Animal Behavior - Second Midterm KEY - Fall 2010

These are examples of particularly well written answers to the exam, or combinations of them.

Section I.

A. Cratsley and Lewis (2003) investigated sexual selection and female choice in fireflies. Specifically, they looked at the value of male flashes as an honest signal females use in mate choice. Fig 2 relates spermataphore mass to flash duration. A spermataphore is a protein mass males provide the female as a “nuptual gift”. Although in many systems females choose males based on “good genes” or other indirect benefits, a spermataphore is a direct benefit to females, since it is the primary source of nutrients available to females during reproduction. Thus, there should be selective pressure on females to accurately assess which males can provide large spermataphores. Fig 3a demonstrates variation in female response to flash durations from an experimental manipulation of flash duration. Female response is positively correlated with flash duration. This supports the hypothesis that females choose males based on flash duration. If spermataphore size is related to flash duration and longer flash duration elicits stronger response from females, then it is likely females are using flash duration as one means by which to assess male quality in terms of direct benefits to the female. Zahavi would say that flash duration is a reliable signal of spermataphore size. Zahavi would also say that for any signal (such as flash duration) to be honest, it must be costly. Only costly signals provide reliable information. Thus, Zahavi would say that flash duration must be
costly. In this case, the energetic demands of producing the spermataphore is correlated with the energetic demands of producing the flash (it is also possible that flash duration increases predation risk). Thus the correlation between flash duration and spermataphore mass can’t be faked and is therefore an honest and reliable signal that can be used by females to assess potential mates.

**B.** It had previously been reported that the cultural transmission of taking the long route from founder guppies (who had been trained to avoid the shorter route) to naïve guppies was maladaptive, as this learning prevented the naïve guppies from obtaining food using the lowest amount of energy (Laland & Williams 1998). However, this study did not consider possible benefits of being part of a shoal. One such benefit might be protection from predation when moving in large groups. Bates and Chappell (2002) hypothesized that individual fish would choose the energetically favorable short path, while fish in a shoal would take the longer path when led by a founder, as the costs of predation are greater than the costs of swimming further. If cultural transmission were maladaptive, the researchers expected that individual guppies would continue to swim the energetically unfavorable route after being exposed to a founder. Figure 2 from Bates and Chappell (2002) showed the mean proportion of trials in which guppies chose the longer route to a food reward. When guppies were tested in shoals with a founder, the shoal almost always took the longer route. Without a founder, however, the shoals usually chose the shorter route. Similarly, when guppies were tested in isolation after being led by a founder, the frequency of taking the longer route was
very low. These results do not support the conclusion that cultural transmission was maladaptive, as guppies swimming alone chose the energetically favorable route despite exposure to a founder. Instead, it would seem that the protection offered by swimming in a shoal, exceeded the energetic costs of following a founder on a longer journey. Thus, swimming in a shoal appears adaptive for guppies, and cultural adaptation was not shown to be maladaptive.

Section II

C. Optimality is the body of theory at the heart of modern behavioral ecology. It assumes behavior is shaped by natural selection to maximize fitness. It explains behavior in terms of benefits and costs and the optimal behavior is that which provides the best benefit to cost ratio. Optimality models apply this approach to predict optimal behaviors under specific circumstances. These models specify variation in the behaviors under consideration, choose a measure of fitness, assess the costs and benefits of possible behaviors, and define the relationships between costs, benefits and the behaviors. Model predictions can then be scientifically tested.

D. Optimality weighs costs and benefits of a behavior and favors the behavior with the most benefits for the least cost. Therefore, the chickadees should choose the nuts that contain 15 cal/seed and require 1 minute to open over the 25cal/seed that require 2 minutes to open. This is because the first seed provides 15 calories per minute vs. 12.5 calories per minute. Thus, assuming that search time and travel time
are the same and that multiple seeds of each type are available, the optimal choice is the 15 calorie seeds.

E. Sexual selection is not different from natural selection. It is a subset, or special case, of natural selection. Natural selection requires variable, heritable fitness. While survival can increase fitness under some circumstances, fitness is what matters. Sexual selection deals with increasing reproductive success only, generally through mate acquisition and can act on either sex to exaggerate traits in order to increase reproductive success relative to others in the population, i.e., fitness.

F. Greater variance will exist in the male dominance system, because male-male competition will lead to a few males that mate with females, while many losers will have no chance to reproduce in that mating season. In contrast, a system in which males provide females with spermatophore will give opportunities for more males to mate. These males are defending a resource that is costly to produce. Thus males producing spermatophores are limited in the number of females with which they can mate, allowing more males an opportunity to mate with females needing nutrients.

G. While testosterone may reduce the average lifespan in male mammals, it also increases their reproductive success. Individuals with high testosterone are more aggressive, which is advantageous in some mating systems for defending females, resources, or fighting other males for the right to mate. Despite the fact that costs of
reproduction reduce male lifespan, aggressive individuals produce more viable offspring in the next generation than males with lower testosterone, and thus have greater fitness. The genes for high testosterone will then be propagated into the future without regard to individual longevity as long as testosterone increases relative reproductive success in males.

**H.** [NOTE: this question is essentially asking you to make predictions for the two hypotheses, not an explanation of why this happens – many answers are possible, here is one:] A. If flipping behavior is adaptive, then we might expect that males that are eaten during copulation produce more offspring than males that are not eaten. Likewise, if the size of the eaten male is positively correlated with the number of offspring produced, then flipping behavior B. If flipping behavior is maladaptive, then we would expect to see that some males are not eaten during copulation and that they are able to mate with other females and produce more offspring from those subsequent matings.

**I.** This is clearly a polygynous species, in which a few males mate with many females. The high variance (75% of the matings by 3 males, etc.) suggests extreme sexual selection in which there is no male contribution to reproduction other than sperm. This is probably a lekking species.
J. The polygyny threshold is the point at which the benefit of being the second female on a territory is greater than the benefit of being the first female on an inferior territory, resulting in some territories with 2 females per male.