

Professor's hypothesis may be game changer for evolutionary theory

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(PhysOrg.com) -- A new hypothesis posed by a University of Tennessee, Knoxville, associate professor and colleagues could be a game changer in the evolution arena. The hypothesis suggests some species are surviving by discarding genes and depending on other species to play their hand.

The groundbreaking "Black Queen Hypothesis" got its name from the game of Hearts.

In Hearts, the goal is to avoid "winning" the Queen of Spades (the Black Queen), which is worth a lot of points. Subsequently, players allow others to take the high-point card while they enjoy low-score tallies.

This same premise applies in evolution, the scientists say.

According to the hypothesis, evolution pushes microorganisms to lose essential functions when there is another species around to perform them. This idea counters popular evolutionary thinking that [living organisms](#) evolve by adding genes rather than discarding them.

"A common assumption about evolution is that it is directed toward increasing complexity," said Erik Zinser, associate professor of microbiology. "But we know from analysis of [microbial genomes](#) that some [lineages](#) trend toward decreasing complexity, exhibiting a net loss of genes relative to their ancestor."

Zinser's opinion piece is published in *mBio*, the online open-access journal of the American Society for Microbiology. Jeffrey Morris and Richard Lenski of Michigan State University are co-authors. Morris was Zinser's doctoral student at UT.

The authors formed their theory after studying [photosynthetic bacteria](#) called *Prochlorococcus*.

"This marine microorganism continued to mystify us because it is the most common [photosynthetic organism](#) on Earth, but it is extremely difficult to grow in pure culture," Zinser said. "A major reason for this difficulty is that *Prochlorococcus* is very sensitive to reactive [oxygen species](#) such as hydrogen peroxide and relies on other bacteria to protect them by breaking down these toxic substances for them."

Prochlorococcus had once performed this function itself, but natural selection decided it was too costly, like carrying the Queen of Spades, and discarded this ability. Instead *Prochlorococcus* benefits from the hard work of others within its community allowing it to concentrate its energies elsewhere—such as multiplying.

The hypothesis offers a new way of looking at complicated,

interdependent communities of microorganisms.

"We know that certain microbial activities, such as [hydrogen peroxide](#) scavenging, are 'leaky,' meaning their impacts extend beyond the cell and into the environment," Zinser said. "What the hypothesis suggests is that this leakiness can drive a community toward greater interdependence, even if some members are unwitting participants in this process."

This interdependence could lend itself to vulnerabilities. The scientists say the work highlights the importance of biological diversity, because if rare members are lost, "the consequences for the community could be disastrous." This would be analogous to attempting to play Hearts without the Queen of Spades.

Currently, the hypothesis is limited to [microorganisms](#), but Zinser thinks the [hypothesis](#) could be extended to larger free-living organisms. All that is needed is a card which no player wants yet is crucial for the game to be played.

Provided by University of Tennessee at Knoxville

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