Cooperation, not struggle for survival, drives evolution

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Researchers believe that competition tends to differentiate ecological requirements after repeated interactions and allows biodiversity. Even if the mechanisms that allow species to evolve, coexist, compete, cooperate, or become extinct are understood, the factors that allow species to coexist within the same environment are still debated. From Gause's principle of competitive exclusion to Connell's ghost of competition in the past, intra- and interspecific competition for the evolution of biodiversity are important.

Recently, the principles of competitive interactions as an explanation for biodiversity have been criticized from both theoretical and empirical approaches. Since Hutchinson proposed the provocative "paradox of plankton," a series of alternative hypothesis has been proposed to explain why the principle of competitive exclusion is not actually found in nature. The reason probably lies in the fact that ecologists have not questioned some of the principles of evolution. In fact, most ecological models are too simplistic and are often considered outdated.

A new conceptual evolutionary model first proposed in 2015 in bioRXiv and then published this year in the journal *Biologia* by Roberto Cazzolla Gatti, associate professor of ecology and biodiversity at Tomsk State University (Russia), reviewed the debated mechanism of speciation, suggesting that competition and a struggle for existence are not the main drivers of evolution. This research points out the importance of avoidance of competition, biological history, endogenosymbiosis, and three-dimensionality as the main forces that structure ecosystems and

allow the evolution of biological diversity.

A few weeks ago, researchers from the University of Bern in Switzerland published an empirical experiment that proves this theory. David Marques and colleagues demonstrated that a population of stickleback fish that breed in the same lake (Lake Constance, where they were introduced around 150 years ago) was splitting into two separate species at rapid speed. The study shows that even if both types of fish breed in the same streams at the same time of year and have been interbreeding, they are splitting into two genetically and physically different types.

In his paper, published in *Biologia*, Roberto Cazzolla Gatti wrote, "My model predicts that the coexistence of two species in a sympatric way can happen only if there is low competition or weak competitive exclusion between them and a kind of avoidance of competition that leads to a slight shift of the niche of a meta-population, which accumulated a series phenotypic differences due to genomic inclusions coming from other sources of genes. Thus, eventually, it's the avoidance of competition and the process that I call endo-geno-symbiosis that drives the expansion of the diversity of living beings."

In the paper, endo-geno-symbiosis describes the capacity of endogenous 'gene carriers' to share parts of their genome in a symbiotic relationship with their hosts, after the idea of 'endosymbiosis.'

There are numerous examples of rapid evolution, including cancers developing resistance to drugs and pests becoming resistant to pesticides. Even some species of fish are evolving smaller sizes to avoid being fished. This very rapid evolution through sympatry, thanks to the avoidance of competition, may be the norm rather than the exception.

Marques and colleagues wrote, "We cannot know for sure that the Lake

Constance sticklebacks will continue evolving until they become two non-interbreeding species. But evidence for sympatric speciation is growing, from mole rats in Israel to palms on Lord Howe Island, Australia, and apple maggots evolved from hawthorn maggots in North America, leading some evolutionary biologists to think it could be surprisingly common."

Gatti became interested in the role of cooperation in evolution in 2011, when he published a controversial paper titled "Evolution is a cooperative process: the biodiversity-related niches differentiation theory (BNDT) can explain." He concluded: "These theoretical findings, confirmed by empirical approaches, should motivate our species to think before it is too late about how human competition, for the first time in the history of life on Earth, has been systematically leading to the extinction of animals and plants. My new model of evolution does not only attempt to explain some of the mechanisms that underlie the current presence of the myriad forms of life, but it also sheds new light on the need of periods of sufficient time scale to generate the awesome number of species that currently inhabit our planet. If humanity does not stop its 'unnatural' competitive spirit in the massive elimination of species, more billions of years could be needed before the diverse set of living beings that we now call biodiversity can be regenerated. And the extinguishing power of the sun will not allow it."

More information: Roberto Cazzolla Gatti, A conceptual model of new hypothesis on the evolution of biodiversity, *Biologia* (2016). DOI: 10.1515/biolog-2016-0032

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