Pelvic girdle reduction and asymmetry in threespine stickleback from Wallace Lake, Alaska

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ABSTRACT

**Questions:** Can a bimodal frequency distribution of phenotypes persist over multiple generations despite ecological changes? Can an organism’s environment elicit fitness trade-offs between armour development and somatic growth?

**Background:** Wallace Lake, located in south-central Alaska, contains a population of threespine stickleback (*Gasterosteus aculeatus*) exhibiting a bimodal distribution of pelvic phenotypes with modes at both highly reduced and fully developed pelvic armour. The lake has low ion availability, abundant macroinvertebrate predators, and introduced piscivorous fish.

**Methods:** Analyse temporal variability of the bimodal frequency distribution of pelvic phenotypes, direction and degree of asymmetry in bilateral armour traits, and whether extent of pelvic girdle development is inversely related to body size.

**Conclusions:** Distributions of pelvic phenotypes and of individuals with asymmetrical pelvic girdles persist over a 20-year time span. Individuals with greater pelvic expression exhibit more symmetrical anterior processes and ascending branches than those with pelvic reduction. Both directional and fluctuating asymmetry are present in armour traits. Stickleback with complete pelvic structures do not appear to experience reduced somatic growth compared with those with reduced pelvic girdles.

**Keywords:** directional asymmetry, disruptive selection, fluctuating asymmetry, frequency-dependent selection, stickleback.

INTRODUCTION

A core problem in evolutionary biology concerns the origin and maintenance of intra-specific divergence, a process that is crucial to intraspecific polymorphisms, speciation, and adaptive radiation (Mayr, 1963; Schluter, 2000, 2003; Nosil and Crespi, 2006; Grant and Grant, 2008). Traditionally, natural selection has been viewed to reduce intraspecific variation through elimination of unfit individuals (Fisher, 1930). However, both frequency-dependent and disruptive selection give rise to and maintain intraspecific variation.
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