

# Investigating ecological speciation in non-model organisms: a case study of killer whale ecotypes

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## ABSTRACT

**Background:** Studies of ecological speciation tend to focus on a few model biological systems. In contrast, few studies on non-model organisms have been able to infer ecological speciation as the underlying mechanism of evolutionary divergence.

**Questions:** What are the pitfalls in studying ecological speciation in non-model organisms that lead to this bias? What alternative approaches might redress the balance?

**Organism:** Genetically differentiated types of the killer whale (*Orcinus orca*) exhibiting differences in prey preference, habitat use, morphology, and behaviour.

**Methods:** Review of the literature on killer whale evolutionary ecology in search of any difficulty in demonstrating causal links between variation in phenotype, ecology, and reproductive isolation in this non-model organism.

**Results:** At present, we do not have enough evidence to conclude that adaptive phenotype traits linked to ecological variation underlie reproductive isolation between sympatric killer whale types. Perhaps ecological speciation has occurred, but it is hard to prove. We will probably face this outcome whenever we wish to address non-model organisms – species in which it is not easy to apply experimental approaches and comparative studies among multiple taxon pairs. We need new genomic approaches that identify genes under selection and then link alleles to phenotypic differences and reproductive isolation.

**Keywords:** ecological speciation, genome-wide scans, killer whale, niche variation, non-model organism, phenotypic variation, reproductive isolation.

## INTRODUCTION

Ecological differences have long been recognized as having a key role in promoting speciation through natural selection (Darwin, 1859). Early studies on speciation were primarily descriptive and species were typically categorized based on phenotypic traits. Subsequently, reproductive isolation rather than simply phenotypic divergence came to be recognized as the critical indicator of speciation (Dobzhansky, 1937; Mayr, 1942). Modern studies use the term ‘ecological speciation’ to refer to a three-stage process that encompasses and links

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