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NewScientist

New Scientist

June 19, 2004

SECTION: News; This Week; Pg. 14

LENGTH: 477 words

HEADLINE: **Algae** use sex to beat stress

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BODY:

PRIMITIVE pond-dwelling **algae** are helping to answer one of biology's ultimate questions -- why did sex evolve? It seems that combining genes with your pond-mates is all about repairing DNA when the going gets tough.

Sex is puzzling because many species, including some plants and reptiles, manage to reproduce perfectly well without it. Instead of combining their genes with another individual they simply churn out carbon copies of themselves.

Richard Michod and his colleagues from the University of Arizona in Tucson argue that sex started out as a way of repairing damage to DNA. A version of sex in bacteria backs up his hypothesis. They sometimes exchange bits of DNA via tube-like structures that form between cells. "If you look at bacteria, the sex genes are intimately coupled with the DNA repair system. It seems obvious that bacterial sex originated for repair," says Michod. But conventional sex involving the fusion of two sex cells is very different and some experts doubted that the same explanation would hold.

However, sex can help repair DNA: if a section is damaged in one individual, and the same site is intact in a partner, then recombination during sex can discard the damaged portion and fill the gap with the correct sequence from the mate.

Now Michod's team has demonstrated that sex and DNA repair are closely linked in the multicellular green alga *Volvox carteri*. Most of the time, these algae clone themselves to reproduce. But when the temperature rises to 42.5 degreesC, DNA damage triggered by heat stress causes them to resort to sex. Females release eggs and males release sperm, which float off into the water and combine.

Heat stress causes the alga's metabolic machinery to produce highly reactive forms of oxygen, including hydrogen peroxide. Collectively termed reactive oxygen species (ROS), these chemicals are known to damage DNA. When ROS levels cross a threshold, the expression of two sex-associated genes goes up and the alga switches to sexual reproduction. But when the team added antioxidants to mop up ROS, the alga stayed asexual, showing that the switch-over only happens in response to ROS (Proceedings of the Royal Society B, DOI: 10.1098/rspb.2004.2747).

Evolutionary biologist Neil Blackstone of the Northern Illinois University in DeKalb agrees that the study supports Michod's DNA-damage hypothesis. "But this is just one organism. There will have to be corroborative work on other species."

Michod says that there is preliminary evidence of a similar link between stress and sex in the related single-celled alga, *Chlamydomonas reinhardtii*. In this case it is nitrogen depletion rather than heat that stresses the organism and leads to sexual reproduction. Michod is confident that similar mechanisms will be found in all organisms that can choose between sexual and asexual reproduction.

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