Study questions: Part 2 (Phenotypic models). First Exam. Evolution (L567) 2015

Give a formal definition of an ESS. Contrast an evolutionarily stable strategy with an evolutionarily stable state. What is a mixed ESS? What is a pure strategy? What is a conditional strategy? Give examples.

In the hawk-dove game, when would hawk be an ESS (in general)? When would dove be an ESS (in general)?

Is it possible that, in a two-strategy game, both strategies would be evolutionarily stable? If so, explain how. Is it possible that neither strategy is an ESS? If so, what would you predict about the population?

What is meant by “frequency-dependent selection”? Give an example.

What did the study by Nick Davies show regarding the defense of sunspots by butterflies?

What is the difference between dynamic equilibria (limit cycles) and stable equilibria? Give examples.

What is the difference between discrete strategies and continuous strategies? How does the difference affect the modeling approach?

In the Hawk-Dove-Bourgeois game, why is the payoff for B vs. B equal to V/2? And why is this an ESS? It is the same payoff as for Dove vs. Dove, but Dove is not an ESS. How is that possible?

What was Fisher's argument for the evolution of investment in the sexes? What were the assumptions, and how were these assumptions later relaxed by Hamilton?

How could restricted access to mates (Local Mate Competition) affect the evolution of gender allocation (male vs. female function) in hermaphrodites? Give an intuitive explanation.

How could restricted access to mates (LMC) affect sex ratio evolution in species with separate sexes (females and males)? How could you find the optimum investment in sons? How could you tell if the candidate ESS was actually stable to invasion (i.e., at a local maximum)?

What is the difference between an ESS and a CSS? Why is Fisher's sex ratio problem a CSS and not an ESS?

How will natural selection operate on offspring size? What is a size-number compromise? How can a size-number compromise lead to parent-offspring conflict? Give a graphical model for the evolution of optimal allocation to each offspring. Is the size-number compromise an example of frequency-dependent selection? (Why or why not?)
What was the main result of the Salmon study (by Einum & Fleming) with respect to life-history evolution?

When might selection operate to reduce the variance in offspring survival over time? How would such a reduction in variance affect the geometric mean? How might it affect the amount of resources allocated to individual offspring? What, if anything, would the solution have to do with Bet Hedging?

Write your own question, and briefly answer it (5 points for the brilliance of the question and 5 points for the answer; total score is the product of the two).

Write your own question, and briefly answer it (13 points for the brilliance of the question and 12 points for the answer; total score is the sum of the two).

Which of the above two questions is more scary? Why?

What three concepts would you insist on including in an undergraduate course in evolution?

What is meant by diminishing returns? Give an example. Exactly how do diminishing returns figure into Local Mate Competition? How do they figure into the size-number compromise?

What is Bateman's principle? Can you think of ways in Bateman's principle it can be violated?

How would you determine “candidates” for a local maximum for fitness? How would you determine whether a “candidate” is an ESS? Advanced: how would you determine whether the “candidate” is convergence stable (a CSS)?

In our model of local mate competition: Why did mean fitness decline as the population evolved to increase male allocation (starting in a population where the resident's allocation was 0.25)? Why was the plot of fitness against an individual’s allocation to male function almost linear for large mating populations (e.g. K=100)? And why did it have a non-linear shape in small mating populations (e.g., K=4)? In other words, how are diminishing returns on male allocation manifested?

Assuming infinite, randomly mating populations, how could the investment in sons and daughters be equal, but the sex ratio be female biased? In Fisher’s result, what is being equalized: the sex ratio or the allocation of resources to sons and daughters?

What is $R_0$? How is our model on the evolution of virulence similar to our model for the size-number compromise? How would you test the idea that virulence evolves such that parasite fitness is maximized?
Across modeling strategies.

In your opinion, what are the strengths and weaknesses of using the following kinds of models to study evolution by natural selection: population genetic models (1-locus, 2 allele); quantitative genetic models; discrete games models (e.g. the Hawk-Dove game), and continuous strategy models (e.g. sex ratio models). Which one would you use to study the evolution of anisogamy (unequal sized gametes) from isogamy (equal sized gametes)?