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Q&A



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QUESTION

Submitted by

Anonymous,

I was watching the 2005 HHMI Holiday Lectures on Science, "Evolution: Constant Change and Common Threads," and have a question about the natural selection of the rock pocket mouse. In the animation, it explains how once the landscape changed from tan to black, the mice with the mutation for black fur had a selective advantage over the mice with the tan fur. The specific advantage could be numerically expressed as a selection coefficient. I was wondering how natural selection would be affected in an area where mice were on the border of the lava and natural landscape, where they could move to either the tan or the black landscape. Would both mice have an equal probability of survival? Would mice be able to consciously know which landscape would be more beneficial for their survival?

Science

PROFILE

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ANSWER

Provided by

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 (former HHMI predoctoral fellow)**

You are absolutely correct that the advantage that one allele (a version of a gene) has over another allele can be expressed as a selection coefficient (the fraction of extra or fewer offspring contributed to the next generation by one allele compared with that contributed by another allele).

However, populations are seldom completely isolated, and the rock pocket mice are no exception. Migration (and hence gene flow—the exchange of alleles between populations) between the black populations on the black lava rock and the tan populations on granite rock does occur and can be measured by looking at genes not under selection. This has been done, and migration is low enough that selection can still act quite efficiently to create nearly entirely black populations on lava and largely tan populations outside the lava.

The black lava outcroppings are interrupted by regions of sand that also include tan-colored granite rocky areas. Since the mice prefer rocky areas, their distribution is not continuous across the landscape, and they are generally found in the black lava rocky outcroppings or the tan granite rocky areas. As a result, movement from one rocky area to another doesn't happen regularly for a given mouse. Even when mice are sampled from the edge of

the lava fields, almost all are black. By comparing these frequencies to the migration rate and the frequencies of adjacent mostly tan populations, it has been estimated that selection is extremely strong and asymmetric such that tan alleles are more strongly penalized on lava than black alleles are penalized on granite.

Because of this asymmetry in selection, it seems that if a mouse and its offspring really had an even chance of being on either lava or granite during their lifetimes, a black coat color is better. The further away one moves from the lava fields, the less likely the mouse and its future offspring are to encounter lava, so tan coat color becomes selected for. A few kilometers away from the lava fields, some populations are mostly tan, while others are almost entirely tan, probably reflecting differences in migration to these areas from the lava fields.

As you rightly point out, given the migration and gene flow between black and tan populations, a mouse that knew where its coat color was most beneficial might have an advantage, especially if it was near enough to the border to choose which rocky area was best. Unfortunately, there is not any evidence that this occurs.

The 2005 Holiday Lectures are available online:

<http://www.hhmi.org/biointeractive/evolution/index.html>

References

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