Bio 45 -- Guide to Reading Norris 1999
Oystercatcher Foraging Constraints

I. The functional response model (p. 1704)

You recognize E/T – that is what needs to be maximized – total energy for total time. Prey differ in profitability (E/h) and how often they are encountered (□). The model is more complicated because it takes into account things like:

How many cockles are handled but not eaten (waste handling) and the chance a given cockle can even be opened, and the chance it will take a particular prey once encountered (Q). If you take these things out of the model it becomes pretty straight forward (and remains that way when you put them back in).

E/T = Sum (for each prey type of its **E** times the encounter rate with it □) **divided by** 1 + sum (for each prey type its **h** times □)

Then they do a neat thing. These birds are probing in the mud for things they cant see. So, how do you calculate the chance they will hit cockles of different sizes. Each size cockle has different chance of being hit with a single probe. Bigger means more likely. They use some clever thinking and come up with an estimate. Now all they need to do is measure cockle density and distribution and they can predict encounter rate with each size.

They then go on to use the model to estimate how cockle size relates to the amount of parasites eaten. There they start talking about log-linear models and regressions. Don't worry about that they are just estimating the average amount of parasites found in cockles of different size classes (Fig. 1). All the statistics here is to assure hard core ecologists that the estimates they then use (Table 1) are reasonable.

The last paragraph of the Methods is back to the general approach. This is an important paragraph since it is the guide to the steps in their analysis that follow.

II. The statistics

There are a variety of statistics used in the Results section. Log-liear regression analysis is a kind of curve fitting statistic. The results are given as Chi-square values. The thing you need to look for is the "p" value. That is the significance value of the statistical test. By convention we use p = 0.05 as the boundary between significant (less that 0.05) and not (more than 0.05). What does it mean? Roughly speaking it means we accept a 5% chance that we will conclude something is significant when it actually isn't. Remember that this is all about estimates, statistics cannot really tell us if something is true or false. It only gives us a perspective, given a bunch of assumptions and standardized testing procedures of where we are, sort of.

Values of p less than 0.001 are generally though to be quite significant. Thus in the 1st paragraph of the results we can feel pretty confident about the increase of helminth intensity with cockle size (Fig. 1). However, comparing sites used and not used in January, we do not find a significant difference in the relationship ($p > 0.5$).

The only other statistics to be concerned with occur at the end of the Results section. Here they are comparing the predictions with the results in Fig. 3. The test simply asks if the "eaten" distribution (# of cockles vs. size class) differs from the "available" distribution (it does, $p < 0.001$) and if it also differs from the "energy maximizer distribution (it does, Jan. $p<0.05$ and Nov. $p<0.001$).

III. Table 1 – model parameters

The numbers here are calculated for the samples they took in the two months (see methods for how they got the samples. How does the fact that these oystercatchers are hammerers make the study possible. Would it be possible to do it if they were stabbers?

These parameters are then used to calculate the graphs in Fig. 2 and the "energy maximizer" expectation in Fig. 3.

IV. Figure 1 – risk of infection for different cockle sizes

These graphs simply show the results of taking cockle samples from two areas in each of two moths and counting parasites. The sizes are grouped in to categories (size classes). What do these graphs tell you about 1) seasonal changes in oystercatcher food and parasite levels and 2) about where they seem to feed compared with where they could feed? Note that the Y axis of the two graphs in Fig. 1 differ. It is always a good idea to check graph axes, you can be easily fooled by changes in scaling.

You should get in the habit of "reading what each graph says" in plain words. For example, one way to read the graphs is "There are more parasites in mussels of each size class in January than in November but the birds do not seem to feed in areas that are relatively low in parasites in January."

V. Figure 2 – what the model predicts

So, how would you describe or read the 4 graphs in Figure 2? I'll try one and you do the rest. Graph b (profitability) says that E/h increases with cockle size such that the most profitable cockles in both months are the biggest ones. All else being equal, the best size to eat is the biggest one. Remember that there are a series of other factors besides E and h that go into their model. That is why graph d has a different shape than graph b (they both are about profitability relative to size).

All else is clearly not equal. You should be able to read the other three graphs and explain why not. Watch out for graph "d", the X axis is different. What is the conclusion of the model expressed in Figure 2. Make sure you can explain how to get from graphs card and d to Figure 3. Why does the parasite avoidance strategy predict different sizes than the energy intake rate one

VI. Figure 3 – what the oystercatchers did

There are three categories in each of the two graphs. One is the null hypothesis, one the prediction of the "energy maximizer" model and the other is what the birds did. These are frequency distributions so we now have to describe the graphs by shifts of shape changes in the three distributions.

Again you can and should describe the graphs. Figure 3b shows me that the ones eaten distribution is shifted to the right relative to the null hypothesis. That tells me they are eating non-randomly and preferring bigger cockles in general. Yet, the eaten distribution is still to the right of the 22-29mm size class (the one predicted for energy maximization). Thus they are not taking the energetically "best" sizes. In all, they conform to the author's view that oystercatchers are trading off higher energy intake against relatively lower risk of parasites. How would you describe graph 3a?

VII. What remains to be done – what is the next study to do

The discussion is a critical part of the paper. Here Norris interprets his results for you. Do you agree with him? Are there places you feel the study is weak? If so, how could it be made stronger? Try to put yourself in Norris' shoes and think about what you might do next with oystercatcher foraging. Use you imagination. Look for better tests of his ideas. Look for novel experiments (e.g., "curing oystercathcers of helminth parasites) that you might do.

Think about what the parasites actually cost the oystercatcher. Do they take away energy and nothing else? Could an oystercatcher "beat" the parasites by just eating more? Also think about stabbers. How would the curves in Figure 2 change for them? Draw your expected curves and defend them to the class. Could you justify doing the study again with stabbers? How?