Sunflower seed preference among wild birds: gray-striped or black oil?

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I. Abstract

Bird feeders are a popular hobby across the United States, resulting in the widespread availability of commercial feeder seeds. While many previous studies have focused on factors that influence wild bird seed selection, few have focused on commonly used seeds at feeder stations run by hobbyists and which seeds are best for causal feeding stations. This study aims to determine seed preference among wild birds for two common seed types: black oil sunflower seeds and gray striped sunflower seeds. Using an infrared game camera at an established feeding station in Stillwater, Oklahoma, USA, we gathered data on bird seed selection. Seeds were offered in equal availability using trays along a brick wall, their location being reversed each day with respect to the camera. Data analysis was conducted using Jacobs' D-index. Overall, birds displayed a clear preference for black oil sunflower seeds (D=0.50) and avoidance of gray striped sunflower seeds (D=-0.50). In addition, two mammal species (Fox Squirrel and Raccoon) also showed a high preference for black oil seeds. This research can help beginner bird feeding hobbyists determine which basic seed type is best for meeting their needs.

II. Introduction

Bird feeders are a common occurrence in residential areas across the United States. Over 52 million Americans own bird feeders and enjoy this relatively easy and simple way of appreciating wildlife [11]. Bird feeding includes hummingbird feeders, oriole feeding, tossing bread to pigeons and waterfowl in public parks, and the more commonly thought of feeding station for seed and millet. People across the country use bird feeders as a means to bring wildlife to their own backyard and enjoy the comfort and entertainment watching wild bird visitors brings. Setting up a feeding station also gives birders a sense of accomplishment that they are helping wildlife by providing birds with food and a safe place to rest. Indeed, past studies suggest feeder increase the survivability of wild birds, especially overwintering species [2]. Despite the potential for non-target species, such as squirrels, raccoons, and chipmunks, becoming pests bird feeders are still a popular hobby across the United States [12].

As a result of its popularity, many companies began producing and selling wild bird feeds. These feeds vary from multi-seed blends to basic, single seed, bags that can be bought in large quantities. Two of the most commonly sold individual seed types are black oil sunflower seeds and gray striped sunflower seeds (*Helianthus annuus*), each marketed as the best way to attract granivorous bird species. Multiple studies support sunflower seeds as a popular food supplement at feeding stations [14] with black oil being particularly popular for larger finch species [8] but this provides little insight on what seed is best overall. For a beginner hobbyist, or casual hobbyist, this poses a potential problem. Choosing the wrong seed type might reduce the success of a feeding station, resulting in wasted seed and a loss of money. People can regularly spend

anywhere between $20 to $40+ per purchase for seed and other feeders The relationship between seed size, nutritional value, and the bird's bill size/form are key factors influencing seed selection [5]. These factors affect handling time which, if not outweighed by the nutritional benefits, can cause a bird to select against a particular seed type. Birds with larger bills are most effective at husking larger seeds, while birds with smaller bills husk smaller seeds more efficiently; however, when given a variety of seed species most wild birds selected seeds with lower nutritional value if handling time was low [15][6]. Additional studies also suggest that, while nutritional value is a factor in seed selection, it is perhaps less important than seed size and morphology [11][13][15]. While black oil sunflower seeds claim to have a higher oil content and nutritional value, which birds are able to distinguish between and select higher for [3], it can not be assumed that this is the preferred seed for wild birds at feeding stations. Many studies have focused on what influences seed selection, but few have focused on how this applies to the bird feeding hobby and which seed types on the market are best for attracting birds.

With the increase in popularity of bird feeders came an increase in seed selection and nutrition research. With it came commercially available seeds, often not a part of the native diet, which lacked definitive research for their claims of being the best seed type for feeders. By studying seed preference for two basic seed types, black oil and gray stripe, beginner and advanced hobbyists can make more informed decisions regarding seed type, ensuring their feeding station is a success. This study aims to determine sunflower seed preference among wild birds and how this might affect the variety of species attracted to feeding stations.

III. Methods

Data were collected at an established bird feeding station in Stillwater, Oklahoma, USA. Approximately equal volumes (250 mL) of sunflower seeds were offered to wild birds in small piles on a brick patio wall approximately 0.5m apart and 0.5m from an infrared trail camera (Browning). Piles were placed either directly on the wall or in commercially available watering trays designed for young poultry. The watering trays were intended to keep piles better consolidated during trails than the piles placed directly on the wall; both methods provided useful data for the study. Piles of seeds were refurbished each day so that seeds of each type would be available at all times. Each day the locations of each seed type were reversed with respect to the camera. Two stations including 1 camera and 2 seed piles were continuously operated 13 March-11 April 2020, recording images day and night (Figure 1).

Cameras recorded either still images or video. Video recorded visits to seed piles in either 10-second or 30-second bursts. Each visit to a feeding station was considered to be a single foraging bout, whether it was represented by a single photograph, dozens of photographs, or a video. If the individual left the area and then came back, it was counted as two bouts. Other than instances during which the same species could be identified simultaneously in an image or for sexually dichromatic species, unique individuals could not be identified for trials. Data analysis focused on discrete foraging bouts regardless if the individual selected a seed on a given image.

A single observer downloaded images and scrolled through them to build a database of species recorded, the number of foraging bouts by species, the number of images per bout, the number

and type of seeds selected within each bout, and if no seed was selected in a bout, the number of photographs of an individual nearer to one seed type or the other. For the purpose of counting photographs, each video was considered to be a single photograph and a single foraging bout. This led to some instances in which the database reflected more than one seed selected within a single image, but the data were analyzed according to the sample size of seeds selected rather than images obtained. Only those species for which at least 18 seeds were selected were included in analyses of selection by species. Species with insufficient sample size to calculate their own preference were pooled for calculation of overall selection by all species.

Selection was determined using Jacobs' D-index [10], a modification of Ivlev's [9] index of electivity. The D-index uses an absolute scale of -1.00 (complete avoidance) to +1.00 (exclusive preference). Jacobs' D is robust to changes in availability of food items over time, calculated as

$$D = \frac{r-p}{r+p-2rp}$$

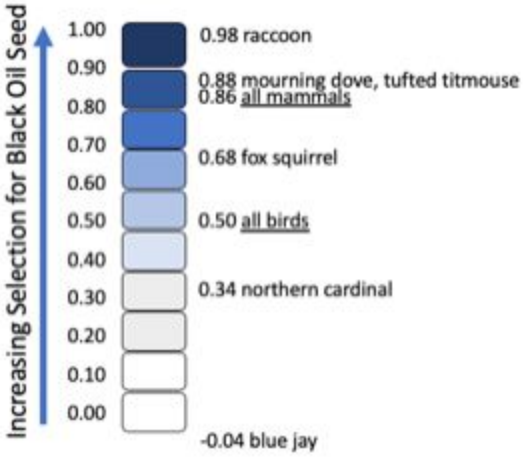
Where r = proportion selected and p = proportion available. For this study, analysis with D is a conservative approach because piles were monitored daily to ensure that both seed types were available at all times and assumed to be 0.50.

Figure 1. Example photographs used for identification of seed selection in multiple bird species. Top row (from left): Northern Cardinal (female), Carolina Chickadee, Downy Woodpecker (male), Red-bellied Woodpecker (female), and Mourning Dove. Bottom row (from left): Northern Cardinal (male), Tufted Titmouse, Harris's Sparrow, Blue Jay (with gray stripe seed), and Blue Jay (with black oil seed).

IV. Results

Cameras recorded 3034 photos/videos consisting of 197 foraging bouts. This included 183 photos and 16 videos of foraging bouts. Within these foraging bouts, 492 total seeds were selected by both birds and mammals with 221 photos showing birds on seed piles, wherein no seed was selected. The data included information on 12 bird species and two mammal species: Dark-eyed Junco, Carolina Wren, Lincoln's Sparrow, Harris's Sparrow, Downy Woodpecker, Brown-headed Cowbird, Carolina Chickadee, Red-bellied Woodpecker, Tufted Titmouse, Northern Cardinal, Mourning Dove, Blue Jay, Fox Squirrel, and Raccoon (Appendix 1). All species were seen on or selecting a black oil sunflower seed whereas only 7 of the 12 observed species were seen selecting a gray striped seed. Sample sizes for the Dark-eyed Junco, Carolina Wren, Lincoln's Sparrow, Harris's Sparrow, Downy Woodpecker, Brown-headed Cowbird,

Carolina Chickadee, and Red-bellied Woodpecker are too small to analyze for seed preference by species.



Because availability of the different seed types was assumed to be equal in all trials and only two types of seed were offered, selections for one seed type was mirrored as avoidance of the other (Table 1). Among birds, Tufted Titmouse and Mourning Dove showed a strong preference for black oil seeds (D=0.88) and a concomitant avoidance for gray striped seeds (D=-0.88). Northern Cardinal also preferred black oil seeds but selection was weaker than that calculated for Tufted Titmouse and Mourning Dove ($\underline{D}$=0.34). Blue Jay was the least selective of all species in the study, showing little preference between either seed type with a D value of -0.04 for black oil seeds. Considering all birds, preference for black oil sunflower seeds (D=0.50) and avoidance of gray striped sunflower seeds (D=-0.5) was clear. Among mammals, both Fox Squirrel (D=0.68) and Raccoon (D=0.98) showed a high preference for black oil seeds.

Table 1. Jacobs' D selection scores for two mammal and four bird species. *insufficient sample size for estimate of selection by species

	Jacobs' D Score			
Species	black oil	gray stripe	total seeds selected	total photos
Dark-eyed Junco	*	*	1	1
Carolina Wren	*	*	5	3
Lincoln's Sparrow	*	*	2	4
Harris's Sparrow	*	*	3	15
Downy Woodpecker	*	*	4	9

Brown-headed Cowbird	*	*	2	9
Carolina Chickadee	*	*	1	21
Red-bellied Woodpecker	*	*	1	22
Tufted Titmouse	0.88	-0.88	18	79
Northern Cardinal	0.34	-0.34	27	129
Mourning Dove	0.88	-0.88	79	747
Blue Jay	-0.04	0.04	61	411
Subtotal Birds	0.50	-0.50	204	1450
Fox Squirrel	0.68	-0.68	107	336
Raccoon	0.98	-0.98	181	1248
Subtotal Mammals	0.86	-0.86	288	1584
Total	0.86	-0.86	492	3034

Figure 2. Jacob's D selection indices for black oil sunflower seed.

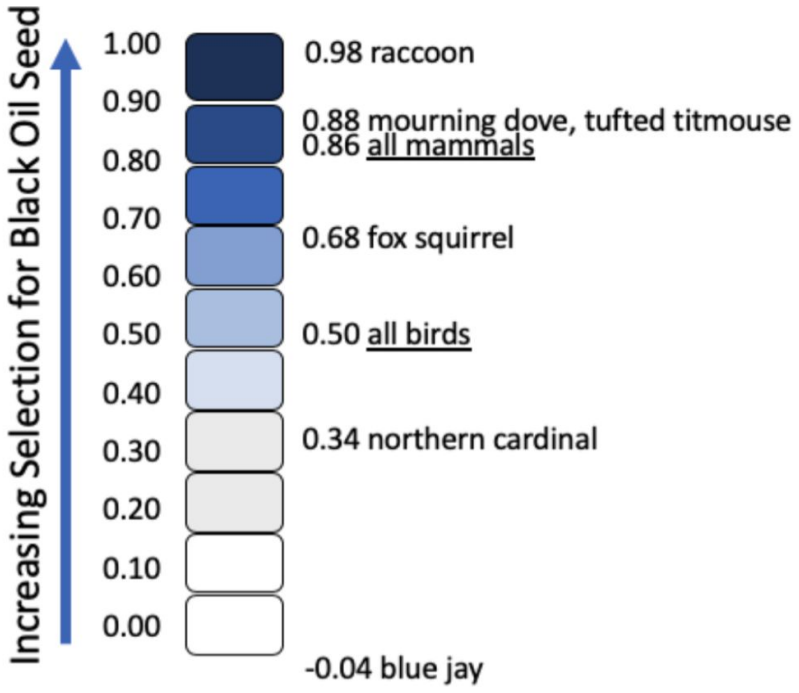


Figure 2. Jacobs' *D* selection indices among four birds and two mammals for black oil sunflower seed in Stillwater, Oklahoma, USA.

V. Discussion

This study found a clear preference for black oil seed by wild bird and mammal species. This supports conclusions in previous studies wherein wild bird species selected for seed with higher oil content and lower handling time. Black oil seeds have more nutritional value and thinner husks that reduce handling time for most wild birds [3]. This premise also applied to mammal species in this study. While not the target subject, both mammals strongly preferred black oil seed. This suggests both wild birds and mammals select seed based on similar premises.

Birding is a popular hobby in the USA and across the world. Many birders start the hobby simply to enjoy watching the wild birds that visit feeders; however, this can become an expensive hobby as seeds need to be regularly replenished. With the numerous blends and seed types available on the market, it can be difficult to know which seed types are worth buying and which will attract more birds to the yard. The data collected addressed two basic seed types that beginners might choose from. Knowing which basic seed wild birds prefer can help beginner and casual birders set up and maintain a feeder at a lower cost and make a more informed decision on what seed type is most suitable for their goals.

The study results are limited in their scope and application. Data was only gathered at one location and feeding station. Future studies could improve this by including more trial locations over a longer observation time. This would help to mitigate confounding variables and increase the quality and quantity of data. Switching the feeding station from a tray, which is easily accessible to non-target species, to an automatic feeding station designed to deter such pest

species would reduce seed waste and ensure that seed availability remains consistent throughout the day. Reduced availability throughout the day could alter results, driving selection for a less appealing seed. Given that most seeds in the study were eaten by racoons and squirrels, commonly considered pests by bird feeder hobbyists, offering gray stripe seeds could be a better and more affordable option. While black oil is preferred by wild birds it is also highly attractive to non-target species that could consume all the seed provided, leaving little or nothing for the birds. Not only is this counterproductive to a birder's goals, but it is wasteful monetarily as well.

Now that seed preference for commercially available seed types is better understood, further steps can expand upon this. Previously, studies focused on what drives seed selection overall, but few have focused on how this can be applied to the bird feeding hobby. This study suggests that similar factors affecting seed selection in birds, such as seed size and nutritional value, apply to mammals as well. An attractive seed to birds can also attract unwanted pests that are unappealing to hobbyists. Further studies could explore seed preferences and feeding methods that are appealing to wild birds while less preferred by mammals. This research could help inform beginner and advanced hobbyists which seed type is best for their desired results. In addition, making the bird feeder hobby easier to understand and providing a simple way to establish a feeder could increase public awareness and interest in wildlife.

VI. Acknowledgements

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VIII. Appendix

Common Name	**Scientific Name**
Blue Jay	*Cyanocitta cristata*
Brown-headed Cowbird	*Molothrus ater*
Carolina Chickadee	*Poecile carolinensis*
Carolina Wren	*Thryothorus ludovicianus*
Dark-eyed Junco	*Junco hyemalis*
Downy Woodpecker	*Picoides pubescens*
Fox Squirrel	*Sciurus niger*
Harris's Sparrow	*Zonotrichia querula*
Lincoln's Sparrow	*Melospiza lincolnii*
Mourning Dove	*Zenaida macroura*
Northern Cardinal	*Cardinalis cardinalis*
Raccoon	*Procyon lotor*

Red-bellied Woodpecker	*Melanerpes carolinus*
Tufted Titmouse	*Baeolophus bicolor*