Experiment gives insight into how species maintain diversity

November 18 2011, by Bob Yirka

(PhysOrg.com) -- One of the big problems evolutionary biologists have to wrangle with is in trying to explain why members of an individual species aren't more alike. If say, high testosterone in males makes them more aggressive, for example, and thus more successful at mating, why doesn't the level of testosterone level off at some point as that trait is passed on to successive generations while those with lower levels continue to lose out? And how do so-called antagonistic traits between the genders contribute to diversity? If males with more testosterone get to mate more, but more testosterone in females leads to smaller litters, how do the two traits work together to ensure that diversity wins in the end? Well, nobody really knows for sure, but a group of international researchers has taken a step towards figuring it out. In their paper published in *Science* the team shows that so-called frequency-dependent selection may have a lot to do with it.

Many researchers have suggested that antagonistic traits, those that benefit one gender, but inhibit the other, can explain how species keep up their diversity. High testosterone male mammals for instance, are very successful at mating, but tend to have sisters with high testosterone levels who produce small litters, which sort of evens things out. This new research team says that such explanations are too simplistic though and that there is likely much more at work here. They suggest it has more to do with environmental factors that lead to frequency-dependent selection.

To show how this type of selection process might come into play, the team set up a three part experiment. The first part involved breeding bank voles and separating them by testosterone levels. They then allowed the voles to mate and reproduce in the lab. In that controlled environment, they found that the high testosterone males were, as expected, much more successful at breeding then their meeker male peers.

Next, the voles were released into an enclosed area of wilderness that simulated how the voles would live in the wild and it was here that the team came up with some interesting results. They found that when they released just a few of the high testosterone males and lots of low testosterone males into the same area, the males once again reigned supreme with the ladies. But when they released lots of high testosterone males with lots of lots of low testosterone males, the males with the lower levels actually did better than those with the high levels, indicating that there was something clearly at play. The researchers suggest that such results came about because the high testosterone level males spent more time fighting or showing off than mating, which gave the low testosterone males more of a chance to mate.

It's these kinds of unexpected environmental scenarios that come into play in the wild, the authors surmise, that help keep a species diverse, which is important of course, because if it didn't happen, any given species would become less able to fend off disease over time and would become more susceptible to gene disorders.

More information: Negative Frequency-Dependent Selection of Sexually Antagonistic Alleles in Myodes glareolus, *Science* 18 November 2011:
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ABSTRACT
Sexually antagonistic genetic variation, where optimal values of traits are

sex-dependent, is known to slow the loss of genetic variance associated with directional selection on fitness-related traits. However, sexual antagonism alone is not sufficient to maintain variation indefinitely. Selection of rare forms within the sexes can help to conserve genotypic diversity. We combined theoretical models and a field experiment with Myodes glareolus to show that negative frequency-dependent selection on male dominance maintains variation in sexually antagonistic alleles. In our experiment, high-dominance male bank voles were found to have low-fecundity sisters, and vice versa. These results show that investigations of sexually antagonistic traits should take into account the effects of social interactions on the interplay between ecology and evolution, and that investigations of genetic variation should not be conducted solely under laboratory conditions.

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