Tuesday 1 February 2011, 11:30 – 12:50

- **This exam is composed of 12 questions worth a total of 50 marks**
- **The value of each question is indicated in square brackets**
- **Budget your time appropriately**

- **This exam should contain a total of 6 pages including this cover page**

- **No aids allowed**
- **Write only in the spaces provided**

1. Young white-crowned sparrows are remarkably good at remembering the sounds produced by adult white-crowned males singing around them. If the learning abilities of this bird evolved by Darwinian natural selection, which of the following conditions must have applied to the species in the past? For each of the statements below, indicate whether they are correct or incorrect. **[5]**

a) There must have been variation in the memory skills of individuals. ***Correct***

b) The sparrow species must have been threatened by extinction at some point. ***Incorrect***

c) Individuals that were better than average at remembering must have been able to pass on their abilities to their offspring. ***Correct***

d) Better than average song "rememberers" must have had more surviving offspring on average than the typical sparrow at that time. ***Correct***

e) Any changes that took place in the past must have promoted greater population stability in this bird. ***Incorrect***

2. We observe a frog that carries its babies on its back away from where the eggs hatched. Below are two questions about this observation.
(X) I wonder if the frog does this to move the babies to place where they will be safer.
(Y) Why does the frog expend time and energy moving its offspring from the place where they were "born"?
Which of the two is a true causal question? **[1]**

a. X, because this is the more specific of the two questions.
b. X, because we can test this idea but not the idea presented in Y.
c. Y, because this statement tells what we should expect to find in nature.
d. Y, because it is not a hypothesis itself but could be answered by a hypothesis.

3. When a tropical moth of the genus *Automeris* is touched on the thorax it lifts its forewings up abruptly, exposing its brightly colored hindwings. What causes the moth to behave this way? For each explanation, first identify whether it focuses on a proximate or ultimate cause. Then label each explanation as G (genetic-developmental), P (physiological-psychological), EH (evolutionary history) or EF (evolved function). **[5]**

a. The behavior is instinctive. ***Proximate G or P***

b. Wing flipping scares some predators away. ***Ultimate EF***

c. The behavior is the product of a special set of muscle contractions. ***Proximate P***

d. The behavior is a modified version of wing movements that many moths use to raise their body temperature in order to begin flying. ***Ultimate EH***

e. *Automeris* moth genes influence the way the adult animal's nervous system forms connections between its muscles and its wings. ***Proximate G and P***

4. For of the following statements indicate if they are or are not based on group selection theory. **[5]**

Male white-throated sparrows sing in the springtime because

a. this is the best way to keep the species' population from getting too large. ***GS***

b. singing males attract mates in the spring. ***Not GS***

c. this enables females to pick the best males, thereby improving the genetic quality of white-throated sparrows. ***GS***

d. this enables a females to pick the best males, thereby improving their chances of having viable offspring. ***Not GS***

e. females prefer males whose songs indicate that they belong to the right species to mate with. ***Not GS***

5. Garter snakes only recently invaded California and have evolved the ability to eat slugs since that recent invasion. This tell us that **[1]**

a. evolution acts to expand the diets of animals to buffer the species against changes in food supply that might lead to extinction.
b. the early slug-accepting garter snakes must have survived better on average than those that lacked this ability in the early populations in California.
c. every slug-accepting garter snake had higher reproductive success than all the slug-rejecting snakes generation after generation, until there were no more slug-rejecters in California.
d. None of the above

6. Match each of the phenomena with one of the following three terms: releaser, innate releasing mechanism, fixed action pattern. **[3]**

a. Male wasp pounces on orchid flower petal ***FAP***

b. Odors coming from orchid flower petal ***R***

c. Hypothetical element of the wasp's nervous system ***IRM***

7. Based on her observations of free-living Hanuman langurs, Sarah Hrdy concluded that male langurs commit infanticide in order to enhance their own reproductive success. She went further and predicted that she should see the males in certain other species using infanticide in a similar way as a response to similar selection pressure. Using the same logic would you ever expect to see females using infanticide as a means to enhancing their reproductive success? Explain your reasoning. **[5]**

Yes. If females also commit infanticide to enhance their own reproductive success, then we expect to see it occurring in situations where the presence of one female's offspring inhibits or prevents another female from being able to produce her own. This situation might arise, for example, where males provide parental care and their ability to care for offspring is limited. An example is the giant water bugs mentioned in chapter 1 in Alcock. Males care for clutches of eggs by gluing them to their backs. Each male is limited in the number of eggs he can carry by the available space on his back. Females will kill the eggs of other females to make room for their own eggs.

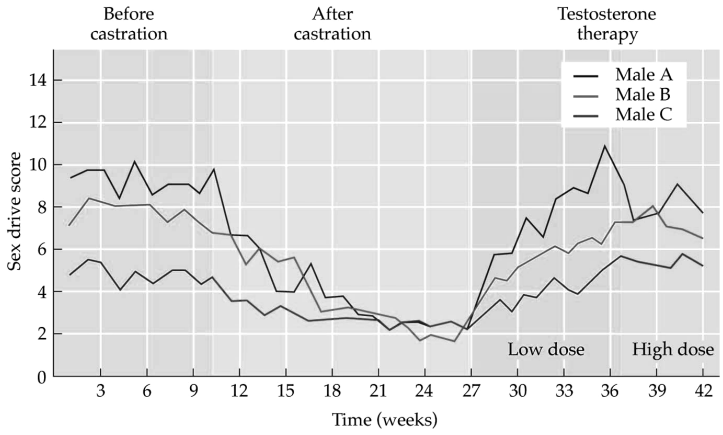
8. When a female baboon copulates, she vocalizes loudly, but her cries are longer and louder if her partner happens to be a high-ranking "alpha" male. A primate researcher has suggested that females cry out more vigorously when copulating with top males because this warns low-ranking baboons to stay clear. (Subordinate males sometimes harass mating pairs to such an extent that the copulation ends prematurely, but if that happens, they may be attacked by the dominant male whose mating has been so rudely interrupted.) The same researcher also says, however, that the more vigorous cries may simply reflect the fact that females are more strongly stimulated by the larger, more energetic, alpha males. Are the two explanations really in competition with each other? Explain why they could both be right and how they could be shown to be complementary. **[5]**

What we have here is a dispute based on thinking that proximate and ultimate explanations are competitors when in fact they are complementary. The proximate cause of the female's loud calls could be related to the nature of stimulation provided by a dominant male; the adaptive consequence of giving those calls in response to that stimulation could be a reduction in interference from subordinate harassers.

9. Explain what is meant by *instantaneous*, *one-zero* and *continuous* sampling of behaviour highlighting the differences among the three methods. **[5]**

Instantaneous sampling involves recording the behaviour that occurs at the start of set time intervals. One-zero sampling involves recording the presence of behaviours within an interval; once a particular behaviour has been noted, no further instances are recorded until the next interval. Continuous sampling involves recording all instances of each behaviour in the order they occur. Instantaneous and continuous sampling are better methods for determining the frequency of occurrence of different behaviours. Continuous sampling gives a more complete picture than the other two methods. Instantaneous sampling may improve efficiency by reducing the amount of time spent observing. One-zero sampling may improve efficiency by removing the onus to maintain a count of the occurrence of each behaviour within an interval, but it becomes less accurate as time intervals are lengthened.

10. In the guinea pig, individual males vary in their sex drive, as measured (for example) by the number of times a male ejaculates when given access to receptive females for a standard period of time. One hypothesis for this variation is that male sex drive correlates with circulating testosterone concentrations. What prediction follows from this hypothesis? The accompanying figure presents data from an experiment with three guinea pigs in which male sex drive was measured. All three males were castrated, after which their sex drive continued to be monitored, until finally, after some weeks, the three males were all given the same amount of supplemental testosterone, and their sex drive measured again at intervals. What is the relevance of these data for the hypothesis in question? What scientific conclusion can you reach based on these results? **[6]**



The hypothesis that male sex drive is a function of circulating testosterone concentrations generates the prediction that castrated males given the same amount of replacement testosterone will exhibit the same amount of sexual activity. The actual results do not match the expected ones, leading to the conclusion that the testosterone control hypothesis is wrong.

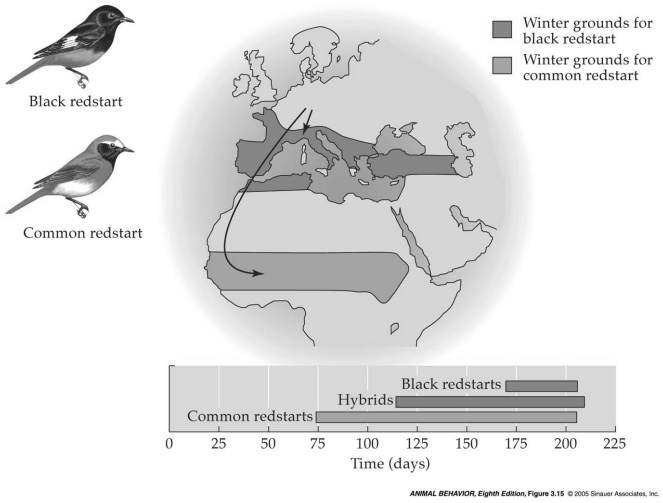
11. An American cockroach can begin to turn away from approaching danger, such as a hungry toad lunging toward it or a flyswatter wielded by a cockroach-loathing human, in as little as a hundredth of a second after the air pushed in front of the toad's head or the descending flyswatter reaches the roach's body. A cockroach has wind sensors that react to even slight air movements; these sensors are concentrated on its cerci, two thin projecting appendages at the end of its abdomen. One cercus points slightly to the right, the other to the left. Use what you know about moth orientation to bat cries to suggest how this simple system might provide the information the roach needs to turns away from the toad, rather than toward it. How might you test your hypothesis experimentally? **[6]**

Hypothesis: The right cercus and left cercus monitor the right rear and the left rear tactile environments for the insect, providing information about the location of potential danger.

Prediction: If the right cercus is more strongly stimulated tactilely than the left, this would activate systems that would cause the roach to turn to the left, and vice versa.

Test: If one were to surgically remove or otherwise inactivate the right cercus, then a puff of air directed at the right side of the roach would cause the insect to turn to the right rather than toward the left as would be predicted for animals with intact cerci.

12. The black redstart is a bird species that migrates a relatively short distance from Germany to the Mediterranean region of Europe, whereas the common redstart travels as much as 5000 kilometres from Germany to central Africa. The scale in the accompanying figure shows the duration of migratory restlessness in three groups of captive birds all hand-raised under identical conditions: black redstarts, hybrids created by crossing black and common redstarts, and common redstarts. Why do black redstarts exhibit migratory restlessness at night for fewer days than common redstarts? What does the behaviour of the hybrids tell us about the genetic differences hypothesis for the difference in the duration of migratory restlessness in the two parental species? **[3]**



Given that environmental differences have been ruled out as a factor contributing to developmental differences between these birds, we can only conclude that a genetic difference is responsible for the differences in their migratory restlessness. If this conclusion is correct, then hybrids, which will have a mix of the relevant genes, should exhibit an intermediate level of restlessness than either parental species (assuming that the relevant alleles contributed by one species are not uniformly dominant to those contributed by the other species). The actual data shown in the figure match the expected results, confirming the genetic differences hypothesis.