How Does Genetic Divergence Affect the Success of Hybrids Colonizing a Novel Environment?

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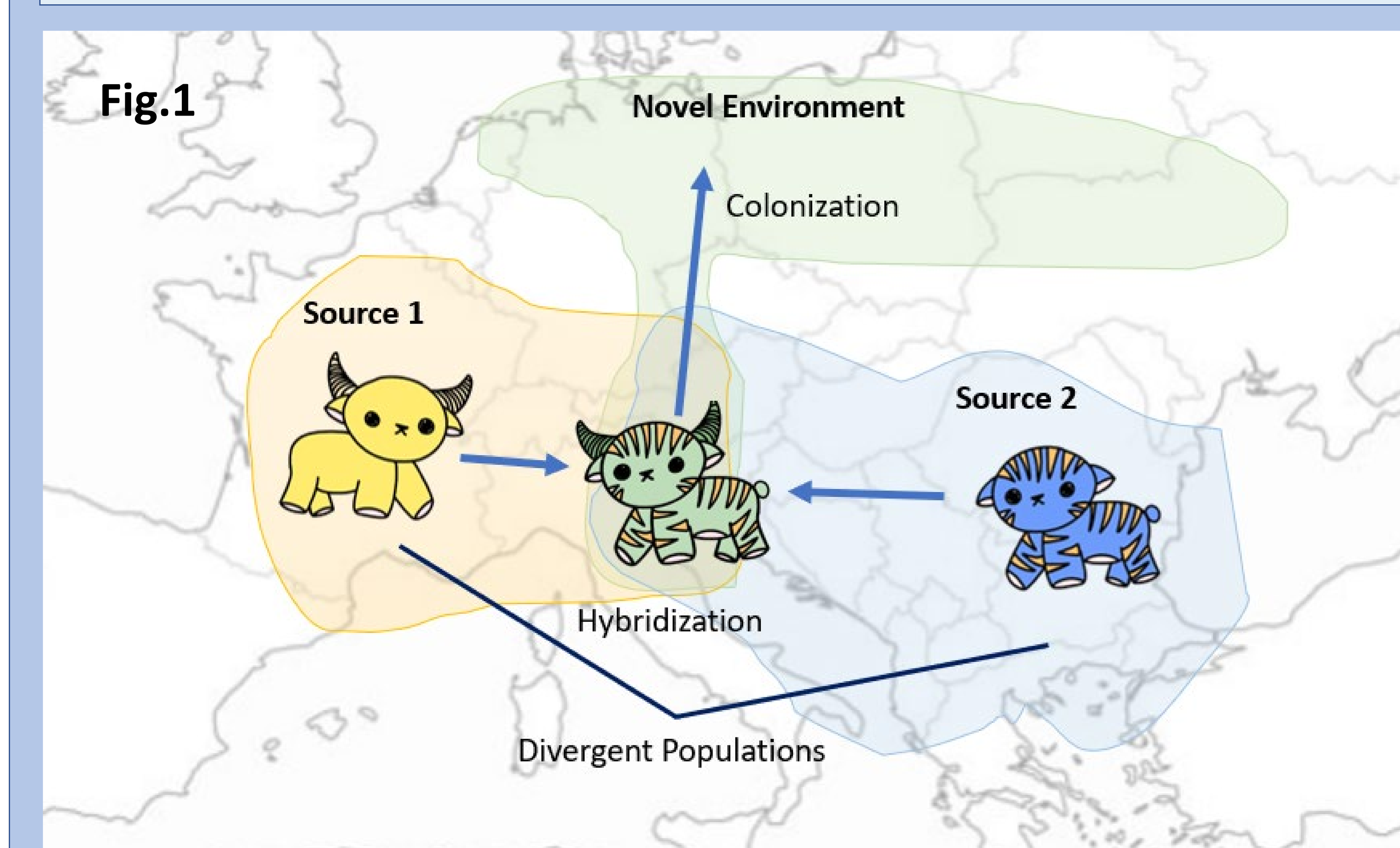
Hybrid colonization is when the offspring of two species colonizes a novel environment

- Hybridization colonization is thought to often lead to invasive populations which can disrupt ecosystems

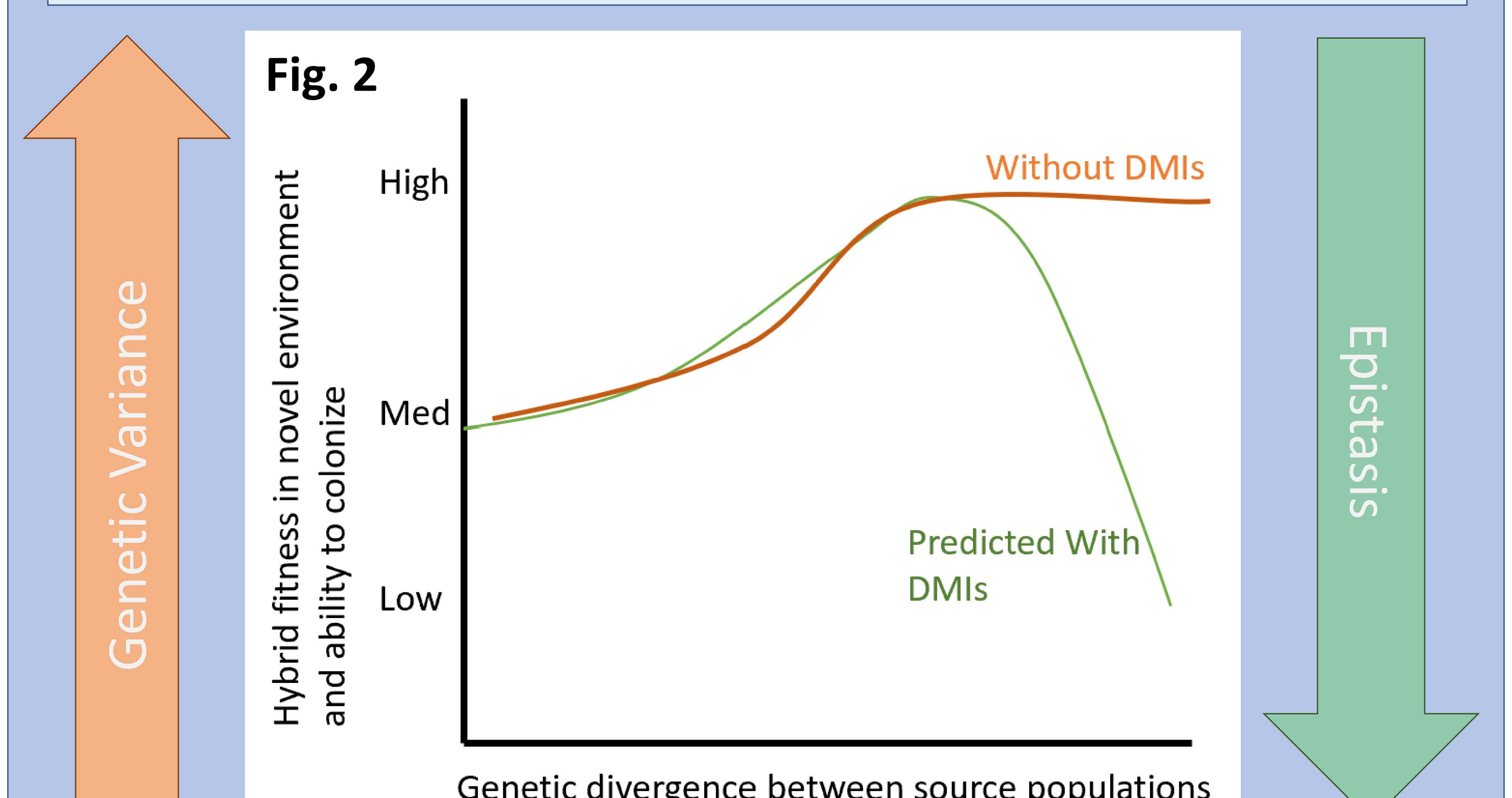
Fig.1



Do negative genetic interactions in hybrid populations decrease their ability to colonize novel environments?

- Ref. 1 established that an increase in divergence increases probability for colonization success using an individual-based population genetic model
- Greater divergence between hybridizing populations results in increased genetic variance, increasing a hybrid population's ability to colonize a novel environment [Ref. 1]
- We wish to test the hypothesis that greater divergence also leads to negative genetic interactions (Fig. 2) which should reduce the viability of a hybrid population and thus its colonization success

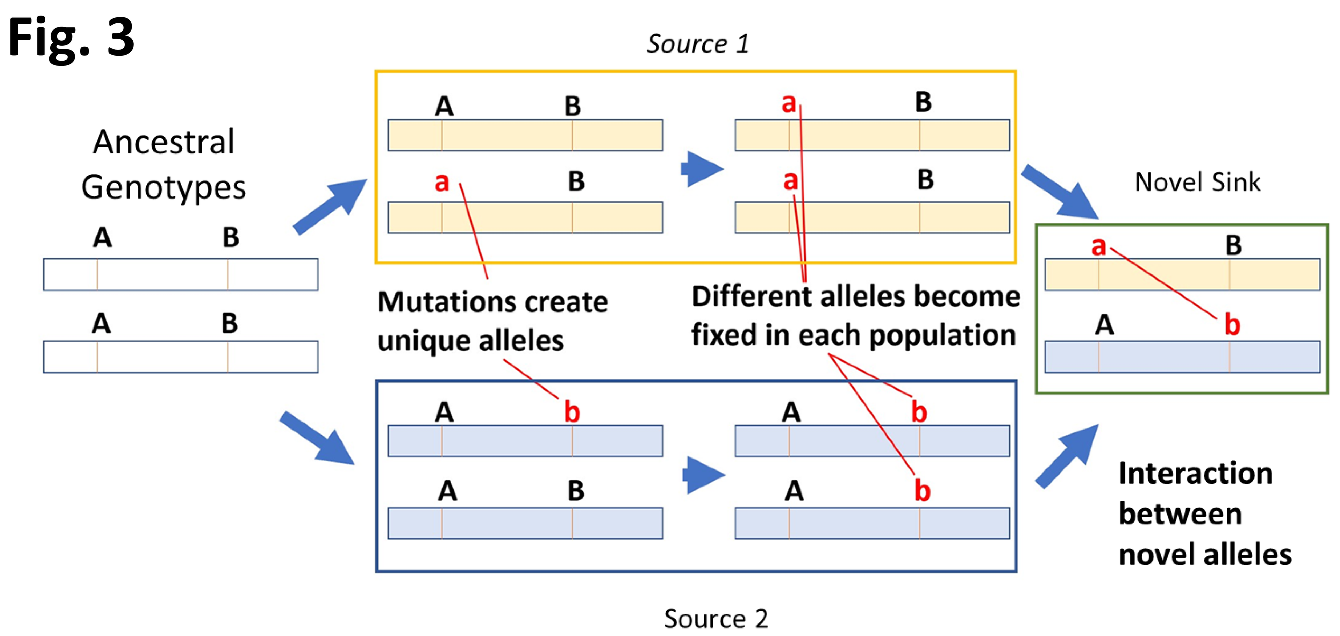
Fig. 2



Genetic divergence can lead to accumulation of negative genetic interactions known as Dobzhansky–Muller Interactions (**DMIs**)

- DMIs can arise when two divergent populations (sources) fix novel alleles at two different interacting loci
- The populations can hybridize in a novel sink (Fig. 3)
- The novel a and b alleles, never having been exposed to natural selection together, may have negative genetic interactions that cause reduction in fitness

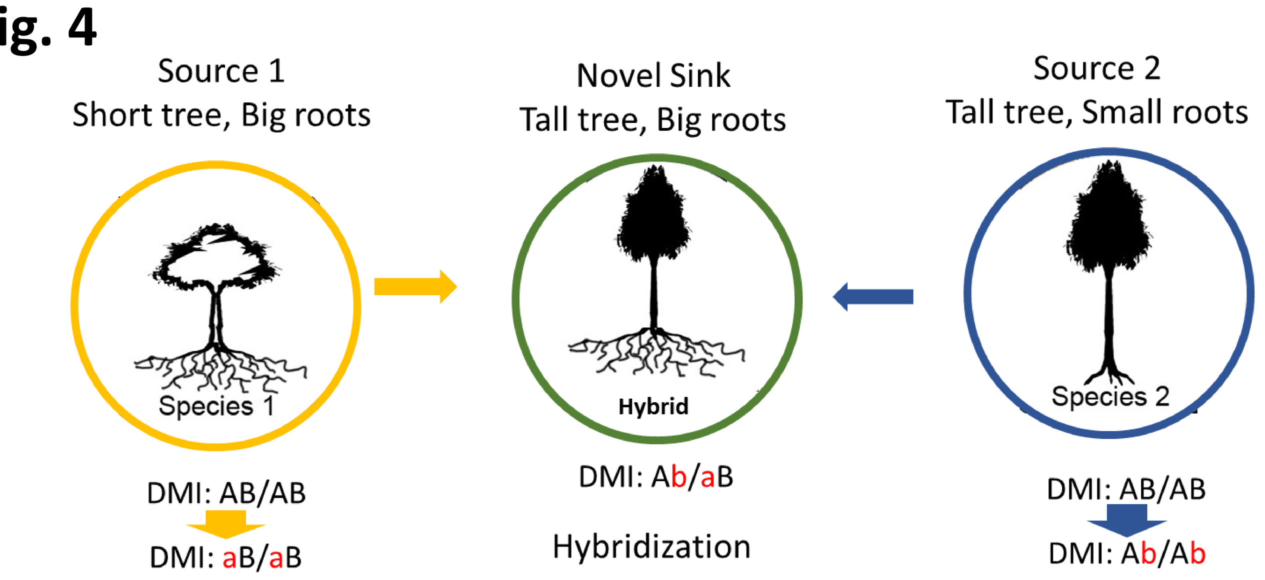
Fig. 3



We simulate hybrid colonization in an individual-based population genetic model [Ref 2]

- Here, we introduce additional loci at which DMIs may evolve as the source populations diverge
- We compare models in which we vary the levels of positive selection that facilitates the fixation of individual DMI alleles and negative selection on their pairwise interactions
- Following Ref. 1, contrasting adaptive optima in the two source populations ensure that only hybrids can colonize the sink

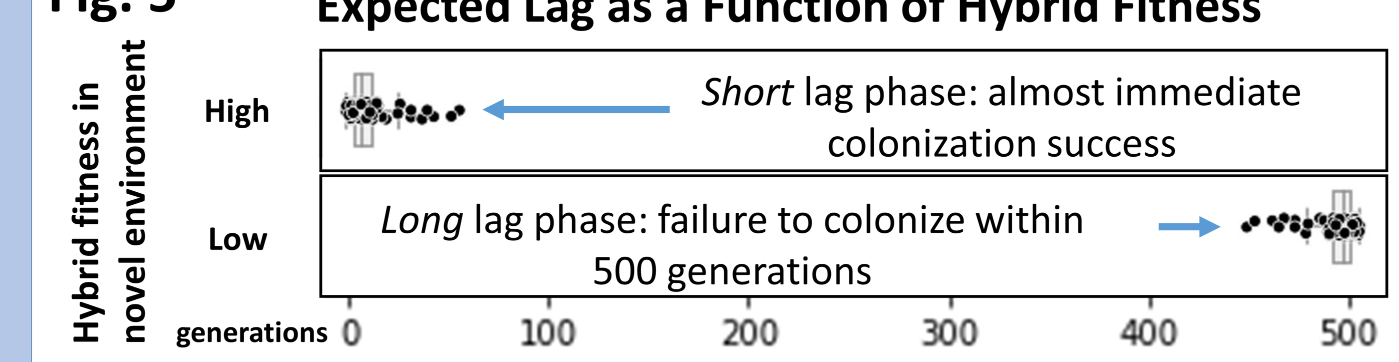
Fig. 4



We measure the **lag phase** as an indicator of colonization success

- Lag phase is the number of generations of dispersal before the sink reaches carrying capacity (successful colonization)
- If the hypothesis is correct, the lag phase would be longer when DMIs have been allowed to evolve in the source populations
- Fig. 5 shows a hypothetical outcome. Each point represents the lag phase of one replicate

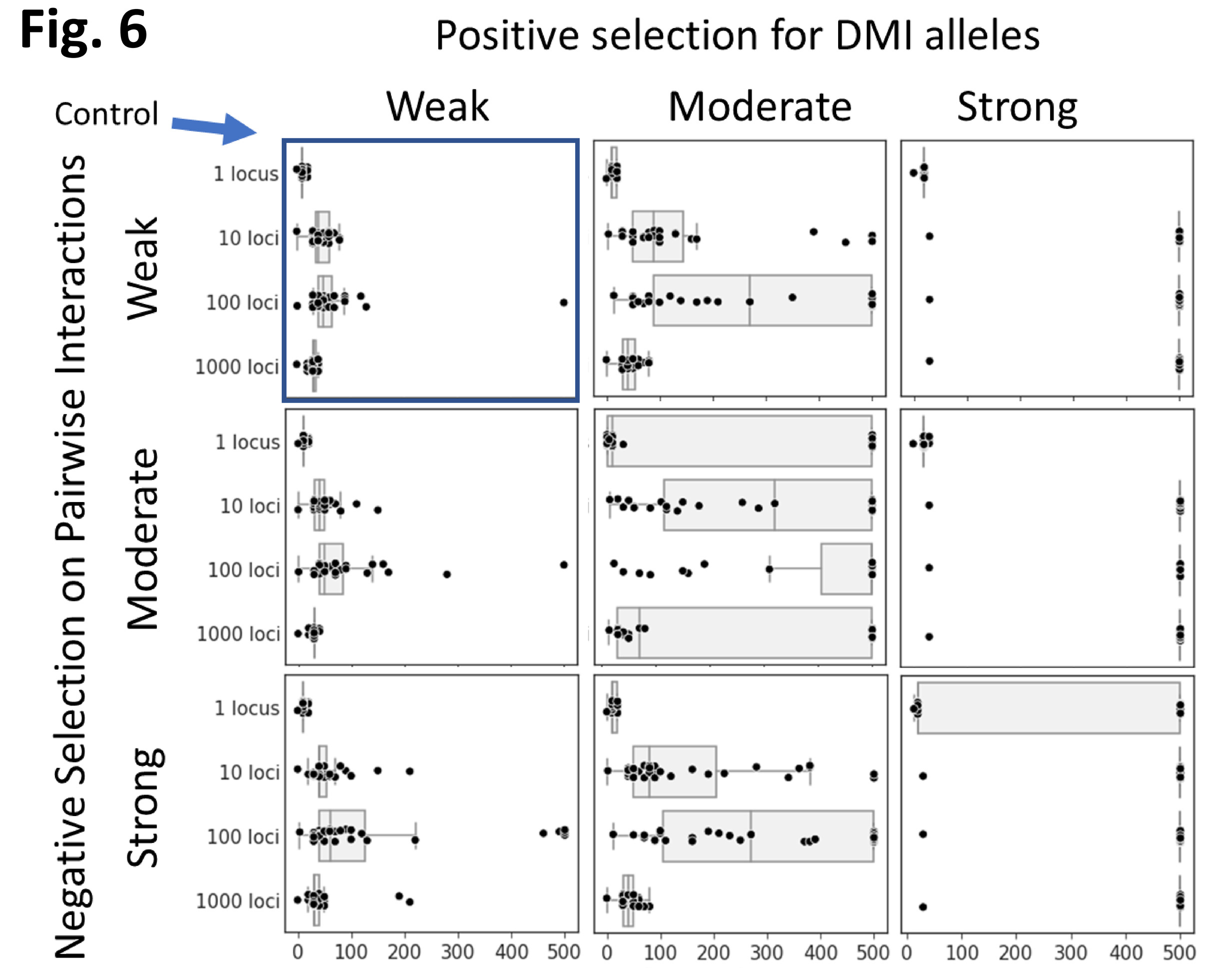
Fig. 5



Negative genetic interactions do reduce colonization success of hybrids between divergent populations

- Lag phase was affected both by strong positive selection for individual DMIs and strong negative genetic interactions (Fig. 6)
- Results varied based on number of loci contributing to non-DMI trait

Fig. 6



Conclusions

- As predicted (Fig. 2), success of hybrid colonization is reduced by DMI alleles arising in the source populations
- DMIs evolve only rarely without positive selection for DMI alleles
- The effect is only seen for the strongest negative genetic interactions in this model

References

1. Reatini and Vision, *Evolution* 74, 1590 (2020)
2. Neuenschwander *et al.*, *Bioinformatics* 24, 1552 (2008)