16. (16 points) On the surface, some behaviors that we observe in nature, like altruism or homosexuality, seem to exist in defiance of our understanding of Natural Selection. Or do they? If these behaviors usually prevent animals from producing their own offspring and result in zero fitness (in the ultimate sense), shouldn't they be quickly eliminated from a population once they arise? How, then, can we account for the consistent and extensively documented homosexual behaviors found in many different animal taxa?

a. Explain why individuals who exhibit homosexual behaviors and never reproduce themselves can still have positive fitness (4 points).

b. Describe TWO examples of how it is possible for one individual to display homosexual behaviors, but their siblings do not (8 points).

c. What does could this suggest about the proximate mechanisms (e.g. genes, hormones) that underlie these behaviors? (4 points)

17. (6 points) Scrub Jays are notorious cuckolders, meaning the females often mate with multiple males and lay a nest in which the eggs are the product of multiple fathers. Despite this common practice, males who believe they have sired the majority of the eggs will stay at the nest and help guard the eggs. If a focal nest has 9 eggs, and the smell of this nest is picked up by a local scavenger, predator, should the male risk his life to defend the nest? Support you answer with calculations and/or a clear diagram that include paternal uncertainty and Hamilton's rule. (6 points)

18. (10 points) Even though they feed alone, Surfperch tend to nest and associate in familial groups, in which they protect the fry (juveniles) from predation and strong wave action. A young Surfperch is watching its own young (6 offspring) and the young of its parents (4 additional offspring --full siblings--, not including the focal perch), and the young of two of its siblings (10 offspring –total-- from two siblings).

a. Which group would he most likely choose to abandon if it needed to in order to protect the other two groups? Support you answer with clear accounting based on Hamilton's rule. (6 points)

b. What is this focal perch's inclusive fitness if all relevant family members have been described above? Calculate your values both in individuals and genetic equivalencies (how many replicates of the focal perch's genome are represented). (4 points)

19. (10 points) Albatross can fly for miles during foraging. If an albatross leaves from nesting site A (10 miles from the feeding grounds) and another albatross leaves from nesting site B (33 miles from the feeding grounds), what is the difference in their optimal load sizes if the curve of diminishing returns diminishes to "no change in load size relative to search time" at 60 minutes and 15 "fish units". Complete the following graph, and report, based on your graph the information above, the following concepts:

a. The labeled axes (3) for load, distance, and search time including units. (3 points)

b. A clear sketch of the three lines associated with this graph with lines labeled. (3 points)

c. The optimal loads of albatross A and B based on your graph and how you sketched the curve. (3 points)

d. The difference in optimal loads between the two albatrosses. (1 point)

20. (4 points) How do habitats change
(a) the fitness of the individuals competing for them and (b) whether or not the offspring of those competitors have the same level of competitive ability?

21. (10 points) Proximate mechanisms of migration

a. Describe (don't just list) four mechanisms that migratory birds use to navigate (6 points)

b. Explain why birds might have evolved to use multiple modalities for migration rather than just one. Note I'm asking you to speculate why based on other lectures from this course. (4 points)

22. (10 points) Wolves and other wild dogs are well-known for their adaptability in food resources. Canine biologists observed that during the late winter months, wolves in a local state park shift their food choice from rabbits to rats even though the abundance of the two groups is approximately the same at the end of the fall season. Using the concepts and variables from the optimal foraging theory equation, please provide three potential hypotheses about why these wolves might have changed their food preferences and explain why each hypothesis might be true based on information from the course materials.

a. Hypothesis 1:
b. Explanation:

b. Hypothesis 2:
Explanation:

c. Hypothesis 3:
Explanation: