Ecology Practice Exam Questions: Ecology & Evolution – Answer Key

1. In a given population, some barnacles have thick "shells" and some have thin "shells". Suppose that shell thickness is determined by the alleles of a gene, *T*. Barnacles with the *T1*/*T1* and *T1*/*T2* genotype have thick shells, while those with *T2*/*T2* genotype have thin shell.

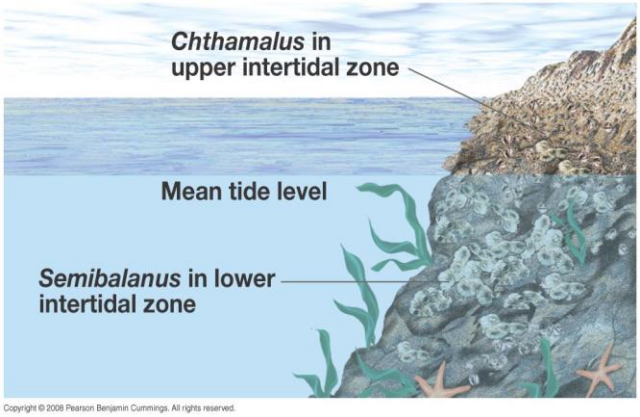
a. In a population of barnacles at Towers Beach you find 82 individuals with a thin shell and 18 with a thick shell. If this population is in equilibrium, what proportion of the barnacles are expected to be heterozygous?

82/100 are *T2*/*T2*, so if in HWE then √(82/100) would give us the frequency of *T2* = ~0.905
1 – 0.905 = 0.095 = frequency of *T1*
If HWE, freq of heterozygotes = 2*0.905*0.095 = 0.17 (roughly)

b. Do you actually expect this particular population to be in equilibrium? Explain why or why not, making specific reference to the criteria/assumptions required for equilibrium.

Can argue either way… important thing = consider all criteria:
- **Mating is random with respect to shell thickness**
- **No gene flow (this is hard… there may be lots of larvae that float there from other populations)**
- **No mutation (this is pretty typical-mutations are so rare)**
- **No selection, all have the same fitness (we really don't know…)**
- **No genetic drift, i.e., population needs to be huge**

2. Consider the barnacles in the image below. In general, barnacles of the genus *Chthamalus*, which are quite small, are found in the upper intertidal zone. While barnacles of the genus *Semibalamus*, which are larger in size, are found in the lower intertidal zone.



a. Several ecologists found that, in the absence of *Semibalanus, Chthamalus* colonizes and lives in both the lower and upper intertidal zone. However, in the absence of *Chthamalus*, *Semibalanus* still only colonizes the lower intertidal. What do you conclude about the respective niches of these two organisms?

The (fundamental) niche of *Semibalanus* is the lower intertidal and the conditions that are there (and possibly some of the resources). The (fundamental) niche of *Chthamalus* is the entire intertidal and conditions there (and some of the resources). The realized niche of *Chthamalus* in the presence of *Semibalanus* is the upper intertidal and the conditions + resources there.

b. What do the data reported in part a suggest about the interaction between the two barnacles in the lower intertidal zone? Include how the interaction affects their fitness.

They are most likely competing (for space; food is usually plentiful in the intertidal); we now know that the lower intertidal is suitable for both organisms to live, and when two species are able to use the same (limited) resource, and are present in the same place, they usually compete for the resource.
Competition reduces fitness of both species in this case (both have fewer resources available for themselves, so they have fewer resources to support a bigger population, or, carrying capacity for both of them is lower in the presence of the competitor).

***Note*: Often students think that the stronger competitor does not have a fitness loss, but this is inaccurate-in this case; for example, some *Chthamalus* could still be present in the lower intertidal, taking up space from the *Semibalanus*.**
We don't expect to see evolution due to natural selection as a result of this interaction because barnacle larvae are just free floating in the water, and they develop and grow wherever they land (there is no existing mechanism to control where they land/attach and grow).

c. A similar experiment was carried out using a two species of sea snails, and it was found that the "upper intertidal" species always moved to, and lived in the upper intertidal even in the absence of it "lower intertidal" competitor. This was interesting, because this "upper intertidal" species was known to be able to live, grow and reproduce in the lower intertidal too, if forced to by the experimenter. Propose how competition could have driven the evolution of these "upper intertidal" sea snails from a population of sea snails that lived both in the upper and in the lower intertidal.

"Choice of intertidal place to live" may be genetically controlled. In the original population, some sea snails may have alleles that made them be non-specific in terms of which part of the intertidal they lived in, while some individual sea snails may have alleles that cause them to automatically go live in the upper intertidal.
At some point a very strong competitor that lived only in the lower intertidal arrived, and the sea snails had to compete for space with this other species. Those individuals that had the alleles to live in the upper intertidal did not have to deal with the competition (they had all the space they needed), so they could reproduce successfully.
The other sea snails would be able to access enough space when they went to the upper intertidal, but if their offspring went to live in the lower intertidal, their reproductive success was hampered (→ they had lower fitness).
So, over time, the "upper intertidal allele" became increasingly more frequent, and so did the upper intertidal sea snails… until all sea snails had only "upper intertidal" alleles.