

POPULATION GENETICS PROJECT #3

Industrial melanism in the peppered moth, *Biston betularia*, is a textbook example of directional selection. There has been controversy about aspects of the story, and the story is more complicated than you'll read in most textbooks. We'll use a simple version of some of the data drawn from Kettlewell's marked release and recapture experiments (*Heredity* 9:323–342; 1955). Specifically, these are the data:

		<i>typica</i>	<i>carbonaria</i>
Dorset	Released	486	473
	Recaptured	62	30
Birmingham	Released	137	447
	Recaptured	18	123

Using these data answer the following questions:

1. What are the absolute viabilities of *typica* and *carbonaria* in each location?
2. What is the viability of *typica* relative to *carbonaria* in each location?
3. If you assume that the fitnesses remain constant and that viability selection is the only evolutionary force acting on the populations, what will the long-term outcome of selection in each location be? Will it be the same in both locations? How might you explain the outcome in each location?
4. How confident can you be in your answer to # 3?
5. One complication that we usually ignore when we teach about this story is that the heterozygote is somewhat intermediate between the two homozygotes. It's closer to *carbonaria* in appearance, but it's not identical. J. B. S. Haldane estimated the relative viabilities of the three genotypes as follows:¹

<i>typica</i>	<i>insularia</i>	<i>carbonaria</i>
0.50	1.00	0.92

¹*insularia* is the heterozygote, in case you didn't guess.

Is the fitness of *typica* relative to *carbonaria* in either location consistent with the corresponding relative fitness estimate that Haldane obtained?

Hints

- Model the number of survivors for each phenotype separately in each population. Assume that the number of survivors is drawn from a binomial distribution with a probability equal to its absolute viability and a sample size equal to the number of moths released.
- Use uniform priors on the absolute fitnesses: `dunif(0, 1)`.
- Estimate the relative fitnesses within JAGS so that you get both the posterior mean and 95% credible intervals.
- Make the estimates separately for each location.