Fish Management (Zool 466)
Lecture 16

Mortality

I. We need to understand mechanisms influencing mortality in populations - this will allow us to determine how populations should respond to regulations

II. Mortality of young-of-year fish (YOY)
  A. Often quite variable - not simple to model
  B. Sources of mortality
    1. Density dependent
    2. Density independent

III. Mortality of older ages (usually want to model mortality when fully recruited to sampling gear)
  A. Major assumptions that must be met to model mortality
    1. Survival is equal among all age groups (cohorts)
    2. Survival is constant among years
    3. The number of individuals recruiting is constant among years (a big assumption; see above)
    4. In other words, assume that the population is in steady state; no change in size is occurring
  B. If all assumptions are met, the number of individuals within cohorts should decline exponentially with increasing age (exponential decay curve)
  C. To characterize the *instantaneous rate* of decline
    1. Log_e-transform number of individuals (CPE or population estimate) versus age
    2. Negative slope of the linear regression is **Z** (instantaneous mortality rate)
    3. This equation can be arranged to $N_t=N_oe^{-Zt}$
  D. From Z, we can get *actual, total annual rates*
    1. Survivorship, $\mathbf{S} = e^{-Z}$
    2. Mortality, **A** = 1- S
  E. Mortality can be divided into fishing and natural components
    1. Instantaneous mortality rate; Z = M + F
      a. M = natural mortality rate
      b. F = fishing mortality
    2. Total mortality rate; A = v + u
      a. v = natural mortality
      b. u = exploitation rate
    3. Compensation; Z is comprised of fishing and natural components; increases in F should result in a decline in M, to some degree

IV. How do we quantify mortality to get these relationships?
  A. Fishing mortality (u)
    1. Mark and release fish
    2. Use creel survey to estimate number being harvested
    3. Provide some reward for tag return
  B. Total mortality (Z)
    1. Several methods are available; catch-curve analysis is typical
    2. Use gear to sample fish that does not have size/ age bias
    3. Plot log_e-transformed number versus age
    4. Slope of the linear, least squares regression is Z
  C. Natural mortality (v)
    1. Use estimate of Z to get A (total actual mortality)
    2. By difference of u and A, get v (natural mortality)

V. Regulations should act to reduce u and thereby to reduce A