Genetic Drift: the tendency for allele frequencies to change as a result of random sampling error in a small population.

Drift assumptions:

1.) even sex ratio

2.) non-overlapping generations

3.) constant population size

** In an ideal population, none of these assumptions are violated.

With genetic drift:

1.) the genotype composition of allele frequencies of the offspring generation cannot be predicted....

2.) but, on average the allele frequencies do not change.

3.) like a random walk, eventually one of the two alleles will be lost. Genetic drift always causes loss of diversity.

4.) which allele is lost is random, but the chance that an allele will go to fixation is exactly equal to its frequency in the population.

5.) a. magnitude or importance of drift is inversely proportional to population size.

b. variance or uncertainty in allele frequency change is equal to **1/N**.

c. loss of diversity expected by **4N** generations.

6.) coalescence: all alleles will eventually share a single common ancestor.

7.) drift in independent populations will lead to loss of different alleles. Drift leads to divergence between populations.

...but most populations are not ideal.

The effective population size, N_e = the size of an ideal population with the same properties as our real population.

Calculating N_e for a population with an unequal sex ratio.

$$N_e = \frac{4N_mN_f}{N_m + N_f}$$

********Always use N_e when doing any calculations!

$4N_e$ = number of expected generations before loss of genetic diversity.

$1/N_e$ = variance or uncertainty in allele frequency.

Migration requirements:

1.) must be born in one population and move to another.

2.) must reproduce in new population.

Migration Rate (*m*) = fraction of population composed of individuals born in a different population.

If ***P*** = the frequency of an allele in a given population, $\boldsymbol{P_m}$ = the frequency the allele in the home population of the migrants, and ***m*** = the migration rate, than the allele frequency in the next generation, ***P'*** is:

$$\boldsymbol{P' = P\,(1-m) + P_m m}$$

Drift and Migration

Drift cause the divergence of populations, while migration makes populations more similar...

So, what happens to the frequency of alleles in a population when both forces are acting?

If N_e is small and migration is rare, ie. $\mathbf{2N_e}\boldsymbol{m} < \mathbf{1}$, the populations with diverge. In this case drift has more of an effect on the population than migration.

If N_e is large and migration is common, ie. $\mathbf{2N_e}\boldsymbol{m} > \mathbf{1}$, the populations will become more similar. In this case migration has more of an effect on the population than drift.

What would you expect to happen to allele frequencies in a population if drift and migration had equal effect?