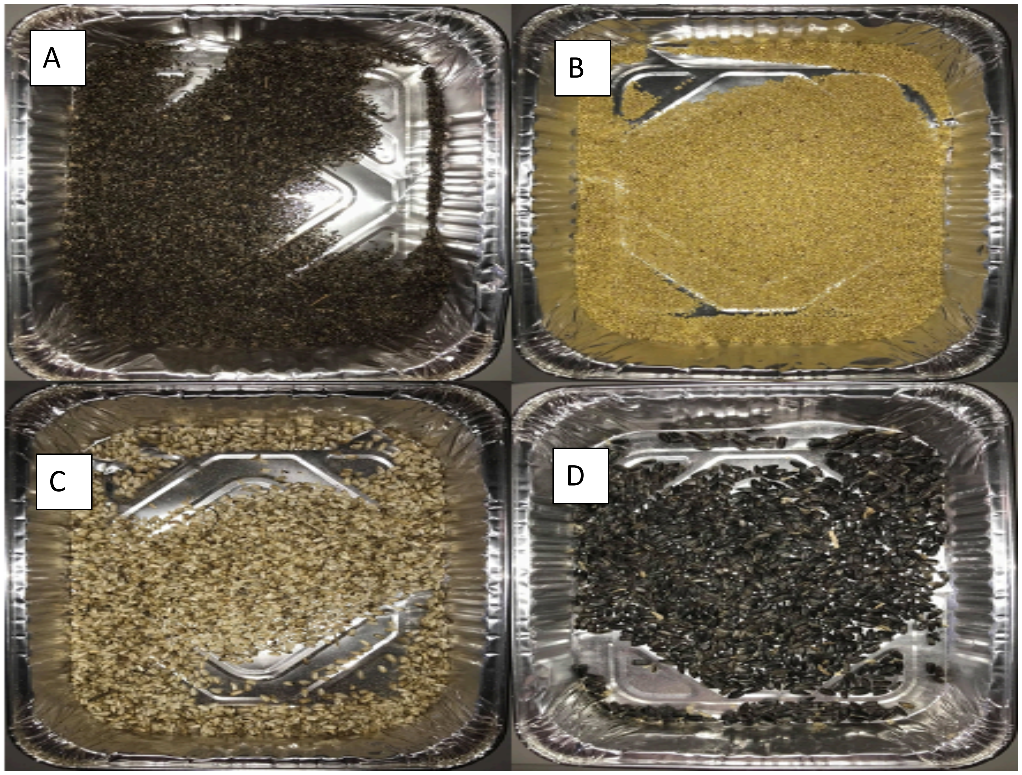

Figure 1. Photo depicts seed types for the control and treatment groups. A: Nyjer seeds, B: millet seeds, C: safflower seeds, D: black oil sunflower seeds (control).

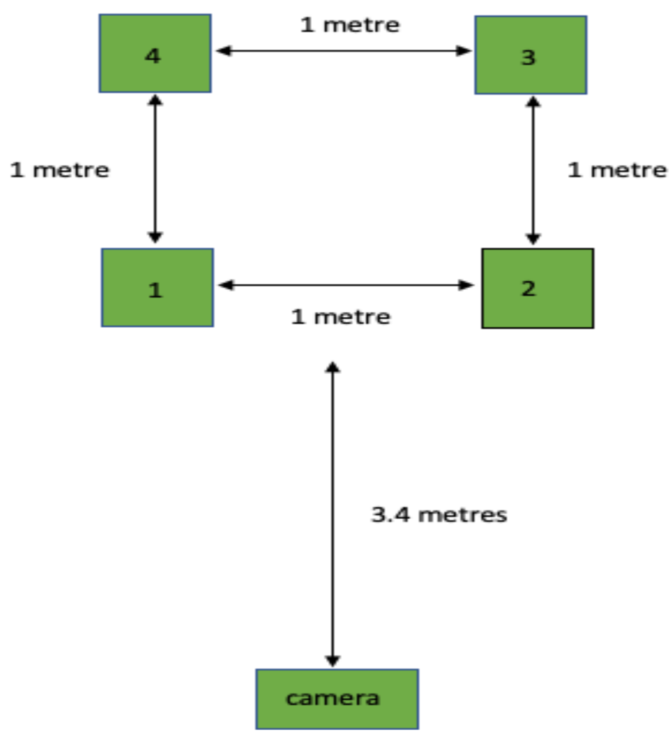

Figure 2. Diagram depicts the experimental floor plan of treatments and distances between each seed type.

To analyze the recordings, we allowed for a 15-minute acclimatization period for the birds to become familiar with the treatment groups we set out. At the 15-minute mark, we began quantifying the number of birds per seed type. Over a 20-minute period (eg. 15 minutes - 35 minutes), we manually counted the number of birds that landed at each seed type to determine the average abundance. We included the birds that landed on the outer rim of a treatment group when quantifying our data. To determine whether birds had a significant preference for certain seed types, we used Prism as a data analysis program to conduct a one-way ANOVA test. An alpha value of 0.05 was used for both trial analyses.

Results

Following data collection, seed preference was determined by quantifying the number of birds that landed and/or foraged at each treatment group per 20 minutes of monitoring. From Trial 1, we removed day 1 and day 3 as no birds were present during data quantification. The greatest average abundance of birds was observed at the treatment group of black oil sunflower seeds (158 +/- 150), followed by nyjer (38 +/- 38), safflower (23 +/- 23) and finally, millet (2 +/- 2) (Fig 3.). The greatest variation, as modeled by the height of the 95% confidence intervals, was also present in the black oil sunflower seeds (control). Interestingly, a considerable outlier was present during day 2 sampling of Trial 1. During this day, an inordinate amount of birds were present at each treatment type, most notably, the black oil sunflower seeds. As compared to the mean abundance of birds for black oil sunflower seeds (158), day 2 of sampling recorded 308 birds at the treatment group over 20 minutes of monitoring.

To test whether seed preference differed for the four different treatment groups of varying protein content, a one-way ANOVA statistical analysis was conducted where a p value of 0.55 was determined for Trial 1. The data was observed to be normally distributed for both trials where all assumptions of a one-way ANOVA were met and therefore, no transformations were needed.

From Trial 2, the greatest abundance of birds was observed at the treatment group of black oil sunflower seeds (9.75 +/- 3.71), followed by nyjer (0.50 +/- 0.29), millet (0.25 +/- 0.25) and safflower (0.25 +/- 0.25) (Fig 4.). The black oil sunflower seeds had the greatest variation among the different seed types as exhibited by the height of the 95% confidence intervals. A p value of 0.010 was determined for Trial 2. In addition, a post-hoc Tukey-Kramer test was conducted where the comparison between means of black oil sunflower seeds and nyjer, millet, and safflower resulted in p values of 0.020, 0.017 and 0.017, respectively.

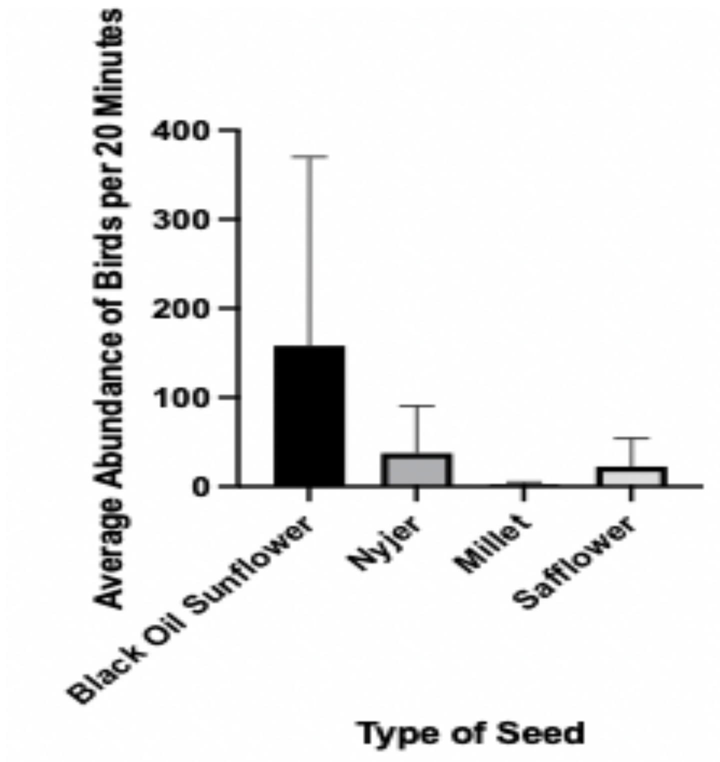

Figure 3. Graph depicts the average number of birds over 20 minutes per seed type for Trial 1. Treatment groups include black oil sunflower seeds (control), nyjer, millet and safflower seeds. 95% confidence intervals were used and are depicted by the error bars. One-way ANOVA: p value = 0.55. One replicate was used for each treatment group (N = 1).

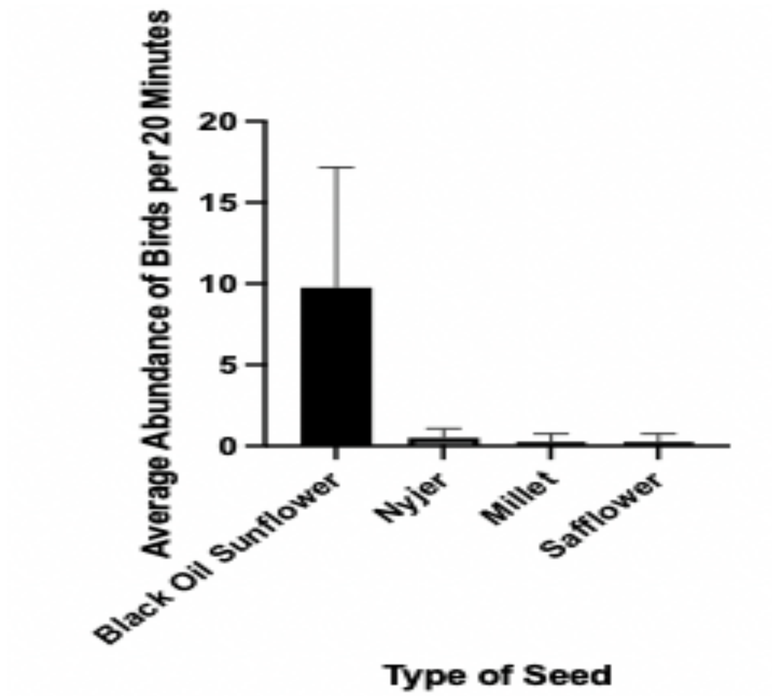

Figure 4. Graph depicts the average number of birds over 20 minutes per seed type for Trial 2. Treatment groups include black oil sunflower seeds (control), nyjer, millet and safflower seeds. 95% confidence intervals were used and are depicted by the error bars. One-way ANOVA: p value = 0.010. One replicate was used for each treatment group (N = 1).

Discussion

This study provided some support for bird preference in seed types ($p < 0.05$). In Trial 2, we found significant differences in seed preference between the four treatment groups ($p = 0.010$) and therefore, rejected the null hypothesis. An additional statistical test, the Tukey-Kramer, showed that there were significant differences in preference for the black oil sunflower seeds over the other three treatment groups (nyjer, millet and safflower). Black oil sunflower seeds had the greatest variation which may be explained by the natural unpredictability of bird behaviour. For example, some days the birds may not have been inclined to forage at a certain spot or may have been preoccupied with other tasks and therefore, would not land/forage on the sample area. This would likely result in some days of limited bird activity that may have implicated the results.

In addition, in Trial 1, we did not find significant differences in seed preference between the four treatment groups ($p > 0.05$) and therefore, failed to reject the null hypothesis. It is likely that due to limited bird abundance on day 1 and day 3 that led to the removal of such experimental data, the limited sampling time could have led to insignificant results. Black oil sunflower seeds once again had the greatest variation, while the other three treatment groups (millet, nyjer and safflower) had a significantly lower variation. A considerable outlier occurred on day two of Trial 1 sampling where there was an abnormal amount of bird activity. Most notably, a total of 308 birds were counted at the black oil sunflower seeds as compared to the mean of 158 birds for the same treatment group. Due to the inordinate amount of bird activity that occurred on day two of sampling of Trial 1, the mean of all treatment groups were inflated and therefore resulted in an enormous variation, specifically in black oil sunflower seeds.

Interestingly, our alternative hypothesis, where birds would consciously favour safflower seeds due to high nutritional content (protein), was not supported. Rather, birds seemed to prefer the black oil sunflower seeds, a seed type that they were most familiar with. This may suggest that in addition to making conscious food decisions based on nutritional content, a considerable factor in making such choices may include familiarity to seed type. In a study that analyzed bird feeder use in the United States and Canada, black oil sunflower seeds were found to be more commonly used than safflower and nyjer seeds (Horn et al., 2014). This may suggest that because the sampled bird species most often fed on bird feeders, black oil sunflower seeds were already the most familiar and attractive seed present in their natural diet. Therefore, black oil sunflower seeds were preferred over the other three treatment groups despite a lower protein content.

However, black oil sunflower seeds were found to have a relatively high fat content (43%) (Horn et al., 2014). In a study conducted by King and Farner, seasonal fat-cycles were measured of the house sparrow where an increase in fat accumulation was noted in April (1965). This bird was identified as non-migratory and found in temperate regions (Blem, 1976). Due to the present study being conducted in the winter/early spring in the temperate region of Quesnel, BC, it is likely that the observed non-migratory birds were undergoing a period of fat accumulation for energy storage. This would suggest that the black oil sunflower seeds were not only consumed due to familiarity, but further, in terms of fat storage for winter survival.

During this study, potential sources of error were present. Such errors likely occurred in the sampling method where quantification of birds relied on the human observer. Due to human inconsistencies and inaccurate tabulation of birds, especially in times of extraordinary high bird activity, this may have introduced a potential source of error. In addition, the canine disturbance that occurred during Trial 1 of day 2 and day 4 could have contributed to experimental error. This may have resulted in a lingering scent of a predator that may have warded off any potential birds to land and feed on the seeds. In regard to technical difficulty, at times, the camera would cut out and therefore, lost footage may have implicated the accuracy of birds counted. Furthermore, the implication of feeding in the tinfoil pans resulted in seeds being dispersed on the forest floor, which resulted in numerous birds feeding directly outside of the pan. This likely contributed to sampling error as quantification methods only accounted for birds that were on, or in the pan.

This study presented many limitations that included sudden changes in feeding equipment, insufficient acclimatization periods and seasonal shifts in foraging behaviour. The present study sampled birds that typically fed on bird feeders at a height of 2.9 metres. Since the present study tested different seed types on the forest floor, a potential limitation would be that the birds were having to forage in a foreign way, now on the forest floor as opposed to an elevated bird feeder. In a study conducted on bird feeder height and distance from tree cover, Lee et al. found that birds feeding closer to the ground spent more time scanning for predators (2005). Such implications may have affected our results where foraging behaviour in the current study was not entirely representative of normal conditions. In addition, the bird seeds were kept in pans instead of a bird feeder, another unfamiliar change that may have deterred feeding behaviour. This may have been a limitation to our study as preferences for seed types were conducted in a novel foraging setting that may have influenced the results and was therefore, not directly transferable to ordinary feeding behaviours.

Another potential limitation would be the constraint on acclimatization time to the new feeding arrangement. Since the birds were consistently fed black oil sunflower seeds in feeders, the birds would have likely gravitated to the specific seed type that was most familiar to them. Therefore, the extremely short acclimatization period (15 minutes) may have been a limitation in accurately assessing bird preference for seed types. Moreover, another potential limitation would be the seasonal changes in bird behaviour. Due to our study taking place over a concerted amount of days (8 in total), it is likely that a comprehensive understanding of bird foraging behaviour was unattained as were very susceptible to small changes in bird activity and foraging desire. Therefore, the results of our study may not be entirely conducive to explaining bird preference of different seed types.

Conclusion

The significance of our findings suggest that birds make conscious food decisions and is not simply a random outcome of food availability. The results of our study further showed that the explicit preference for black oil sunflower seeds, the control, was likely indicative that birds chose such diets that they were most familiar to. Interestingly, nutritional content (protein) did not seem to be specifically preferred during this study, however, more research should be conducted. Further research should be owed to exploring how nutritional content, specifically caloric value, influences food decisions and how relative digestibility implicates seed preference.

Acknowledgements

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Appendix

Trial 1	Black oil sunflower	Nyjer	Millet	Safflower
Day 1 (Number of Birds)	0	0	0	0
Day 2 (Number of Birds)	308	75	4	45
Day 3 (Number of Birds)	0	0	0	0
Day 4 (Number of Birds)	8	0	0	0

Trial 2	Black oil sunflower	Nyjer	Millet	Safflower
Day 1 (Number of Birds)	20	0	0	1
Day 2 (Number of Birds)	10	1	0	0
Day 3 (Number of Birds)	6	1	1	0
Day 4 (Number of Birds)	3	0	0	0

Trial 1-1:

1 = safflower, 2 = nyjer, 3 = millet, 4 = sunflower

Trial 1-2:

1 = millet, 2= nyjer, 3 = sunflower, 4 = safflower

Light snow, stopped snowing -1C

Trial 1-3:

1 = millet, 2 = sunflower, 3 = safflower, 4 = nyjer

Trial 1-4:

1 = safflower, 2 = millet, 3 = nyjer, 4 = sunflower

Cloudy 2C

Trial 2-1

1= nyjer, 2 = millet, 3 = sunflower, 4 =s afflower

Cloudy -1C

Trial 2-2

1= sunflower, 2 = nyjer, 3 = millet, 4 = safflower

Cloudy, -2C

Trial 2-3

1= safflower, 2 = millet, 3 = sunflower, 4 = nyjer

Sunny, little cloudy, 2C

Trial 2-4

1= safflower, 2 = sunflower, 3 = millet, 4 = nyjer

Sunny, 6C