



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  $N_e$

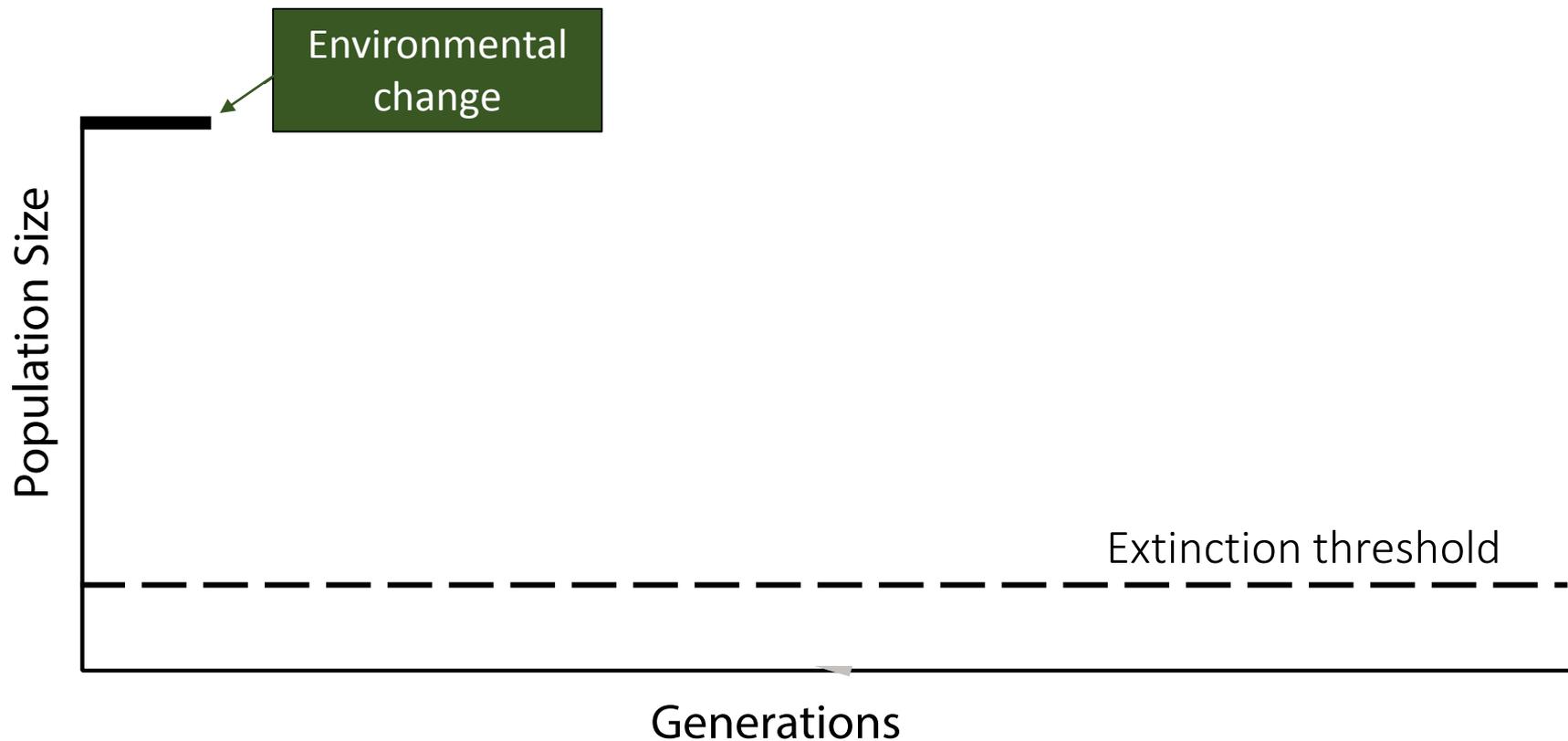
**Evolutionary  
Potential?**

**Environmental  
variation**

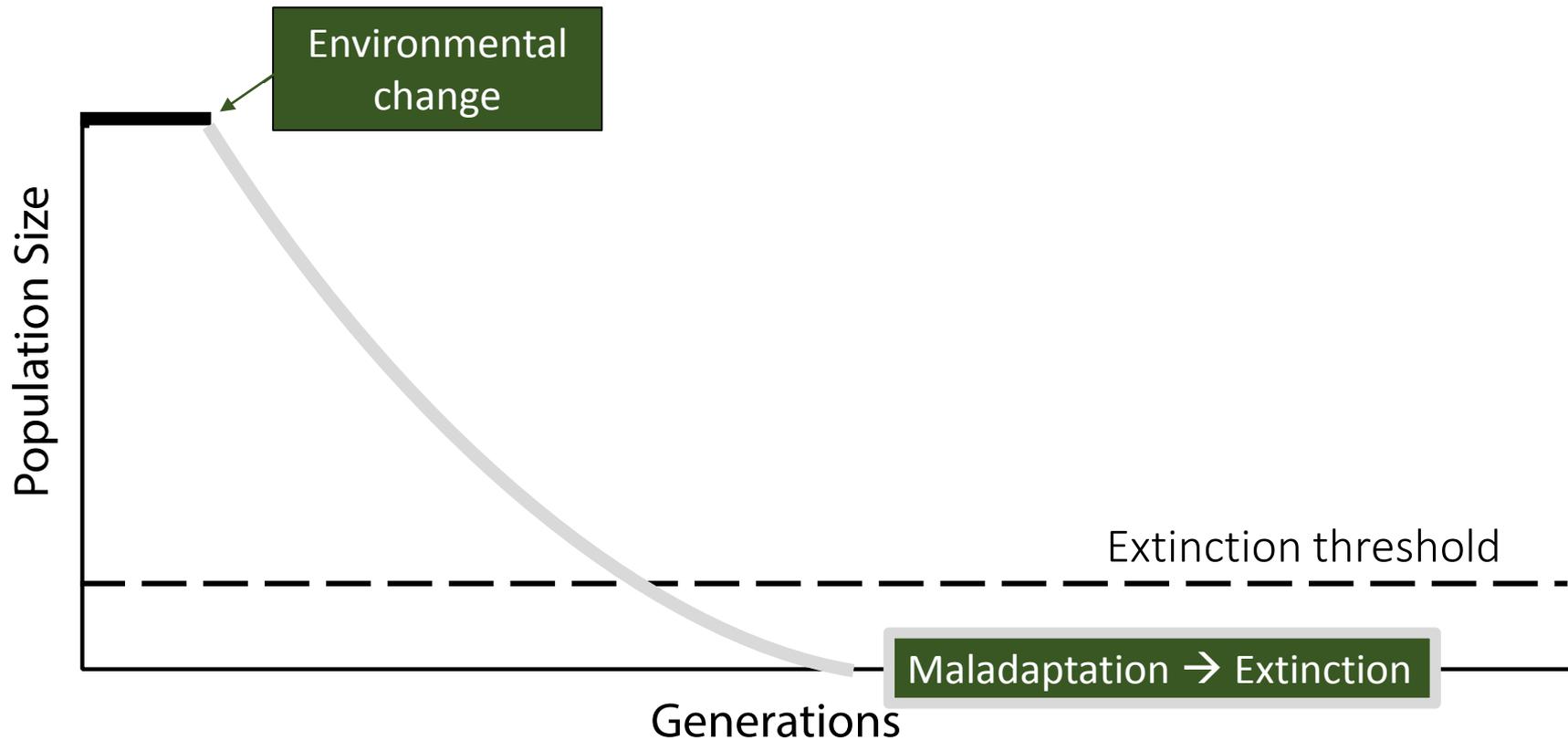
Fluctuations Disease Stress

# How might genetic rescue impact a species evolutionary potential?

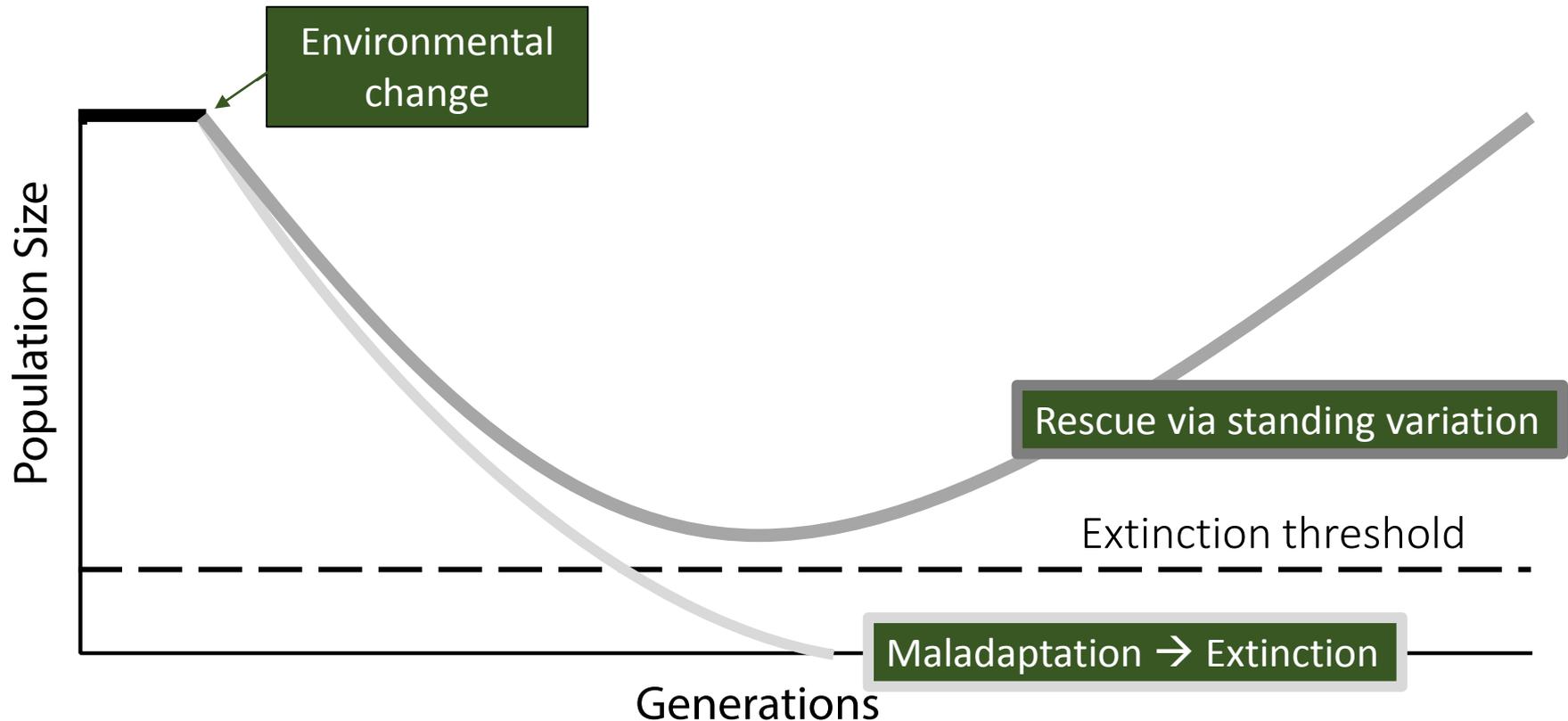
Natural or facilitated introduction of genetic variation from unrelated individuals with an aim to increase population fitness



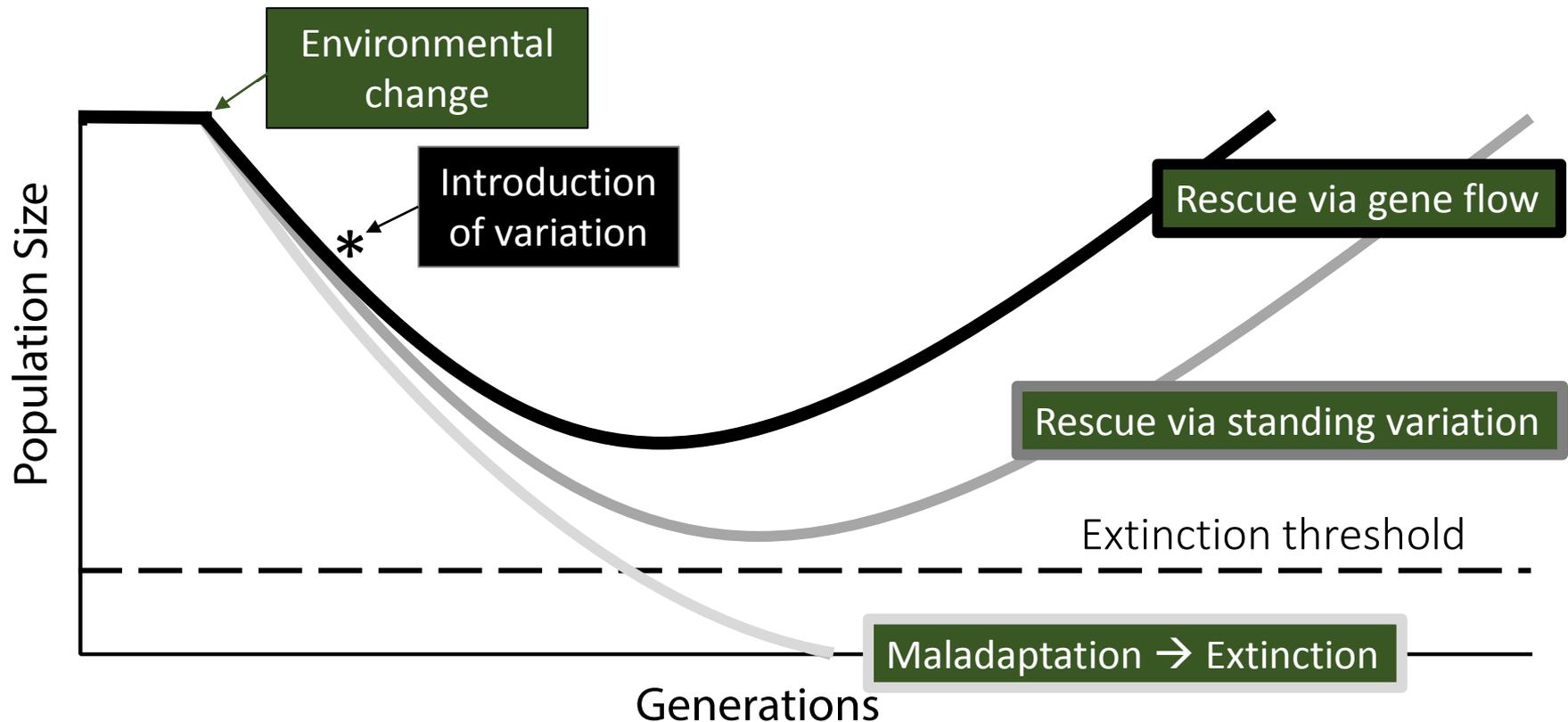
# Maladaptation to changing conditions could lead to extinction



# 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)

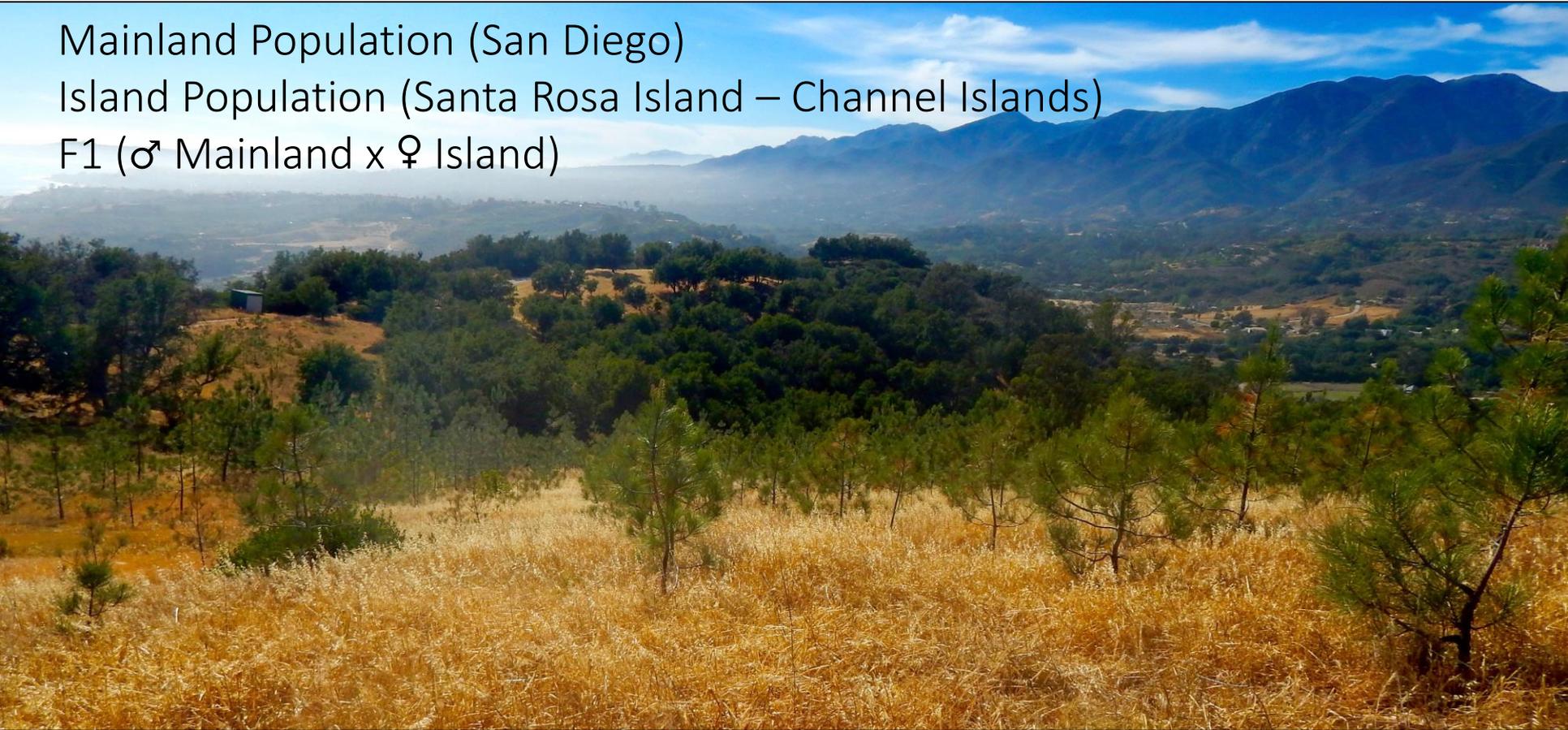
# Common garden experiment:

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)

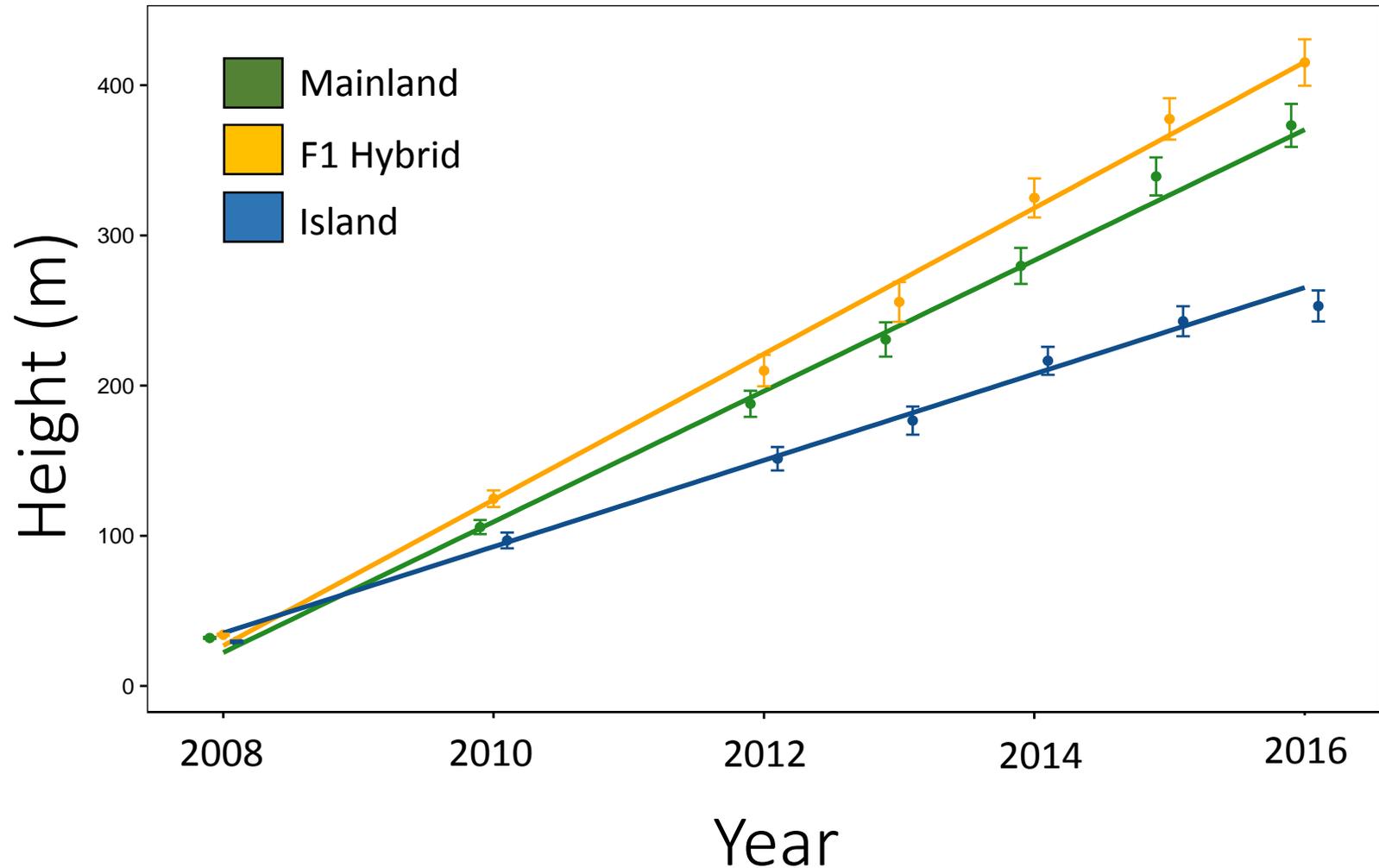


Is Torrey pine a candidate for genetic rescue?

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?

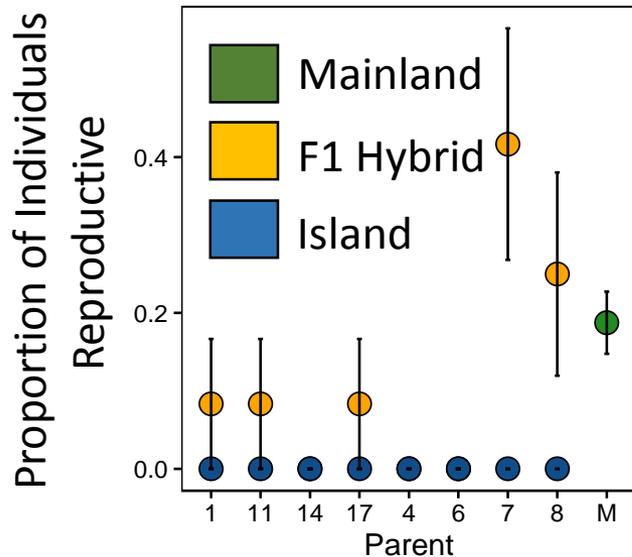


# How has reproductive output changed over time?

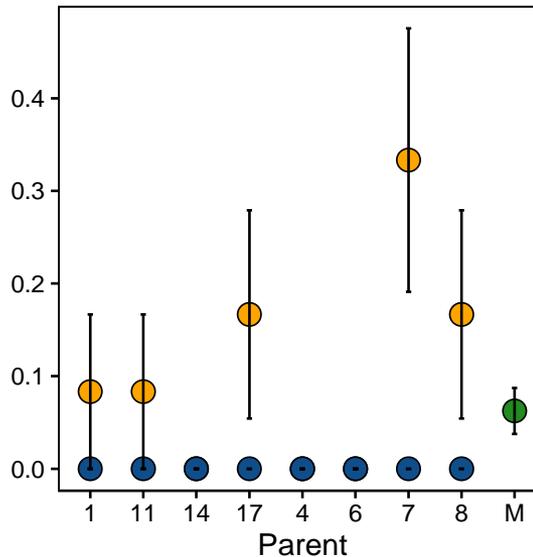


Increase in the mean frequency of conelets produced per maternal tree over time in hybrid and mainland trees

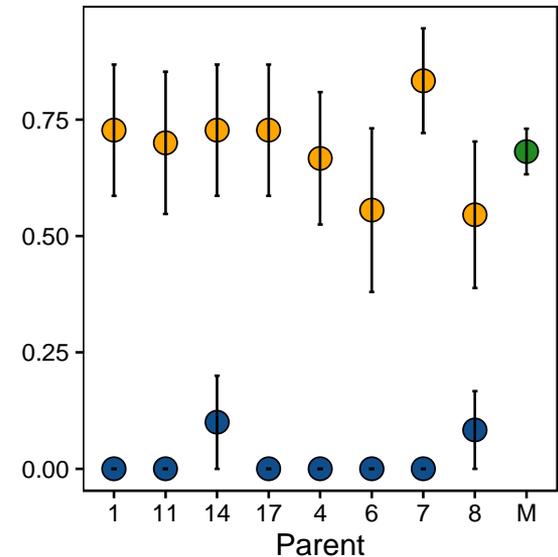
2013



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 2<sup>nd</sup> 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