Researcher discover fundamental processes behind nature's constant balancing act

October 29 2008

The natural world behaves a lot like the stock market, with periods of relative stability interspersed with dramatic swings in population size and competition between individuals and species.

While scholars may be a long way from predicting the ins and outs of the economy, University of Calgary biologist Edward McCauley and colleagues have uncovered fundamental rules that may govern population cycles in many natural systems. Their discovery is published today in the prestigious scientific journal *Nature*.

"Ecological theory has always predicted that predator-prey relationships cause large fluctuations in populations but in reality, many ecosystems are very stable," says McCauley, a populations ecologist and Canada Research Chair in the Department of Biological Sciences. "It's been a long-standing conundrum that we are now finally starting to understand."

The basis of their study is the feeding and life cycle of a tiny crustacean called Daphnia and their microscopic algal prey commonly found in lakes and ponds throughout the world. Using aquaria to keep environmental conditions as stable as possible, the researchers observed both very large and very small fluctuations in abundance of these populations over time even under the same global environmental conditions.

McCauley was able to show that the key mechanism giving rise to the small-scale fluctuations is how the availability of food affects both the maturity and mortality rate of these freshwater herbivores.

By understanding how food affects juvenile growth in populations, they were able to show using mathematical models why different types of cycles are found in predator-prey systems. Further experiments confirmed that these simple life-cycle features common to many organisms, led to the different cycles.

"Nature is often described to be in different states. For example, lakes are often characterized as to whether they are clear or turbid and these states resist changes over time. Here we are dealing with cycles in abundance being the different states -- lakes can have populations displaying large cycles or small cycles or both," says McCauley.

McCauley's work solves a fundamental problem raised over 25 years ago. Then, McCauley and his colleagues showed that Daphnia and their algal prey have an incredible range of population dynamics. They joined forces with a group of theoreticians and explored how time delays caused by food availability and energy requirements might affect population dynamics.

"In our new work, we wanted to determine how these cycles could co-exist, and our study shows that models which take into account some very general life-cycle characteristics can explain the fluctuations in these systems," says McCauley.

Their results and general models may improve our ability to explain how populations respond to different environmental changes.

"For example, will changes in temperature signals caused by climate change lead to large fluctuations in population size becoming more prevalent, or will they increase the prevalence of small amplitude cycles?" McCauley questions.

Source: University of Calgary