Running head: Food storing, birds

Stimulus for Food-storing in the Black-capped Chickadee

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Honours Thesis

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Abstract

The black-capped chickadee stores food for later consumption during the fall and winter. Three feeding sites were erected in the natural environment of the black-capped chickadee. The amounts of food placed on the first site were varied heavily every observation day. The amounts of food at the second site were varied moderately. At the third site the amounts of food remained stable. The sites were observed using a time-sampling procedure. Whenever a chickadee carried a seed away from the site being observed, the response was recorded. The hypothesis was that fluctuations in the amount of food at a feeding site stimulates food storing from that site. It was found that even though there was a difference between the heavy site and the other two it was not found to be a statistically significant difference. There was nearly no difference between the stable and moderate fluctuation site totals.

The black-capped chickadee is a food storing bird. During the fall and winter these birds spend a great deal of time storing seeds in the cracks and crevices scattered throughout its environment (Smith, 1991). Known for its incredible memory, the black capped chickadee may store hundreds of items a day during the food storing season. Usually the food is retrieved for consumption within two or three days of storing (Shettleworth, 1992).

Storing food is an adaptation by the black capped chickadee, to its environment. Wintering birds face many difficulties (Vander Wall, 1990; Shettleworth, 1990; Sherry, 1985). These problems include inconsistent and limited food supplies, low temperatures (requiring great expenditures of energy to maintain body temperature), and fewer hours of day light. Food storing helps deal with these problems (Vander Wall, 1990). An animal stores food either to have food when food is scarce, to have food at a time when energy demands are very high, or for a combination of both the reasons(Vander Wall, 1990). In the case of the black-capped chickadee, energy demands are high and food is scarce because of the cold and snow. By storing food, the animal controls the availability of food in space and time. This means the storer chooses where the food will be and when it is available. Storing food allows the birds to construct and maintain their own consistent food supply that can be accessed when needed. Black-capped chickadees start storing food a short time after sun rise and end sometime in the afternoon. The prime storing time varies so as to leave the bird exposed to the environment most during the warmest parts of the day. During the winter, the food available to the birds is reduced. Storing food makes the food unavailable to other foragers, but available to the storer. Most of the stored food is consumed during the colder periods of the day when energy needs are highest.

For food storing to work as an adaptation the storer must be sensitive to the environment.

Paying attention to changes in the environment allow the birds to store efficiently and successful. Temperature is a stimulus taken into account by the birds when determining what time they will venture into the environment to begin storing and when they will stop and spend more time eating. The colder it is in the mourning, the more time they spend eating, as opposed to storing. When it warms up they spend more time storing than eating (Pravosdov & Grubb, 1997; Shettleworth, Hampton, & Westwood, 1995). Shettleworth (1992) found that black capped chickadees notice when seeds they store are being stolen. She found that, if she removed the seeds the birds had stored in a specific area, the birds would stop storing in that area. Birds remember where good food sources are and will return to them (Kamil, Balda, Olson, & Good, 1993).

The black-capped chickadee must carefully decide when it is the opportune time to begin the storing season. It would be a waste of time and resources for the birds to store food when food is readily available and the weather is mild. As well, it would be disastrous to begin storing later than appropriate because too little food would be available for the birds to survive the cold. There are different stimuli the birds could be looking at to help them decide when to begin the storing season. The birds could use temperature changes, they could use changes in the light/dark cycle, or they could use changes in the food supply.

Studies of temperature fluctuations and light/dark cycles and have found that manipulation of these can change the birds' storing behaviour (Shettleworth, Hampton, & Westwood, 1995). One likely stimulus to take into account would be the food supply. There are great fluctuations in the amount of food available to the birds throughout the food-storing season (Smith, 1991). It would seem reasonable that food-storing birds would be sensitive to the changes in the amount of

food available in the environment, perhaps recognizing a fluctuating food supply as one that should be stored, because it is unpredictable and may not remain available for long.

Roberts, Macuda, and Brodbeck (1995) found that pigeons can understand numbers when rewarded for responding to a specific number of light flashes. The pigeon is not a food-storing bird but this is evidence that a bird is capable of understanding numbers, so therefore birds of other species may well be. Also, it was found that tufted titmice react to manipulations in the amount of food available at their food sources by altering what time of the day they concentrate more energy storing than retrieving (Pravosdov & Grubb, 1997). This shows that the task of recognizing changes in the amount of food is within the capabilities of some birds and that the recognition of these changes can cause them to alter their behaviour. This ability would enable the food-storing bird to react directly to the stimulus that they seek to control, that is food availability.

The theory that fluctuations in the amount of food available will stimulate storing in the black capped chickadee, was tested in this study. Three food sites were introduced into the birds' natural environment. Once birds began to feed at the sites, they were stocked in three different ways. The amount of food placed at one site was varied greatly every feeding day. At the second site the amount of food was varied minimally. The food supply at the third site was stable. The sites were observed. When a bird carried away a seed from a site it was recorded. The hypothesis is that the site most seeds would be removed from would be the site that fluctuates the most. The site with the minimal amount of fluctuation will come second leaving the site that would have the fewest seeds removed from it as the site with no fluctuation.

Method

Participants: The subjects in this experiment were the black-capped chickadees located in the forest area behind the George Leach Fitness Center on the campus of Algoma University in Sault Ste Marie, Ontario, Canada. The number of chickadees that came to the site is unknown.

Apparatus: Three wooden five x five centimeter boards each measuring approximately 121 centimeters tall were used to hold the feeding dishes off the ground. The boards were pounded into the ground approximately 20 centimeters, leaving the feeding dishes approximately 101 centimeters off the ground. The feeding dishes were plastic dinner plates. One dinner plate was nailed to the top of each board. The seed used to bait the birds were shelled sunflower seeds purchased at a bulk food store. A watch was used to keep track of time for the time sampling procedure.

Procedure: The food stands were hammered in the ground approximately 15 centimeters. The stands were placed approximately 5 meters apart and each was approximately 10 meters from the forest in the area. Each site was baited with 50 seeds in the morning 4 days a week for one week. The seeds left from the previous day were removed from the feeding plate. Once birds were coming to feed at the sites, the manipulation of the amount of food available at each source began.

The sites were randomly assigned to the three treatment conditions. One site was the heavy fluctuation site, one moderate fluctuation site, and the third was the stable site. Prior to the onset of the treatment conditions random numbers were generated using Corel's Quattro Pro 7. The parameters used in the generation of these random numbers were different for each of the three groups. The parameters for the random numbers generated for the heavy fluctuation site

were set so that Corel Quattro Pro 7 generated 28 random number from 0 to 30 and randomly chose these numbers to be either added or subtracted from 50. This function was also designed to generate these numbers so that the mean of the resulting 28 number list would equal 50. The numbers were then used to dictate number of seeds that were placed at the heavy fluctuation site each of the four per week for seven weeks, resulting in 28 feeding/observation days. The total number of seeds used at this site was 1400. The amount of food placed at the moderate fluctuation site for the 28 feeding/observation days was generated using the same procedure as the heavy fluctuation site. The difference being the parameters were set so the random number was chosen from 0 to 15. The mean was also designed to be 50 and the total amount of seeds used 1400. The stable food site had 50 seeds placed at the food site on the 28 feeding/observation days, with the total number of seeds used being 1400.

All sites were observed on the same feeding/observation days using a time-sampling procedure. The observation period ran from 10:00 a.m. to 12:00 p.m.. Each site was observed for five minutes. This was repeated until the completion of the two hour observation period. The first sampling site was randomly chosen each feeding/observation day. If a bird came to the site being observed during the five minute time-sampling, and carried away a seed, this response was recorded. At the end of the 28 feeding/observation days the total carries for each site was analyzed using a chi-squared statistic.

Results

If the birds were reacting to the three sites as being the same in eliciting food-storing then they should equally often carry away seeds from each of the three sites. Thus the total number of

carries from all three sites added together and divided by the three sites would be the expected number of carries from each site if the sites were equal.

After the 28 feeding/observation days the total number of carries observed from the stable site was 37, form the moderate fluctuation site it was 36, and from the heavy fluctuation site it was 54. With each site having a mean of 50 seeds used per feeding/observation day and each site having a total of 1400 seeds used at the end of the 28 feeding/observation days. The only difference between the sites was the level or lack of fluctuation in the amount of food. There were 127 carries observed when the results from all three sites were combined. If the sites were equal in their ability to elicit storing then each site should have had 42.3 carries. This was not the case.

The data was analyzed using chi-squared with 2 degrees of freedom and was found to be insignificant at the 0.05 level, $X^2(2)=4.84$, $p>.05$. A point that came up while analyzing the data was that there seemed to be a pattern between the temperature of the day and the corresponding carry totals of the day. There appeared to be a trend that on warmer days then tended to be less carries. Another test that was run was to correlate the total carries of the day with the corresponding high temperature for that day as reported by the Sault Star. This resulted in $r = -0.66$.

Discussion

The total carries from the heavy fluctuation site was quite different when compared with the total carries from the moderate fluctuation or the stable site while the number of carries from the moderate fluctuation and the stable site were nearly equal. The hypothesis that fluctuation in

the amount of food at a food site would stimulate storing has not been supported statistically. However, there seems to have been something happening with the heavy fluctuation site. The difference between the totals of the heavy fluctuation site and the other two sites may not be statistically significant but the heavy fluctuation site is obviously different than the others. It appears to have enticed the birds to store more from it than the other sites and perhaps with more research the hypothesis will be supported.

There are a number of possible reasons the heavy site did not cause a large enough reaction in the storing behaviour to be significant. Many variables are unknown and/or uncontrollable when research is done in the natural environment. The number of carries total was quite low perhaps being due to one or many of these variables. The weather system El Ninio has brought an unusually warm winter in Ontario, Canada and this likely effected the behaviour of the black-capped chickadees in the area. If it is warm than the environmental pressures are not as strong to store. The ground is not covered by snow as much as usual which takes away the usual lowered availability of food sources. As well, since the temperature is up the birds do not have a higher need for food energy to maintain body temperature.

An explanation for the near equality in the amount of carries from the moderate fluctuation site and the stable site is that the amount of fluctuation in the moderate site may not have been enough to influence the birds food storing behaviour. Future research may want to adjust the fluctuation levels used here. Perhaps greater levels of fluctuation will have a stronger effect on the storing behaviour of the black-capped chickadee.

For further study the ideal situation would be the use of an aviary if one is available, if not then beginning observations sooner would be prudent. With larger numbers of observations it is

likely that significance will be reached.

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