Analysis of the consequences of genetic rescue and its dependence on purging

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INTRODUCTION

- Many populations are affected by severe reductions in the effective population size (N_e), resulting in increased inbreeding and reduced fitness (**inbreeding depression**; Charlesworth & Charlesworth, 1999).
- When evaluating conservation strategies, the role of natural selection (**genetic purging)** against those deleterious alleles exposed by inbreeding (inbreeding load) is often neglected, despite it has been proven to be efficient with moderate N_e (García-Dorado, 2012).
- The introduction of individuals from another population (**genetic rescue program**) has resulted in multiple occasions in short term population recovery, but there is very little information about its consequences in the medium to long term (Whiteley *et al.*, 2015).
- One of the **risks** is the introduction of rare detrimental variants (Hedrick & García-Dorado, 2016).

The present work aims to explore the role of genetic purging as a determinant of the circumstances where a genetic rescue program should or should not be recommended.

COMPUTER SIMULATION

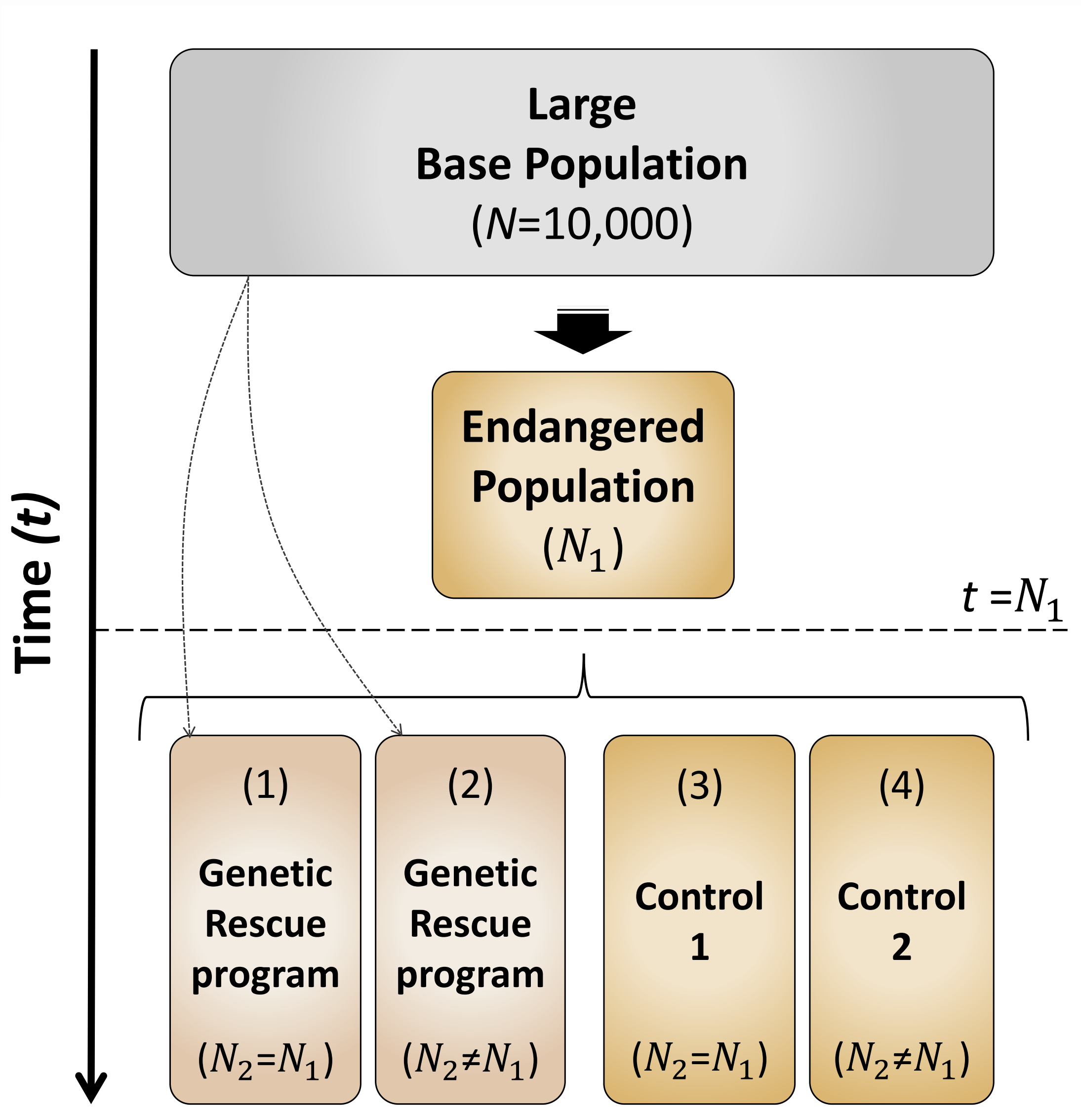


Figure 1. Simulation scheme. A small number of individuals (N_1) is sampled from the base population to fund a threatened population (TP). After $t = N_1$ generations, four different scenarios are simulated from the original TP: (1) TP enters a genetic rescue program maintaining the same constant size ($N_2 = N_1$); (2) TP enters a genetic rescue program but the size is simultaneously modified to another value ($N_2 \neq N_1$); (3) and (4) are controls (without a genetic rescue program) of the first and second scenario, respectively. Horizontal dashed line indicates the start of the rescue program.

Table 1. Mutational parameters (gamma distributed) (López-Cortegano *et al.*, 2018).

λ	$\bar{s}$	*Shape*	$\bar{h}$	*B*
0.2	0.2	0.33	0.283	6.23

CONCLUSIONS

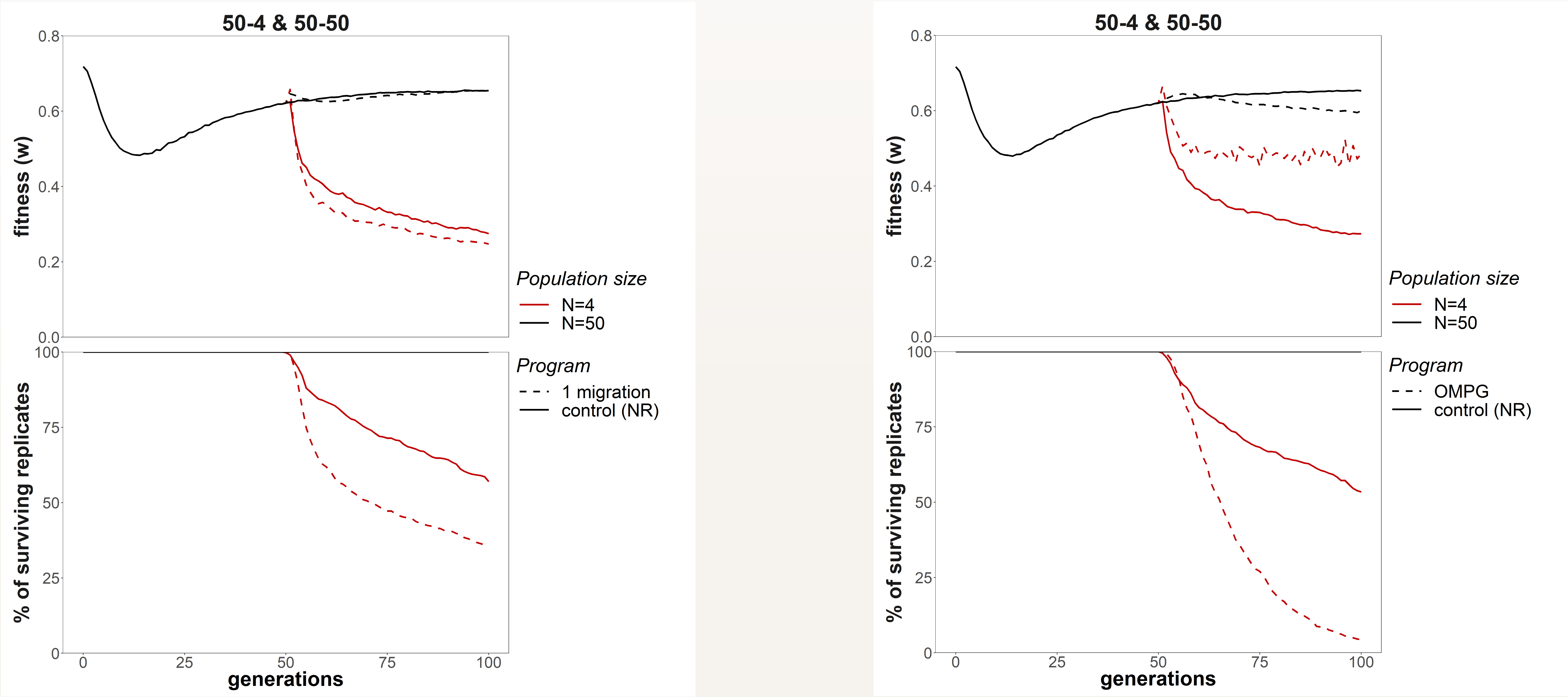
- Migration results in a transient hybrid vigor and an increase in genetic diversity, but also of the inbreeding load (*B*).
- With moderately effective population sizes (e.g. N_e=50) purging is able to efficiently reduce the inbreeding load, but not with very small sizes (e.g. N_e=4).
- If the endangered population had previously suffered a drastic reduction of size, migration will produce an initial hybrid vigor. If the size recovers quickly after migration, the introduced inbreeding load will be efficiently purged, with a **positive fitness effect** (not shown).
- If the endangered population comes from a period of moderate size, migrants can bear higher genetic load than native individuals, with a **negative effect** if the population size becomes smaller.
- **Extinction risk** increases due to genetic stochasticity introduced by each migration event.

Our results illustrate the need of recovering reasonable population size during rescue programs and of restoring connectivity systems that can alleviate the consequences of migration stochasticity.

RESULTS

Occasional migration

One Migrant Per Generation



Figures 2 and 3. Evolution of fitness (*w*) and percentage of surviving replicates of endangered populations entering a genetic rescue program (migration of 5 males if N_2=50, and 1 male if N_2=4; dashed lines) and of control populations (solid lines).

References

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