

A Virus-Bacteria Coevolutionary 'Arms Race' Solves the Diversity Paradox

BACKGROUND: There is remarkable biodiversity on Earth. When many species are competing for the same finite resource, a theory called competitive exclusion suggests one species will outperform the others and drive them to extinction, limiting biodiversity. But this isn't what we observe in nature – a phenomenon known as the diversity paradox.

THE RESEARCH: A stochastic model was developed that accounts for multiple factors observed in ecosystems, including competition among species and simultaneous predation on the competing species. Using bacteria and their host-specific viruses as an example, the researchers showed that as the bacteria evolve defenses against the virus, the virus population also evolves to combat the bacteria. This “arms race” leads to a diverse population of both and to boom-bust cycles when a particular species dominates the ecosystem then collapses—the so-called “Kill the Winner” phenomenon. This coevolutionary arms race is sufficient to yield a possible solution to the diversity paradox.

TAKE-HOME: The diversity of ecosystems, especially microbial ones, is a key factor in understanding the likelihood that life can gain enough of a toehold in a planetary environment. With the discoveries of global oceans of liquid water on Europa, Enceladus and other moons in our solar system, marine microbial ecology is poised to become an even more active component of astrobiology. Understanding the fundamental mechanisms driving biodiversity—a pervasive feature of terrestrial ecosystems—will help us predict the observability of non-terrestrial life on worlds that will be within reach of our probes in the coming decades.

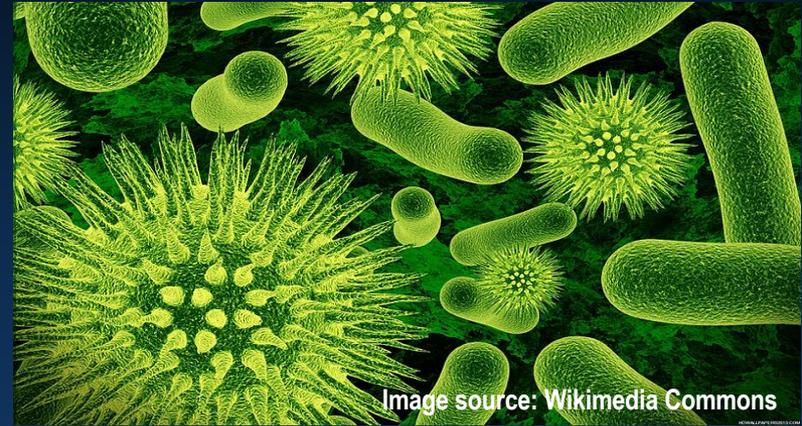


Image source: Wikimedia Commons

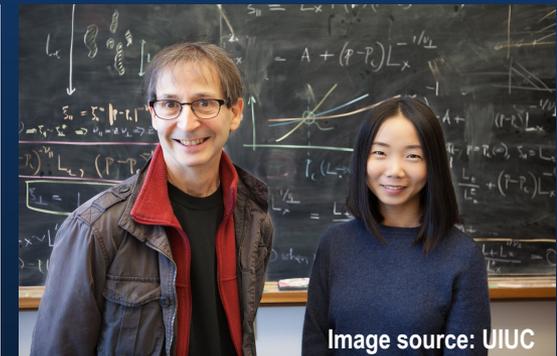


Image source: UIUC