Effective Population Size

N = population size

N_e = effective population size

Effective population size is important because it is related to the loss of genetic diversity with population as indicated in Wright's (1931) formulation:

$H = 1 - 1/(2N_e)$

where

H = the proportion of original heterozygosity remaining after a generation

$H_t = H^t$

Heterozygosity remaining after t generations can be approximated by original heteroztgosity to the t power

Note: *Heterozygosity is a measure of genetic diversity that reflects the proportion of gene loci that have two (or more) alleles. Most relatively large natural populations have surprisingly high heterozygosities (comment on Lewontin & Hubby and protein electrophoresis in late 1960s)...*

Why is this surprising?

– heterosis, hybrid vigor, heterozygote advantage (comment on clinal variation in H)

– rise of neutralism

N_e/N typically ranges from 0.2 to 0.4 – useful heuristic if lacking other information

Factors influencing effective population size:

– Unequal sex ratio $N_e = (4N_mN_f)/(N_m + N_f)$ | comment on anisogamy and mating systems (seals)

For example:

What is the Ne of a population of 100 prairie chickens in which 10% of the males do 100% of the mating (assume a 1:1 sex ratio)

– Population fluctuations and bottlenecks $N_e = t\ (1/N_1 + 1/N_2 + ... + 1/N_t)$ | harmonic means implies large effect of individual generations with small population

For example:

What are the effective population sizes in the populations represented in the table below

generation	**1**	**2**	**3**	**4**	Average
Population 1	25	25	25	25	25
Population 2	30	30	10	30	25

– Unequal reproduction and/or survival....other factors....