Selective advantage of irreversible and reversible phenotypic plasticity

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With 7 figures, 1 table and 1 appendix

Abstract: A recent model on phenotypic plasticity is extended so that reversible and irreversible plasticity can be compared. It is assumed that the plastic organism receives an environmental cue that induces a change of the phenotype. Complete and incomplete information are treated as two extreme cases of the reliability of those cues. Relative fitness is calculated depending on the difference between inducing and non-inducing states of the environment and its coefficient of variation, on the time pattern and on the relative length of the inducing environment. In addition, fitness of reversible plasticity depends on the time delays for changing the phenotype from non-induced to induced and back. Irreversible plasticity can successfully compete with reversible plasticity only if at least one of these time delays becomes large, irrespective of the reliability of environmental cues. For either complete or incomplete information, there are parameter regions in which irreversibility is advantageous.

Key words: phenotypic plasticity, reversible phenotypic plasticity, irreversible phenotypic plasticity, environmental tolerance, response time lag, reliability of environmental cues, completeness of information, breadth of adaptation.

Introduction

If the ability of a genotype to express different phenotypes in variable environments leads to a fitness advantage, then such phenotypic plasticity is adaptive. Adaptive phenotypic plasticity is common among all organisms from microbes to mammals. Plastic traits are found in such different areas like morphology, life history, physiology or behavior. Recent reviews on phenotypic plast-