Critical genetic variance and evolutionary rescue in an organism with a complex life cycle.

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Résumé

Climate change causes the maladaptation and decline of many populations, which are therefore threatened with extinction. Some populations, however, manage to escape extinction by recovering a positive growth rate through rapid adaptation, a mechanism known as evolutionary rescue. Several theoretical studies showed that a large adaptive genetic variance initially present in the population favors evolutionary rescue, and that below a critical variance, rescue is unlikely. This theory mostly modeled homogeneous populations. However, many endangered populations are composed by individuals in different stages. Transitions between stages depend on life history traits that have different sensitivities to stresses and contribute differently to population growth, as measured by their demographic elasticities. Our aim was to determine how the distribution of genetic variance across different life history traits influences the probability of rescue of a stage-structured population. We used 25 years of monitoring of 6 populations of *Centaurea corymbosa* threatened with extinction, to parameterize a quantitative genetics model of evolution in a stage-structured population. In a first scenario where genetic variance is confined to a single trait, we identified for each population and for each life history trait, the range of genetic variances that allowed evolutionary rescue. We showed that the minimum amount of genetic variance allowing rescue is lower for the life history traits with the highest demographic elasticities and is higher in small populations. We then examined a multivariate case where all life history traits could evolve and found that, the amount of genetic variance leading to rescue is lower if the variance distribution is aligned with the largest elasticities. We also found that in some cases when variance on a first trait allows rescue, increasing variance on a second trait can lead to population extinction. Our study is a first step toward informing how conservation actions could use genetic variance measurements to prevent the extinction of populations threatened by climate change.

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Mots-Clés: evolutionary rescue, stage structured population, eco, evo dynamics, quantitative genetic, conservation, modelling