LAB 4: IDEAL FREE DISTRIBUTION
Feeding Strategies in Chickens

When the best behavioral strategy for an individual (e.g. foraging) depends on what others in the population are doing, the strategy the individual adopts should be an evolutionarily stable strategy (ESS). An ESS is a strategy that, if adopted by individuals in a population, is not susceptible to invasion by any alternative strategy. For example, given an ESS in which the optimal strategy is for individuals to stay in a food patch for one minute before moving to the next patch, any individual who moves earlier or later will not gain a fitness advantage through increased food intake. In an environment where food is patchily distributed, and individuals have a choice between food patches that differ in quality (e.g. patches may contain more or less food, or be closer or farther away), natural selection should favor individuals who adopt feeding strategies that maximize the net rate of food intake. According to optimal foraging theory, we would expect individuals to distribute themselves in relation to patch quality so that each individual has the same feeding rate. One possible distribution of individuals has been termed the "ideal free distribution".

The ideal free distribution would be expected under the following conditions:

(1) Patches differ in profitability (i.e. food intake rate).

(2) The profitability of a patch always decreases with increasing competition.

(3) Individuals are able to enter or leave a patch without interference from other individuals (i.e. there is no resource guarding).

(4) All individuals choose the most profitable patch available.

(5) All individuals in the population have identical expected intake rates within any given patch i.e. all individuals are competitively equal).

(6) All individuals react independently to food supply only (i.e. they do not use the actions of others to determine where to feed).

In this experiment, we will determine whether domestic chickens (gallus gallus domesticus), given a choice between two food patches of different profitability, distribute themselves in an ideal free manner. For many birds, the condition most likely *not* be true is #6, independent reactions. The benefits of flocking (e.g. survival or information transfer) may be much more important than independent feeding and may thus keep the birds from grouping in an ideal fashion with regard to "patch" quality.

We will use a video of 7 chickens moving between sides of a 10ft x 20ft enclosure consisting of different amounts of food based on each treatment.

The experiment consists of three experimental treatments:

Treatment 1 – Baseline Data on Distribution in the Absence of Food

To understand if chickens distribution is affected by food, we must first determine how they distribute themselves in their "environment" in the absence of food. Record the distribution of the chickens on each side every 20 sections. When you are finished recording these observations, calculate the "D-scores" for each observation. This metric is simply the absolute value of the difference in the number of chickens on each side of the field (i.e. |# on left - # on right|). For example, if there were 2 chickens on the left side and 5 on the right side the D-score for that observation is calculated as: |2-5| = |-3| = **3**. If the chickens are always clumped the average D-score from all observations will be near 7, if they are evenly distributed it will approach 1, the Z score could never be 0 since there are an odd number of chickens. How do the mean value of chickens in each side, and the mean D-values you obtained reflect on the distribution of your chickens? Do the chickens prefer one side of the field? Do they tend to stay together or are they spread out evenly?

Treatment 2 – Does the Addition of Food Cause a Change in Chicken Distribution?

Does the introduction of two spatially distinct feeding patches of equal quality cause the chickens to change their behavior from that in the absence of food? It is possible any prior clumping will break down as chickens begin to feed in an ideal fashion. It is also possible clumping will increase if chickens use each other for information. Treatment 2 begins by having equal amounts of food placed on each side of the field. As soon as the treatment changes (as seen on the whiteboard, treatment 2 starts at 5:01) begin recording the number of chickens in each half of the field every 20 sec for 5 minutes. Did you witness a change in chickens distribution? If there was a change, was that change consistent with the predictions of IFD theory?

Treatment 3 – Directly testing for the Ideal Free Distribution

Do the chickens respond to changes in patch quality in a manner consistent with the IFD? Now that we know background levels of chicken distribution, we can test whether chickens respond to changes in patch quality in a fashion consistent with IFD theory. In this treatment, one side of the field will begin with three times as much food as the other side. The ratio of food amount (profitabilities) gives us the expected ratio of chickens in each patch if they distribute themselves in an ideal free manner. In other words, if one side has at three times the amount of food as the other, it should attract three times as many chickens if they distribute themselves according to an ideal free distribution. Alternatively, the tendency to school may overcome any tendency to adjust numbers to food availability.

Five minutes were allowed to pass after the end of the second treatment, then food was added as described above. After 5 minutes of observation, the experimenter removed remaining food from both sides and added 3 times as much food to the right side (What is the purpose of this switch?) Look at your data for chickens distribution from each 5-minute set in Treatment 3. Are the results different from the last treatment? If so, did the chickens tend toward conforming to the ideal free distribution?