Systems, Networks, and Strategies **Name:** _____
Homework due April 23, 2015

Reading: "Introduction to Evolution" chapter of Wikibooks, *General Biology*, `https://en.wikibooks.org/wiki/General_Biology/Introduction_to_Evolution`.

(a) What part does **variation** play in the process of natural selection? Please answer these questions in your own words. Very brief answers are fine.

(b) What part does **the environment** play in natural selection?

(c) What part does **inheritance** of traits play in natural selection?

(d) Where does **mutation** fit into this outline of the process of natural selection?

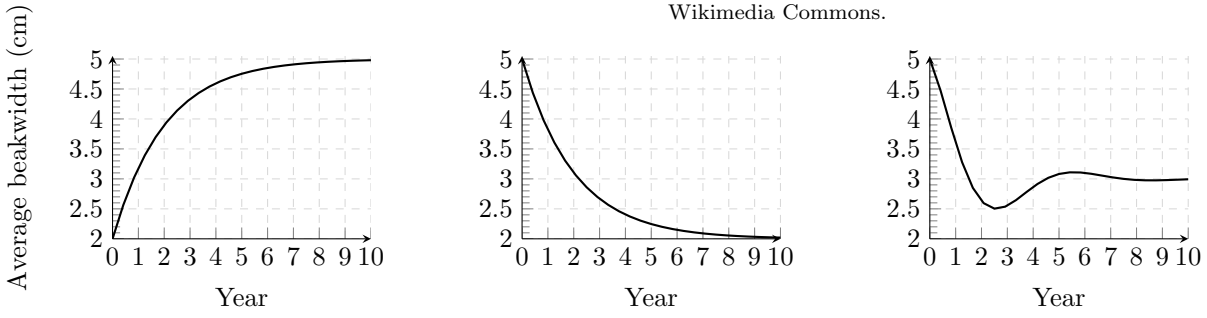
Darwin's finches.

The finches that Charles Darwin studied on his famous voyage to the Galápagos islands have plentiful variation in their beaks. Wide and strong beaks are better at biting into the bases of local cacti, to get food from them. Long and narrow beaks are better for poking into the cactus's fruits, so different shapes are better for different years, depending on whether the cacti are producing a lot of fruit.

Let us assume a series of dry years, so that fruit is rare. As time passes, differences in survival and reproduction lead to changes in the population.

Figure 1: Charles Darwin, *Journal of researches into the geology and natural history of the various countries visited by H.M.S. Beagle round the world, under the command of Capt. Fitz Roy, R.N.*, second edition, 1845. Public domain, Wikimedia Commons.

(a) Which of the following is a plausible plot of average beak width over time?

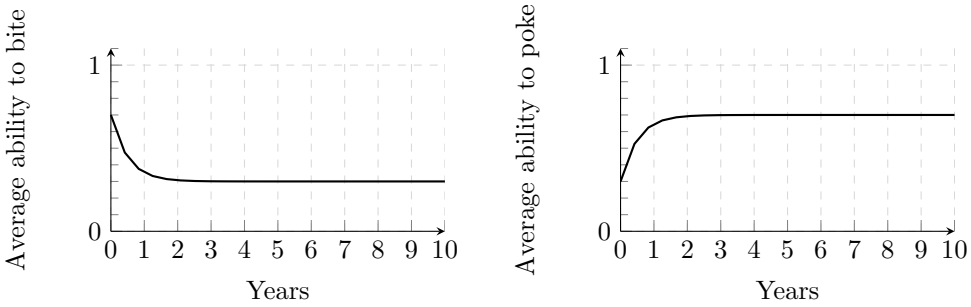


(b) Explain your answer briefly.

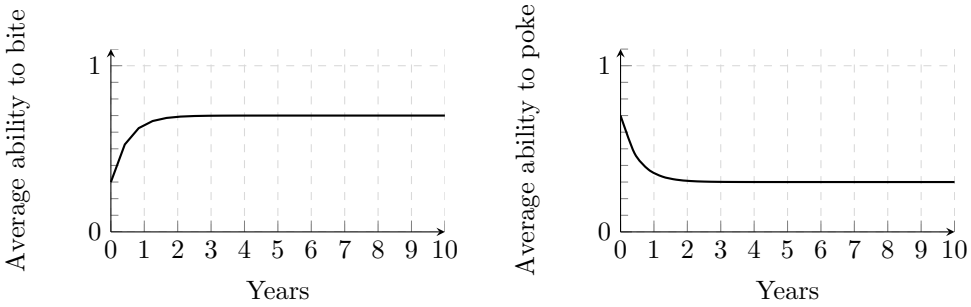
Here's a different view of the same situation, plotting the birds' ability to bite through cactus stems and ability to poke into fruit over time.

(c) Which of these is a plausible plot of the finches' changing abilities? Assume the same scenario as above, of a series of dry years?

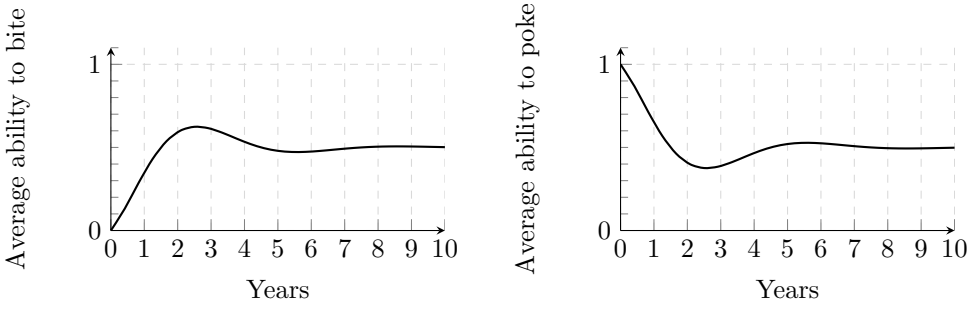
Notice that the left plot is ability to bite*, and the right plot is ability to* poke*.*



(a)



(b)



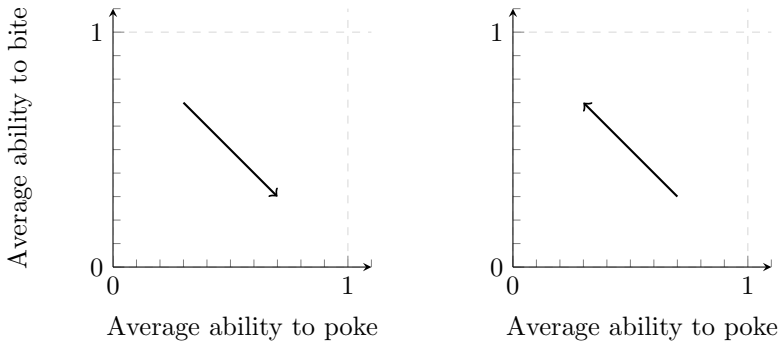
(c)

(d) Explain your answer briefly.

Here's another way to plot the same situation, using the birds' ability to bite through cactus stems and ability to poke into fruit as the two axes. So the average ability to do these things is a point somewhere in this square, and it will move from place to place as time passes.

Since their beaks can't be good at both, the birds can't go to $(1, 1)$ in the upper right corner of the square, they can only go back and forth roughly between $(0, 1)$ and $(1, 0)$.

(e) Which of these is a plausible plot of the finches' changing abilities? Assume the same scenario as above, of a series of dry years.

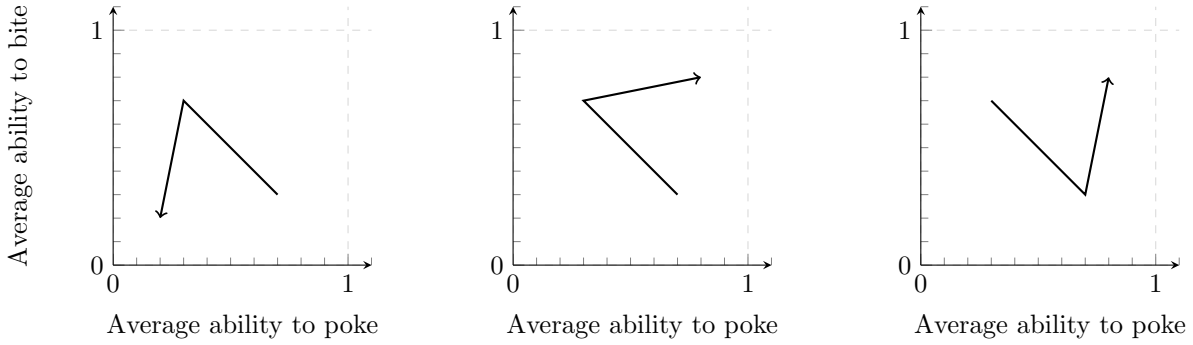


(a) (b)

(f) Explain your answer briefly.

Now suppose that after the above scenario happens, after a thousand years, a rare mutation arises that gives a bird the ability to use a stick as a tool to poke into cactus fruit, so that they can do it while having thick beaks.

(g) Which of these is a plausible plot of what happens?



(a) (b) (c)

(h) Explain your answer briefly.