Dlugosch, K.M., and I.M. Parker (2008). Founding events in species invasions: genetic variation, adaptive evolution, and the role of multiple introductions. Molecular ecology (2008) 17, 431-449

Introduction to the paper

Invasive species often undergo a reduction in genetic variation due to the founder effect when established in a novel ecosystem. This paper examines this genetic loss through a review of the literature and two cases studies.

Box 1: Bottlenecks and Mendelian trait inheritance

- Genetic loss is governed by population size and growth rate
- Only rare alleles will likely be lost
    - Most are deleterious
    - Those under frequency dependent selection may have fitness consequences
- Multiple introduction events may be responsible for overcoming this problem.

Box 2: Bottlenecks and quantitative trait variation

- Quantitative traits respond differently to genetic bottlenecks
- Likely to see a shift from dominant traits to additive traits
- How loss of genetic variation interacts with a gain in additive variation is unknown

Box 3: The challenge of making relevant comparisons with source regions

- Studies traditionally sample a large area of species native range and a large area of the invaded range
- There may be subpopulations within the entire native range with low genetic diversity
    - However evaluating the entire range may obscure this
- The entire invaded range will almost certainly show evidence of low genetic diversity
- Comparisons should be made of the invaded range and the source range
    - Rarely is the specific source population of an invasion known

Hypothesis 1: introduced species lose genetic variation relative to source populations

- A literature review was used to investigate this
    - Microsatellites and protein markers were used
    - Allelic richness and heterozygostity were response variables
- Frequently genetic loss occurs but there are rare exceptions

Hypothesis 2: multiple introductions rescue invaders from losses in diversity

- A literature review was used to investigate this
- Multiple introduction does increase the mean genetic diversity across species
- However, the degree in overlap between species is large

- A trend in invasive species exists where selection and drift move the population to lower genetic diversity, followed by a return to higher diversity with time
    - However this occurs regardless if there are multiple introductions

Case study 1

- **Single introduction, bottleneck and rapid evolution in *Hypericum canariense***

Dlugosch K.M., Parker I.M.(2007), Molecular and quantitative trait variation across the native range of the invasive species *Hypericum canariense*: evidence for ancient patterns of colonization via pre-adaptation? Molecular Ecology (2007) **16**, 4269–4283

- What are methods that non-native species use to invade native ecosystems
- Looked at *Hypericum canariense* from the Canary Islands
- Use ITS sequence and AFLP variation to descried and find two major lineages of *H. canariense*
- The conclusion suggested that pre-adaptation influences establishment

Case Study 2

- **Multiple introduction and a geographical mosaic of maladaptation' in *Verbascum thapsus***

Parker, Ingrid M. Rodriguez, Joseph and Loik, Michael E. An Evolutionary Approach to Understanding the Biology of Invasions: Local Adaptation and General-Purpose Genotypes in the Weed *Verbascum thapsus* Conservation Biology, Pages 59–72 Volume 17, No. 1, February 2003

- Looks as how adaptation and genetic structure may encourage or inhibit the expansion of *V. thapsus* an invasive weed
- General Purpose Genotyping and rapid adaption may help in the widespread invasion of invasive weeds
- Identified 10 representative populations of *V. thapsus* and tested them for cold tolerance
- Results support that invasive plants may not necessarily rapidly evolve new physiological limits

Conclusions and implications for management

- Most introduced species suffer from substantial loss of Mendelian genetic variation
- However some very successful invaders (*Bromus tectorum, Ambrosia artemisiifolia, Tamarix spp.*) gain in variation in the new environment
    - Inbred populations mixing in the new environment
    - Hybrid species who's parent species do not overlap natively
- Pathogen resistance is generally a Mendalian trait, and it suffers heavily in invasive populations
- Quantitative traits generally do not suffer fitness penalties as severely as Mendalian traits
    - Quantitative may rapidly respond to adaptive evolution in a new environment
- Multiple introductions take decades to increase an invading population's genetic diversity
    - By then species have moved out of the lag-phase associated with invasion
- It is unknown what effect genetic bottlenecks have on invasion success
    - Missing the species that went locally extinct after invasion
    - Multiple invasions only seems to offset the bottleneck effect in rare cases