Inbreeding depression

- A reduction in fitness as a consequence of increased homozygosity.

Genetic rescue

- Populations with historically large habitat ranges now existing in smaller fragmented populations may benefit from crossing between populations.
  - Artificially manage gene flow between subpopulations.
  - Has the potential to counter inbreeding depression within populations.

Rocky Mountain Bighorn Sheep

Rocky Mountain Bighorn Sheep

- Population established on the National Bison Range in Montana in 1922
  - isolated until 1985
- In 1985, animals derived from two outbred herds were introduced.
- Analysis of data collected from 1979-2003 (Hogg, et al. 2006, PNAS 273:1491-1499)
  - Reported a net positive effect of outbreeding in both males and females for a number of traits observed, including major components of fitness.

Hogg, et al. 2006,
PNAS 273:1491-1499

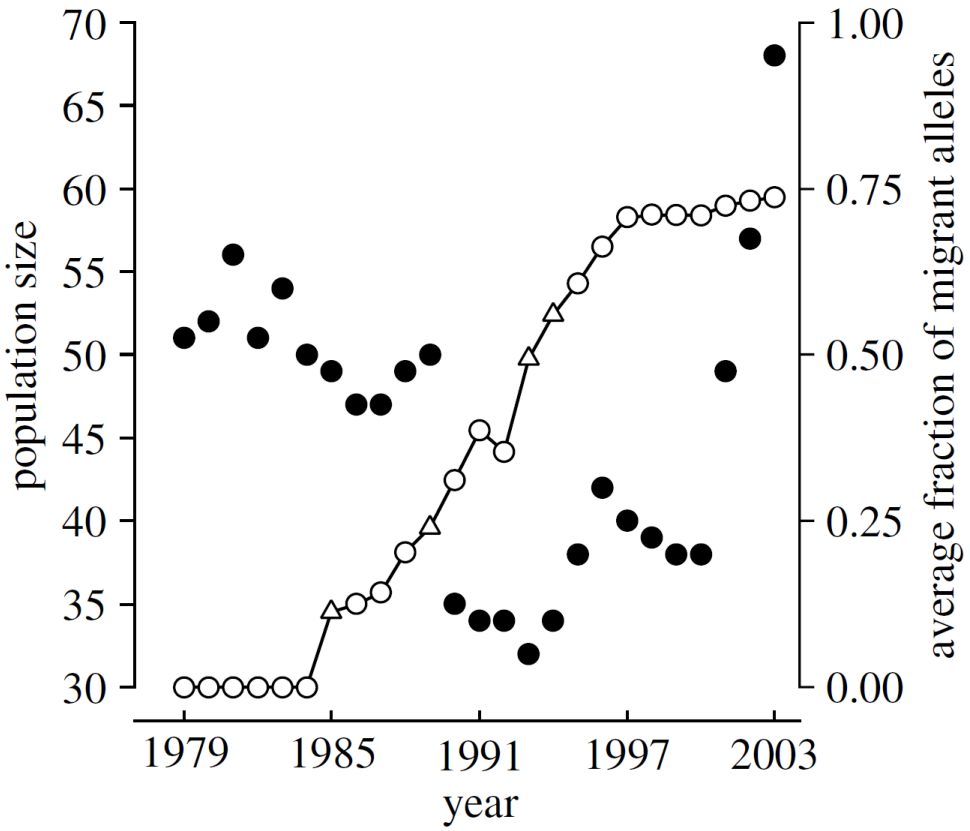

Figure 3. Total number of native bighorn (residents minus migrants; filled symbols) in relation to the average fraction of migrant alleles carried by resident bighorn (natives plus migrants; open symbols) during 1979–2003. Reversal of a multi-year decline in population size coincided with the year (1993) in which the average resident carried a majority of migrant alleles. Because migrants were excluded from annual population number (filled symbols, left axis), population changes are entirely due to reproduction and mortality within the NBR population. Years in which migrants arrived are

Outbreeding depression

- If populations are highly adapted to their local environment, bringing in non-beneficial genetic variants may reduce fitness of the population.
- If populations are substantially diverged, hybrid incompatibility may occur.
- Small number of published examples.

Arabian Oryx

Arabian Oryx

- Original habitat extended across the Arabian peninsula.
- Hunting led to severe decline of natural population.
- Extinction in the wild in 1972.
- Captive breeding in zoos in the 1960s
  - animals had been collected from various diverse locations.
- Reintroduction of animals to the wild beginning in the 1980s.

Arabian Oryx

- Analysis of juvenile mortality was performed over the next few years
  - Marshall & Spalton, Animal Conservation (2000) 3:241–248.
- Conclusions were that the reintroduced population suffered both inbreeding and outbreeding depression
  - Juvenile mortality was associated with both high levels of inbreeding and with high levels of heterozygosity.

Genetic rescue vs outbreeding depression

- Published examples of inbreeding depression are numerous.
- Many experiments have demonstrated the ability to reverse inbreeding depression.
  - Only a handful of published cases of genetic rescue for conservation purposes exist.
- Few examples of outbreeding depression in natural populations have been published.
- Methods to predict outbreeding depression have been developed (e.g. Frankham, Molec. Ecol. 2015)
  - Expectation is that natural selection will ultimately overcome outbreeding depression.