ANSWERS:
Study Questions: Construction and Interpretation of Experimental Results
Introductory Biology
Fall 2009

Let's consider Andersson's widow bird experiment again.

1. State the biological hypothesis and prediction that with his experiments? How many predictions of this hypothesis did he test? Explain your answer. (You should be able to answer these questions directly from class lecture)

- *Female widowbirds prefer males with longer tail feathers.*
- *Andersson tested* ***two predictions*** *from this hypothesis:*
    - *Lengthened tails (when compared with the population average) attracted greater numbers of females and*
    - *Shorter tails (compared to the population average) were less attractive (their possessors obtained fewer mates)*

2(a). State the null and alternative hypotheses for a comparison of one control (banded only) with the other (banded with tail cut and re-attached).

- H_0: *any differences in the mean (average) number of mates between these two groups are due to chance factors (e.g., improper randomization of males into groups, problems with counting mates in the field).*
- H_A: *differences in the mean number of mates between these two groups are in part due to the act of cutting and reattaching tail feathers to the sham controls; some of the difference is also due to chance factors.*

2(b). Suppose that an inferential test of your null hypothesis from question 2(a) finds $P = 0.62$ (this is a made up value – it is not from the original study). What will you do with respect to the null and alterative hypotheses? What does this suggest about your controls?

- *There is a 62% chance that the null hypothesis is true. Thus, we will accept* H_0 *and reject the alternative hypothesis.*
- *The meaning of this decision is that we have found no evidence that cutting and reattaching tail feathers (without changing the overall length) caused a difference in attractiveness of males to females (that we were able to detect in this experiment). Thus, both controls are useful for comparison with the groups whose tail*

feather length was changed – cutting the tail, by itself, did not change the attractiveness of males to females.

3(a). State the null and alternative hypotheses for the comparison of increased tail length with the sham control.

- *H_0: lengthening the tail of a male widowbird does not increase its attractiveness to females; any differences in the mean number of mates between sham and lengthened tail groups were due to chance and error factors.*
- *H_A: lengthening the tail of a male widowbird increases its attractiveness to females; differences in the average number of mates in the two groups are, at least in part, due to lengthening the tail feathers of the members of one group.*

3(b). Suppose that an inferential test of the null hypothesis you just stated for the comparison of lengthened tail and sham groups showed was that $P = 0.04$. (This is also a "made up" statistical result – it is not exactly what Andersson found.)

- What does this (P) mean with respect to the null and alternative hypotheses?

We would reject the H_0 since there is only a 4% chance that it is correct (and a 95% chance that H_A is correct).

- What does this mean with respect to the original hypothesis (question 1)?

We have not been able to falsify one prediction of the original hypothesis (Questions 1) that females prefer males with longer tail feathers. Thus, we tentatively accept the hypothesis and move on from there with either more tests of the same hypothesis or, for example, attempts to explain the reason for the preference.

- Have you proven, disproved (or neither) the original, main hypothesis of question 1? Explain!

We <u>have NOT been able to falsify it</u> and therefore have added support but not proof for the hypothesis. It is always possible (but not very likely in this case) that, in fact, tail lengthening had no effect whatsoever on attractiveness and chance factors explain the results (there was about a 4% chance in this case – and note that even the 4% is an estimate based on certain assumptions). We are never absolutely certain in science – we work on the best available evidence (sometimes stated as "the best available science") and are fully aware that chance factors could still result in mistakes and that future work might also result in a different view of the results we obtained.