Biology 321

Midterm Test 2

November 8, 2011

This test is out of 29 marks, and is worth 15% of your final grade.

Use full sentences for short answer questions, not point form.
Write legibly in the space provided.
Use pen, otherwise there will be no opportunity for remarking later.

Total

Name: _____

Student #: _____

Part 1: Multiple choice

Choose one option that is the best fit for each question. Write the letter corresponding to your answer in the box to the left. **[*1 mark each*]**

C 1. In the study by Marzluff et al. (2010) of scolding in American crows, what made a mask "dangerous"?

a) The person wearing the mask also wore a red cloth armband.
b) The person wearing the mask was someone that crows had scolded in the past.
c) The mask had been previously worn by a researcher while trapping and capturing crows.
d) The mask was an exaggerated "caveman" face.

A 2. Young et al. (2008) showed that surprisingly, 31% of the breeding pairs of Laysan albatrosses on the island Oahu are female-female pairs. Why was genetic analysis necessary to demonstrate this?

a) Because Laysan albatrosses are sexually monomorphic.
b) Because Laysan albatrosses pair for life.
c) Because Laysan albatrosses are not perfectly monogamous (i.e., there is some extra-pair mating).
d) None of the above.

A 3. In a species with alternative reproductive strategies, if different male morphs have a heritable, genetic basis:

a) The mean fitness of each male morph type must be equal at evolutionary equilibrium.
b) Males can switch between different strategies within a single bout of breeding.
c) Individual males are potentially capable of developing into either morph type, depending on the environmental conditions.
d) All of the above.

D 4. Vampire bats often regurgitate part of their blood meals for unrelated neighbours in the colony who failed to find food. If this is an example of reciprocity, which of the following is likely to be true?

a) Vampire bats can recognize other individuals.
b) Vampire bats interact repeatedly with the same individuals.
c) Vampire bats should not give blood to those that refused to share with them in the past.
d) All of the above.

C

5. In the polygyny threshhold model:

a) Females should always choose to mate with a monogamous male, if there is one available.
b) Females should always choose to mate with the male with the best territory.
c) Mating with a polygynous male can be a "best of a bad job" option for females.
d) None of the above.

D

6. In a study of bicolor damselfish, Roland Knapp and John Kovach observed the display rate of damselfish males at their nests prior to spawning. Then, after spawning occurred, they removed the fertilized eggs and replaced them with experimental clutches. They found that males with the highest display rate also had the highest percentage of eggs surviving at the end of the breeding cycle. Knapp and Kovach argue that males with high display rates probably have greater energy reserves, and can therefore devote more energy to nest defense – which would lead to increased offspring survival. In order to establish that this is a direct benefit of female preference for displaying males, why was it necessary to remove the fertilized eggs and replace them with experimental clutches?

a) To control for differences in clutch size.
b) To control for potential effects of male genetic quality on egg survival.
c) To control for the fact that females might invest differently in eggs laid in high-displaying males' nests.
d) All of the above.

B

7. In runaway sexual selection:

a) The benefit of mate choice for females is that their offspring gain genes for increased viability.
b) The benefit of mate choice for females is that their male offspring gain genes for increased attractiveness.
c) Females desert males that fail to provide them with sufficient resources.
d) Females choose males that are less likely to desert them without caring for their offspring.

A

8. What is the main difference between kin selection and reciprocity as explanations for the evolution of cooperation?

a) In kin selection, individuals do not need to receive a direct benefit as a result of cooperation.
b) In reciprocity, individuals pay an immediate cost if they do not cooperate.
c) In reciprocity, individuals do not need to be able to recognize each other.
d) All of the above.

D

9. Naked mole rats are:

a) Diploid eusocial organisms.
b) Highly inbred.
c) Highly specialized to eat food that grows underground.
d) All of the above.

D

10. Marion Petrie bred peafowl in captivity, hatched the eggs in incubators and raised young males on their own (apart from their parents and siblings). When they had reached adulthood, Petrie released these males into a free-range population just prior to the start of the breeding season. She found that they tended to set up their lek territories next to their brothers more often than one would expect by chance. What does this suggest about peafowl?

a) That they recognize kin by a rule-of-thumb mechanism.
b) That we can reject the hotspot hypothesis for the evolution of lekking in this species.
c) That we can reject the hotshot hypothesis for the evolution of lekking in this species.
d) That kin selection might contribute to the evolution of lekking in this species.

B

11. Triver's model of parent-offspring conflict assumes that any future offspring are full siblings of the current offspring (i.e., the parents are a permanent monogamous pair). In a species where parents typically mate with a different partner each year, how would the model change?

a) There would be no parent-offspring conflict, because the future offspring of each parent will not be related to each other.
b) The period of parent-offspring conflict would be extended, because current offspring would be less closely related to future offspring.
c) The period of parent-offspring conflict would be shortened, because current offspring would be more closely related to each other than to future offspring.
d) None of the above.

B

12. Suppose you discover a new species of *Formica* wood ant where the queen always mates with exactly 2 different males before founding a colony. This means that female worker ants will be related to one another with a coefficient of $r = 0.50$ on average. Based on Hamilton's rule, what would you predict about how workers would provision the other offspring of the queen in this new species?

a) They will invest in females over males at an approximate 3:1 ratio.
b) They will invest in females over males at an approximate 2:1 ratio.
c) They will invest in males and females equally.
d) They will invest in males over females.

Part 2: Short answer

13. In his nest transplant experiment, Vanya Rohwer removed nests built by yellow warbler females in Southern Ontario and replaced them with much thicker nests built by females in Churchill, Manitoba. He found no change in nestling survival for the offspring of the Southern Ontario females that were given thicker nests in this experiment. Explain why this does not necessarily mean that there is no benefit to having a thin nest in Southern Ontario. **[*2 marks*]**

The costs of of a thick nest is most likely incurred during the nest-building phase, since Rohwer's results show that thicker nests take more time and effort for females to build. In the experiment, females were given nests that were already built, so they would not experience these costs.
Another possibility is that the costs of a thick nest might be incurred later, after the nestlings fledge (e.g. if offspring have increased mortality as adults). A clear and plausible hypothesis for how this could potentially occur is needed for full marks.

14. Arctic skuas (a close relative of gulls) are ground-nesting birds that are facultatively colonial: in some areas they breed as lone pairs, whereas in other places they breed in dense colonies. Arctic skuas in colonies will cooperate with neighbouring pairs to mob nest predators. On the Shetland Islands, there are a number of colonies of different sizes. Researchers have found that in large colonies, nestling growth rates are lower, but fledgling survival is actually higher in large colonies.

a) How could you explain this in terms of the costs and benefits of social living? Give a brief hypothesis to explain each of the two results described above. **[*2 marks*]**

A number of answers are possible for both the lower growth rates and the higher survival.
Lower growth rates: skuas may have to compete with other colony members for limited food resources, or there may be higher rates of parasite infection and/or transmission among offspring in dense colonies...
Higher survival: mobbing defences may be more effective in large groups where there are more birds available to join a mob, colony neighbours may occasionally adopt starving nestlings (and there are more neighbours available in a larger colony)...

b) Assuming your hypotheses in (a) are correct, what would you predict about the environment in places where skuas breed as lone pairs? **[*1 mark*]**

Again, several answers are possible, but it must be consistent with the response above.
e.g. Food is very sparsely distributed, presence of a more dangerous parasite, fewer predators (so mobbing not needed).

15. Noctuid moths have very simple tympanic ears that can detect ultrasound, allowing them to avoid bat predators. In the noctuid moth species *Spodoptura litura*, males have evolved specialized air-filled organs called tymbals that allow them to produce their own ultrasound clicks that are very similar to the clicks produced by bats. In *S. litura*, the clicks that males make with their tymbals cause females to freeze up (i.e., stop moving), and accept the clicking male as a mate.

a) Which theoretical model for the evolution of mate choice does this scenario most likely represent? Explain what the hypothetical benefit to females would be. **[*2 marks*]**

This is most likely the result of sensory exploitation. Moths have a "freeze" response to ultrasonic clicks as a result of natural selection. The benefit to females is that this response helps them avoid getting eaten by bats.
Other answers are possible (but less likely).

b) Suppose you want to investigate whether your answer in (a) is correct. Give one prediction for this hypothesis and describe how you could potentially test it. **[*2 marks*]**

Answer must be consistent with response above.
For sensory exploitation: You could record the ultrasonic clicks of *S. litura* males, and then test whether females from closely-related species where the males **do not have tymbals** also respond by freezing up. If a male of her species is present, and *S. litura* clicks are played, does it make the female more likely to mate with that male (vs. when no clicks are played)? If so, it would indicate that the evolution of the freeze response pre-dates the evolution of the male ability to produce clicks, which would be consistent with a sensory exploitation model.
Another possibility would be to test whether females of *S. litura* show the same response to playback of bat clicks as they do to male clicks. If so, it would support the idea that the benefit to females of this response is avoidance of predation.

16. Monogamy is rare, but it does occur in certain species like the Australian shingleback lizard. Give 2 factors that promote the evolution of monogamy, and explain how each might do so. **[*4 marks*]**

A number of answers are possible.
–One factor promoting monogamy is the degree of parental care required. If offspring require extensive care that the female alone cannot provide, a male might gain more fitness by helping his current partner care for their offspring rather than seeking out additional partners (e.g. emperor penguins).
–Another factor is female dispersal. If females are widely dispersed, and difficult to find, a male might gain more fitness by staying with the first female he locates, rather than abandoning her (and risking loss of paternity) when the probability that he will find another receptive female is low (e.g. clown shrimp).
–Other possibilities: breeding is highly synchronous (i.e. all females are receptive at same time), males are capable of contributing to parental care, females are capable of physically preventing males from mating with additional partners, there is a high risk of offspring loss as a result of infanticide by other males...

17. In a comparative study of 11 different bird species, Jim Briskie found a positive correlation between the rate of extra-pair paternity and the loudness of nestling begging calls (see Figure 1). In other words, young birds in species with high levels of extra-pair paternity begged louder than offspring in genetically monogamous species.

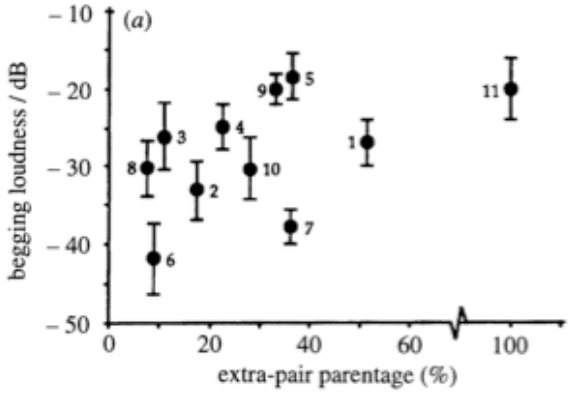

Figure 1. Relationship between average percentage of extra-pair young and loudness of chick begging calls across 11 species of passerine birds.

How would you interpret this result under kinship and inclusive fitness theory? Identify 2 potentially relevant conflicts, and for each conflict explain how genetic promiscuity would affect it, leading to the evolution of loud begging in more genetically promiscuous species. **[*4 marks*]**

The conflict of interest between nest-mates (current siblings) is relevant here. In a genetically promiscuous species, the offspring in a given nest will not be all full siblings of each other - some will be half-siblings. Thus, as the rate of extra-pair paternity increases, the average relatedness of nest-mates will decrease. As a result, the indirect fitness benefits that a bird will gain through its nest-mates will also decrease. Thus, there should be stronger selection on birds to compete with nest-mates for food via loud begging calls in more genetically promiscuous species.

Another relevant conflict is between offspring and the males tending the nest. Extra-pair offspring are not related to their mother's social partner at all (since their father is a different male). Thus, extra-pair offspring will not gain any indirect fitness benefits through the future reproduction of the male who provides parental care for them. Extra-pair offspring will therefore benefit by getting as much parental investment as possible out of that male, even at a cost to his future fitness. As a result, in species with more extra-pair paternity, there will be stronger selection for loud begging to elicit care from the male attending their nest.