**Food Choice**

**Learning Objectives**

By the end of this section, you will be able to:

* Identify the basic tenets of Ecology and how they apply to population success.

Foraging is the act of an animal searching for food. An animal’s choice of food should reflect energetic considerations such as maximizing net energy gain per unit time or net gain per cost expended in foraging. Animals want the most energy return for their caloric investment. They seek out food sources that will give them the most energy reward for the least amount of energy expended. We will be examining the foraging behavior of birds in our quad.

1. **What factors might influence seed selection in the birds we will be watching? Name three factors and their effects.**

Given these factors, we will now form hypotheses and predictions that we will test by observing birds in the courtyard area. After, we will perform a Chi-Square statistical test on our data, and revise our hypotheses and thought processes to fit the new data.

Many birds will visit our feeders and collect seeds. Our feeders are stocked with three types of seeds. The Feathered Friend black oil seed is very soft hulled. The Lyric Sunflower gray striped sunflower seeds are large and thick hulled. Gray safflower seeds are also small and soft hulled.

1. **Look at the three seed types. Feel them and try to break them open. Note the differences you observe between the seed types.**

The table below summarizes measurements for the 3 types of seeds. This shows the average kernel (food part of the seed), hull (outside covering of the seed) and entire seed weight. The kernel/hull ratio for each seed type, and the average caloric (energy) content of the seeds. Use these values and your observations to make predictions about optimal foraging behavior for various bird types that visit the feeders.

**Table 1: Mass and caloric content of sunflower seed components.**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Seed (mg)** | **Kernel (mg)** | **Hull (mg)** | **Entire seed (mg)** | **Kernel/Hull** | **Cal/g** | **Cal/seed** |
| Black oil | 28.8 ± 3.8 | 12.2 ± 1.6 | 41.0 ± 0.5 | 2.37 ± 0.3 | 5400 ± 240 | 150 |
| Safflower | 26.8 ± 3.9 | 10.4 ± 3.3 | 38.3 ± 6.9 | 2.603 ± 0.1 | 6200 ± 240 | 161 |
| Striped | 61.7 ± 4.7 | 59.1 ± 2.7 | 120.8 ± 6.0 | 1.045 ± 0.1 | 5600 ± 240 | 350 |

Now, take a look at the birds that are commonly found in our area during this time period. You will have a list of birds on your lab bench.

Your lab group will propose two experimental hypotheses about avian seed choice and discuss these with your instructor. Provide a rationale for your testable hypotheses. Clearly state each of your ideas in the form of an “If….then…” hypothesis. If your hypothesis is correct, which type of seed do you expect the birds to choose? Why?

1. **Clearly state a testable hypothesis explaining why birds will choose or not choose the different seeds.**
2. **Would this hypothesis change with different birds? Why or Why not?**
3. **What is the alternative(s) to your hypothesis? (i.e., if you are wrong)**
4. **If your hypothesis is right, what would you predict the birds will do at the feeders?**
5. **If your alternative is right, what would you predict?**

**\*\*CHECK WITH YOUR INSTRUCTOR BEFORE PROCEEDING\*\***

In order to test your hypothesis, we need to think a bit about experimental design. Variables are important to consider because they will help us evaluate our hypothesis. For example, if we were interested in the height at which giraffes eat their food from, we might propose a hypothesis that giraffes will eat food from high areas in a tree. Each time the giraffe ate, the height at which the food was taken from would need to be recorded. This gives us two variables: the height at which the mouthful of vegetation came from and the mouthful height. This height is measureable. We will look at what is called “categorical” data. Each of our data points will fit into a category. We will have a bird taking a seed (making a food choice), and the typ0e of seed chosen.

1. **What is the independent variable (what we are manipulating)?**
2. **What is the dependent variable (what we are measuring)?**
3. **Design a data table to record the species of bird and type of seed each bird selects during our lab time. You can use hash marks to record visits. We will be visiting our feeders for a 20 minute time span.**

**\*\*DISCUSS YOUR DATA SHEET WITH YOU INSTRUCTOR BEFORE YOU BEGIN YOUR DATA COLLECTION\*\***

When we return, you’ll need to transfer the data from your table into the following table as totals.

|  |  |  |  |
| --- | --- | --- | --- |
| Bird Type | Safflower | Striped Sunflower | Black Oil |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
| TOTALS |  |  |  |

Bird Observation: Stay well away from the feeders at all times and keep as quiet as possible. One noisy or clumsy move can scare all the birds away, leaving you without any data!

1. **Describe the behavior of the birds with the seeds.**
2. **How long does it take an individual bird (record the species of bird and the type of seed eaten) to eat a seed and return to the feeder for another? Use your binoculars to follow individual birds and record the time from when a bird takes a seed to when it returns for another. Do the birds do anything unusual with the seeds?**
3. **Compare and contrast the seed handling behavior of the birds visiting the feeders. How do the different birds crack each of the seeds? Do they have difficulty opening any of them?**

**Statistical Analysis**

Using your feeder choice data, perform a chi-square Goodness of Fit test to determine if the birds show a preference for any given seed.

A Chi-Square test involves testing the probability that your categorical data differs from random enough to have confidence that the data does not come from chance alone. Typically, we accept that significance is 0.05 (called alpha). This means that there is only a 1 in 20 chance of the data arising from chance alone. When doing a chi-square, we typically call the boring hypothesis (that all the birds would randomly select seeds and your hypothesis is wrong) the “null” hypothesis, abbreviated Ho. The hypothesis where the data support your idea is called the alternate hypothesis, abbreviated Ha. Note: this is a different type of hypothesis, used to fit specifically into statistical tests. This may not match perfectly with your description of hypotheses above. A chi-square also doesn’t tell you exactly where the differences causing significant deviation from the expected. You would need more involved statistics for that. We will visually pick out our differences in data.

First, transfer your choice data into a table like the following table. We will calculate the expected values from the data.

 Add the data for each bird horizontally, then for each seed vertically. The total row and total column should now be filled. These represent how many birds and seeds by type were actually eaten and recorded. Now we will calculate the expected values based on how these would be distributed by random chance. We will take the total for each species, multiply it by the total number of seeds for that seed type, and divide by the total number of seeds

 For example, 111x178/532=37.13

Put the answer into the table. This is how many safflower seeds would be expected to be eaten by the chickadees through chance alone. Complete your own table.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| SAMPLE TABLE | Safflower | Striped | Black Oil | Total |
| **Black-capped chickadee** | 13 | 23 | 75 | 111 |
| (Expected) | 37.13 |  |  |  |
| **Tufted titmouse** | 21 | 32 | 23 | 76 |
| (Expected) |  |  |  |  |
| **House finch** | 45 | 23 | 43 | 111 |
| (Expected) |  |  |  |  |
| **American goldfinch** | 0 | 0 | 0 | 0 |
| (expected) |  |  |  |  |
| **Nuthatches** | 0 | 0 | 0 | 0 |
| (expected) |  |  |  |  |
| **Junco** | 76 | 32 | 32 | 140 |
| (expected) |  |  |  |  |
| **House sparrows** | 23 | 27 | 44 | 94 |
| (expected) |  |  |  |  |
| **TOTALS** | **178** | **137** | **217** | **532** |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Bird Type | Safflower  | Striped | Black Oil | Total  |
|  |  |  |  |  |
| (expected) |  |  |  |  |
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| (expected) |  |  |  |  |
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| (expected) |  |  |  |  |
| TOTALS |  |  |  |  |

To calculate the chi-square value, or χ 2 , we simply add the square differences, divided by the expected, of all the observed and expected. In mathematical terms:

χ 2 = Σ (O-E)2

E

So for our example from the previous sample table, the first (O-E)2 / E would be

(13-37.13)2

 37.13 = 15.7.

We would then add to this value all of the other (O-E) 2 / E in the table to get the χ 2 value.

1. **Compute the χ 2 value for your data. (Use an extra sheet of paper if necessary)**

In order to find something to compare this number with, we need to calculate the degrees of freedom, or the number of different comparisons that can be made within the table. The degrees of freedom are the number of columns (M) minus one times the number of rows (N) minus one. Degrees of freedom = (M-1) (N-1)

**A B**

**C D**

How many ways can this two by two table be broken into individual comparisons? Hint: Use the formula above.

1. **Calculate the degrees of freedom in your experiment.**

Now we can compare against the Chi distribution for the likelihood that our data is generated by chance. Remember, we want a 0.05 or less value to say that it’s not chance, but our hypothesis that’s causing the choices.

1. **Compare to the Chi-distribution table at the end of the lab with your instructor’s assistance. What is the p value or probability that your data came out by chance? Is this less than 0.05? Did your results come about by chance?**
2. **Describe and summarize what you observed in the field. Are some parameters more difficult to measure than others? If so, why? Which predictions did your data support? Interpret you results as they relate to your hypotheses and discuss your interpretation.**
3. **How could you re design your experiment to better measure energy gains, handling time, and energetic costs of foraging, and thus more accurately test the predictions of optimal foraging theory? Think of other hypotheses regarding seed choice by birds? Propose a follow up study that would allow you to test a related idea about avian foraging behavior. Make clear the ways in which your proposed study is an extension of or improvement upon the study on which you report here.**



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