Friday, September 12, 2008

Lovers vs. Fighters Speed Up Evolution

Larger fighting horns or genitalia may drive dung beetles to evolve into new species

Posted September 1, 2008

By Jeremy Hsu, LiveScience

The evolutionary tradeoff between becoming a bigger fighter or lover could lead to new species among dung beetle populations.

Male beetles may not transform in the blink of an eye, but natural selection seems to have driven rapid evolution in the size of their fighting horns—and their reproductive tools—during a time period of just 50 years in one newly studied case.

"As horns get bigger, copulatory organs get smaller, or vice versa," said Armin Moczek, an evolutionary biologist at Indiana University-Bloomington. "What was not known was how frequently and how fast this can occur in nature, and whether this can drive the evolution of new species."

Making tradeoffs

Moczek and fellow researcher Harald Parzer examined four geographically separate populations of a horned dung beetle species called Onthophagus taurus. They found that the relative investment made by each beetle population into horns and genitalia could differ by more than three times the average investment for the overall species.

The different sizes reflect a strategy of making investments with limited resources into either horns or genitalia. If beetles live in low-density environments where fighting is common, males with larger horns and smaller genitalia may find the most success in winning mates. But if fighting is less common, having larger genitalia at the expense of horn size may prove best.

Such tradeoffs between certain characteristics are an "ancient and still poorly understood

issue in biology," Moczek told LiveScience. Biologists are not surprised that secondary sexual characteristics such as horns can drive change in the primary sexual characteristic, or the genitalia, but only two previous studies had hinted at this in action.

Size matters?

Evolutionary biologists think that such changes in genitalia size and shape can eventually lead to new species, when individuals from different populations become sexually incompatible. The size of genitalia tends to resist evolutionary change in order to preserve a species' identity, but evolutionary pressure on the dung beetle horns has forced the changes in genitalia as well.

"We proposed that maybe these tradeoffs are an avenue that forces species in directions they wouldn't go with otherwise with genitalia," Moczek said.

Individuals in most species do not choose mates based on a "size matters" mentality toward genitalia, so the tradeoff between the two characteristics also provides a mechanism to explain the link between genitalia and origin of species.

Moczek and Parzer looked at 10 other related beetle species and found similar variety in horn and genitalia sizes, which suggests that the same natural selection pressures continue to work after species have split off.

"If this is all it takes to change genitalia, it may be easier to make new species than we thought," Moczek said.

Getting around

The O. taurus dung beetle originated in Italy, but has spread to other parts of the world to live in far-flung populations. Humans introduced the dung beetles to Australia in the 1960s as competitors to ward off swarms of flies that hover over cow manure, and the beetles became so beloved there that Moczek found himself universally welcomed down under because of his research.

"When I mentioned I was working on dung beetles, I immediately had a beer in my hand and a place to stay," Moczek recalled.

The beetles also showed up unannounced in the United States during the 1960s. The separate beetle populations in the United States, Italy, and western and eastern Australia now allow biologists to see what evolutionary changes have occurred within the past 50 years—and perhaps figure out where the beetles might go next.

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