Hybridization

• "interbreeding of individuals from two populations, or groups of populations, which are distinguishable on the basis of one or more heritable characters"  
  Harrison 1993 quoted from Harrison 1990

• natural part of evolution – adaptation and speciation

Introgression

• "Incorporation of genes from one population to another through hybridization that results in fertile offspring that further hybridize and backcross to parental populations"  
  Allendorf, Luikart, Aitken 2013

• Creates complex genetic patterns of backcrosses

Admixture

• "The formation of novel genetic combinations through hybridization of genetically distinct groups"  
  Allendorf, Luikart, Aitken 2013

• Useful, because it can be measured in individuals

Natural Hybrid Taxon

Figure 17.1 from Allendorf, Lulbert, Aitken 2013

Photos:  
en.wikipedia.org,  
www.fore.gov.bc.ca,  
www.ucalgary.ca
Natural Introgression

Region of spatial overlap (sympatry) and introgression between two species, without the formation of a hybrid swarm in either parental population

Can be quite stable!

Hybrid Zones

Hybridization without Introgression

Sheep x Goat =

“geep”

“shoat”

“the toast of Botswana”

Hybrid Swarm!

Westslope Cutthroat Trout

Yellowstone Cutthroat Trout

Introgressed Hybrids
Fitness Consequences

- Heterosis = hybrid vigour
  - Can be used for genetic rescue of inbred populations
- Intrinsic outbreeding depression = genetic incompatibilities
- Extrinsic outbreeding depression = ecological incompatibilities

Outbreeding Depression

- Cutthroat x Rainbow → 50% reduction in fitness with 20% Rainbow genome

Genomic Extinction

- Spread of hybrids and loss of parental haplotypes
- Epifanio-Philipp effect
  - Despite reduced fitness, hybrids only produce more hybrids

Detecting hybridization / introgression

- Detecting hybridization
  - Morphological differences between parentals and hybrids
  - Suspected hybridization based on new range overlap
- Monitoring introgression
  - Infertile hybrids only
  - Hybrid swarm!
  - Heterozygotes

Measuring introgression

- Diagnostic loci or differences in allele frequencies
- Neutral or adaptive variation
- Methodologies affect “resolution” and “independence”
  - microsatellites vs SNPs
- Visualize entire genome evenly or particular regions
- Defining reference populations (species and population)
Measuring introgression

- Assignment test → what population did individual / sample come from?
  - STRUCTURE
    - New Hybrids, Admix, IMP, distruct, CLUMPP

- Individual and population admixture
  - Bayesian MCMC analysis
  - Generates Q-values

- Some programs integrate geographic and phylogenetic priors

What to do about introgression?

- Should we control anthropogenic hybridization at all?

- What is a pure species → philosophically and practically difficult

- How much admixture is acceptable?

- Do hybrids play an ecological role?

- Restoration options for species management
  - Hybrid removal
  - Local extirpation and re-stocking
  - Development of wild-type hatchery strains

References


Malik et al. 2014