Coevolution in multidimensional trait space favors escape from pathogens and parasites

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Introduction

Victims avoid exploitation if any one of their traits, the interaction rate is maximized when the exploiter’s trait value exceeds that of the victim. Thus, coevolution in highly dimensional trait space may help to explain why the world is green.

Methods

Most models of coevolution have focused on cases in which species-species interaction rates are governed by one trait in each species. Here, we allow species-species interactions to depend on multiple, potentially correlated traits.

We used numerical simulations and analytical models to investigate the conditions under which the victim species is most likely to evolve a low interaction rate with its exploiter, and thus to win the evolutionary race between defense and counter-defense. This prediction generates an apparent paradox: how do victim species survive and even thrive in the face of a continuous onslaught of more rapidly evolving enemies?

Here, we show that victim species can achieve an evolutionary advantage over their exploiters when species-species interaction rates are mediated by multiple traits in each species. This helps to level the playing field between victims and their exploiters. While our study is general to any victim-exploiter system, thus, coevolution often has strong evolutionary advantage over their exploiters when the interaction rate is maximized when the victim species survive and even thrive in the face of a continuous onslaught of more rapidly evolving enemies.

Results

Victim species are more likely to evolve low interaction rates with their exploiters when the number of traits that mediates the interaction rate is large and when correlations between those traits are strong.

Conclusions

Multiple traits and strong correlations between traits that govern species-species interactions favor victim species in evolutionary contests. Two mechanisms drive this effect:

1. Victims avoid exploitation if any one of their defense mechanisms overcomes the exploiter’s attack. Multiple traits offer victims multiple opportunities for evolutionary escape.

2. When the number of traits is large, G-matrices evolve to favor victim species (Tables 1 and 2).

In nature, correlations between traits are ubiquitous and often strong. Such correlations may play an important role in the evolution of victim species in response to exploitation.

Literature cited


For further information

Please contact rgilman@nimbios.org. More information on this and related projects can be obtained at www.nimbios.org/products/presentations.

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