

Solution concepts and modelling tools for solving and applying evolutionary games

Joel S. Brown
Department of Biological Sciences
845 W. Taylor St.
University of Illinois at Chicago
Chicago, IL 60607
USA.

This is not your grandfather's evolutionary game theory. Since Maynard Smith and Price's seminal work beginning in the 1970's game theory has advanced from pair-wise interactions and matrix game of animal behavior to a much more complete theory for defining, modeling and applying Darwin's theory of evolution by natural selection. The big questions in ecology --- fit form and function, diversity of life, distribution & abundance of species, and the procession of life --- now seem accessible to a growing number of concepts, modeling tools, and applications (many featured by the contributors and talks of this very meeting!). We will begin by examining "life as a game" by drawing on the concepts of the fitness generating function (G-function), invasion fitness and adaptive dynamics. These can form the basis for models that examine adaptive evolution within species, between closely related species, and species with distinct evolutionary histories and possibilities. Such extensions become possible by including both the ecological dynamics of changes in population size and the strategy dynamics of changes in the heritable traits of populations and species. The work of many over 40 years has taught us that the original concept of Evolutionarily Stable Strategies needs to embody three related but distinct solution concepts: resistance to invasion, convergence stability, and neighborhood invasion stability. We shall then see how these concepts and tools can be applied to 1) the evolution of cooperation, 2) ecological and evolutionary niche concepts, 3) gradients in species diversity based on latitude and area, 4) the ecology and evolution of invasive species, and 5) cancer. Throughout the emphasis shall be on exploring the relevant concepts, developing and illustrating existing and novel modeling tools, showing applications to questions of current interest, and highlighting future opportunities and needs for research.