Selection Coefficients and Fitness Worksheet
BIOL 01104 Fall 2019, Dr. Spielman

1. You are studying a population of Amazonian poison dart frogs, some of which have blue stripes and some of which have green stripes. You perform a recapture experiment (just like Kettlewell's moths) to determine the fitness of these two *morphs*, blue-striped and green-striped. In the forest, you capture and tag 50 blue-striped and 50 green-striped frogs. In one week, you return to the same area and see how many frogs you can recover. You recover 37 blue-striped frogs and 22 green-striped frogs.

   A. Calculate the proportion of each frog morph that survived during this week. *These quantities represent the absolute fitness* of each frog morph.

   Blue: $37/50 = 0.74$

   Green: $22/50 = 0.44$

   B. Calculate the *relative fitness* of each frog morph by dividing by the highest absolute fitness.

   Blue: $0.74/0.74 = 1$

   Green $0.44/0.74 = 0.59$

   C. Calculate the strength of selection acting against each frog morph, i.e. the *selection coefficient* using the formula: $s = 1 - w$, where "s" is the selection coefficient and "w" is the *relative* fitness.

   Blue: $s = 1 - w$
   $= 1 - 1$
   $= 0$

   Green: $s = 1 - w$
   $= 1 - 0.59 = 0.41$

   D. Calculate the *average fitness* for a hypothetical population with 75 blue-striped frogs and 50 green green-striped frogs. $N = 75 + 50 = 125$

$$\frac{75}{125} \times 1 + \frac{50 \times 0.41}{125} = \boxed{0.764}$$

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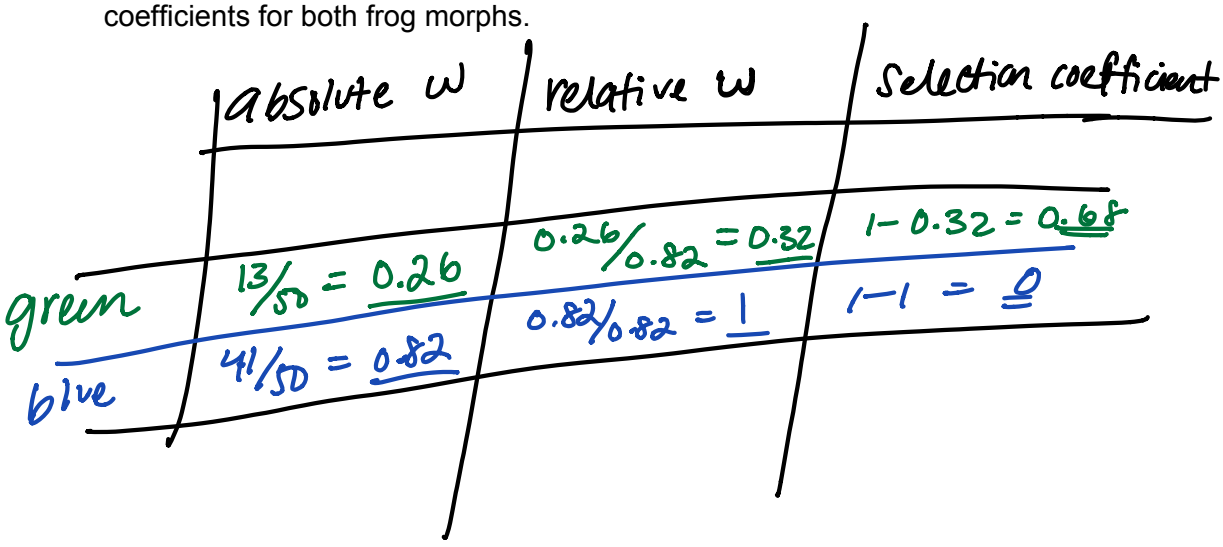
2. You are studying a *different* population of the same species Amazonian poison dart frogs that lives two miles away from the first population. You perform another recapture experiment with this new population. In the forest, you capture and tag 50 blue-striped and 50 green-striped frogs. In one week, you return to the same area and see how many frogs you can recover. You recover 41 blue-striped frogs and 13 green-striped frogs.

   A. Again, calculate the i) absolute fitness, ii) relative fitness, and iii) selection coefficients for both frog morphs.



   B. Based on your calculated *selection coefficients*, is selection stronger or weaker against in the first or second population?

Second population: selection coefficient 0.68 is greater than 0.41.

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3. You are studying a population of fish. Some males of this species have very long tails, some males have average-length tails, and some males have very short tails. You want to know which morph (long, average, or short tail) is more fit. You set up an experiment to test whether females prefer to mate with each morph. You find that long-tailed males successfully attract a female 72% of the time, average-tailed males successfully attract a female 48% of the time, and short-tailed males are successful 37% of the time. You use these measures of mating success as a proxy for fitness.

   a. Calculate the absolute fitness, relative fitness, and selection coefficients for each morph.

	absolute w	Relative w	Selection coeff
long	0.72	0.72/0.72 = 1	0
average	0.48	0.48/0.72 = 0.67	0.33
short	0.37	0.37/0.72 = 0.51	0.49

   b. Assume a given long-tailed male has 20 successful matings. How many successful matings would you expect a short-tailed male to have? Answer this question using *relative fitness* to help you.

short-tail fitness = 0.51

$0.51 \times 20 = \approx 10$

   c. One population of these fish contains 57 long-tailed males, 22 average-tailed males, and 4 short-tailed males. What is the *average fitness* of males in this population? $N = 57 + 22 + 4 = 83$

$$\frac{57}{83} \times 1 + \frac{22}{83} \times 0.67 + \frac{4}{83} \times 0.51 = 0.889$$