Survival of the rarest: Fruit flies shed light on the evolution of behavior

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Sometimes, it pays to be rare—think of a one-of-a-kind diamond, a unique Picasso or the switch-hitter on a baseball team. Now, new research suggests that being rare has biological benefits.

Professor Marla Sokolowski, a biologist at the University of Toronto Mississauga who in the 1980s discovered that a single gene affects the foraging behaviour of fruit flies, has identified the benefit of rarity in populations of fruit flies with two different versions of the foraging gene. This gene is of particular interest because it is also found in many organisms, including humans. The new study appears in the May 10 issue of the journal *Nature*.

"There's considerable genetic variation in nature and we haven't been able to explain why it persists, since natural selection ensures that only the best survive," says Sokolowski, who holds a Canada Research Chair in Genetics. "In some cases, individuals with characteristics that differ from the rest of the population are more likely to survive since their rarity makes them less conspicuous to predators. However, to date we haven't understood this type of survival advantage at the level of the gene."

The findings involve a phenomenon known as "negative frequency-dependent selection." Essentially, it suggests that rare variants have a better chance of survival—just as a rare strain of the flu has a better chance of spreading through a population that is already immune to more common strains of the virus. In this case, flies carry one of two versions of the foraging gene (either the "rover" or "sitter" type). Rover larvae move around more than sitter larvae while feeding and they are also more likely to explore new food patches than sitters. The researchers explored the evolutionary mechanism that favours the persistence of both of these types in nature.

Doctoral student Mark Fitzpatrick raised colonies of flies with different ratios of rovers to sitters and different concentrations of nutrients in their food, and assessed their fitness—how many survived to the end of their larval stage. To distinguish between the rovers and the sitters, which are physically identical, Fitzpatrick "tagged" one of the types with a green fluorescent protein that glows under ultraviolet light. Then, over the course of a year, Fitzpatrick sat in a darkened room for several hours a day counting glowing larvae under a microscope.

The researchers found that when the fruit fly larvae were competing for food, those that did best had a version of the foraging gene that was rarest in a particular population. For example, rovers did better when there were lots of sitters, and sitters did better when there were more rovers.

"If you're a rover surrounded by many sitters, then the sitters are going to use up that patch and you're going to do better by moving out into a new patch," says Sokolowski. "So you'll have an advantage because you're not competing with the sitters who stay close to the initial resource. On the other hand, if you're a sitter and you're mostly with rovers, the rovers are going to move out and you'll be left on the patch to feed without competition."

More generally, Fitzpatrick says these results may help explain why genetic variants such as these are common in nature. "In the case of fruit flies, one variant encourages the survival of the other. In essence, there is not one best type of fly," he says. If this process is common in nature, it may offer one explanation for why individuals, in general, vary so much from one to another in almost all species.

The researchers' next step is to show that this phenomenon is also taking place in the wild. In addition, since the foraging gene is found in many animals, including honeybees, mice and humans, the researchers are examining how variations in the human foraging gene may be linked to food-related disorders.

Source: University of Toronto

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