ABIO320: Ecology

Problem Set A

1. At time t_1 you capture, *mark* and release 60 individuals. At time t_2 you *capture* 144 individuals; 24 of them are marked (= *recaptures*). What is your estimate of **population size**? List 2 behavioral/demographic assumptions underlying the method you use.

M = 60; n = 144; x = 24

M/N = x/n: 60/N = 24/144 = 1/6

N = 360

2. On day 1 you capture, *mark* and release 78 house sparrows. Two days later you capture both marked and unmarked birds; the number *marked* is 26. You estimate a *population size* of 195 individuals. How many **unmarked** birds were captured on day 2?

M = 78; x = 26; N = 195; find (n – x)

M/N = n/x: 78/195 = 26/[26 + (n-x)]

2/5 = 26/[26 + (n-x)]: 130 = 52 + 2(n-x)

n-x = ½(130 – 52) = 39

3. You trap, *mark* and release 35 field mice. Three days later you trap both marked and unmarked mice; 36 individuals are *unmarked*. You estimate a *population size* of 140 individuals. How many **recaptures** were included in the second sample?

M = 35; (n-x) = 36; N = 140; find x

M/N = x/[x + (n-x)]: 35/140 = x/[x + 36]

¼ = x/(x+36): x+36 = 4x: x = 36/3 = 12

---

4. N(t) is population size at time t; time is continuous. Briefly define dN(t)/dt; then define $\left({}^{1}/_{N_t}\right) {}^{dN_t}/_{dt}$. Note that these definitions should apply to any continuous-time model of population growth, not just exponential growth.

5. A population grows *exponentially* from an *initial population* size (i.e., at time 0) of 10 individuals. The *intrinsic rate of increase* is 0.1. What is the **population size** at time 10?

N(t) = N(0) exp(rt): N(t) = 10 exp(0.1[10]) = 10e

6. Population size changes according to $dN_t/dt = rN_t$. The population *declines* exponentially from an *initial population* size of N_0. At what **time** will the population size declined to ½ its initial value? What condition on the intrinsic rate makes your answer positive?

Done in class

7. Consider a population of two asexually reproducing genotypes (1 and 2). Assume that each genotypic lineage $G_i\ (t)$ grows exponentially, at constant rates r_1 and r_2, respectively. If $r_1 > r_2$, what will happen as time grows large? What happens to the ratio $G_1(t)/G_2(t)$ as time grows large?

By unbounded growth, frequency of slower growing type goes to zero.

8. A population grows according to $dN_t/dt = rN_t$, where $r > 0$. Find the expression for $\ln N_t$.

Ln N(t) = ln (N(0)) + rt

9. What assumptions, reasonable or otherwise, underlie the exponential growth model?