INBREEDING DEPRESSION

- How does inbreeding affect the well-being of diploid populations?

- "Inbreeding depression" is a type of load that describes the reduction in mean fitness of a population due to inbreeding.

- Consider a diploid locus with alleles A and a and fitnesses $w_{AA} = 1–t$, $w_{Aa} = 1$, & $w_{aa} = 1–s$, with $s > 0$.

- The mean fitness is

$$\begin{aligned}\bar{w} &= P_{AA}w_{AA} + P_{Aa}w_{Aa} + P_{aa}w_{aa} \\ &= P_{AA}\cdot(1-t) + P_{Aa}\cdot 1 + P_{aa}\cdot(1-s) \\ &= 1 - P_{AA}t - P_{aa}s\end{aligned}$$

- If t is also positive, the load is $L = P_{AA}t + P_{aa}s$

- If the population has inbreeding coefficient f, $P_{AA} = p^2 + fpq$ and $P_{aa} = q^2 + fpq$ and the load is

$$L = (p^2 + fpq)t + (q^2 + fpq)s = (p^2t + q^2s) + fpq(s + t) = L_{seg} + L_{IBD}$$

  – $L_{seg} = p^2t + q^2s$ is the load due to **segregration**, which exists even in a completely outbred population

  – $L_{IBD} = fpq(t + s)$ is the load specifically due to inbreeding, i.e. a measure of **inbreeding depression**

    - Inbreeding depression occurs at loci exhibiting overdominance in fitness (s and t both positive) or at loci with recessive deleterious alleles ($t = 0$ but $s > 0$).

    - Inbreeding depression occurs only if $f > 0$, but also disappears in the absence of genetic variation ($p = 0$ or $q = 0$).

    - Populations with less inbreeding depression have higher growth rates, which suggests that populations with less inbreeding tend to persist longer.

      – By this logic, expect that selfing—the strong form of inbreeding—should be particularly uncommon.

      – Leaves puzzle as to why so many plant species self fertilize to some extent.