Assignment #3: Effective Population Size

[A3] Autosomal, X- or Y-linked, and mt

A3 - For genes that are inherited only though one sex such as mtDNA (mitochondria), cpDNA (chloroplast), and the Y Chromosome, the effective population size for the appropriate sex determines the effect of genetic drift on those genes.

$$N_e = \frac{N_{ef}}{2} \quad \text{or} \quad N_e = \frac{N_{em}}{2}$$

	$N_m = 4$ $N_f = 200$	$N_m = 200$ $N_f = 200$	$N_m = 200$ $N_f = 4$
autosome	N_e=?	N_e=?	N_e=?
chromosome X	N_e=?	N_e=?	N_e=?
chromosome Y	N_e=?	N_e=?	N_e=?
mitochondrial	N_e=?	N_e=?	N_e=?


Solutions

	$N_m = 4$ $N_f = 200$	$N_m = 200$ $N_f = 200$	$N_m = 200$ $N_f = 4$
autosome	N_e=15.7	N_e=400	N_e=15.7
chromosome X	N_e=17.3	N_e=300	N_e=8.9
chromosome Y	N_e=2	N_e=100	N_e=100
mitochondrial	N_e=100	N_e=100	N_e=2

$$N_e = \frac{4N_mN_f}{N_m+N_f} \qquad N_e = \frac{9N_mN_f}{4N_m+2N_f} \qquad N_e = \frac{N_m}{2} \qquad N_e = \frac{N_f}{2}$$

Nm = 4; Nf = 200
autosome: Ne = 4*4*200/(4+200) = **15.7**
chromosome X: Ne = 9*4*200/(4*4+2*200) = **17.3**
chromosome Y: Ne = 4/2 = **2**
mitochondrial: Ne = 200/2 = **100**

Nm = 200; Nf = 200
autosome: Ne = 4*200*200/(200+200) = **400**
chromosome X: Ne = 9*200*200/(4*200+2*200) = **300**
chromosome Y: Ne = 200/2 = **100**
mitochondrial: Ne = 200/2 = **100**

Nm = 200; Nf = 4
autosome: Ne = 4*200*4/(200+4) = **15.7**
chromosome X: Ne = 9*200*4/(4*200+2*4) = **8.9**
chromosome Y: Ne = 200/2 = **100**
mitochondrial: Ne = 4/2 = **2**

The effective population size for mtDNA is generally smaller than for diploid nuclear genes because each individual has only one haplotype (allele) and uniparental inheritance