Stony Brook University
The Graduate School

Doctoral Defense Announcement

Abstract

The Pattern and Process of Evolutionary Diversification:
Lessons from a Threespine Stickleback Adaptive Radiation

By

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How do organisms diversify or "radiate" in nature? I studied an Alaskan threespine stickleback adaptive radiation to examine the rate at which organisms adapt to novel environmental conditions and the importance of different factors that facilitate or constrain adaptive radiation in nature. My dissertation research consisted of two main components.

First, I exploited a recently established population in Loberg Lake to examine the rate and pattern of stickleback adaptation in nature. I established baseline phenotypic variation and covariation using its most likely ancestor, a sea-run population from the same drainage. Within 25 years of establishment, the Loberg Lake population evolved from the ancestral phenotype to become almost indistinguishable from typical resident lake populations in the area, suggesting that adaptation to freshwater environments occurs within decades after freshwater populations form. Evolutionary rates were often highest early in the time series, levels of phenotypic variation remained high during adaptation to lake conditions, and ancestral phenotypic variation was abundant and did not appear to substantially constrain the evolution of the Loberg Lake population. Genetic variation in the Loberg Lake population is high compared to neighboring lake and stream populations, indicating that high levels of genetic variation were also conserved during founding.

Second, I examined the relative importance of gene flow and natural selection on phenotypic divergence within a phenotypically diverse stickleback lake-stream radiation, in a small Alaskan drainage. Genetic distances among populations were associated with geographic distances, indicating that they were generally more important than the nature of the environment for structuring of genetic diversity. Morphological distances, however, were strongly associated with environmental conditions. Consequently, even within small drainages, local environmental conditions can select for adaptively important genes, despite genetic exchange with phenotypically contrasting, neighboring populations.

This study combined powerful morphometric, molecular and geographical methods to examine microevolutionary processes in nature, and provides a novel perspective on evolutionary processes during adaptive radiation of natural populations.

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