Modeling group

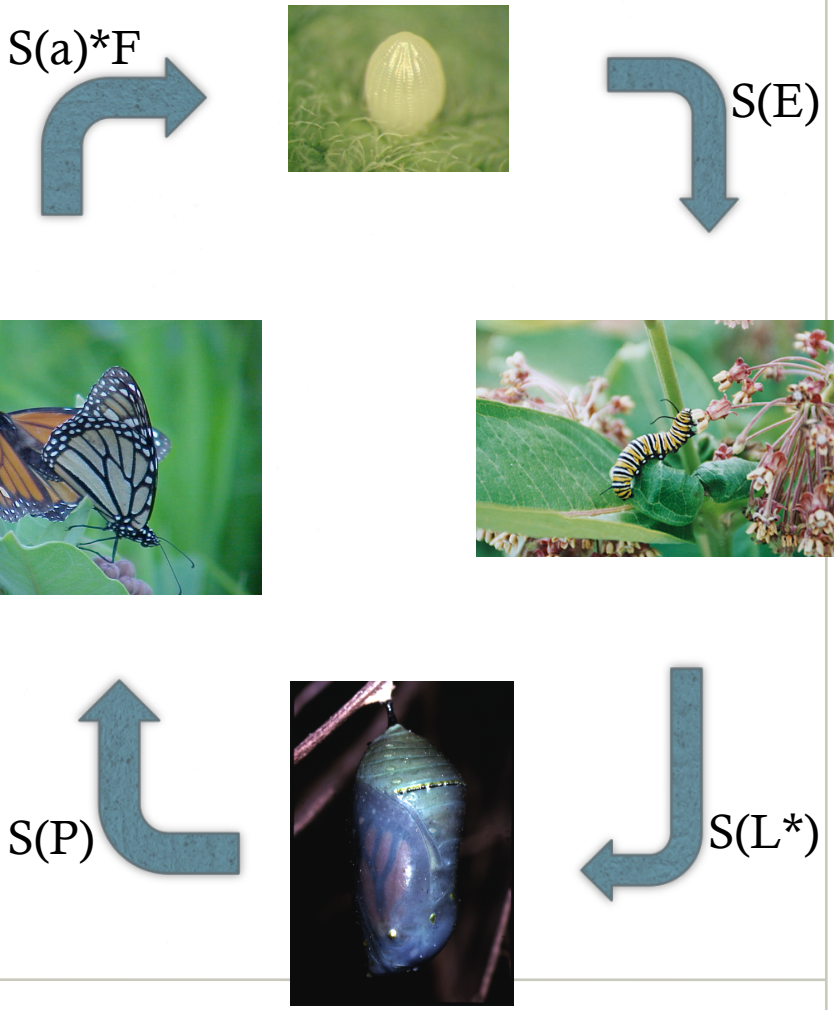
Reba Batalden, James Battin, Elizabeth Howard,
Nate Nibbelink, Monte Sanford, Elise Zipkin

Question 1

- 1) What are the demographic bottlenecks limiting adult population size? Application of a stage-based simulation model
  - a) what is the relative contribution of each stage to adult density (effects of mortality)?
  - b) what are factors affecting dynamics due to density-dependence or external factors?
- Life cycle model
  - spatial scale - start in midwest with really good data (to define/ parameterize life cycle?)
  - Life cycle model can help us get at the expected natural variation due to monarch population dynamics - and ultimately differentiate expected natural variability from environmental effects.
  - First stage might simplify this and look at 4 stages and also look at expected transitions from region to region

Life cycle model

- E(t) = A(t-1) * fecundity
- L1(t) = E(t) * (S(a)*F)
- L2(t) = L1(t) * S(L1)
- L3(t) = L2(t) * S(L2)
- L4(t) = L3(t) * S(L3)
- L5(t) = L4(t) * S(L4)
- P(t) = L5(t) * S(L5)
- A(t) = P(t) * S(P)



Question 2

- 2) Can we use a dispersion model to replicate observed northern migration patters, given simple climatic variables?
- What effects movement north?
  - Temperatures (degree days)
  - Wind direction
  - Precipitation

Question 3

- 3) Can we combine life cycle model with dispersion model in a spatially-explicit framework to replicate both migration and demographic patterns?

Nate's dream

Can we take mechanisms worked out from other groups related to habitat selection, movements, natural enemies, demography, etc in an agent-based model?

Data use/gaps

- Data use
  - Journey north
  - Mechanistic information
    - Survival data
    - MLMP
  - Monarch Watch
- Data gaps
  - Weather data for Mexico
  - Departure date (from Mexico)
  - Movement rate of individuals north
  - Wind direction data