Name _____

IB 146 – Behavioral Ecology 6 March 2002

FIRST MIDTERM EXAM
(6 pages, 100 points)

General instructions: Answer each question as directed. Please make answers clear and concise. Full sentences are not required, but make sure that your answers are complete enough to be understandable. Point values for questions are indicated.

In a study of mate choice in voles, the number of parasites present in 0.5 ml of blood was measured for 20 males. Urine samples were then collected from each male. Mate choice trials were run by placing urine samples from two different males at opposite ends of a rectangular arena and then introducing a female vole to the arena and recording the amount of time that she spent sniffing each urine sample. The data obtained revealed no relationship between the amount of time that females spent sniffing samples from males with different levels of parasitism. Based on these data, the investigators concluded that, in voles, parasites are not used by females to choose mates.

1. (10 pts) Having been trained to be skeptical in IB 146, you do not agree with the investigators' conclusion. Briefly outline an alternative explanation for these findings that does not negate the hypothesis that parasite load is an important aspect of female choice in this species.

A number of answers are possible (this is true for many questions). My line of thinking was that even though the number of parasites differs among males, we don't know that this affects the odor of urine. If it doesn't, then providing females with urine odors to sniff may not give them (the females) any useful cues about male immunocompetence that can be used in selecting a mate. In other words, the point of this question was to get students to realize that even though we have a relationship between male parasite load and female mate preferences, we haven't demonstrated that this preference is mediated by odor cues in urine. I made more of a point of this in lectures in 2002, but it's not very far off the topics we have covered this year during the lecture on immunocompetence.

2. (15 pts) As part of your critique of this study, you note that it uses a correlational approach to explore the relationship between parasite load and female mating preferences. Briefly outline an experimental approach to this question that could be used to address this question. Why is your experimental study a better test of the relationship between parasite load and female choice than the original study described above?

Again, multiple answers are possible. I was thinking of a series of experiments in which male parasite loads were artificially manipulated (either increased via injection with parasites or decreased via treatment with drugs) and females then given urine from and artificially manipulated and a control male. Again, I would look for consistent differences in female preferences for male urine. The reason that this is a better approach is that we are controlling the

condition (parasite load) of the males, rather than relying on natural variation among animals. If females are paying attention to male parasite loads, we would expect to see a particularly clear result in response to our manipulations since we are (presumably) altering only one, critical variable in this system.

3. (10 pts) In a study of crested auklets (shown below), a behavioral ecologist found positive correlations between the size of the crest on a male, the number of females mated with, and the number of chicks sired by a male. Based on these data, the researcher concluded that "the tuft of feathers on the male's head is an adaptation that evolved to attract females." Do you agree or disagree with this conclusion? Explain your answer.

I would disagree. Applying the strict definition of "adaptation," we can't draw this conclusion because we don't know anything about the evolutionary history of the trait. Did it arise as a signal of male quality, or did it arise for another reason and then assume it's current function?

Although I would not call the trait an adaptation, we CAN say that it is adaptive, since variation in the trait is clearly associated with differences in male reproductive success.

4. (10 pts) In the lecture on game theory, you learned that constructing a payoff matrix is the critical step in developing any game theory model. What is a payoff matrix? What important information does a payoff matrix provide that helps us to understand why individuals exhibit particular behavioral responses during social interactions with conspecifics?

We haven't discussed game theory at all this year, so don't worry if this doesn't look familiar.

For those of you with insatiable curiosity, the payoff matrix is a table listing the fitness consequences of interactions between each pair of behavioral alternatives. For example, in the classic hawk-dove game, males can respond in one of two ways when they meet – they can be aggressive and fight (hawk) or they can be submissive and retreat (dove). Pitting hawk against hawk yields an average fitness consequence to each male, as does pitting dove against dove and hawk against dove. These fitness values are determined through observations of interactions and their outcomes. It's important to know these values to be able to predict how an individual should react during a given interaction (the whole point of game theory models is predicting what animals should do). For example, when a dove meets a hawk, the dove is literally going to turn tail and run, which probably results in a fitness loss relative to the hawk. But, when two hawks meet, the feathers are likely to fly and both males (even the winnder) are likely to experience a fitness loss due to injury, etc. Unless we know how big each of those losses typically are, we can't predict whether males should always act like hawks (always fight) or whether, if they perceive that the other animal is a hawk, they should respond like a dove.

Hopefully that satisfies your curiosity – this WON'T be on the midterm this year.

5. (10 pts) As part of a study of mate choice in guppies, you are interested in documenting the number of female glide displays (indicative of sexual receptivity) that are elicited by males with different amounts of orange pigmentation. Assuming that this study takes place in the classic 3-compartment aquarium set up that we discussed in class, which technique for collecting

observational data is most appropriate for examining the relationship between male coloration and female display rate? Explain your answer.

I would say that focal animal sampling would be the best, with the female as the focal study animal. Focal animal sampling follows one individual and records their behavior – in this case, all occurrences of the glide display, which is the information that we are really interested in.

In contrast, scan sampling might miss many glide displays that didn't occur at the exact time that a scan was completed. In this particular case, all occurrence sampling wouldn't be wrong since only one animal – the female – will be giving glide displays, but it would still be better to focus specifically on the female test subject. If, instead, males also gave glide displays, all occurrence sampling would be confusing because the data would include information from three animals even though we are really only interested in the response of the female.

6. (15 pts) As a professor of behavioral ecology, you are approached by a student who is studying sexual selection in Harris sparrows. Specifically, this student hypothesizes that dark coloration on the head and chest is indicative of male quality, or "good genes." This student has successfully demonstrated that females prefer darker males, that darker males survive longer, and that darker males sire more offspring. Based on these data, the student would like to finish their thesis and publish their study. You respond by telling the student that they aren't done yet – the student needs to conduct one more study that examines the survival of chicks sired by dark versus light male sparrows. Why is this last study necessary to test the good genes hypothesis? If dark color in male Harris sparrows is an example of the good genes model of sexual selection, what should the relationship between male darkness and chick survival look like?

In truth, this student has already done more than many published studies of sexual selection. But, to be really complete, the study should look at the survival of young to the age of reproduction in order to determine how many of a male's offspring will actually contribute genes to future generations. In essence, this is a question about measures of fitness, something that we talked about in 144 last fall but didn't talk about as much in this class. Still, I'll bet that most of you can figure out why this last measure of reproductive success is important . . . .

If the dark color of males is a result of good genes sexual selection, than I would predict that chick survival should be positively correlated with male darkness, meaning that darker males have more surviving chicks. You could explain this in words or draw a simple graph to illustrate the expected relationship.

7. (10 pts) If the student finds that the relationship predicted above for male darkness and chick survival is correct, can this student definitively conclude that plumage coloration in male Harris sparrows is the result of a good genes model of sexual selection? Why or why not?

No. Evidence that darker males have more surviving chicks is not definitive evidence of a good genes model of sexual selection. There are a couple of ways to justify this response. One is that, as discussed in lab, the two basic models of sexual selection (Fisherian and good genes) are not mutually exclusive and thus evidence to support one does not preclude the other. A second way in which you could argue this is that even though all of the data for the sparrows are consistent

with a good genes model, we haven't really examined the genotypic aspect of the system. In practice, everyone relies on the type of data outlined above to infer good genes with no real evidence that male genotypes vary in a way that is relevant to female choice.

8. (10 pts) As you read the student's thesis more closely, you notice that the student measured male reproductive success by counting the number of chicks that survived to fledging (independence from parents). Was this the best measure of male fitness to use for this research problem? Why or why not? If you answer yes, briefly explain why this is the best measure. If you answer no, briefly indicate why this measure may be problematic.

Again, this is something that we dealt with more in 144 than in this course. I would argue that it would be more appropriate to measure (1) the number of offspring produced (at hatching) by each male and/or (2) the number of offspring that survive to reproduce. The first measure is better than the number of chicks that fledge because chick survival between hatching and fledging may be influenced by a large number of things other than the genotypic quality of the male. In other words, measuring rs at fledging may be confounded by other factors. Ideally, we would measure how many of a female's eggs are sired by a male but, in practice, we can only do that once chicks hatch. For the reasons outlined above, it would also be appropriate to measure how many of a male's chicks survive to reproduce. I would argue that you should definitely measure (1) and, if you can measure (2) but, for the purposes of this question, it would not be very useful to measure (2) without considering (1). Although male quality and offspring survival to reproduce should be related, again other factors may confound this relationship, particularly if you record these variables over just a single breeding season – for example, if it's a really good year, you may find no relationship between these variables, which would be misleading.

9. (10 pts) The use of molecular genetic techniques to accurately determine the parentage and reproductive success is often said to have revolutionized the study of animal mating systems. List two discoveries about animal mating systems that have resulted from our ability to obtain accurate data on parentage and reproductive success. Briefly explain each discovery and how it has affected our understanding of patterns of reproductive competition in animals.

We haven't talked about this yet – I may mention it in the last two lectures before the exam but I don't plan to spend a lot of time on this topic.

#1. Difference between social and genetic mating system. Now that we can determine parentage genetically, we are finding that behavioral (social) relationships among males and females don't always indicate who is actually producing offspring. This has had a huge impact on our understanding of animal mating systems, forcing us to distinguish between social and genetic mating systems.

#2. Post-copulatory intrasexual competition and intersexual mate choice. Now that we can look at parentage independently of behavior, we've discovered that females often mate with multiple males during a single round of sexual receptivity. This leads to sperm competition and cryptic female choice, two previously unknown or under appreciated aspects of reproduction that have implications for sexual selection. Now, instead of limiting analyses

of competition and choice to pre-mating behavior, we need to consider these post-mating aspects of sexual selection.

Other answers are possible. However, in a question like this, make sure that your two answers are really distinct. For example, it would be iffy to give answer #1 and then use #2 to talk about the discovery of EPC's. These are so closely related that it's arguable as to whether they represent two distinct discoveries that have resulted from the use of genetic data.