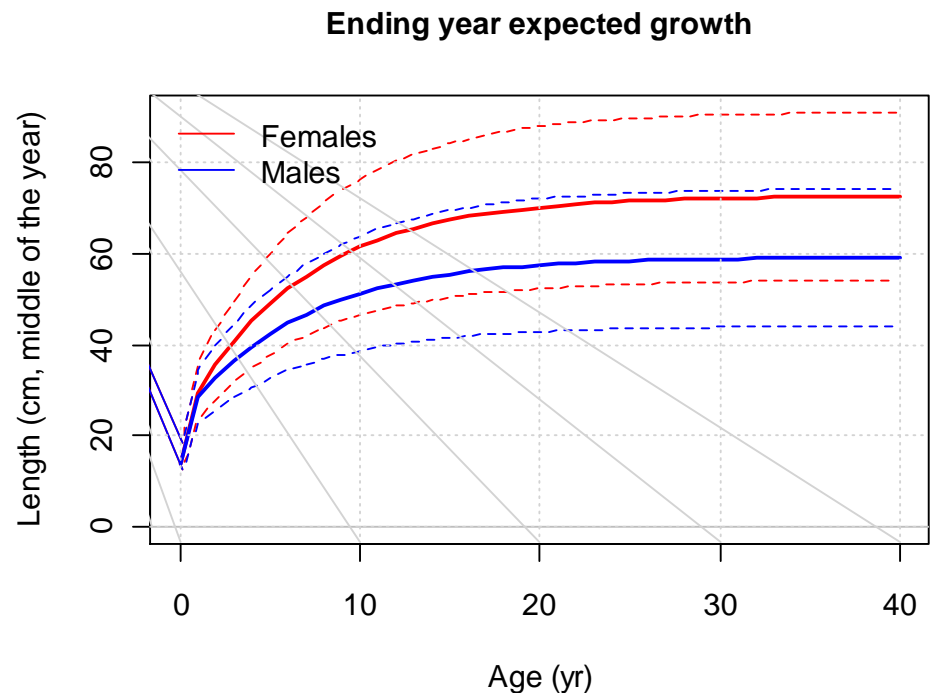


Modeling growth in Stock Synthesis

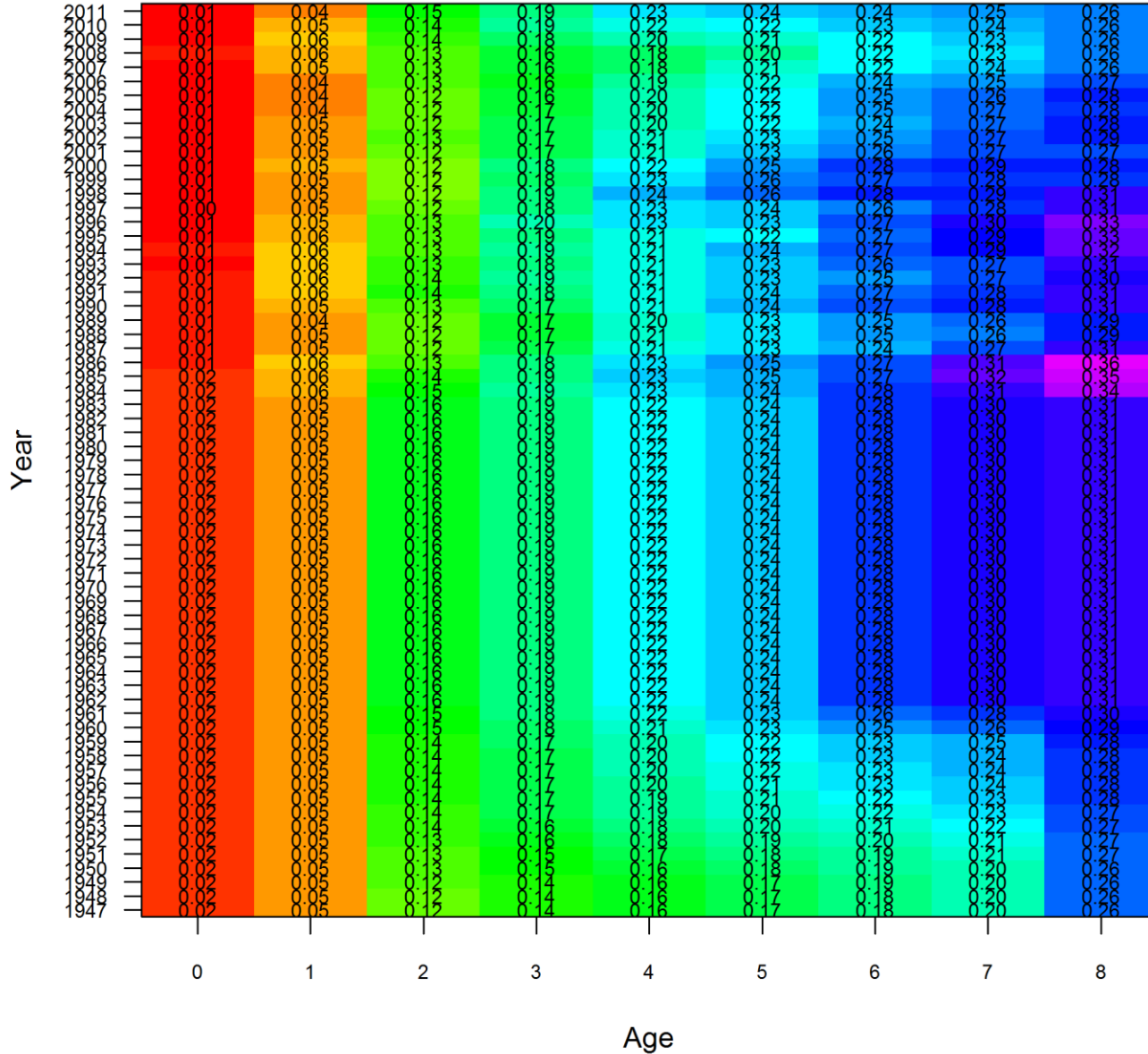
Outline

- Growth curves
 - von Bertalanffy
 - Schnute's generalized (a.k.a. Richards)
- Variation in length at age
- Growth patterns
- Growth morphs
- Empirical weight at age



Empirical weight at age (NS Herring)

Empirical weight at age in middle of the year

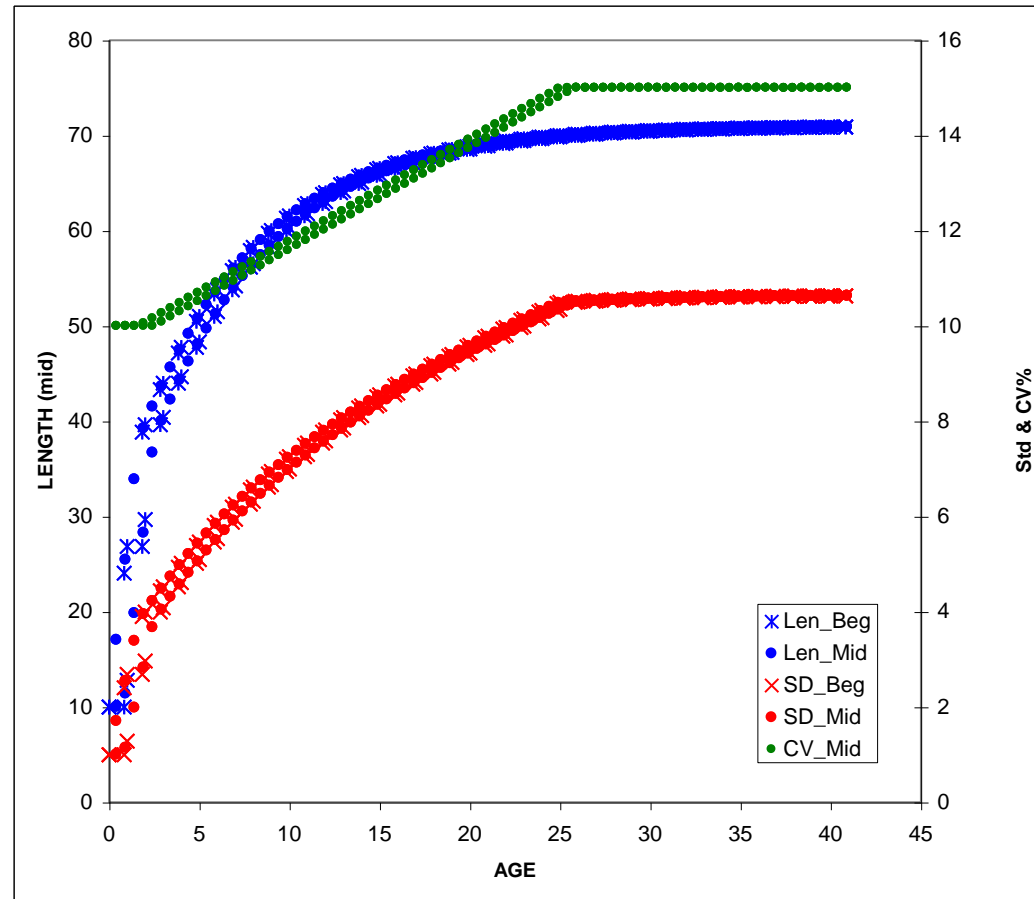


Growth curves

- The von Bertalanffy, parameterized in terms of,
 - length at a given young age,
 - length at a given old age (or optionally L_{∞})
 - growth rate parameter, K
- Growth increment is modeled as a function of current length, current year's L_{∞} and K
 - allow for temporal changes in growth without individuals shrinking

Growth example

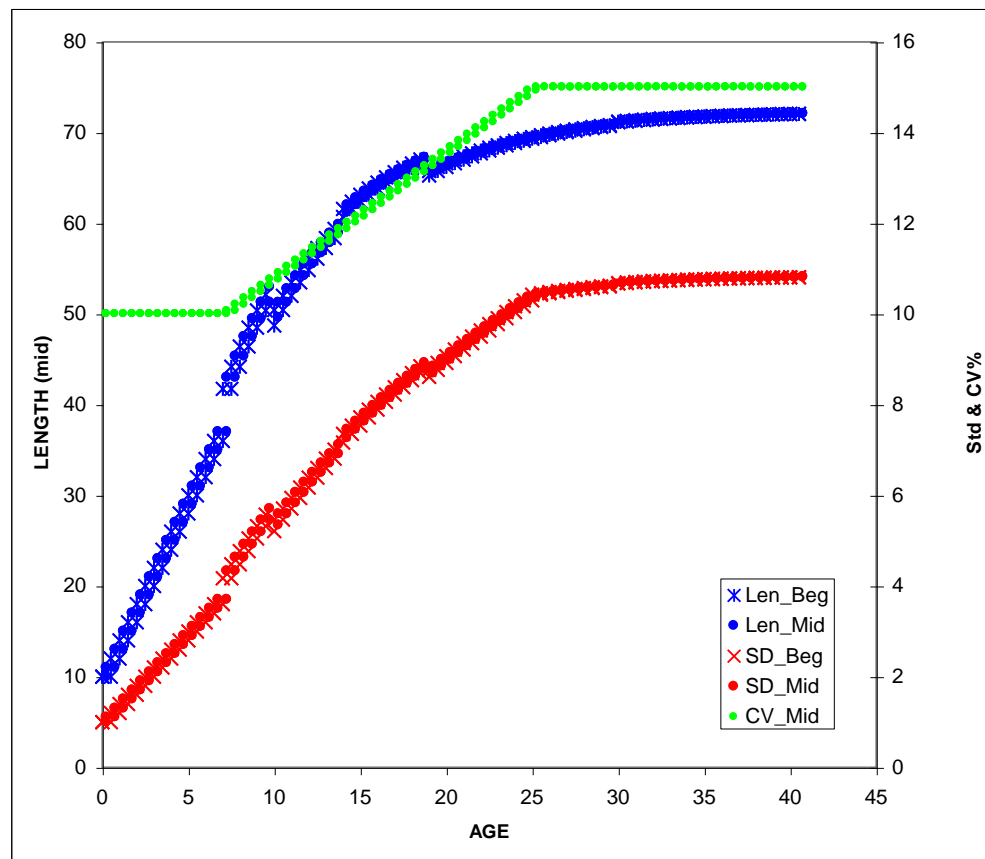
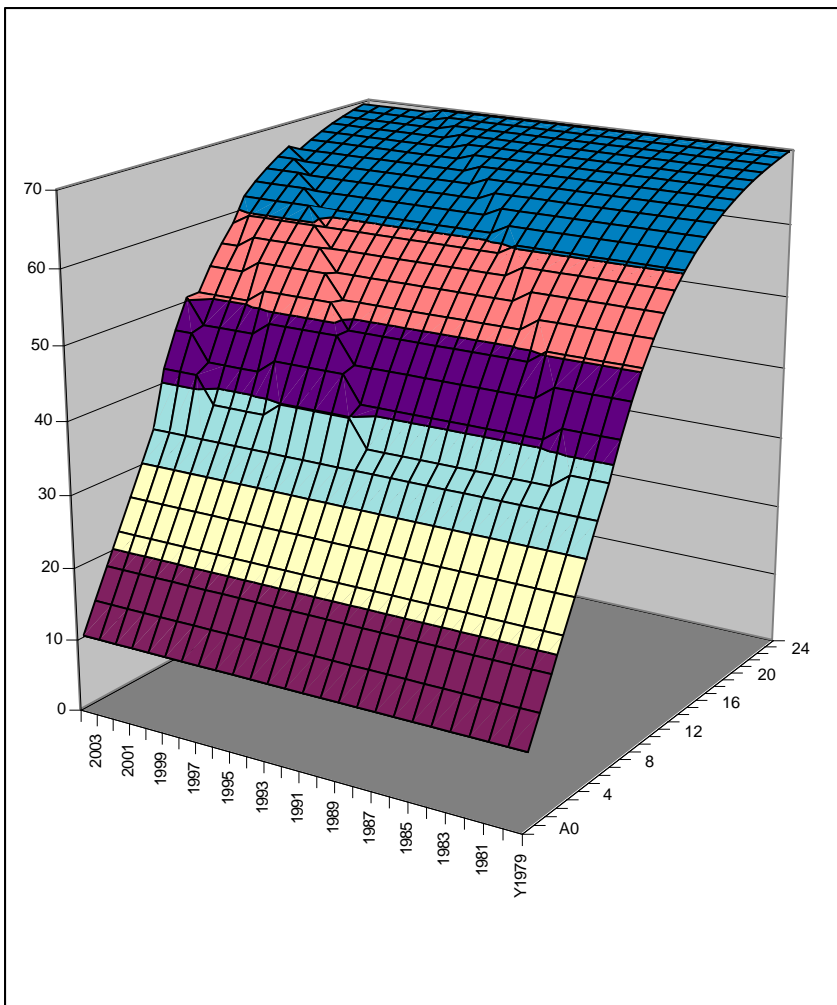
- Example showing:
 - Two birth seasons
 - $CV = F(A)$
 - Season durations:
10 months
& 2 months



Additional growth options

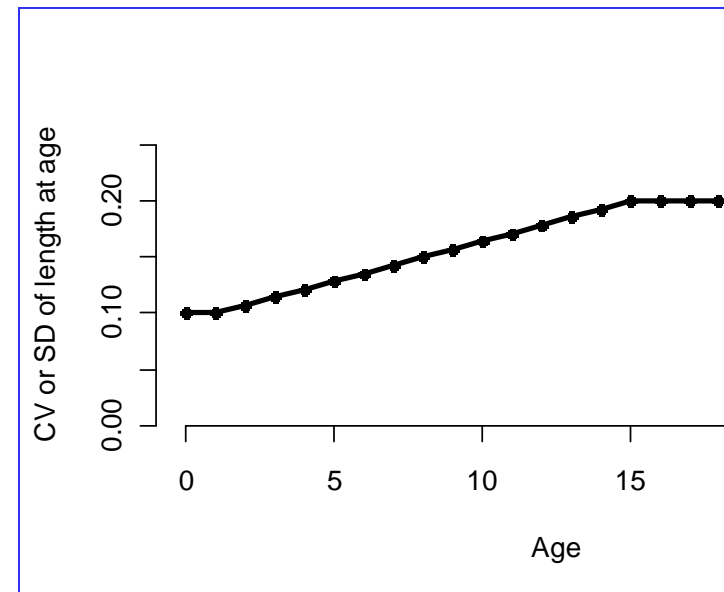
- Cohort-specific growth
 - specified by penalty on deviations
 - allows variation in growth rates between cohorts
 - may be due to intra-cohort density dependence (not modeled explicitly), genetics, or other factors
- Schnute's generalized growth curve (a.k.a. Richards curve)
 - has additional parameter that generalizes the von Bertalanffy curve

Cohort Growth Deviation



Variation of length at age

- Several linear functions are available to model the variation of length at age
 - CV as a function of length at age
 - CV as a function of age
 - SD as a function of length at age
 - SD as a function of age
- Dogleg pattern uses growth A_{\min} and A_{\max}

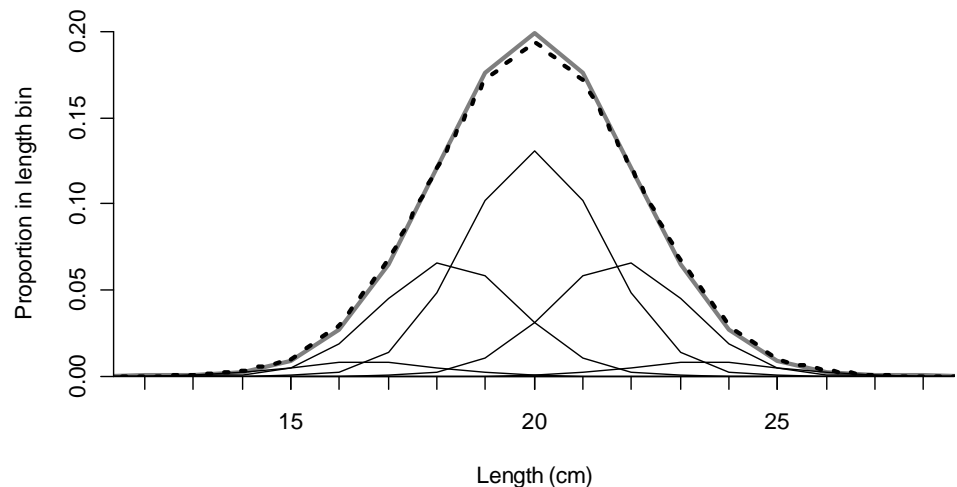


Growth patterns

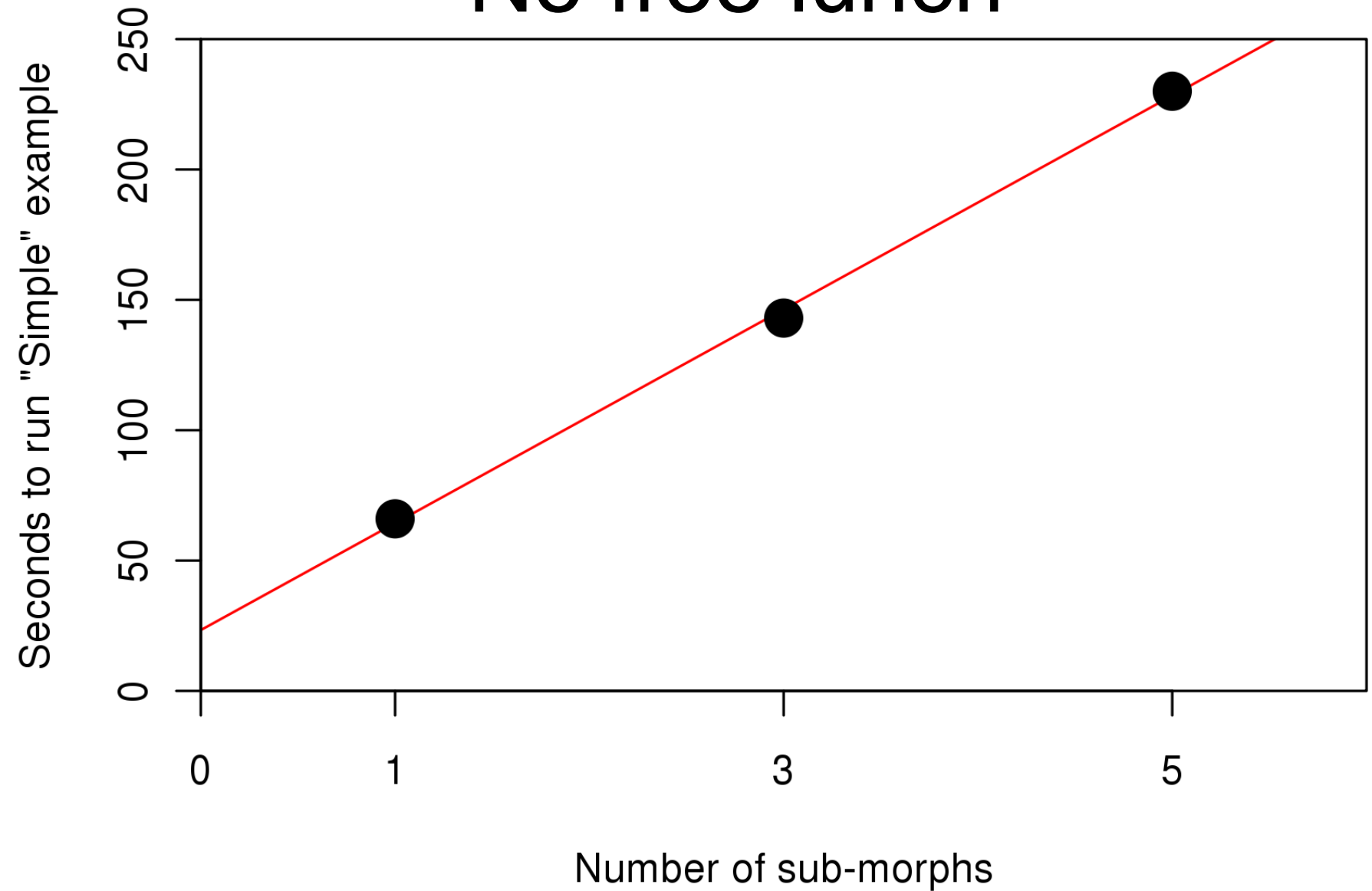
- Can be used to model the difference in growth among sub-populations
- In a multi-area model, the distribution of recruitment among areas and growth patterns is controlled by estimable parameters
- When an individual changes areas, it maintains the growth parameters of its specified growth pattern

Growth morphs

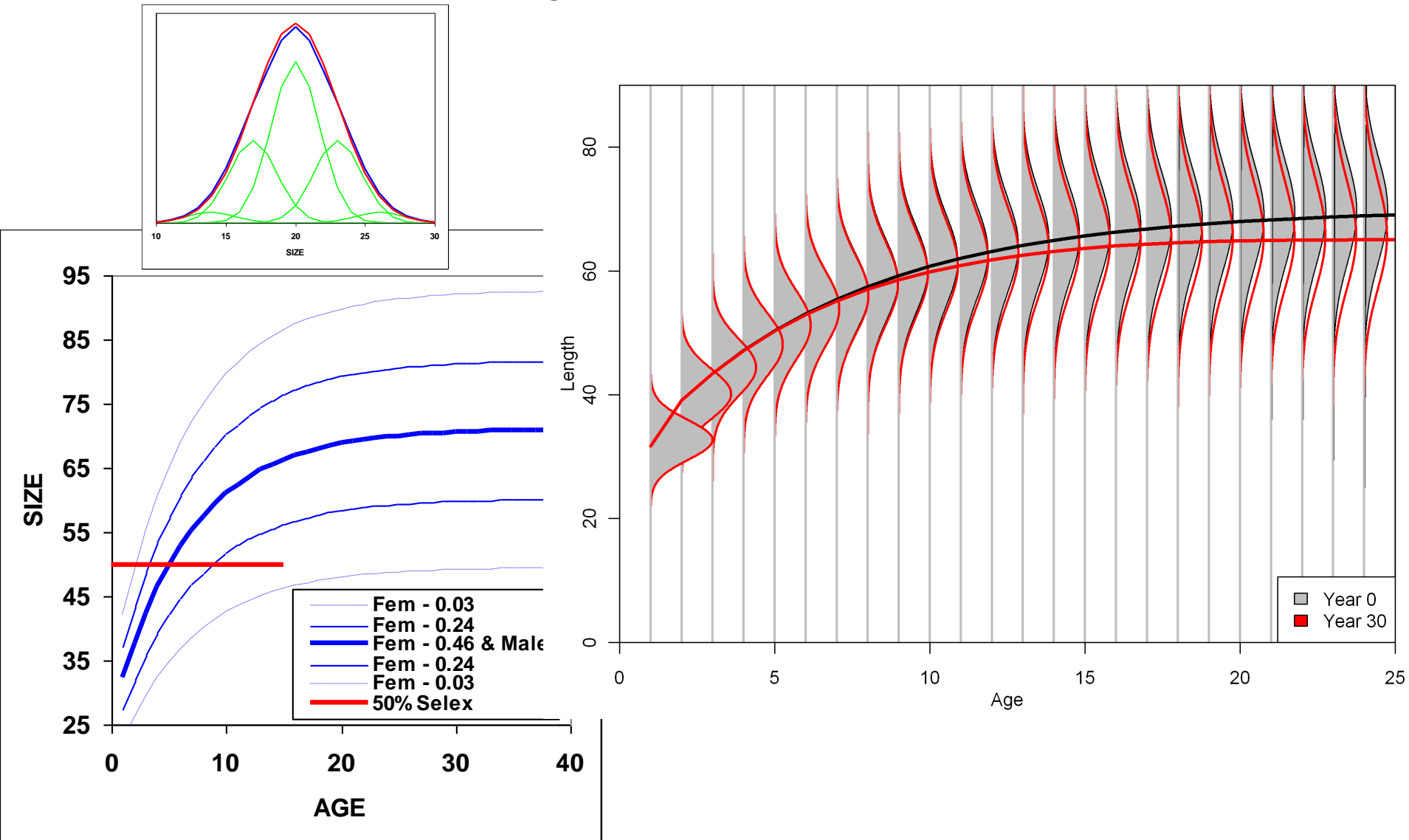
- 3 or 5 morphs nested within growth patterns and genders
- Used to account for the effect of size specific selectivity in the population size structure at age by dividing cohort into components with different size-at-age
- Size selectivity then causes different F-at-age for the different morphs



No free lunch



Length-Specific Survivorship



Growth morph example

Interaction between selectivity and mean weight and length (at age 30)

