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Studies of Small Water Fleas Help Ecologists Understand Population Dynamics

A study of populations of tiny water fleas is helping ecologists to understand population dynamics, which may lead to predictions about the ecological consequences of environmental change.

The study is published in today's issue of the journal Nature. The water flea, called Daphnia, plays a key role in the food web of many lakes.

Co-author Roger Nisbet, a professor and vice chair of Ecology, Evolution & Marine Biology at UCSB, explained that a few animal populations, notably some insects, show huge "boom and bust" cycles. The populations alternate between periods of explosive growth when food is plentiful, followed by crashes when food is replaced too slowly to support the resulting large population.

This behavior is well understood by ecologists, and has been described by many simple mathematical models.

However, most animal populations don't behave in this extreme way. "A key question is why," said Nisbet.

To answer the question, Nisbet and his two Canadian co-authors took a three-pronged approach that required synthesizing evidence from field observations, experiments, and mathematical models. The theoretical foundation for this latest study was a mathematical theory developed several years ago by Nisbet and collaborators.

The new insight came by using this theory to help interpret the results of experiments by first author Edward McCauley, an ecologist at the University of Calgary.

McCauley was able to study the performance of individual water fleas within lab populations. Some of these were executing boom and bust cycles; others were not.

This second group of populations exhibited what the investigators called "small amplitude" cycles.

A key prediction of the theory, worked out through some innovative mathematical work by Bill Nelson, co-author from Queens University in Ontario, was that in the small amplitude cycles, individual animals would take much longer to develop to reproductive maturity.

This was confirmed by the new experiments.

"More broadly, the work illustrates that ecologists at UCSB and elsewhere are getting a deeper understanding of how the physiological response of organisms to a changing environment –– food availability, in these experiments –– is eventually expressed as population change," said Nisbet.

The researchers hope that the processes involved are general, and that the improved understanding of population dynamics will improve their ability to predict the ecological consequences of environmental change.

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