Genetic management of small populations

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Conservation Genomics & Wildlife Management

More info: Inaugural Professorial Lecture https://youtu.be/5gB0NjukRyU


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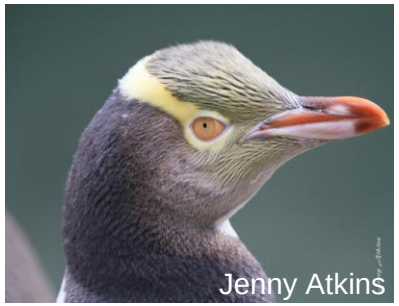
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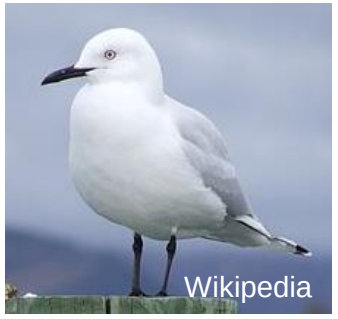
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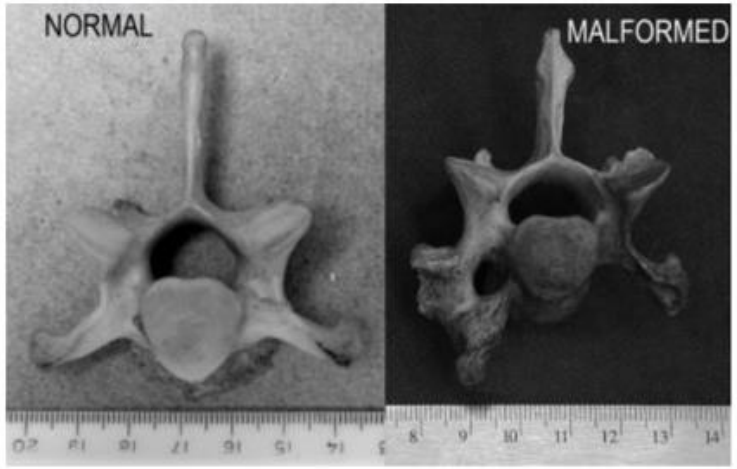
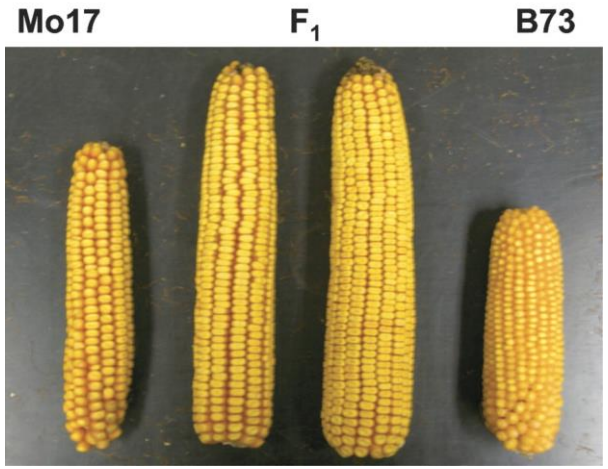
Sonya Clegg

Why is genetic variation important?

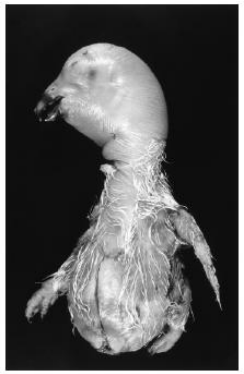
- Positive correlation: genetic variation (heterozygosity) and fitness

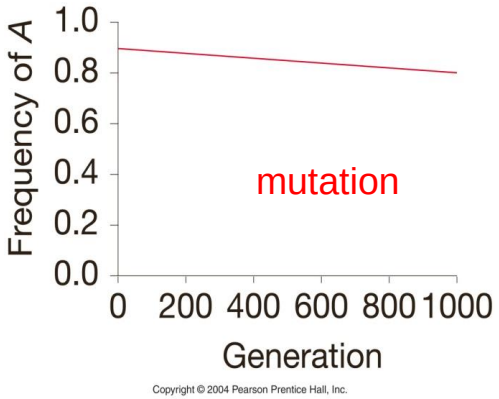




Small populations

- Low genetic variation
- Lose GV at rate = 1/2N per generation
- Mutation only source of new variation
- Fortunately rare





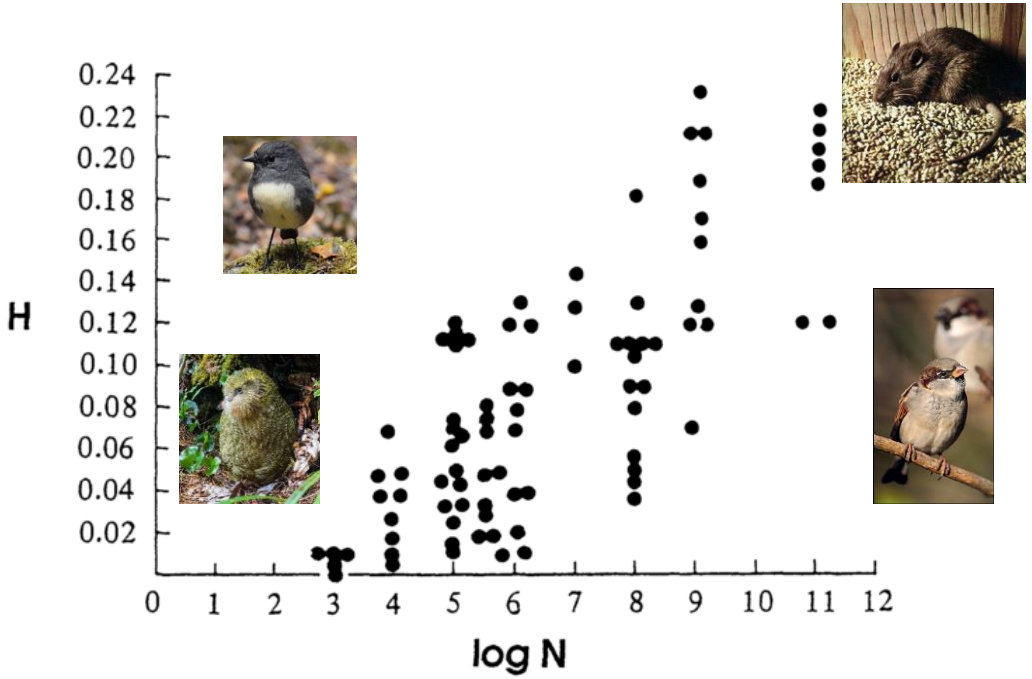


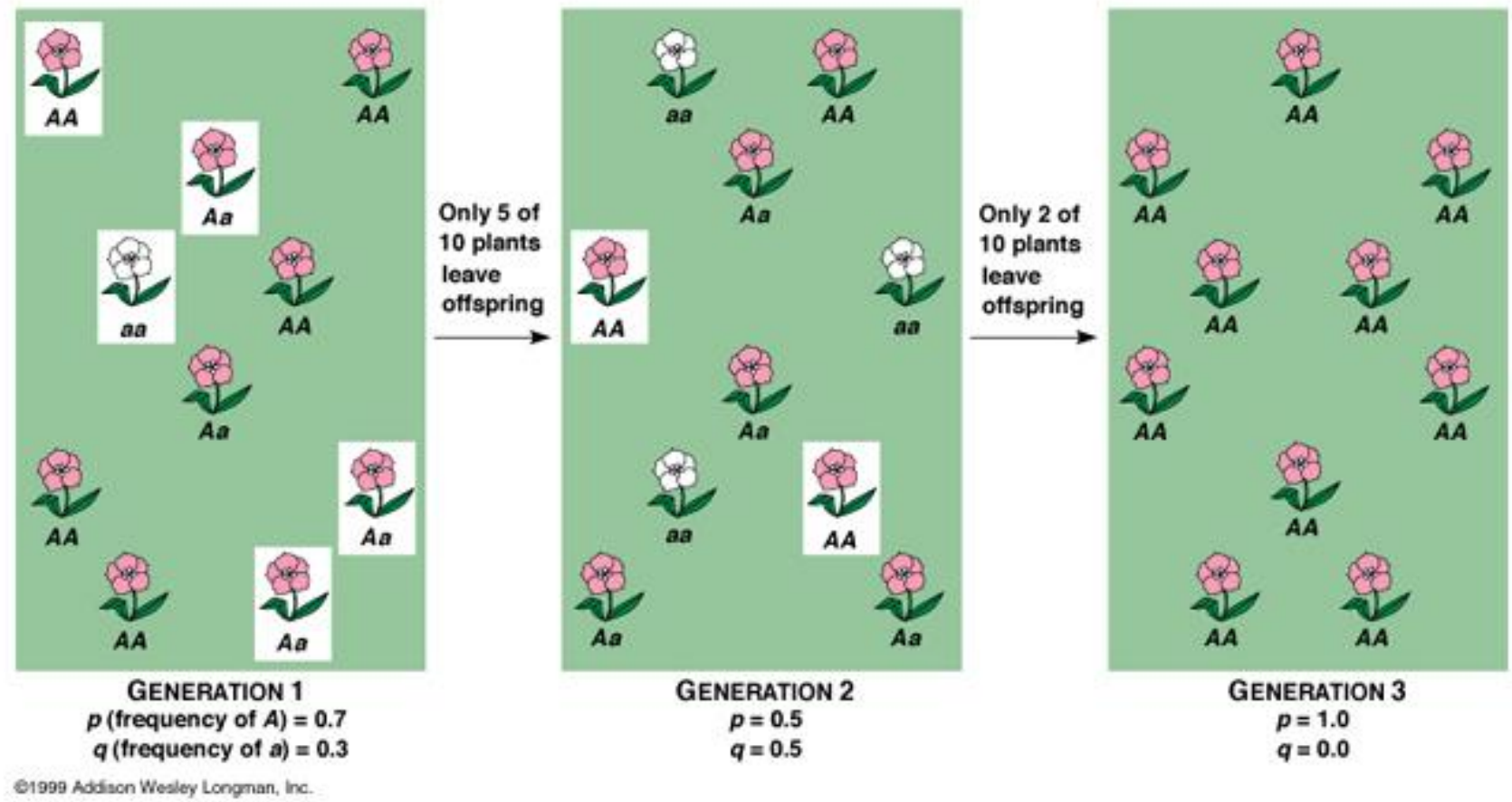
Figure 2. Correlation between heterozygosity (H) and logarithm of populations size (log N) for animal species, as given by Soulé (1976).

Factors leading to genetic variation loss

- Genetic Drift
- Founder Effects
- Demographic Bottlenecks
- Inbreeding (mating between relatives)

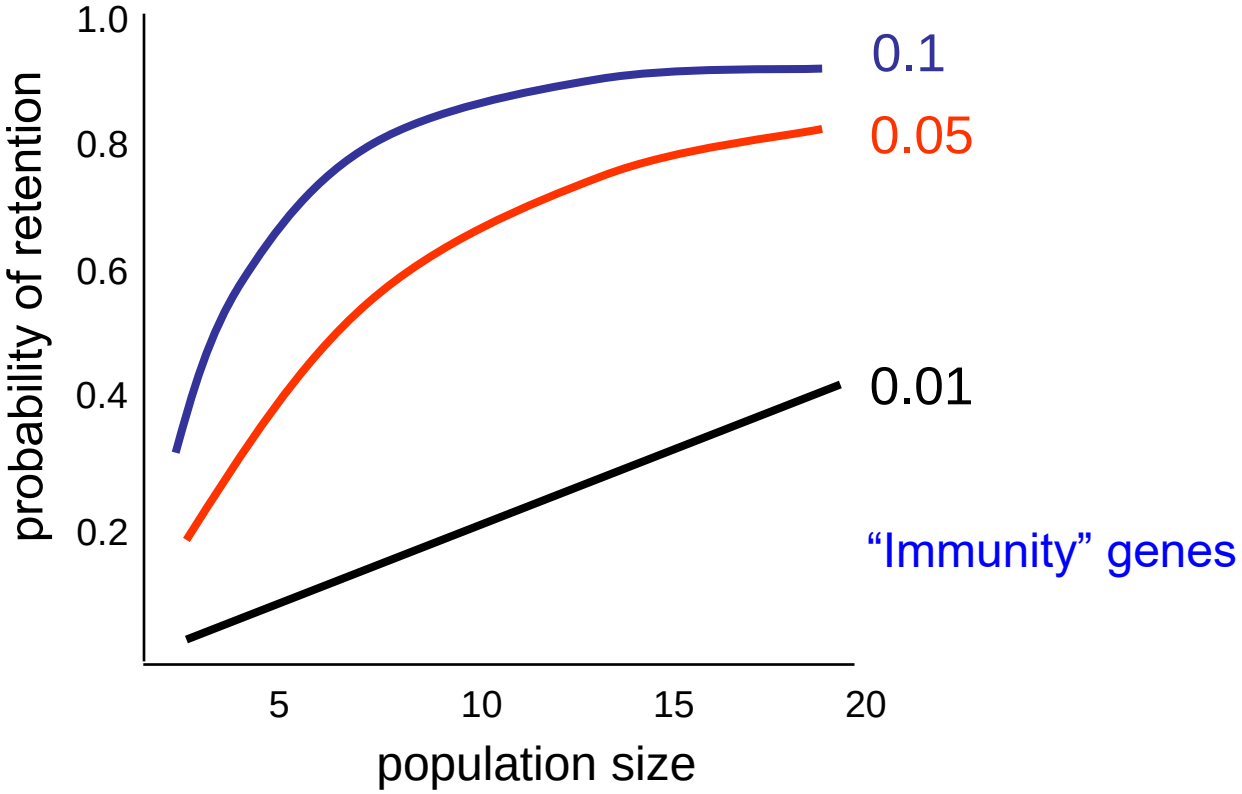
Genetic Drift

stochastic (i.e. random) loss of genetic variation

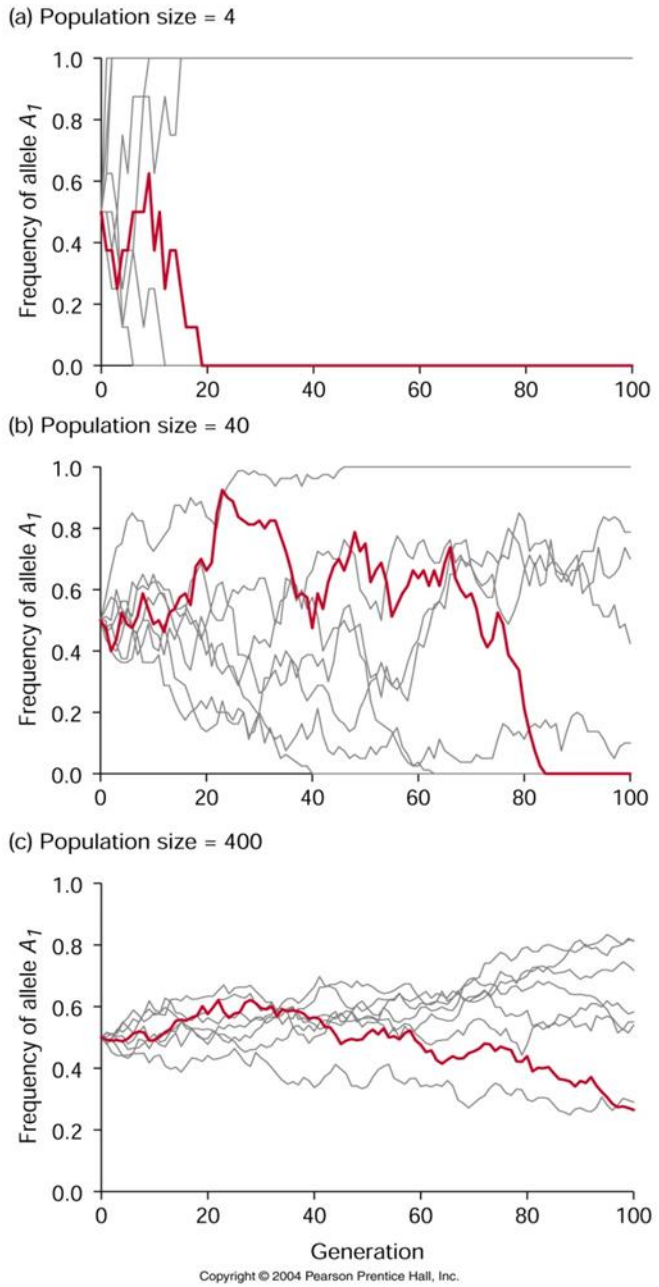


'pink' allele is **fixed;** 'white' is **lost**

Genetic Drift: loss of allelic variation



Frequency dependent: $(1\text{-}p)^{2N}$

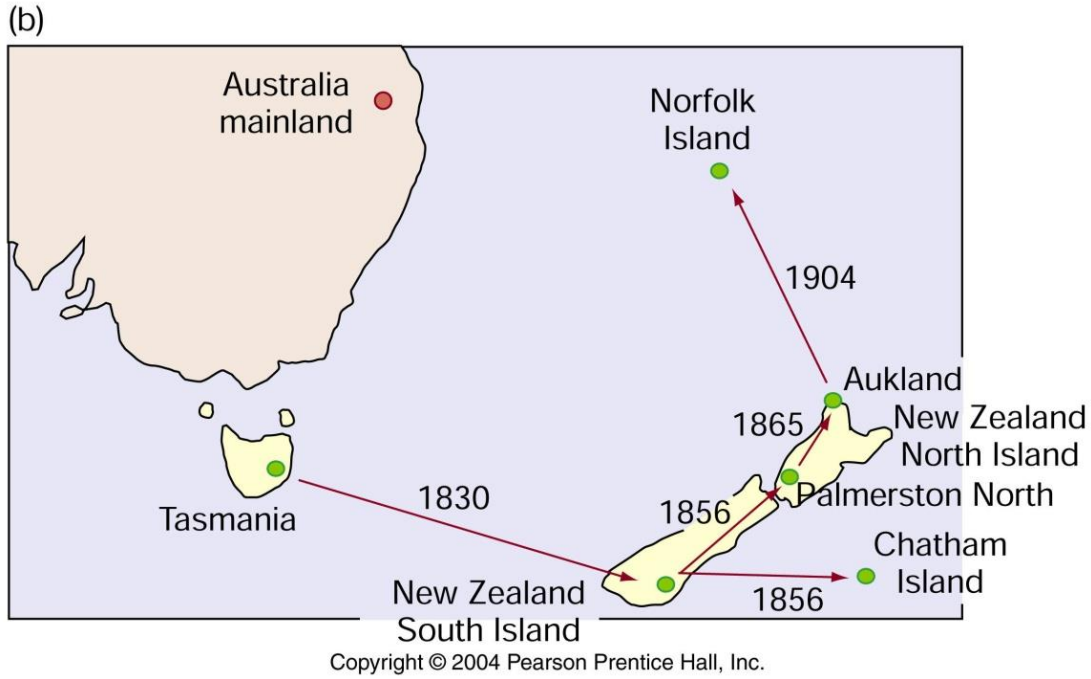


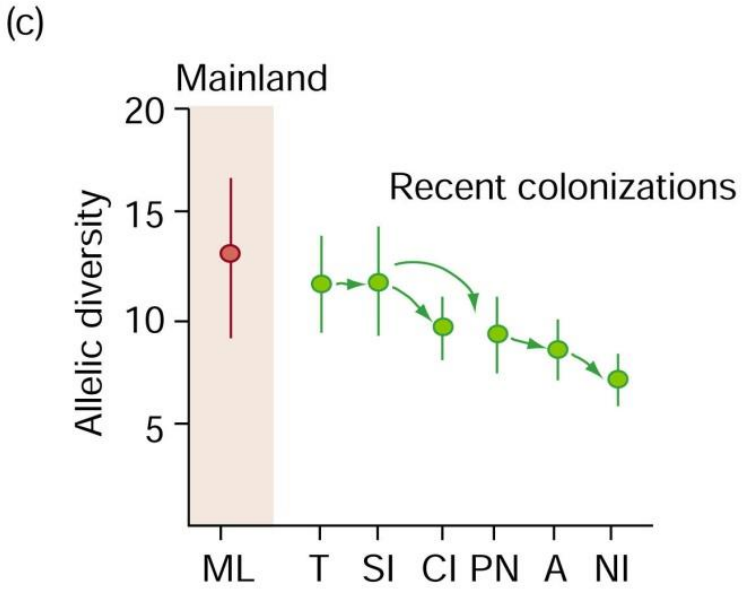
Founder Effect

- Group of individuals start a new population

- Allele frequencies are subset of origin

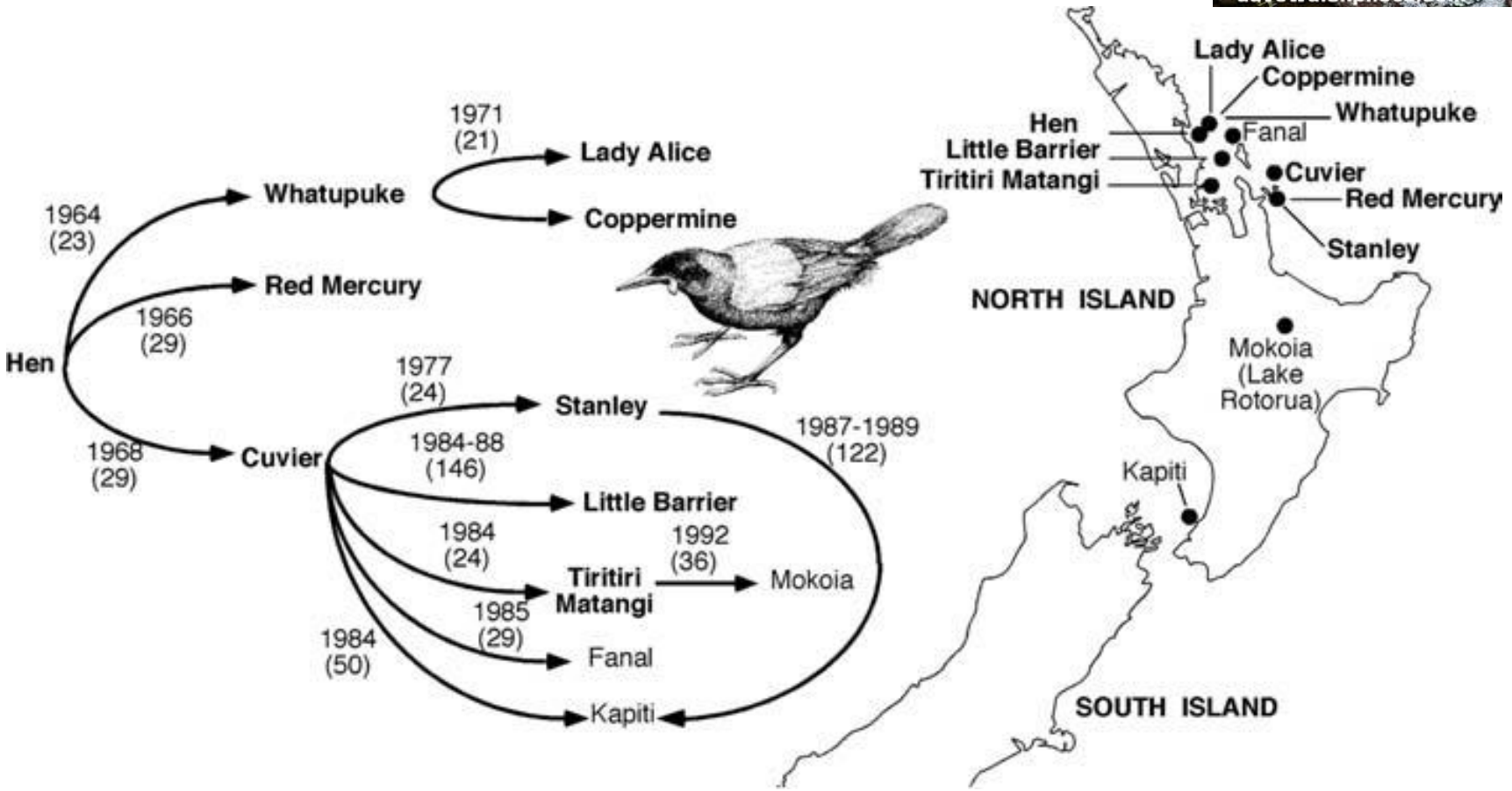
Tauhou, silvereyes



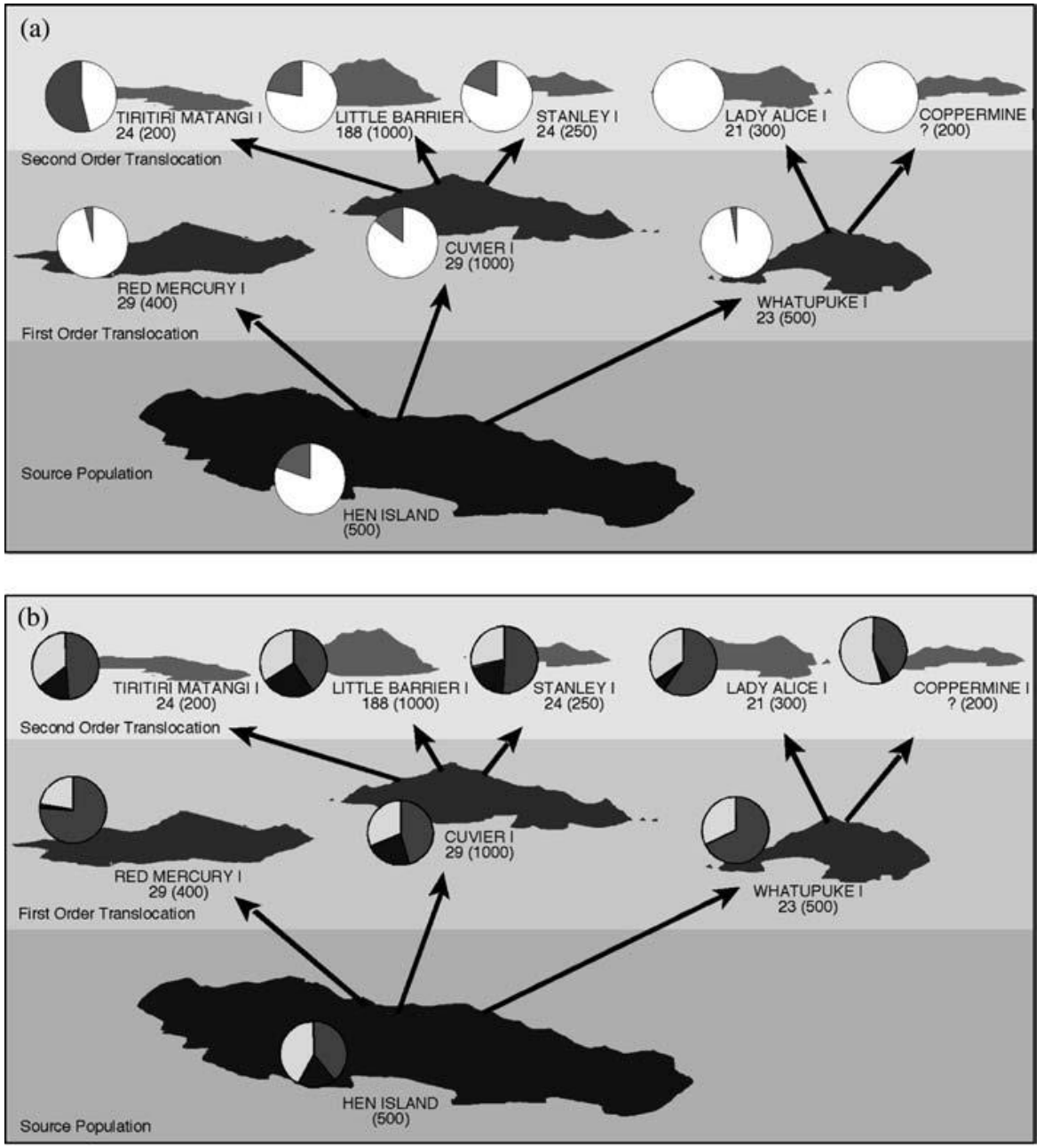


Founder Effect: Tieke translocations

- Sequential movement



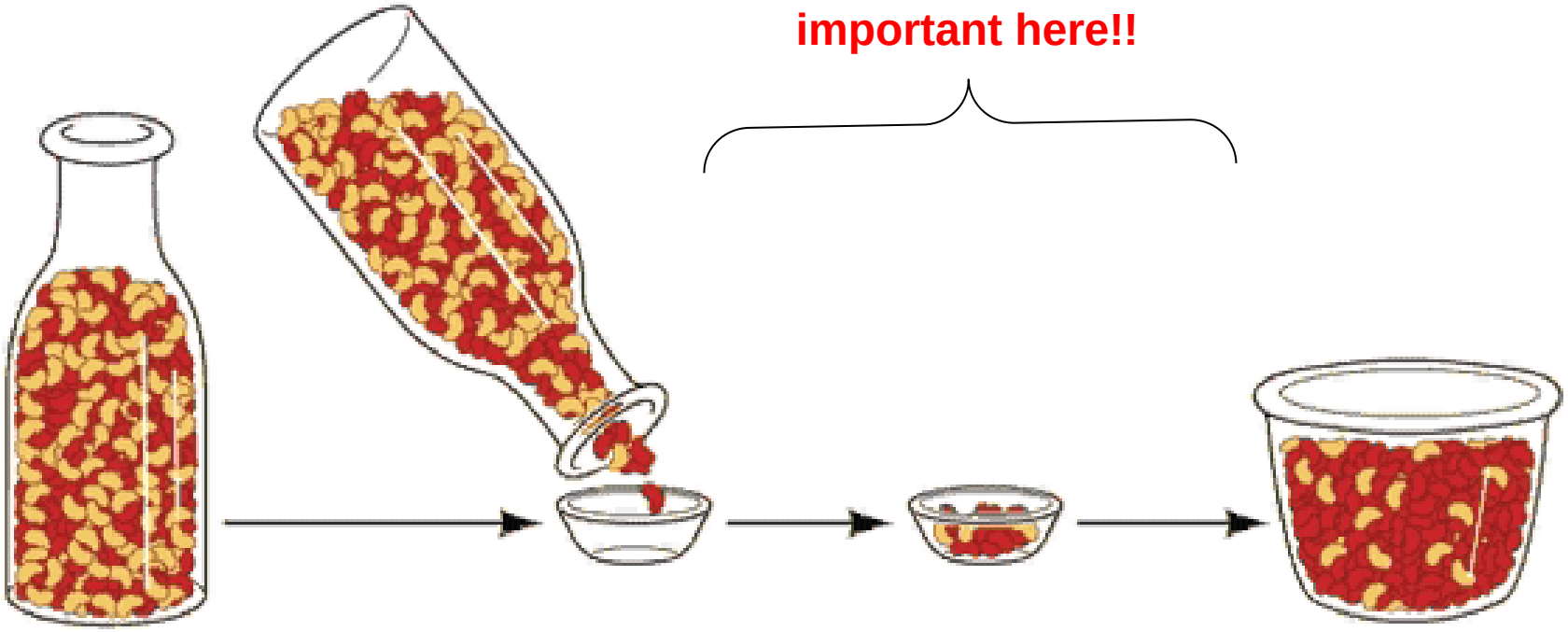
Loss of genetic variation



Lambert et al. 2005

Bottlenecks & Founder Effects accelerate Genetic Drift

Genetic Drift is important here!!



equal frequencies of red and yellow

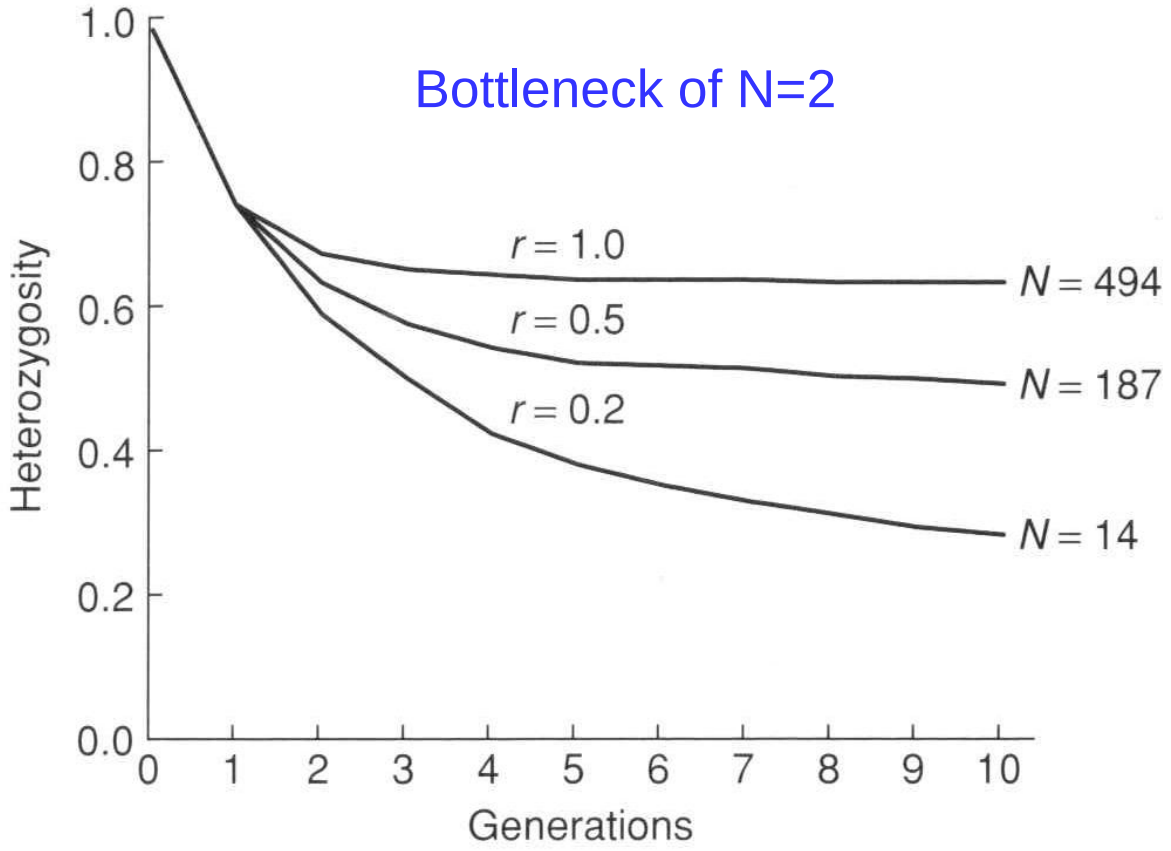
population reduction or bottleneck

survivors have altered allele frequencies

generating a new population

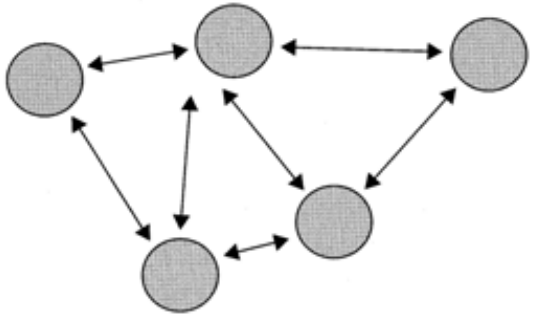
Importance of population growth rate

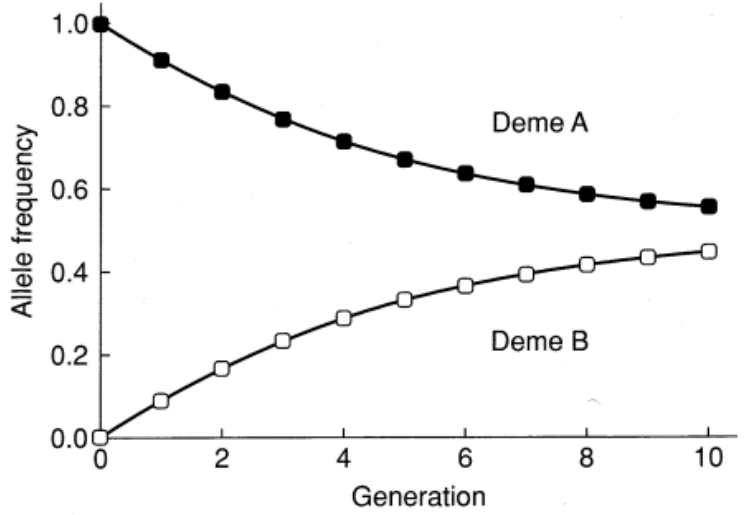
- Minimises Genetic Drift
- Priority: increase N
- Requires productive environment

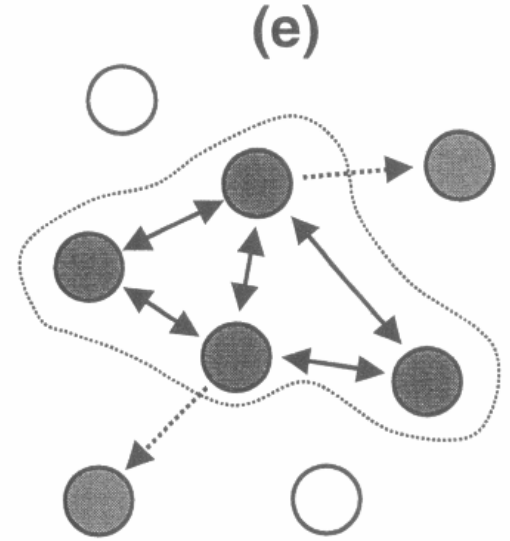


Abating Genetic Drift

- Gene Flow = homogenises allele frequencies
- Requires <u>effective</u> migrants

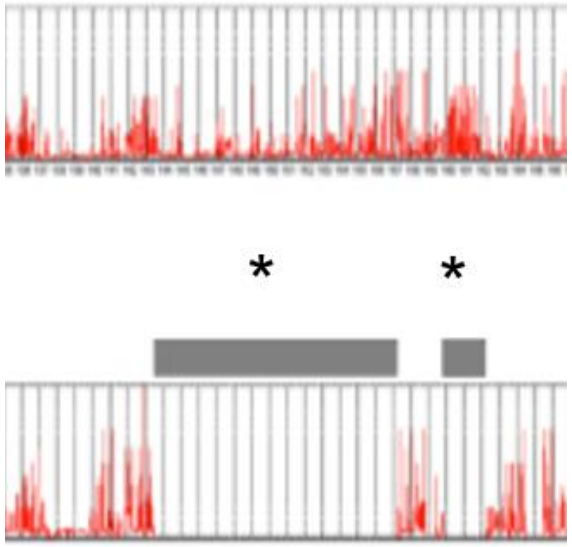


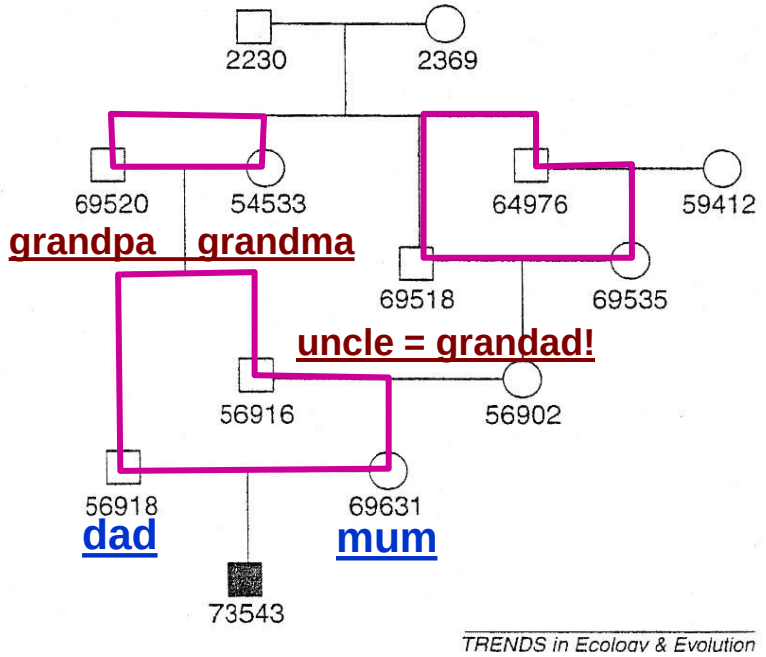




Inbreeding

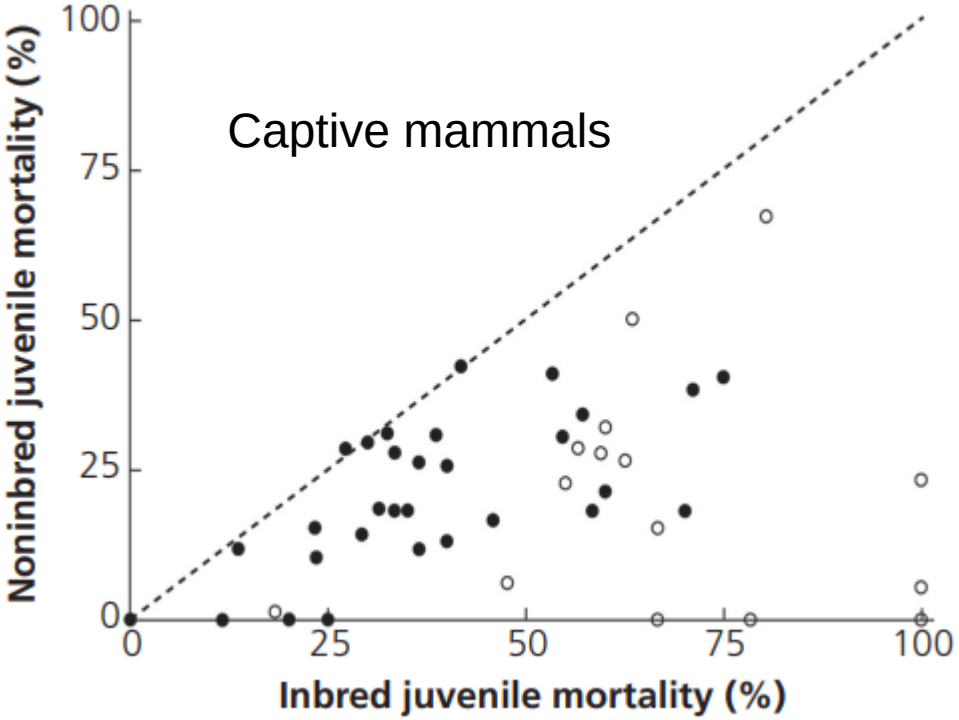
- Reduces genetic variation
- Deleterious mutations expressed
- May lead to Inbreeding Depression

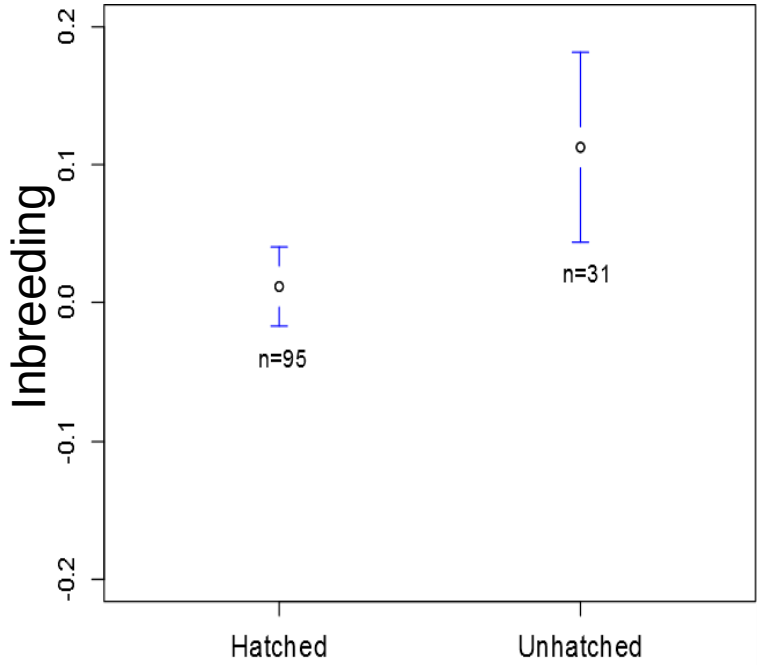




Inbreeding Depression

- Decline in fitness due to high inbreeding

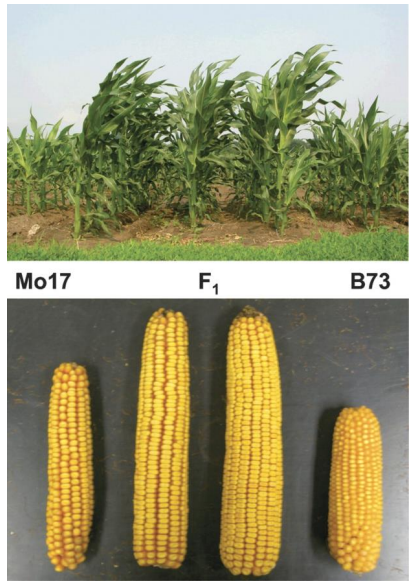


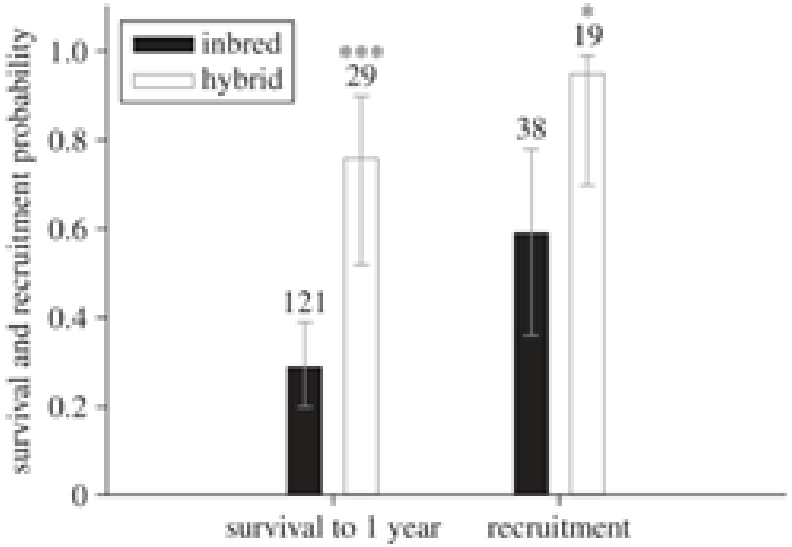


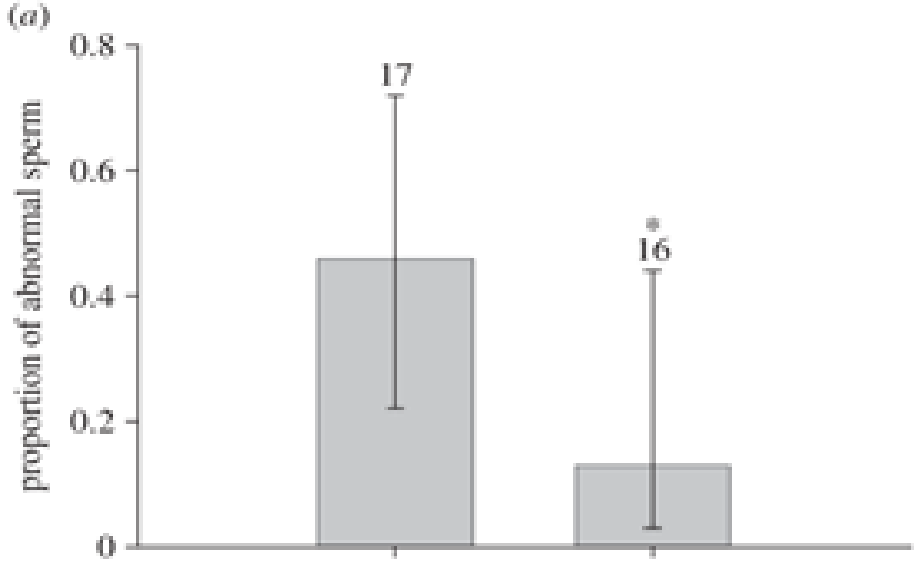
White et al. 2015 *Animal Conservation*

Genetic rescue

- Introducing migrants increases fitness
- Reduces expression of deleterious mutations







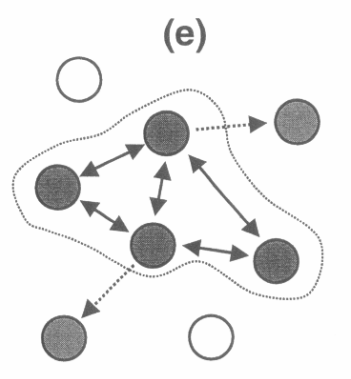
Heber et al. 2013

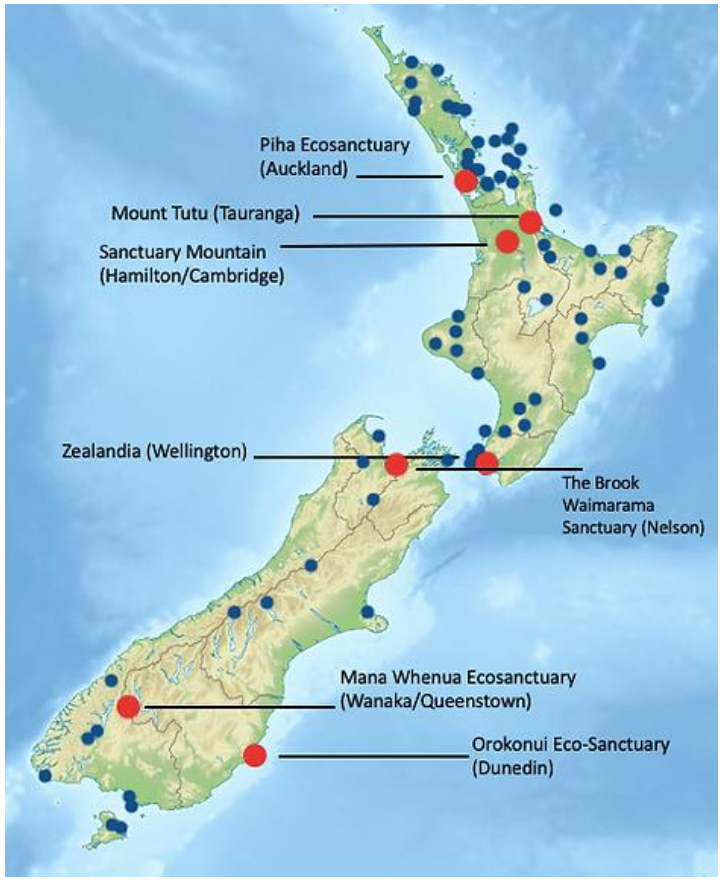
Census N ≠ N contributing to gene pool

- Effective population size (N_e)
- Based on an ideal population:
  - Equal sex ratio
  - Equal contribution to next generation
  - Constant population size
  - Non-overlapping generations
- N_e : N = ~ 0.1
- Need to manage/raise N_e (GV loss: $1/2N_e$ per gen)

Maintaining genetic variation 101

- Avoid bottlenecks/ founder events
- Increase population size to minimize genetic drift
- Also $N_e = N$:
  - Equal sex ratio
  - All individuals contribute to gene pool
  - Equal contribution to gene pool
- Avoid inbreeding
- Gene flow





https://www.ecosanctuary.nz/background

Thank you and any questions?