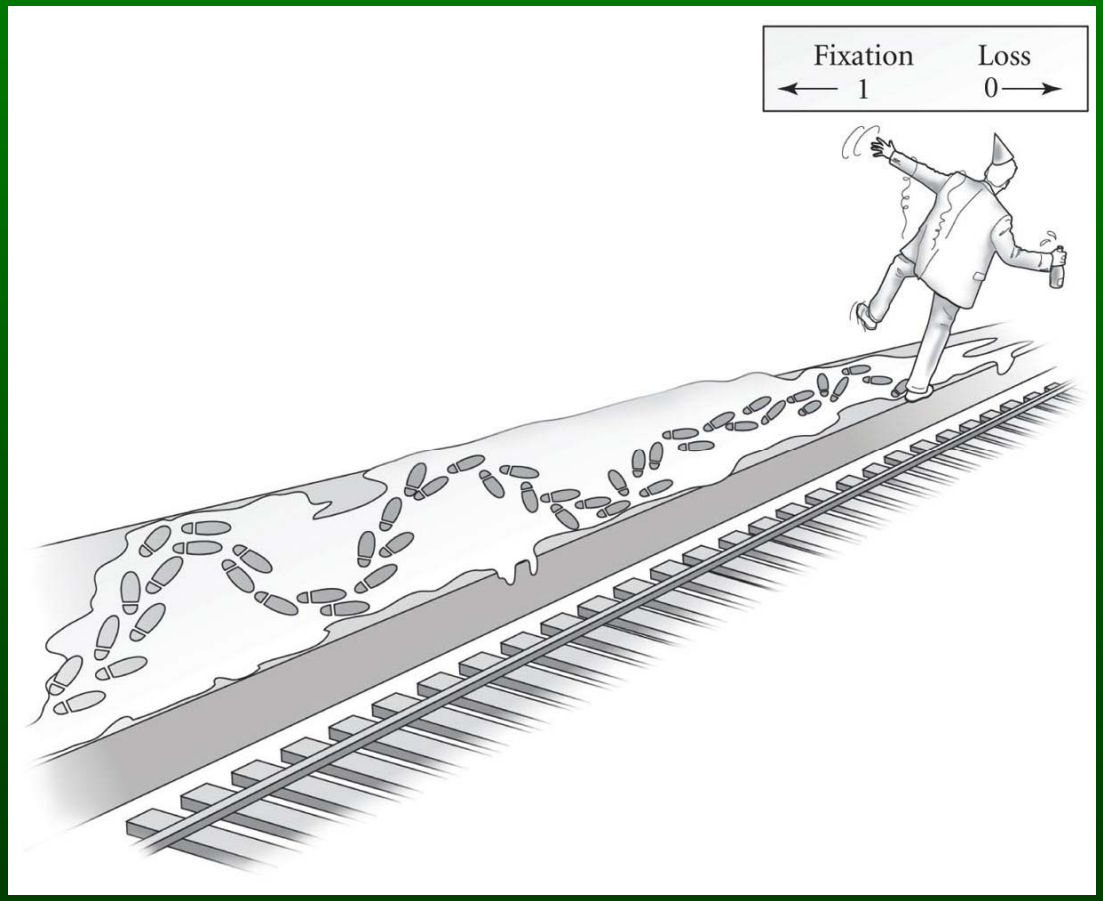
Population Genetics II

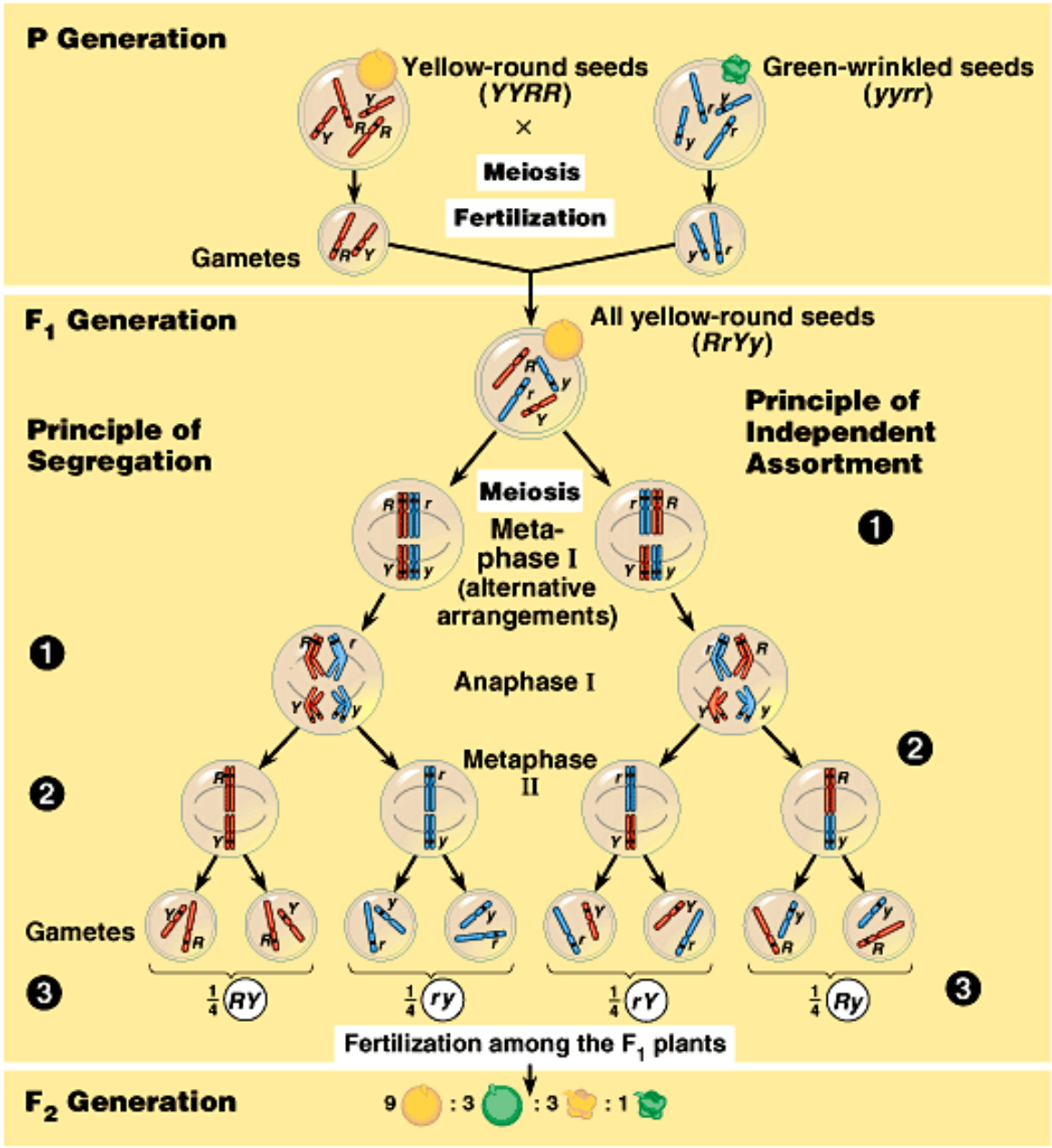


What is Population Genetics?

- The study of alleles becoming more or less common over time.
- Applied Meiosis: Application of Mendel's Law of segregation of alleles.
- Hardy-Weinberg Equilibrium Principle: Acts as a null hypothesis for tracking **allele** and **genotype** frequencies in a population in the absence of evolutionary forces.

Meiosis: Reduction & Division

Meiosis (I) accounts for **Segregation of Alleles**



Expected Genotype Frequencies in the Absence of Evolution are Determined by the Hardy-Weinberg Equation.

Assumptions:

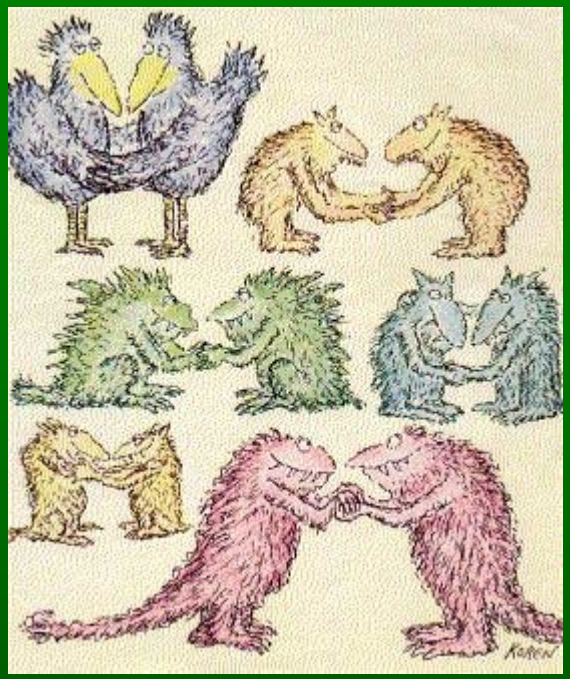
1) No mutation

2) Random mating (panmictic)

3) Infinite population size (No drift)

4) No migration or gene flow

5) No selection (= survival & reproduction)



Non-Random Mating

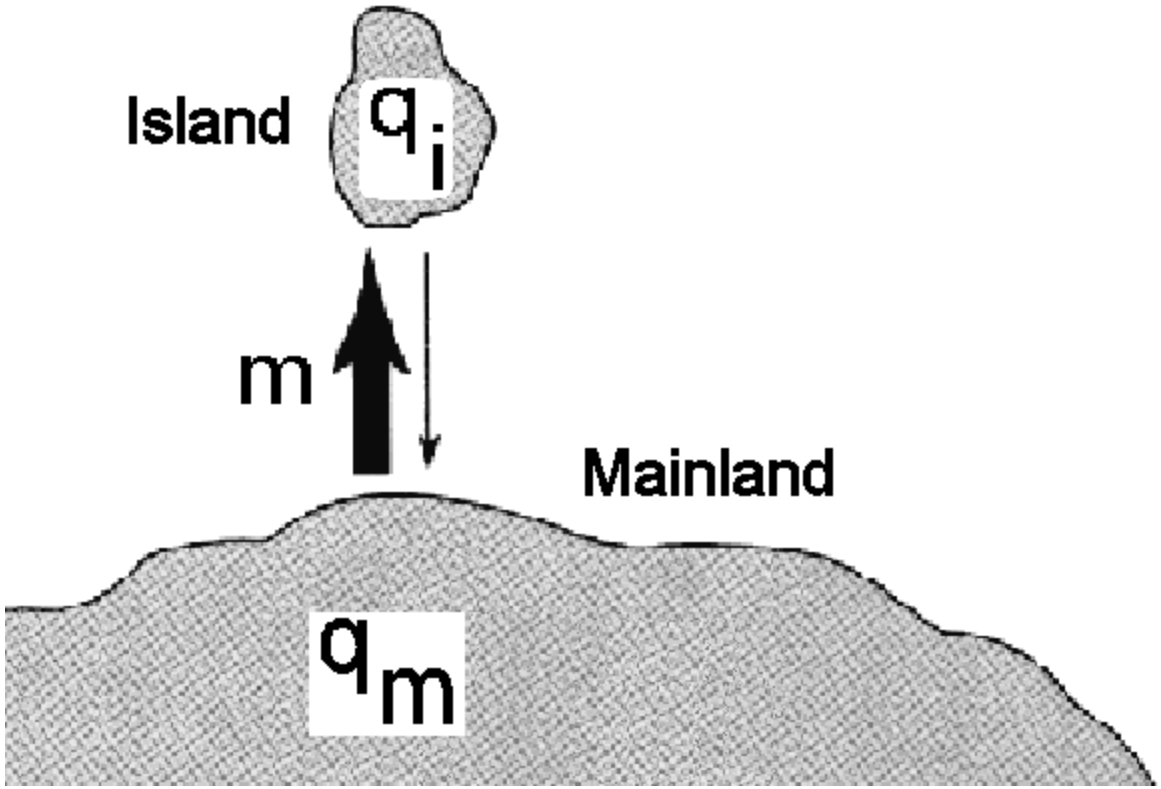
- **Assortative mating**
  - Usually positive with likelihood of mating with similar phenotype.

- **Inbreeding**
  - Special case of assortative mating.
  - The closer the kinship, the more alleles shared and the greater the degree of inbreeding.
  - Inbreeding increases homozygotes, while decreasing heterozygotes.
  - Can expose deleterious recessives to selection.

Effects of Migration

- Generally considered a one-way proposition.
- Overall acts to prevent species divergence in populations.

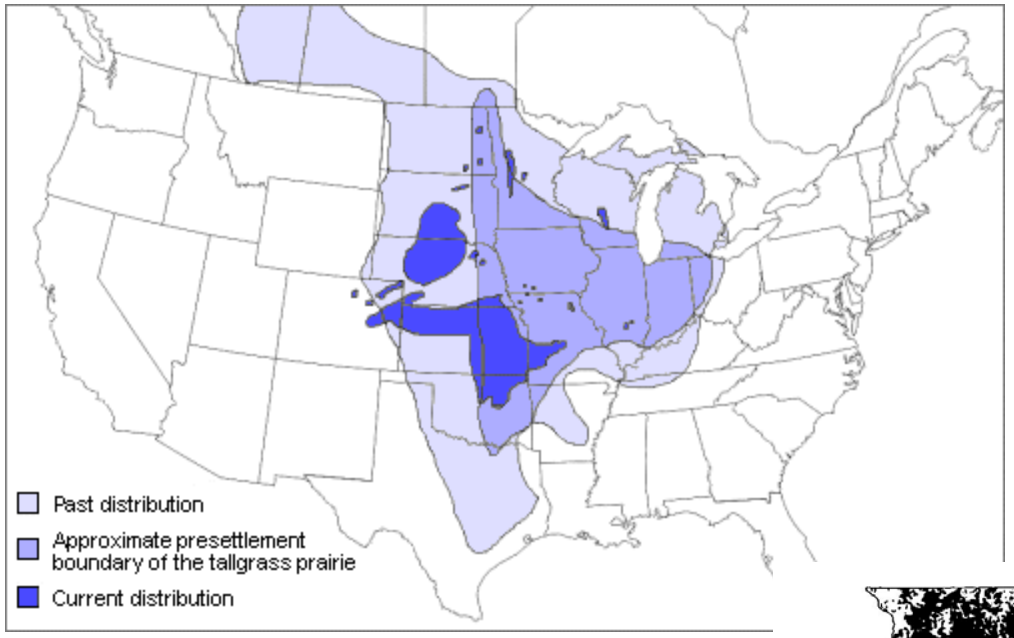
Island Model of Migration



Where q_i and q_m are the initial allele frequencies on the island and mainland, respectively.

Greater Prairie-Chicken: Conservation Genetics

Greater Prairie-Chicken: Historic & Present Range



Habitat reduction:
Islands of prairie in a sea of farmland.

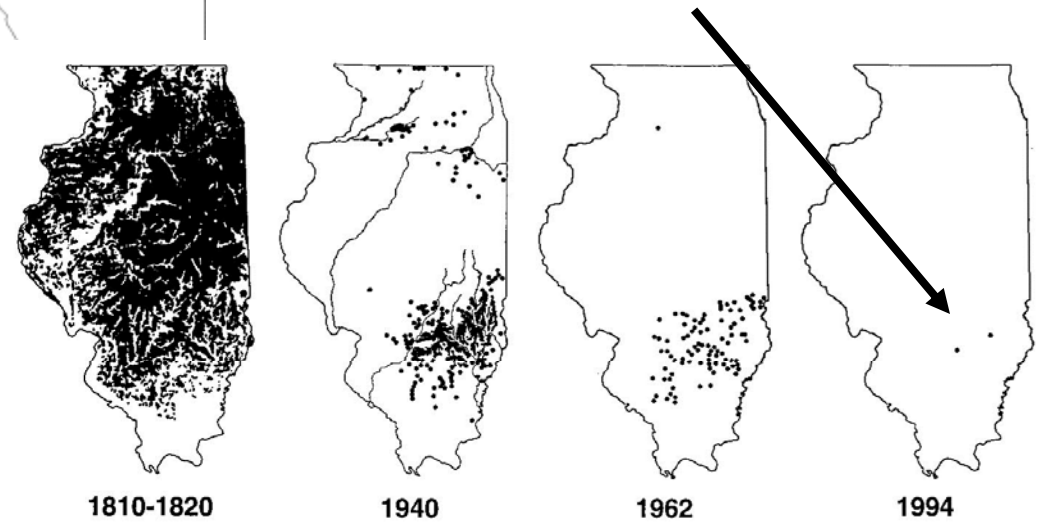


Fig. 1. Illinois prairies during 1810–1820 and distributions of greater prairie chickens in 1940 (*25*), 1962, and 1994. Prairie distributions for 1810–1820 were derived from R. C. Anderson. [Reprinted from R. C. Anderson, *Transactions of the Illinois State Academy of Science* **63,** 214 (1970), with permission.]

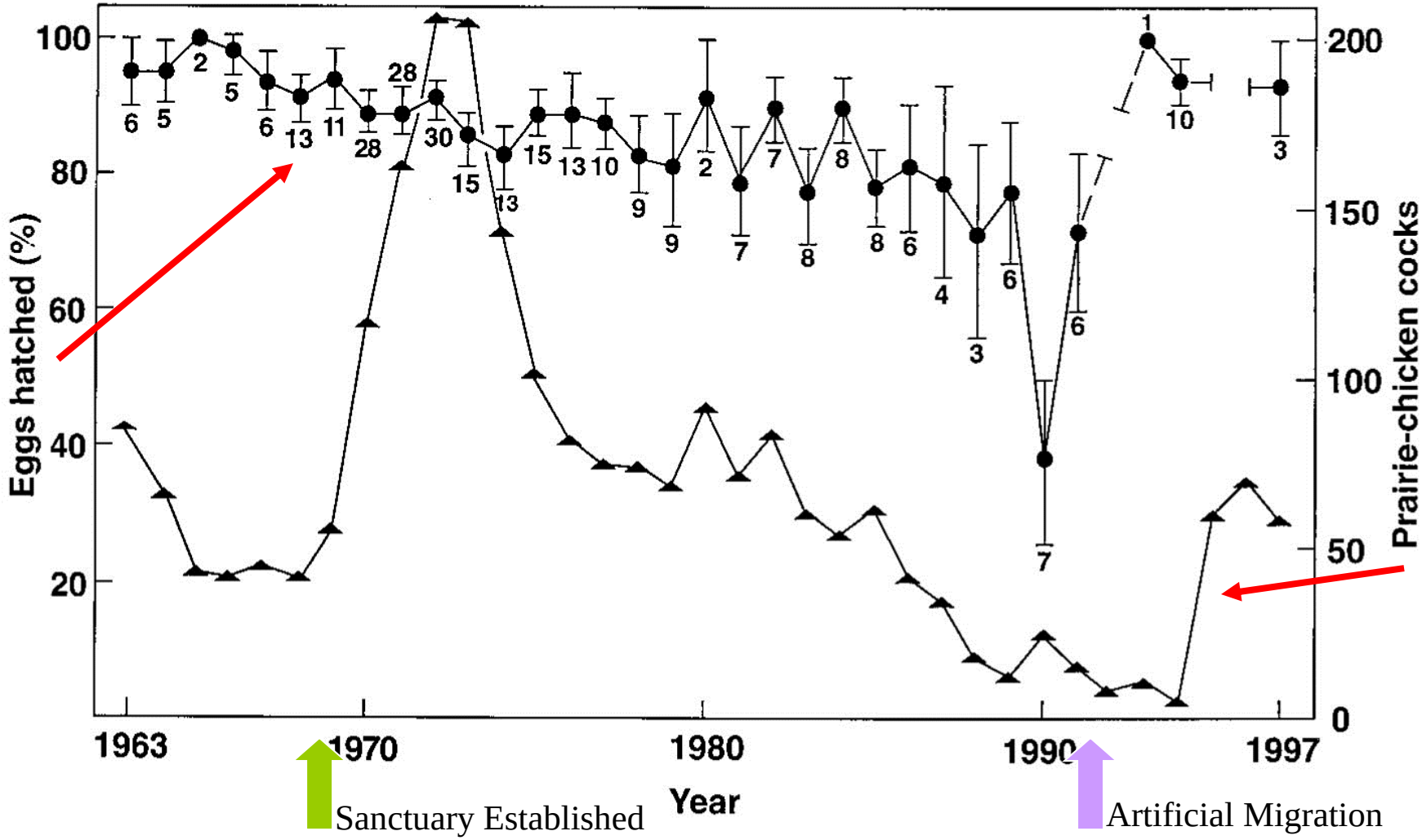


Fig. 2. Annual means for success of greater prairie chicken eggs in 304 fully incubated clutches (circles) and counts of males (triangles) on booming grounds in spring, Jasper County, Illinois, 1963–1997. Translocations of nonresident birds began in August 1992. Test statistics (*24*) for the period 1963–1991 are as follows: egg success rates, $\phi = 4.28$ ($P < 0.001$); male counts, $\phi = 1.88$ ($P = 0.0301$). Bars indicate ± 1 SE and adjacent numbers indicate numbers of nests. For egg fertility rates (not shown), $\phi = 2.18$ ($P = 0.0146$).

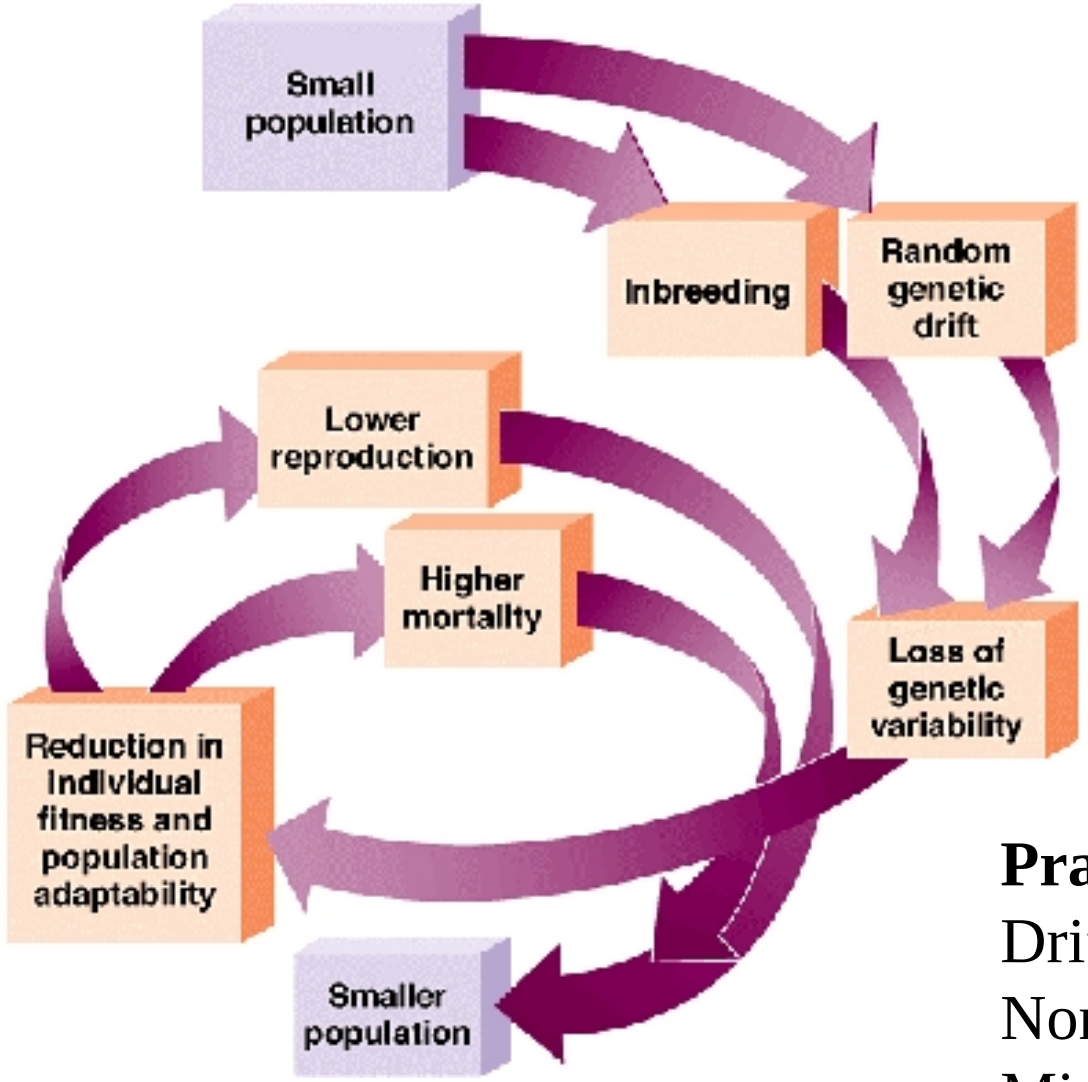
Table 2: Number of alleles per locus found in each of the current populations of Illinois, Kansas, Minnesota, and Nebraska and estimated for the Illinois prebottleneck population

Locus	*Illinois*	*Kansas*	*Minnesota*	*Nebraska*	*Illinois prebottleneck**
ADL42	3	4	4	4	3
ADL23	4	5	4	5	5
ADL44	4	7	8	8	4
ADL146	3	5	4	4	4
ADL162	2	5	4	4	6
ADL230	6	9	8	10	9
Mean	3.67^{A}	5.83^{B}	5.33^{B}	5.83^{B}	5.12^{B}
SE	.56	.75	.84	1.05	.87
Sample size	32	37	38	20	15

Note: SE indicates standard errors of mean number of alleles per locus. Different letters indicate significant differences at $P < .05$ (see "Methods" for statistical analysis).

* Number of alleles in the Illinois prebottleneck population include both extant alleles that are shared with the other populations and alleles detected in the museum collection.

The extinction vortex of the small-population approach



Prairie-Chicken Model:

Drift

Nonrandom mating

Migration