Reading 3.1 – Natural Selection

Natural selection is a mechanism that leads to individuals with trait variations that give them a competitive advantage becoming progressively more common in the population with each new generation.

This mechanism emerges when there are two conditions: 1) the individuals in a population have variation in in an inherited trait 2) interactions in the environment give individuals with some variations a competitive advantage for survival or reproduction over other individuals.

In the previous model you saw how interactions with a simulated predator led to different types of selective pressures. In one case, when the predator was chasing the bugs, this led to selective pressure, which resulted in a population of bugs that became faster over time. In the other case, when the predator waited for the bugs to come to it, this led to selective pressure, which resulted in a population of bugs that became slower over time.

Question #1: Besides predators, there are other living organisms in an ecosystem that interact with a population that can cause natural selection to occur. Brainstorm a list of some of the other organisms in an ecosystem that might contribute to natural selection through their interactions with a bug population:

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Question #2: Besides predators, there are other non-living (**abiotic**) objects and events in an ecosystem that that might lead to natural selection through their interactions with the population. Brainstorm a list some of non-living objects or events in an ecosystem that might contribute to natural selection:

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Migrating Deer Scenario: *Imagine a population of deer lives in the valleys between mountain ranges. The deer have had no natural predators in these ecosystems for many years.*

One group of deer wanders into a new ecosystem they haven't been in before. It is a hard to reach valley between two mountain ranges. The deer find plenty of food to eat in this valley to sustain a large carrying capacity for deer. Shortly after arriving in the valley, a population of wolves also wanders into the same ecosystem. The wolves are predators for other animals, including deer.

Question #3: After wolves enter the ecosystem, what do you expect would happen to the proportion of fast deer in this population in each future generation?

a) Nothing would happen. The proportions of fast deer in the population would never change in each new generation because trait variation related to speed gives no competitive disadvantage or advantage in this ecosystem.
b) There would be some slight fluctuation in the proportion of fast deer in the population. The proportions of fast deer in the population would vary up and down in each future generation, but it would remain close to a stable value because the wolves cannot change the trait variations in the deer population.
c) The proportion of fast deer in the population would decrease in future generations because the selective pressure from wolves would be to kill off the easier to catch deer. The faster deer are easier to catch so they would be removed from the deer population more frequently than the slower deer.
d) The proportion of fast deer in the population would increase in future generations because the selective pressure from wolves would be to kill off the easier to catch deer. The easier to catch deer are the slow ones. Dead slow deer can't have babies, but live fast dear can.
e) It's hard to predict, since there are many opposing selective pressures. One pressure is that using up food too quickly by running too fast might cause the fast deers to starve more quickly. Another pressure is from running to fast and increases the chances of breaking a leg and getting caught by a wolf. Another pressure is from running too slow and being caught by a wolf.

You've seen how natural selection could influence one trait in a population of prey – namely their speed of movement. Consider how natural selection might influence other traits:

Question #4: If smaller animals are harder to find, how might natural selection also influence the size of prey over time?

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Question #5: How might natural selection influence the color of fur in a population of prey that lives in a snow-covered ecosystem that has many predators in it?

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Insecticides are chemical substances that are used to reduce the population of insects. Many types of insecticides used around the home are bug sprays and solids that kill bugs that are exposed to them. To keep harmful bugs from destroying crops farmers often spray them with insecticides.

A population of insects has variation in their inherited traits. On the outside one can observe that insects in the population are larger, or slower, or have different coloration than others.

image from:
http://en.wikipedia.org/wiki/Pesticide_application#mediaviewer/File:1264_Rogator_Spraying_Corn.JPG

Insects also have variation in their internal structures and substances they produce. Some insects may produce substances that allow them to digest food more slowly, that enable them to reproduce more quickly, or that give them greater resistance to effects of poisonous substances.

Insecticide resistance scenario: *In the early 1900's people started to notice that bug populations were now more **resistant** to some pesticides that used to work relatively well. As new insecticides were invented, again cases of resistance were reported in the bug populations they were used on just a few years later.*

Question #6: In the past, these same pesticides used to be far more effective on populations of bugs. They used to kill off most of the bugs in the population when they first were used. Use the mechanism of natural selection to explain why current populations of bugs are now more resistant to the pesticides that had been used on the population in them in the past.

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Herbicides resistance scenario: *Herbicides are chemicals that kills off certain types of plants. Imagine a new type of herbicide is invented this year. It starts being sold in stores under the brand name "DandelionBeGone". Homeowners who use the herbicide the first year might find it works very well, killing off approximately 98% of the dandelions in a lawn with one spraying, without killing the grass.*

Question #7: If homeowners continued to use the same herbicide for many years in a row, the mechanisms at work from natural selection might lead to a disappointing outcome. Homeowners might find it doesn't work so well in future years on the lawn that it used to, even if the company doesn't change the ingredients in the "DandelionBeGone" herbicide they sell. Why?