Bio 352 Quantitative Questions

1) Scavenging female crabs may encounter one another at a fish carcass. In the ensuing contest for this potentially rich food resource, a crab may either immediately attack its opponent by lunging with its claws or, alternatively, it may display threateningly at the other crab, but not attack. When both crabs display at each other, half the time they end up sharing the carcass equally, while the other half of the time, one simply leaves and the other gets the entire carcass to itself. A displaying crab always gives way to an attacking crab before a fight begins; however, if both crabs attack, there is a 75 % chance that a crab will lose a claw in the ensuing struggle, irrespective of who eventually wins. The winning crab gains exclusive access to the carcass while the loser gets nothing. Going into such a contest, crabs have an equal probability of winning.

Based on these probabilities and presuming that access to the entire fish carcass provides a crab with, on average, enough energy to produce 800 eggs, while the energy needed to regenerate a new claw will reduce egg production by 600 eggs, describe what behavioral strategies are expected to evolve in terms of displaying and attacking. If a polymorphic strategy is predicted, calculate the expected frequency of attacking. Show all your work.

How would your answer change if the risk of losing a claw during a fight drops to 20%?

Bio 352 practice questions

2) Gulls feeding on fish in the waters surrounding their nesting colonies perform one of two types of foraging strategies. Some gulls ("foragers") catch their own fish, while others ("chasers") give up some of their own foraging to chase after other gulls. Chasers harass other birds until they drop their catch, which is then eaten by the chaser.

Suppose "foragers" can, on average, catch 400 fish per day if they are not chased. Chasers that find "foragers" will steal 75% of this catch, however, "chasers" will also lose 120 fish per day because of the reduced time they spend foraging for their own fish. If a "chaser" tries to chase another "chaser", a protracted chase ensues, since neither bird has a fish to lose. When this happens, chasers can expect to lose an ***additional*** 200 fish per day. If gulls are otherwise equal to one another and cannot tell whether another gull is a "forager" or a "chaser", predict how many gulls you would expect to see employing a chasing strategy in a colony of 1000 birds. Would your answer change if fish densities increased and the daily catch grew to 4000 fish but otherwise, expected losses did not change? Show all your work.

Bio 352 practice questions

3) A female songbird that lays a single clutch of 4 eggs each breeding season can establish her nest in one of two habitat types. In the first habitat, the insects she will use to feed her offspring are larger and more abundant, such that there is a higher probability of successfully feeding more chicks (see table). There is also, however, a higher risk of nest predation, with a 40% chance that the entire clutch will be wiped out. In the other habitat, insect density is lower, with a lower expected probability of successfully feeding the chicks (see table), but the likelihood of the clutch being eaten by a predator drops to 5%. Based on this information, in which habitat should the female establish her nest if she is attempting to maximize chick survivorship each breeding season? Show all your work

	Probability of occurrence	
# of chicks successfully fed	**Habitat I**	**Habitat II**
4	0.6	0.1
3	0.3	0.3
2	0.1	0.5
1	0.0	0.1
0	0.0	0.0

Bio 352 practice questions
Part 3 (continued)

4) During the fall, field mice gather seeds and store them in various spots within their home range. They exploit these caches during the winter. Because seed caches vary in quality, mice receive different rates of food intake as a function of time within a given cache. Behavioral ecologists have identified three types of seed cache that generate three different *cumulative* rates of energetic return (in Kilojoules, see table). Assuming that: 1) seed caches are randomly distributed within the homerange, with travel time between caches averaging 4 minutes; and 2) that average rate of food intake, including travel time, is 1 Kj/min; estimate the optimal time a mouse should spend in a each type of cache using the available data and the axes below. Show all your work and provide a complete explanation of any graphical approaches you might use.

Time (min)	Cache 1	Cache 2	Cache 3
2	3.00	4.00	1.75
4	5.50	7.50	3.50
6	7.50	10.50	5.25
8	9.00	13.00	6.50
10	10.00	15.00	7.50
12	10.50	16.50	8.25
14	10.75	17.50	8.75
16	11.00	18.00	9.00