



Preserving evolutionary potential:
the role of genetic rescue

Jill Hamilton

North Dakota State University

Genetic consequences of rarity

**Genetic
variation**

Inbreeding depression
Outbreeding depression

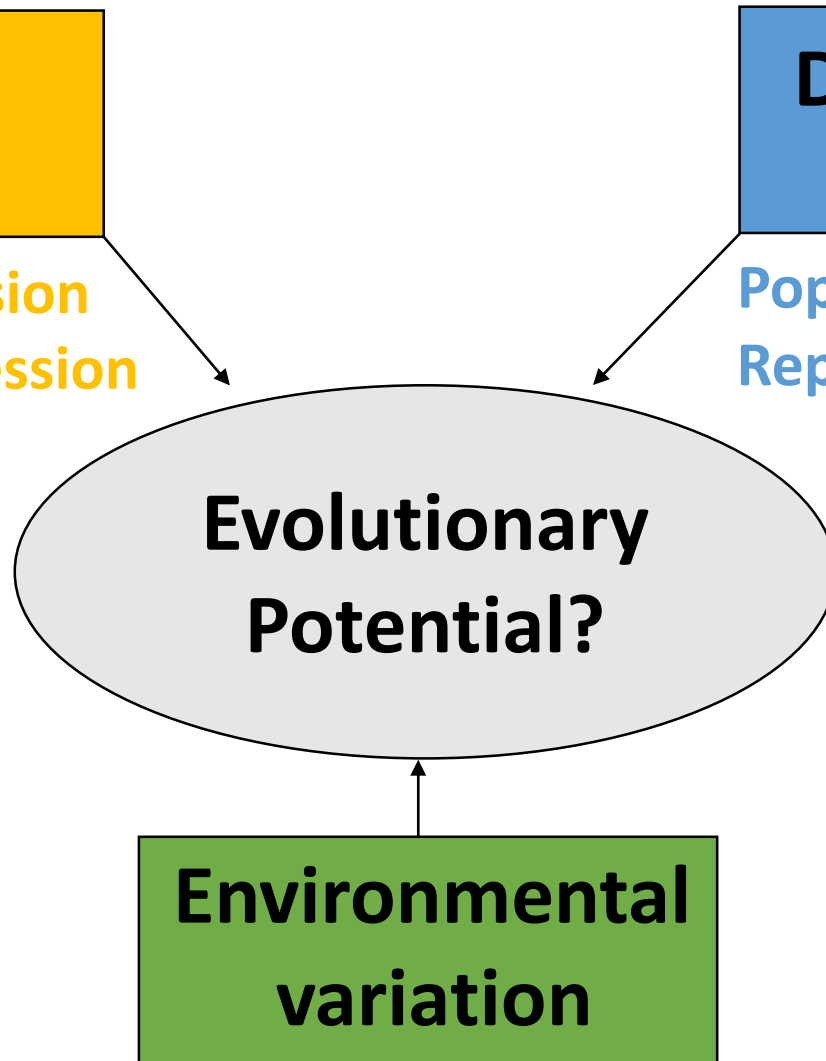
**Demographic
variation**

Population growth rate
Reproductive rates N_e

**Evolutionary
Potential?**

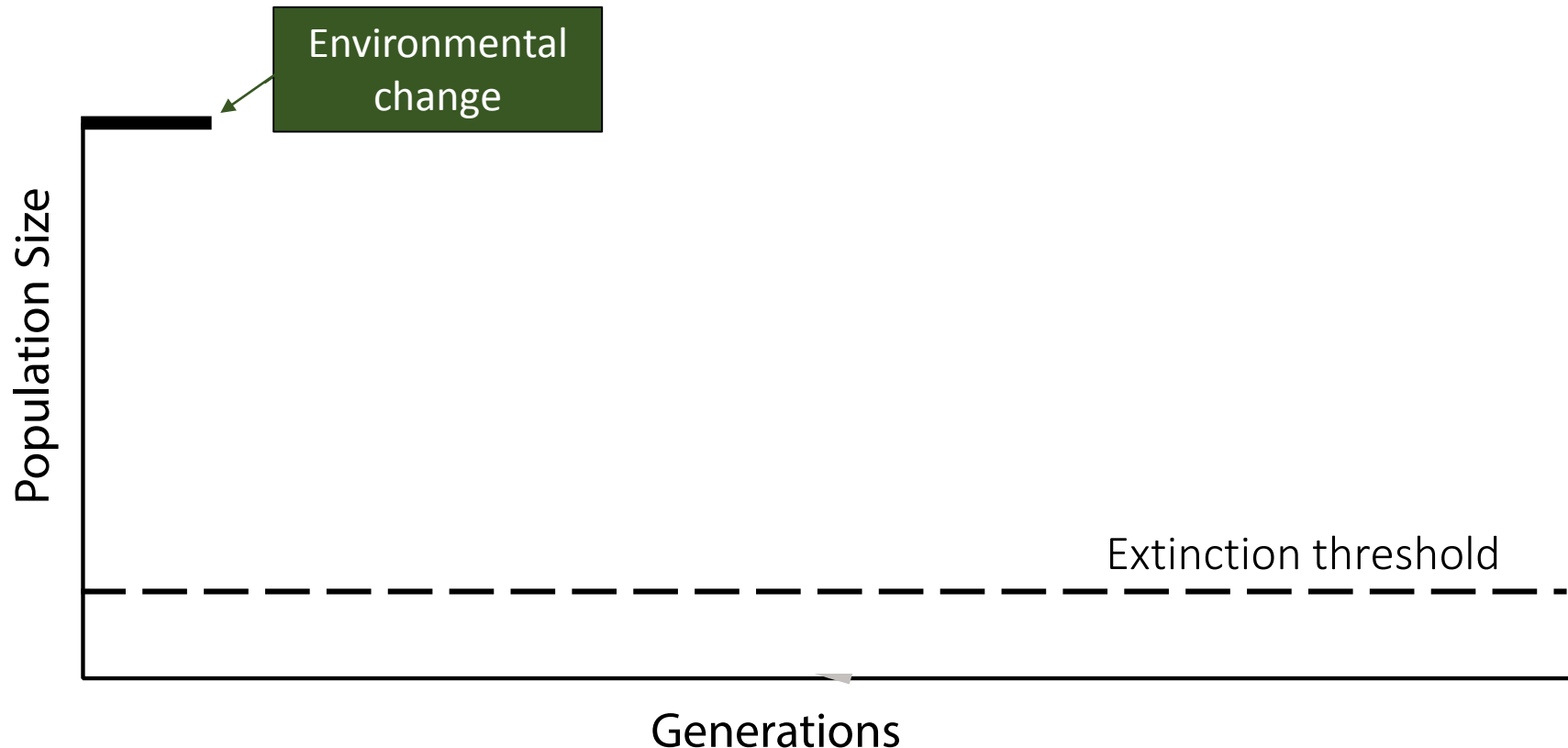
**Environmental
variation**

Fluctuations Disease Stress

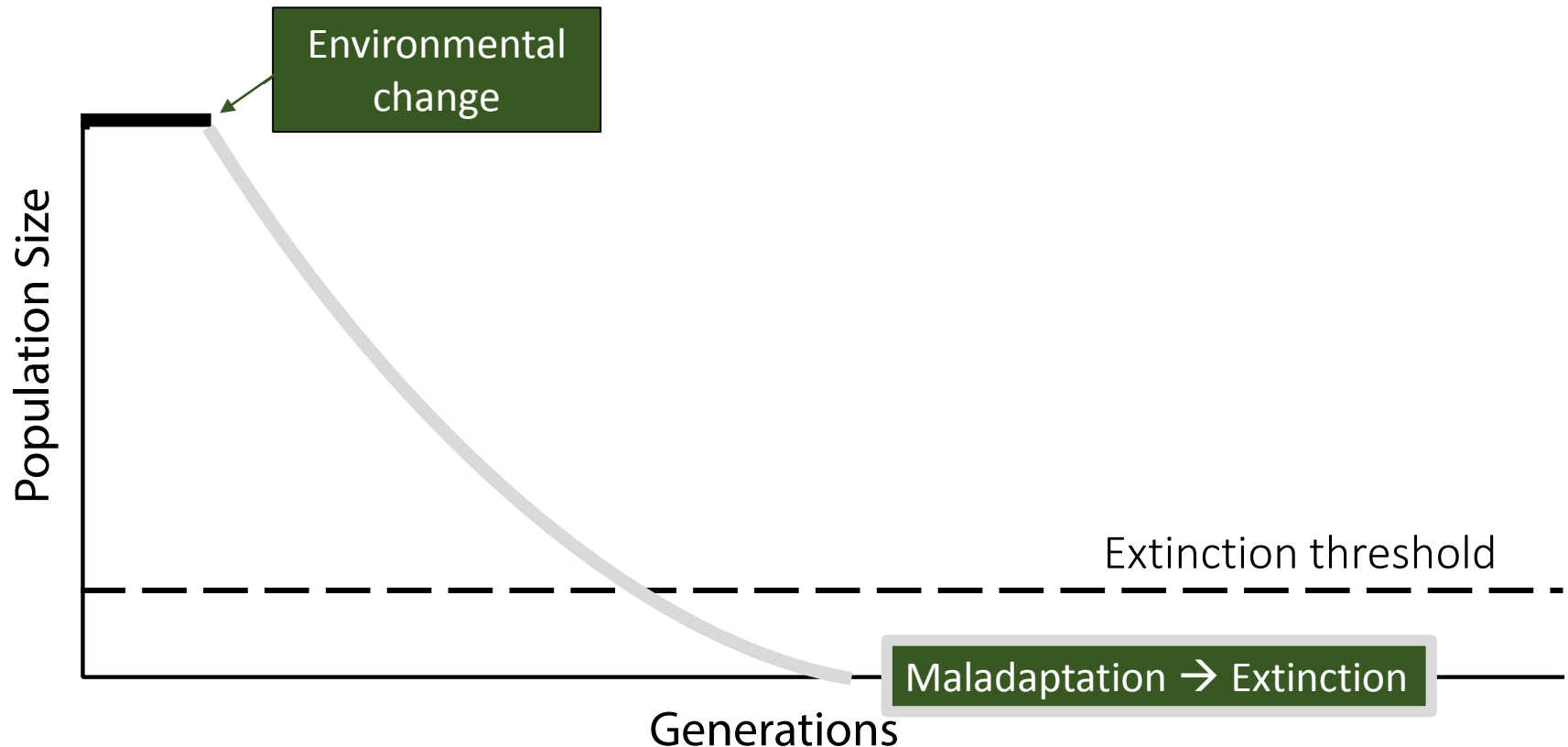


How might genetic rescue impact a species evolutionary potential?

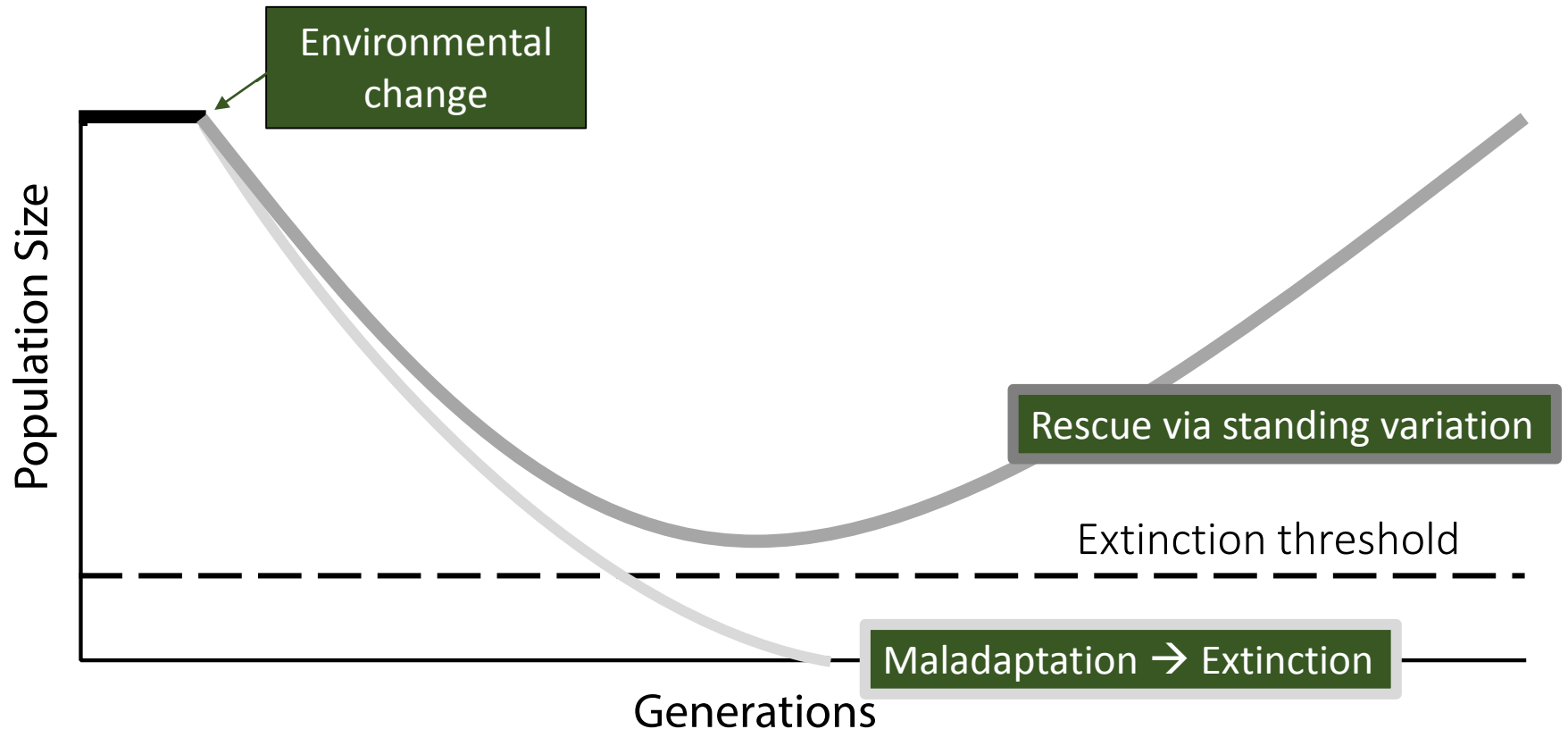
Natural or facilitated introduction of genetic variation from unrelated individuals with an aim to increase population fitness



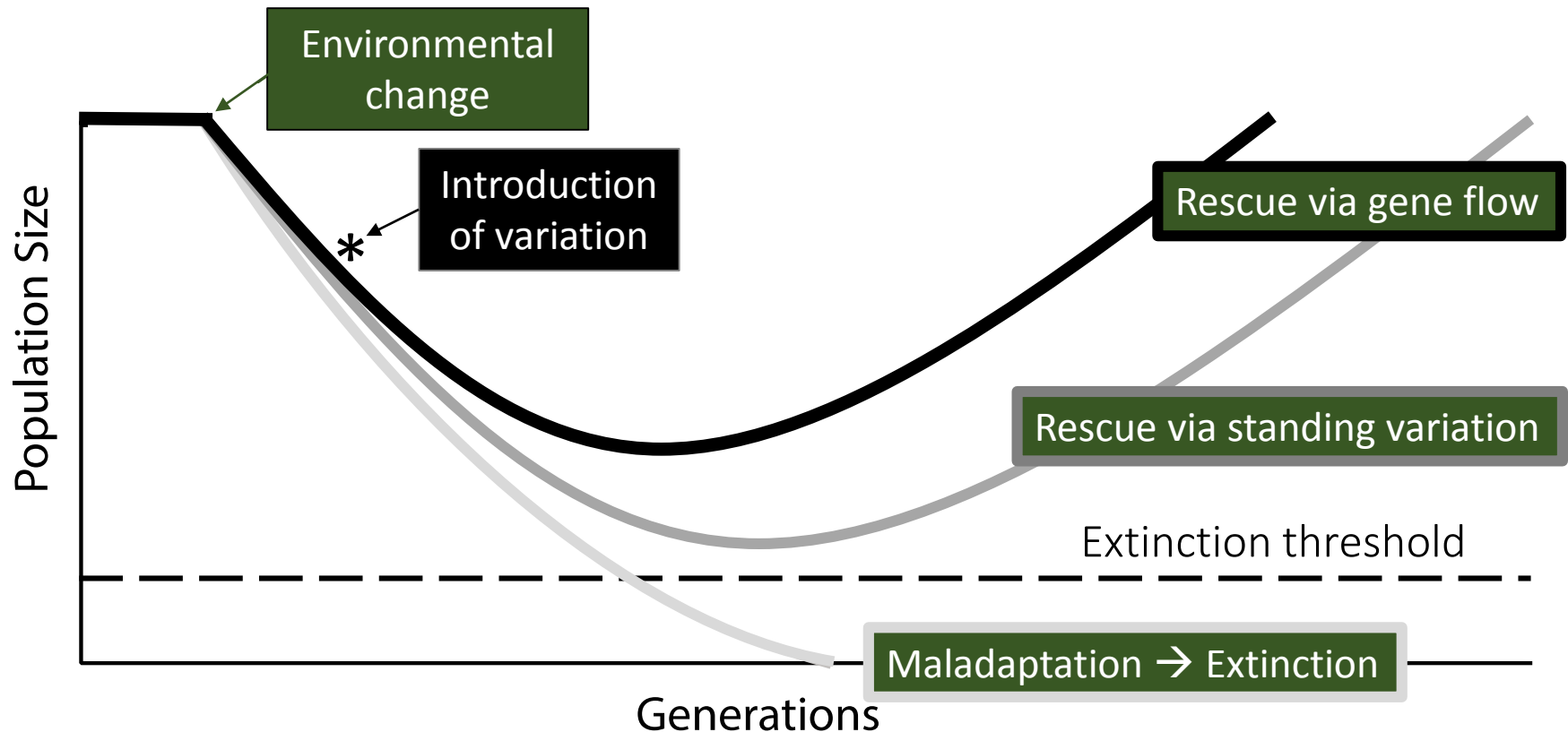
Maladaptation to changing conditions could lead to extinction



Evolutionary rescue from standing genetic variation



Gene flow reduces demographic consequences of maladaptation





One of the rarest pine species in the world, Torrey pine is restricted to one mainland and one island population

Santa Rosa Island

an expanding population



Torrey Pines State Reserve

abiotic and biotic challenges



Genetics: exceptionally low levels of genetic diversity in a conifer

- 59 allozyme gene loci surveyed by Ledig and Conkle (1983)
- Chloroplast gene sequences revealed only a few between population variable sites (Whittall et al. 2010)



Genetic uniformity may leave trees vulnerable to
pests, pathogens and environmental change

(Ledig and Conkle 1983)

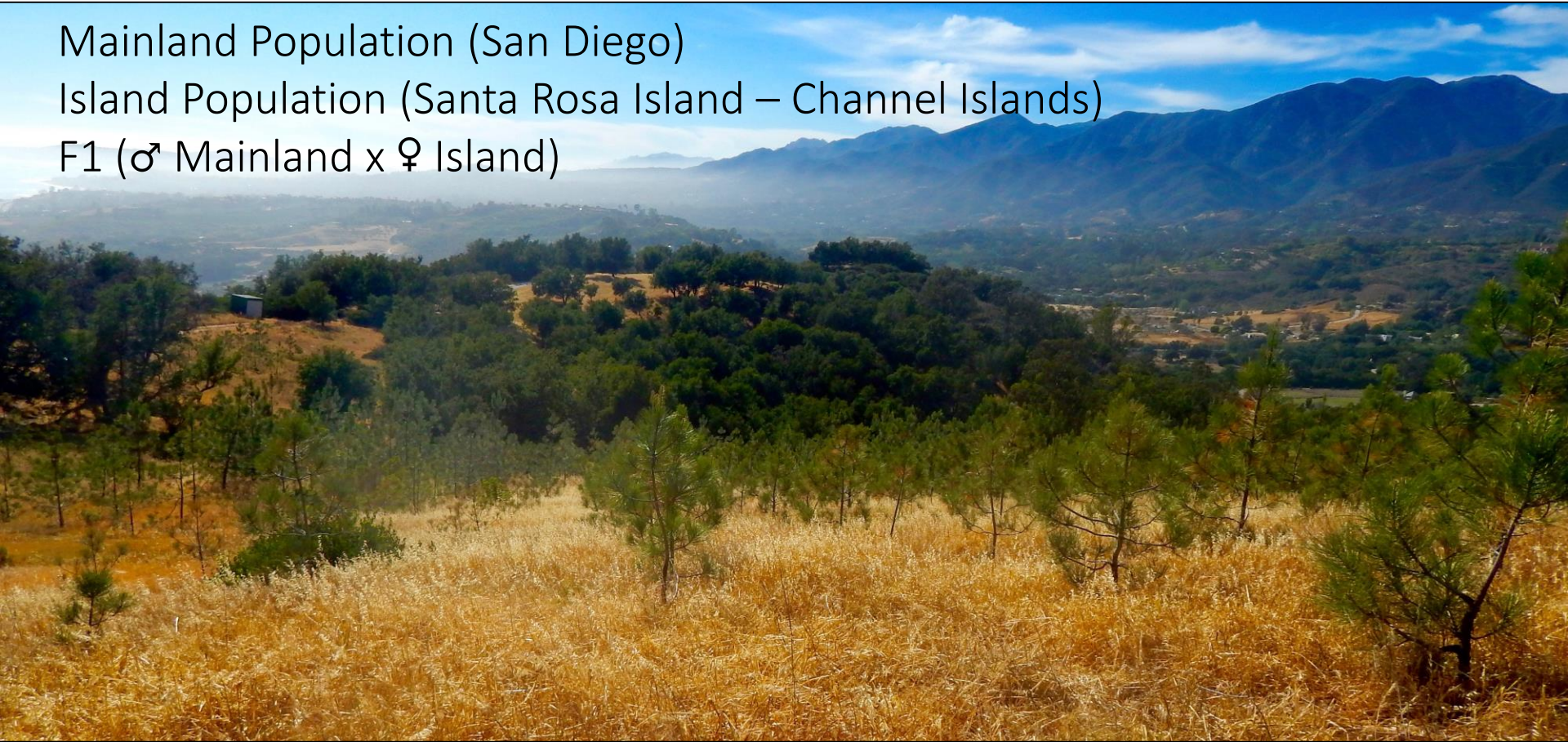
Common garden experiment:

Permit evaluation of fitness variation within and among
Mainland, Island and F1 individuals in a common environment

Mainland Population (San Diego)

Island Population (Santa Rosa Island – Channel Islands)

F1 (♂ Mainland x ♀ Island)

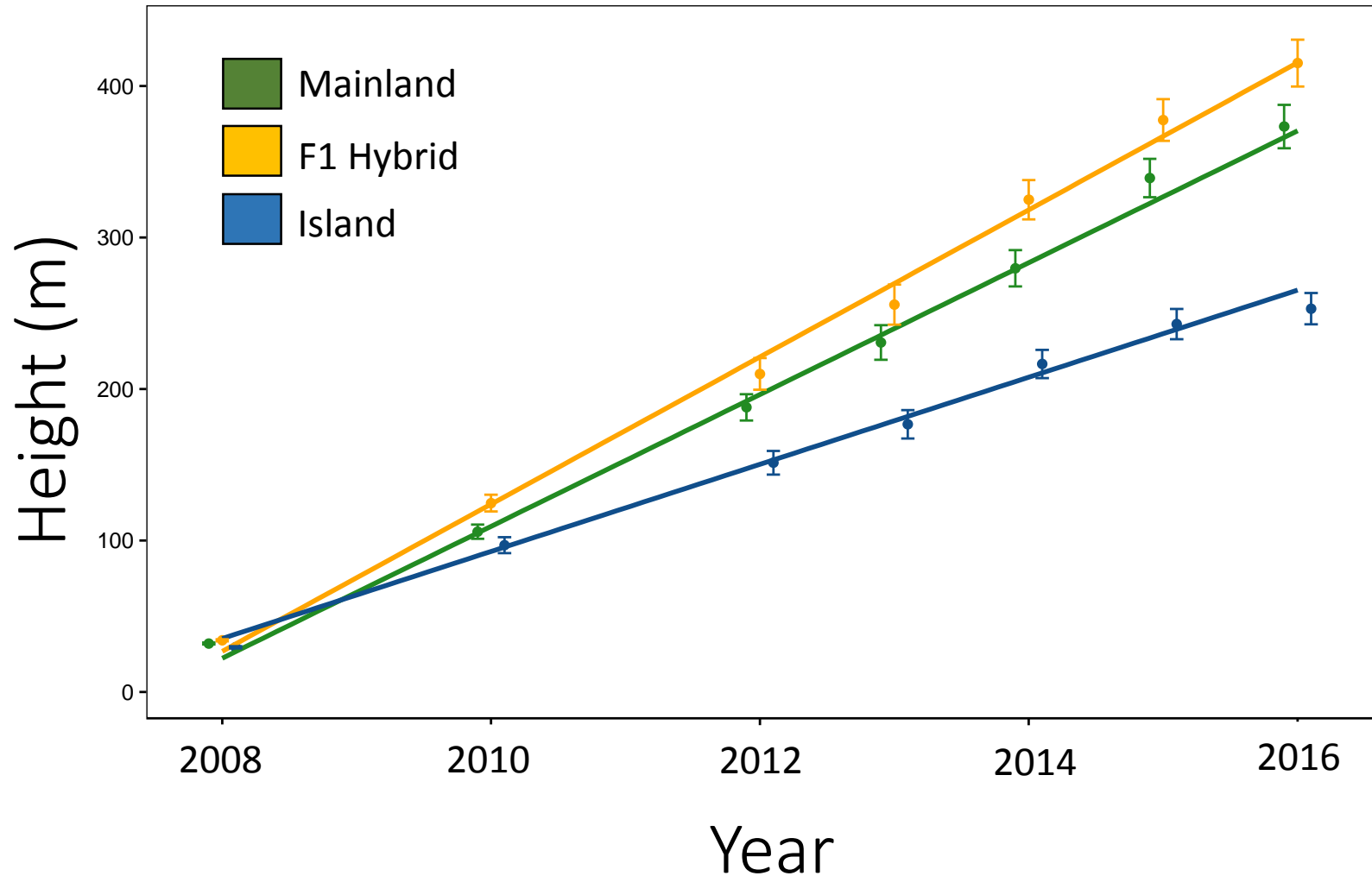


Is Torrey pine a candidate for genetic rescue?

Is there variation within populations? Are hybrids more 'fit'?
and what does this mean to conserving evolutionary potential?

Distinct growth trajectories across time

Will the mainland population 'catch up' to the hybrids?

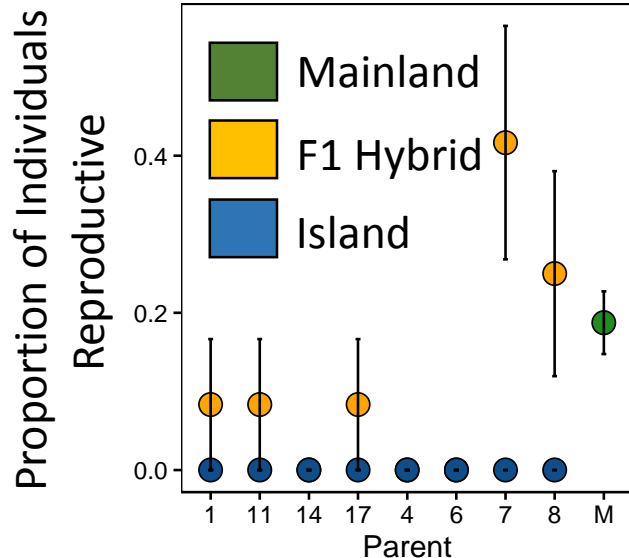


How has reproductive output changed over time?

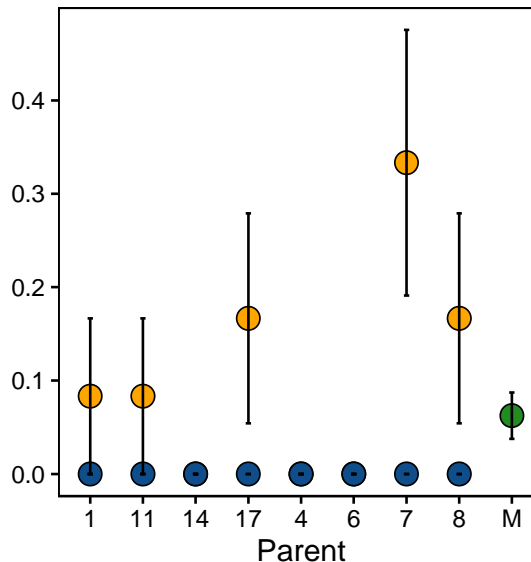


Increase in the mean frequency of conelets produced per maternal tree over time in hybrid and mainland trees

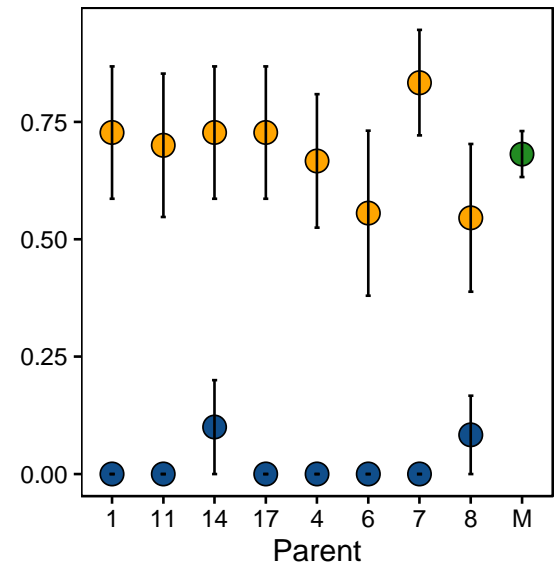
2013



2014



2015



Gap in knowledge: the consequences of genetic rescue in the short and long-term?

- Is fitness observed in F1s maintained in advanced generation Torrey pine (F2s and beyond)?
Opportunity: compare fitness across parent, F1, F2, BC-X progeny in a 2nd generation common garden
- Is there inbreeding in native populations of Torrey pine?
Opportunity: use genomic data to evaluate inbreeding and regions of the genome exhibiting excess homozygosity
- Have barriers to reproduction evolved between populations?
Opportunity: common garden and crossing experiments to evaluate environmental and non-environmental barriers

Key to conservation of rare species: building collaborative partnerships



Thank you to all individuals across institutions that continue to make this research possible