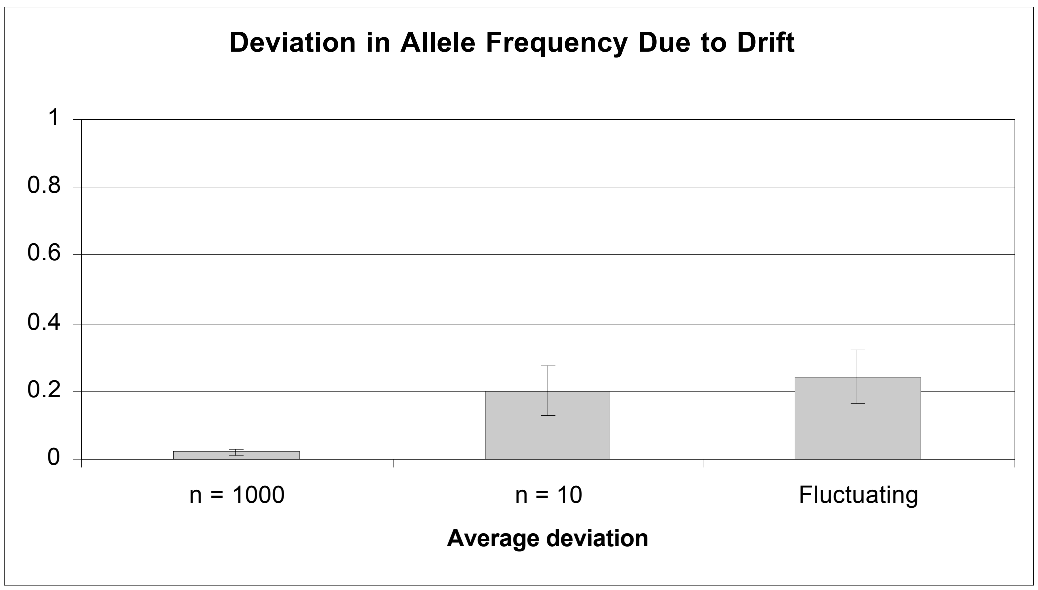
Answers to Exercise 26

Effective Population Size

1. It should be clear that the smaller population drifts more over 6 generations than the larger population size of 1000.

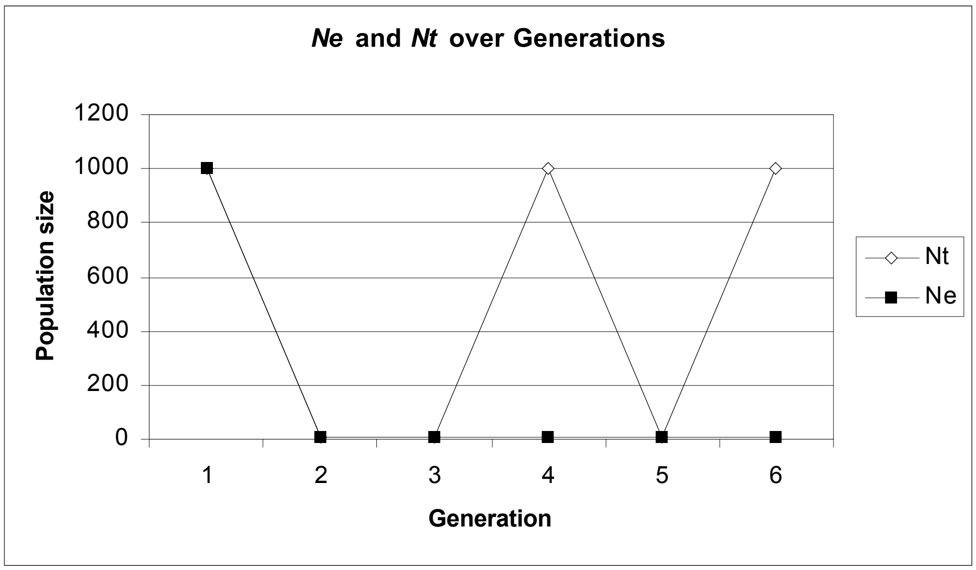
2. In your 100 simulations, the fluctuating population should "behave" similarly to the constant population size of 10 in terms of drift of the A_1 allele. Our results are shown below. Your results will look a bit different, but they should suggest that the fluctuating population is more similar to the constant population of 10 than the constant population size of 1000.



3. Your spreadsheet formulae should be as follows:

	S	T	U	V	W
2	Generation	*Nt*	*1/Nt*	Sum *1/Nt*	*Ne*
3	1	=C4	=1/T3	=U3	=1/((1/S3)*V3)
4	2	=E4	=1/T4	=V3+U4	=1/((1/S4)*V4)
5	3	=G4	=1/T5	=V4+U5	=1/((1/S5)*V5)
6	4	=I4	=1/T6	=V5+U6	=1/((1/S6)*V6)
7	5	=K4	=1/T7	=V6+U7	=1/((1/S7)*V7)
8	6	=M4	=1/T8	=V7+U8	=1/((1/S8)*V8)

4. For any series of numbers, the harmonic mean will be greatest when all of the numbers are the equal (i.e., when populations do not fluctuate). Then the harmonic mean is equal to the arithmetic mean. It is possible for $N_e > N_t$. Try the numbers 1000, 1000, 1000, 500, and 1000. In the fourth generation, $N_t = 500$ but $N_e = 800$. The value of the lowest number (the severity of the bottleneck) drives the harmonic mean calculation, and hence N_e.



Graphically, when you compare N_t and N_e over time, you will see that the first bottleneck reduces N_e to a low level, where it never rebounds in spite of subsequent population increases. This highlights the importance of bottlenecks and their long-term effects on the genetic behavior of a population.