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Genetic and demographic constraints on adaptation: insights from Integro-projection models and research challenges

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The concept of evolutionary potential is central to many questions in evolutionary biology and key in particular to our understanding of adaptation prospects to ongoing global changes. I will illustrate how understanding limits to adaptation necessitates to integrate together genetic and demographic constraints. I will deal with structured heterogeneous populations, where different individuals make different contributions to the demography and evolution of the population, because they belong to different stages in the life cycle, have a different age and size, affecting their growth, fecundity and survival. We use 30 years of demographic surveys in the endangered highly endemic plant Centaurea corymbosa to predict under which conditions boosting the genetic diversity through assisted gene flow could rescue the small declining populations from short-term extinction in an already too warm climate. Through this example, I will introduce Integro-Projection Models, which have become extremely popular in population dynamics studies in recent years, but are the subject of controversies about how evolution is integrated. These Integro-Projection models, which emerged from empirical research, have been explored exclusively numerically and are potentially an area of research where greater mathematical insight could lead to some breakthrough in their validation and use.

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