

# Model-based demographic inference of recent invasions from genomic data

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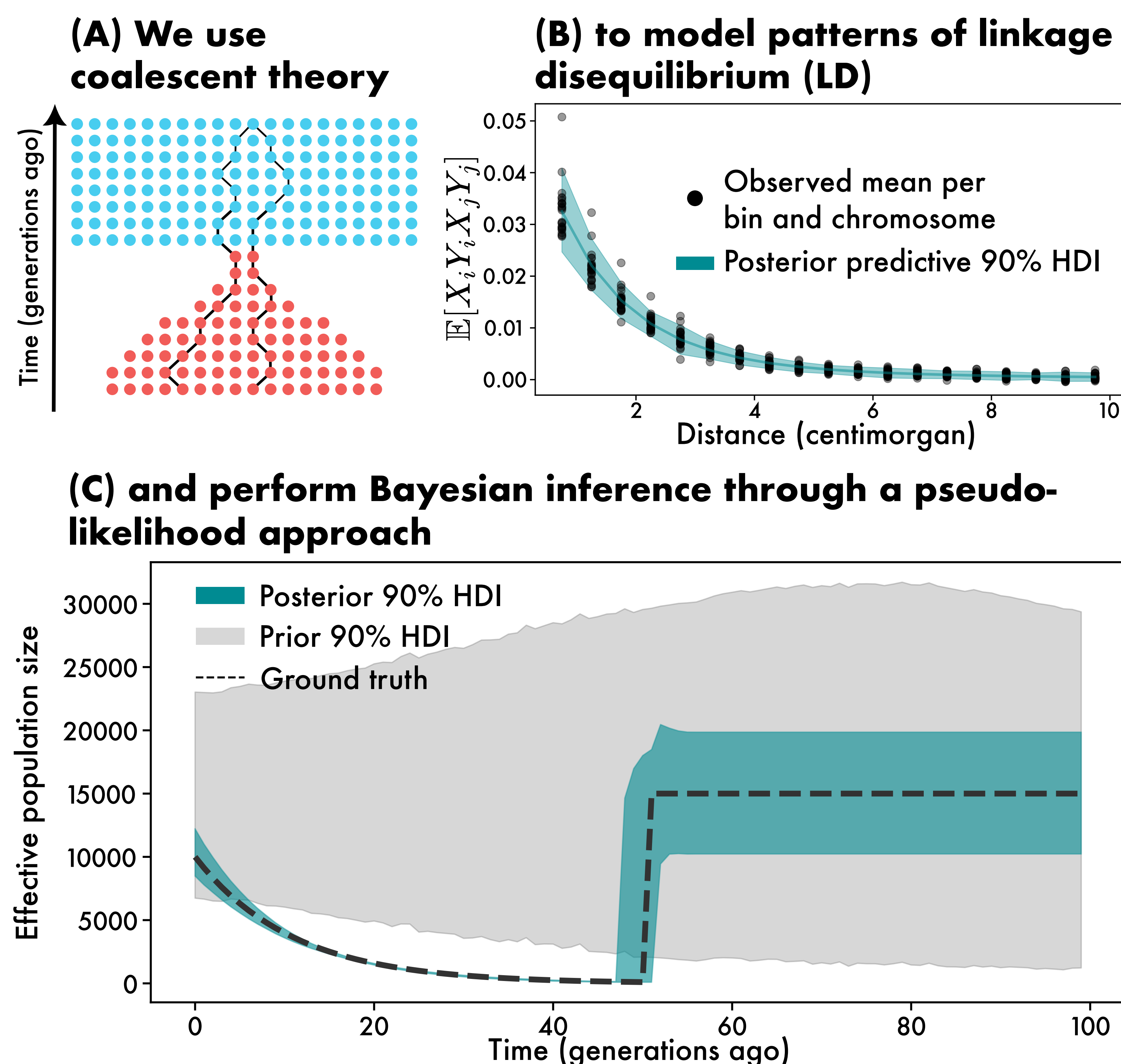
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## Introduction

- Biological invasions are a major threat to biodiversity but also can be viewed as large-scale, unplanned experiments on how populations adapt to novel environments.
- Accurate estimates of recent effective population size ( $N_e$ ) can guide conservation management plans and help disentangle the effects of selection and demography on genetic variation.
- Existing methods to infer very recent effective population size are not well-suited for realistic invasion scenarios.

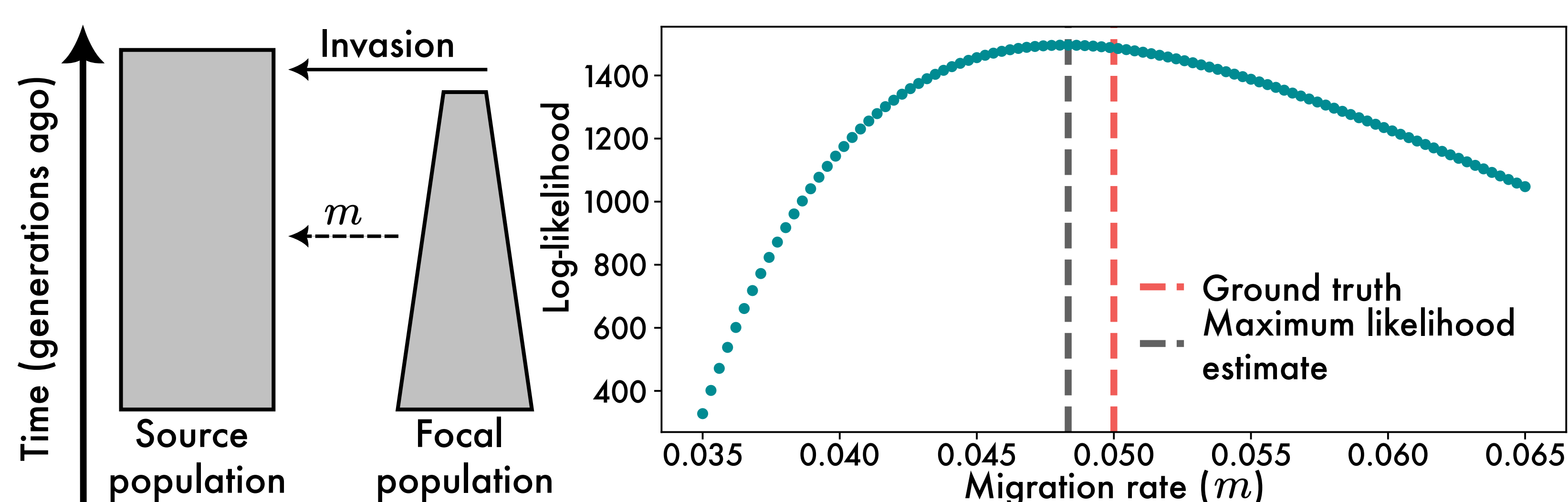
## Theoretical framework

We propose a method to infer recent evolution in  $N_e$  that can incorporate relevant prior information of the invasion process and the source population.



## Modelling multiple introductions

Multiple introductions are common in biological invasions, although difficult to model. In order to accommodate them, we leveraged recent advances in inhomogeneous phase-type distributions to compute approximate likelihoods.



Preliminary results suggest we can estimate the migration rate  $m$  from LD data of the focal population solely. However, the posterior distribution for all other parameters is highly multimodal and raises concerns about identifiability.

## Method comparison

The proposed method works better than existing state-of-the-art methods, at least in part because it does not penalize an abrupt change in  $N_e$  at the beginning of the invasion.

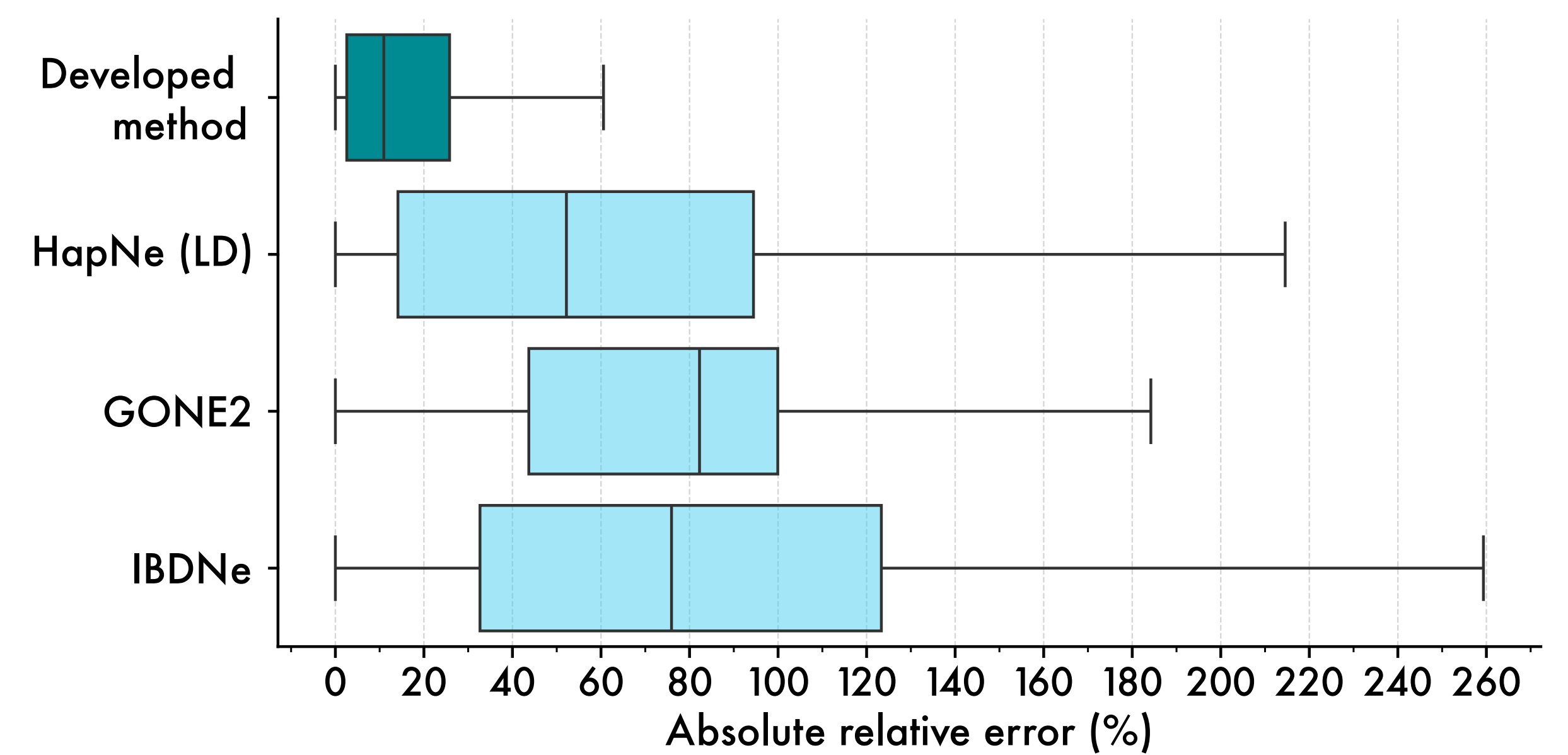
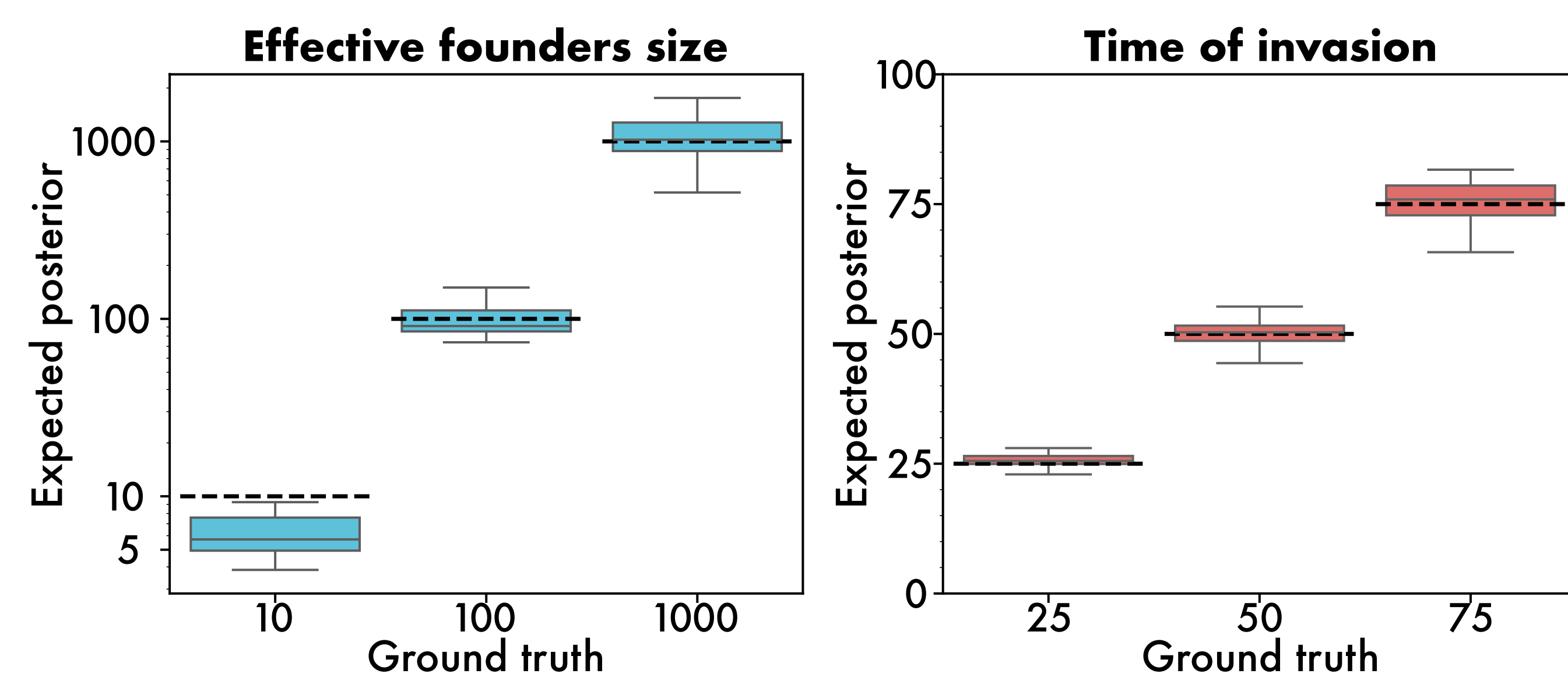


Figure 2: We computed the absolute relative error of  $N_e$  across the last 100 generations in 9 demographic scenarios (25 replicates each). Each dataset consisted of 200 diploid individuals and 25 chromosomes. HapNe-IBD has higher error than other methods (not shown).

## Estimating key parameters

The time of invasion and the order of magnitude of the effective founder size can be estimated precisely, even without any *a priori* knowledge of the source population.



## Take home message

- Model-based methods based on LD data can provide better estimates of demographic parameters for invasion scenarios than existing methods.
- Recent advances in computational and statistical methods enable modeling more complex demographic scenarios and going beyond overly simplistic models.



More information and code on GitHub

