

Variable food intake and models of the Northeast Arctic cod

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Jackmann et al. 1995 *Afr. J. Ecol.* **33**: 230-235



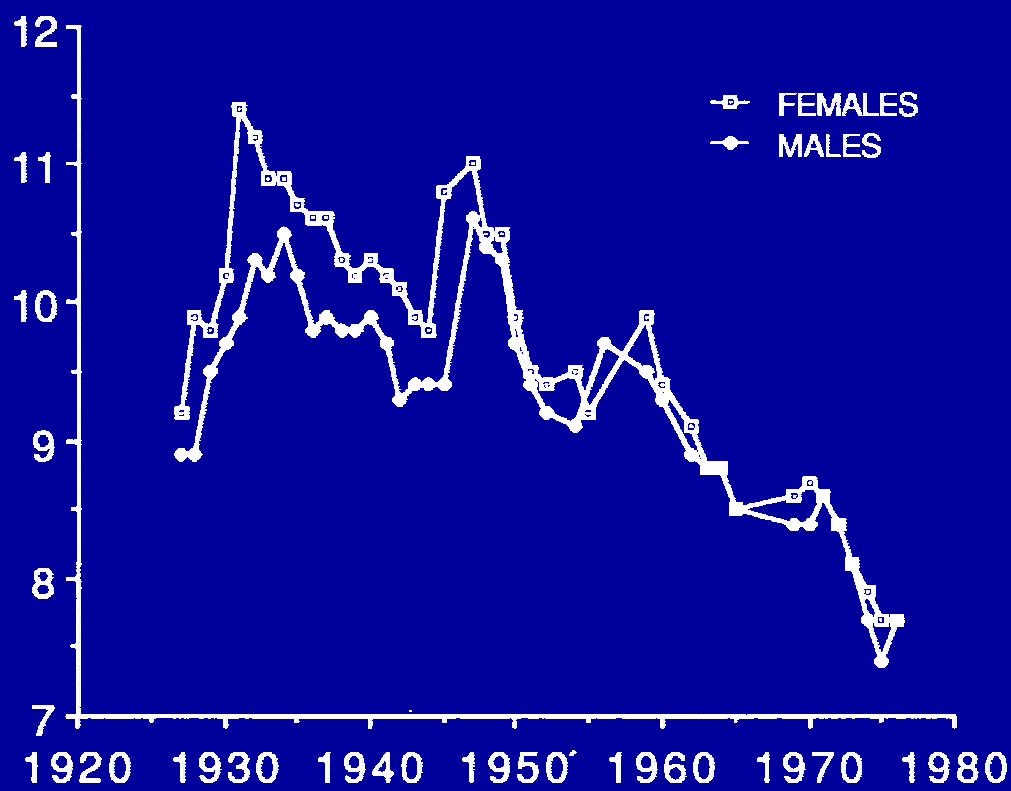
Coltman et al. 2003 *Nature* **426**: 655-658



Law and Grey 1989 *Evol. Ecol.* **3**: 343-359

Human harvest
changes the
targeted species

MEDIAN AGE AT MATURITY (years)

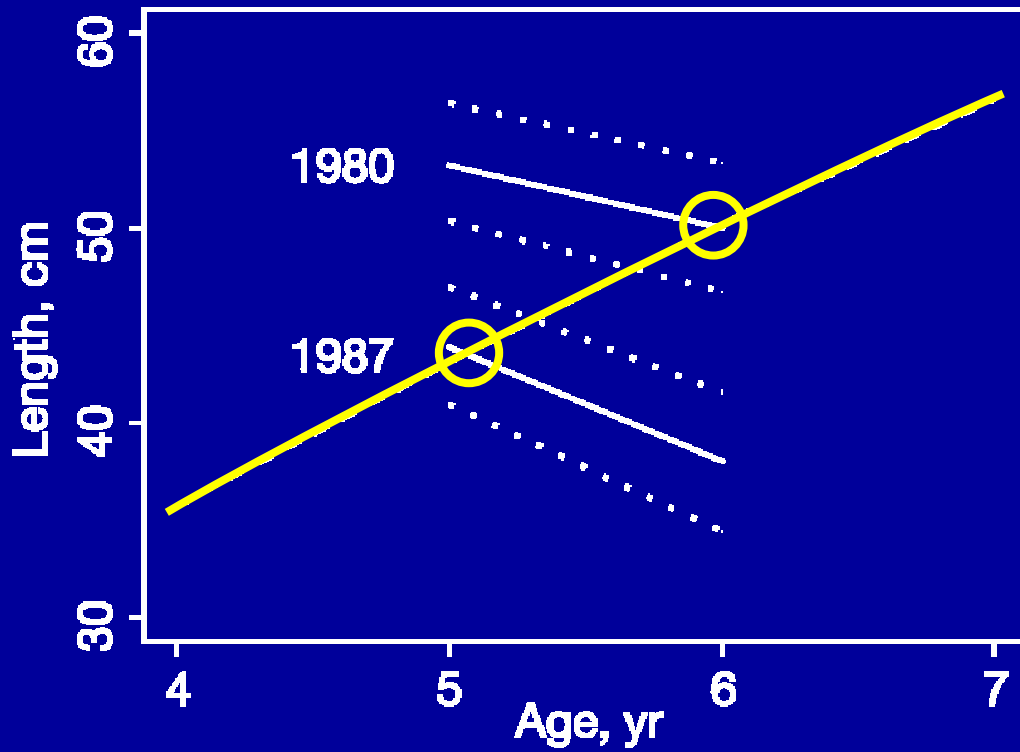


Jørgensen 1990
J. Conseil 46: 235-248



Human harvest
changes the
targeted species

Law and Grey 1989 *Evol. Ecol.* 3: 343-359



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Maturation trends indicative of rapid evolution preceded the collapse of northern cod

Esben M. Olsen^{1*}, Mikko Heino^{1,2}, George R. Lilly³, M. Joanne Morgan³, John Bratley³, Bruno Ernande¹ & Ulf Dieckmann¹

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Human harvest changes the targeted species - within decades

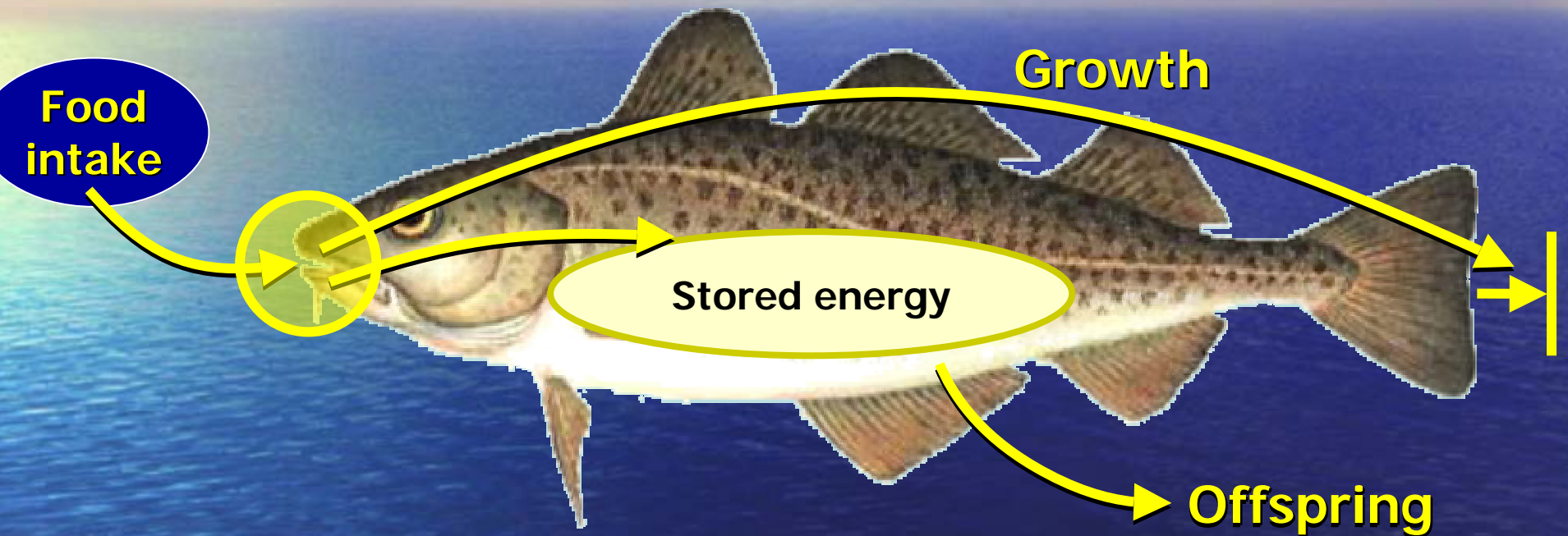
Climate and evolution?

- Marine climate is **central** to life history
 - survival, growth, reproduction
- Climate change can have **regional** impacts
 - as dramatic as human-induced mortality changes
- **Phenotypic plasticity** in response to variability
 - genetic variation that predisposes for rapid evolution

Conclusion 1:

An evolutionary life-history approach seems fit when asking questions about climate-driven biological change.

Allocation to growth and reproduction



Mechanistic description of energy allocation

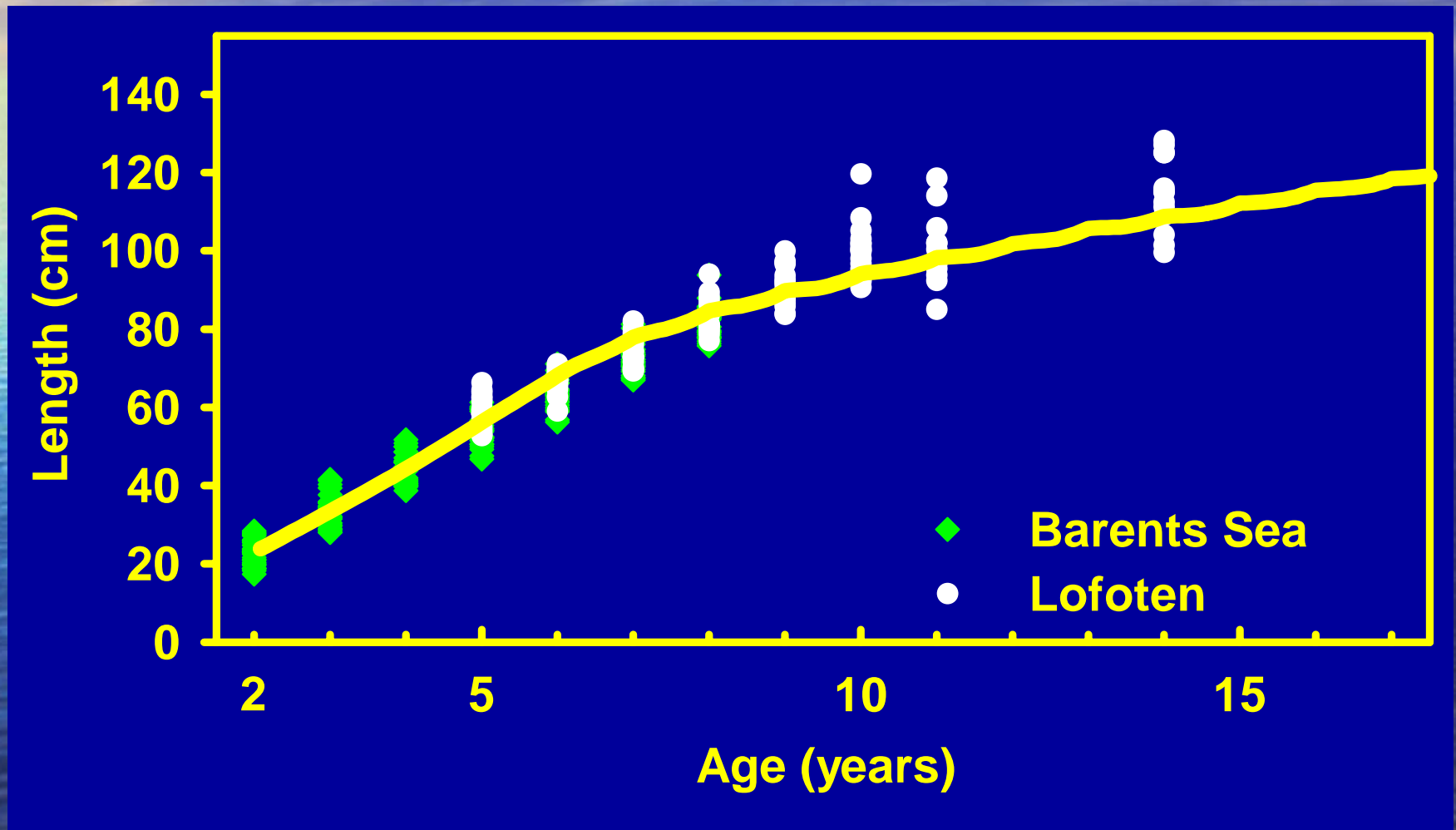
16 equations, 27 parameters

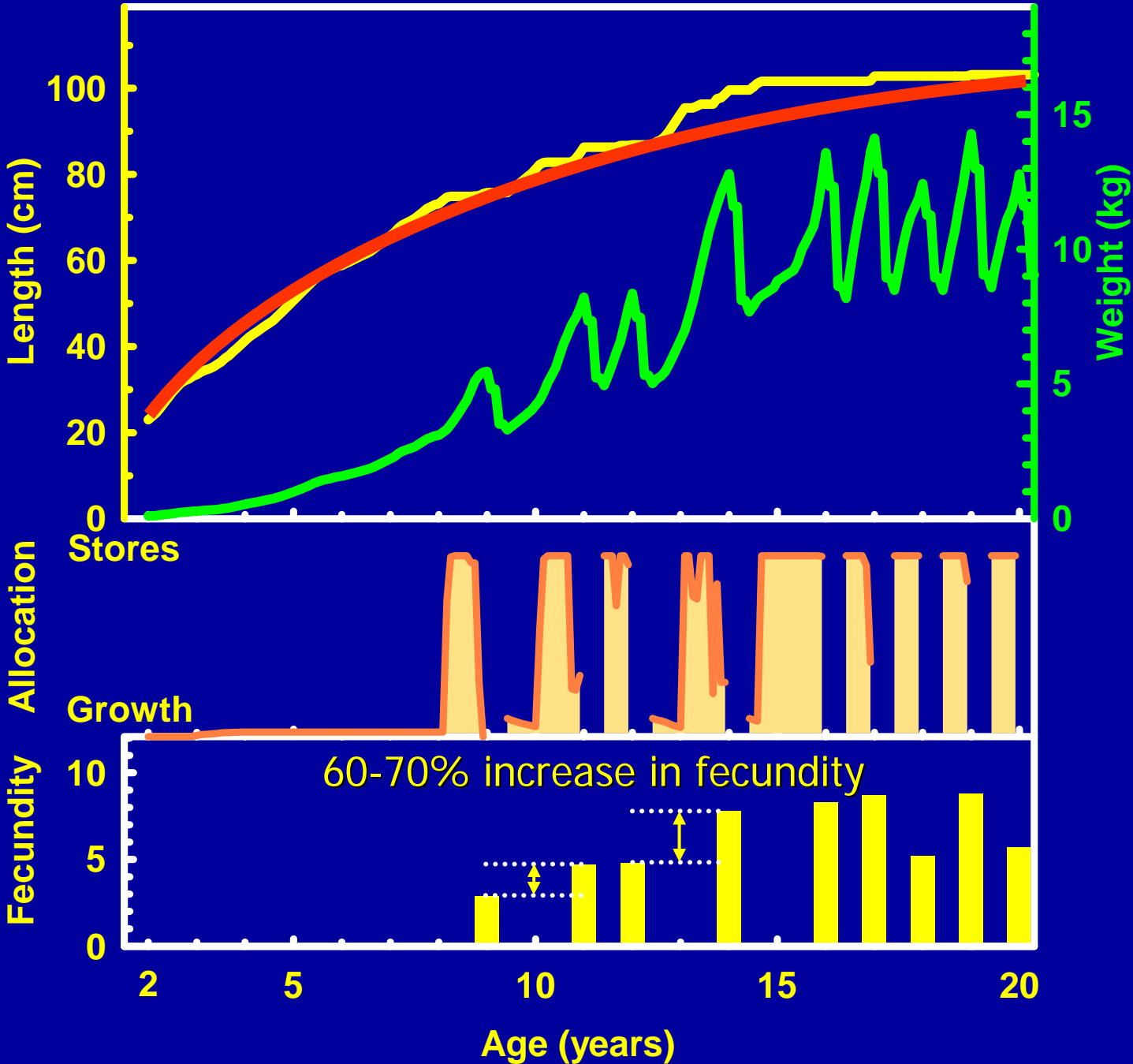
A state-dependent model

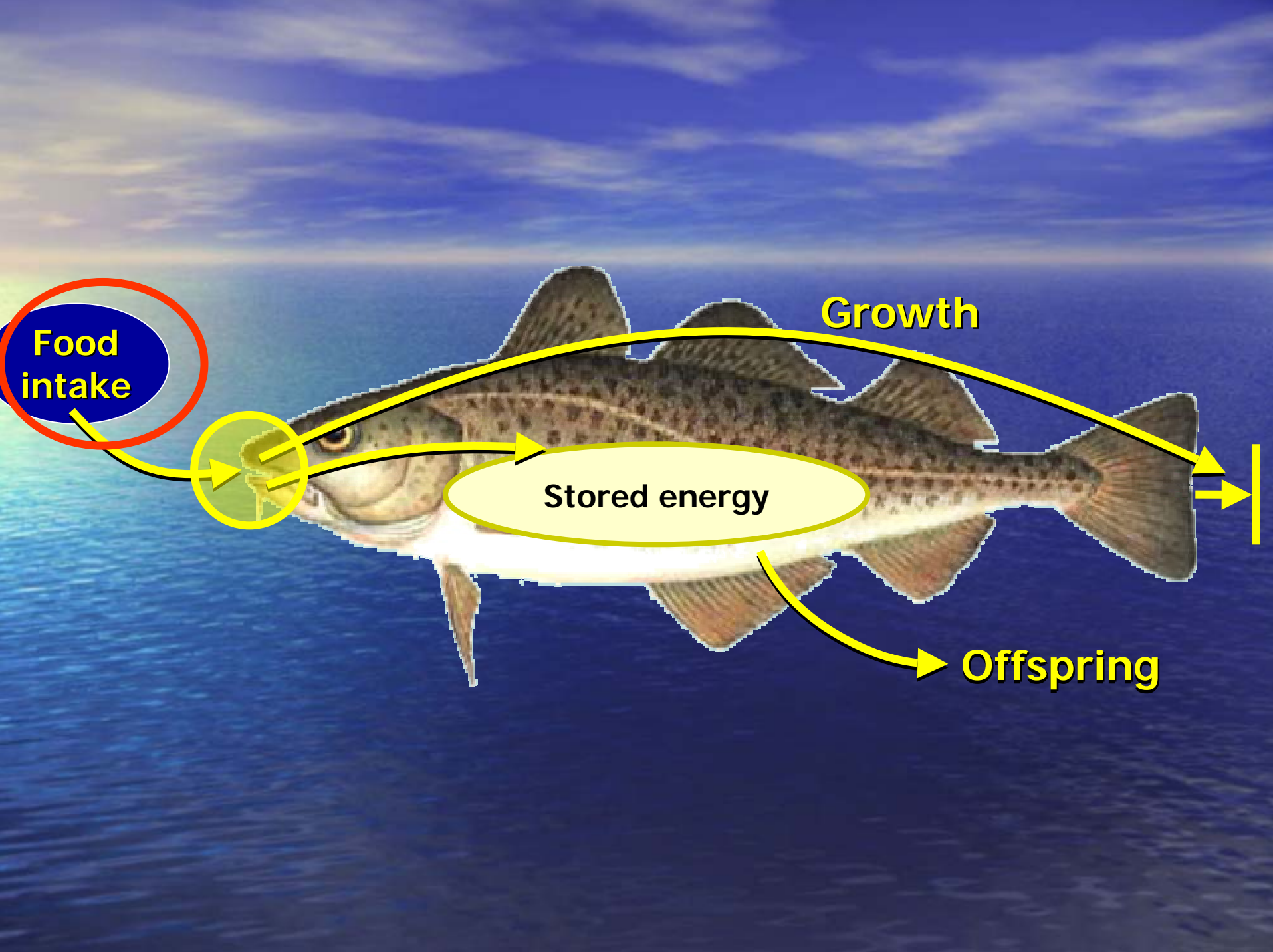
- Age
- Length
- Energy stores
- Month (season)
- Current food intake

Optimized using dynamic programming

Fit with field data







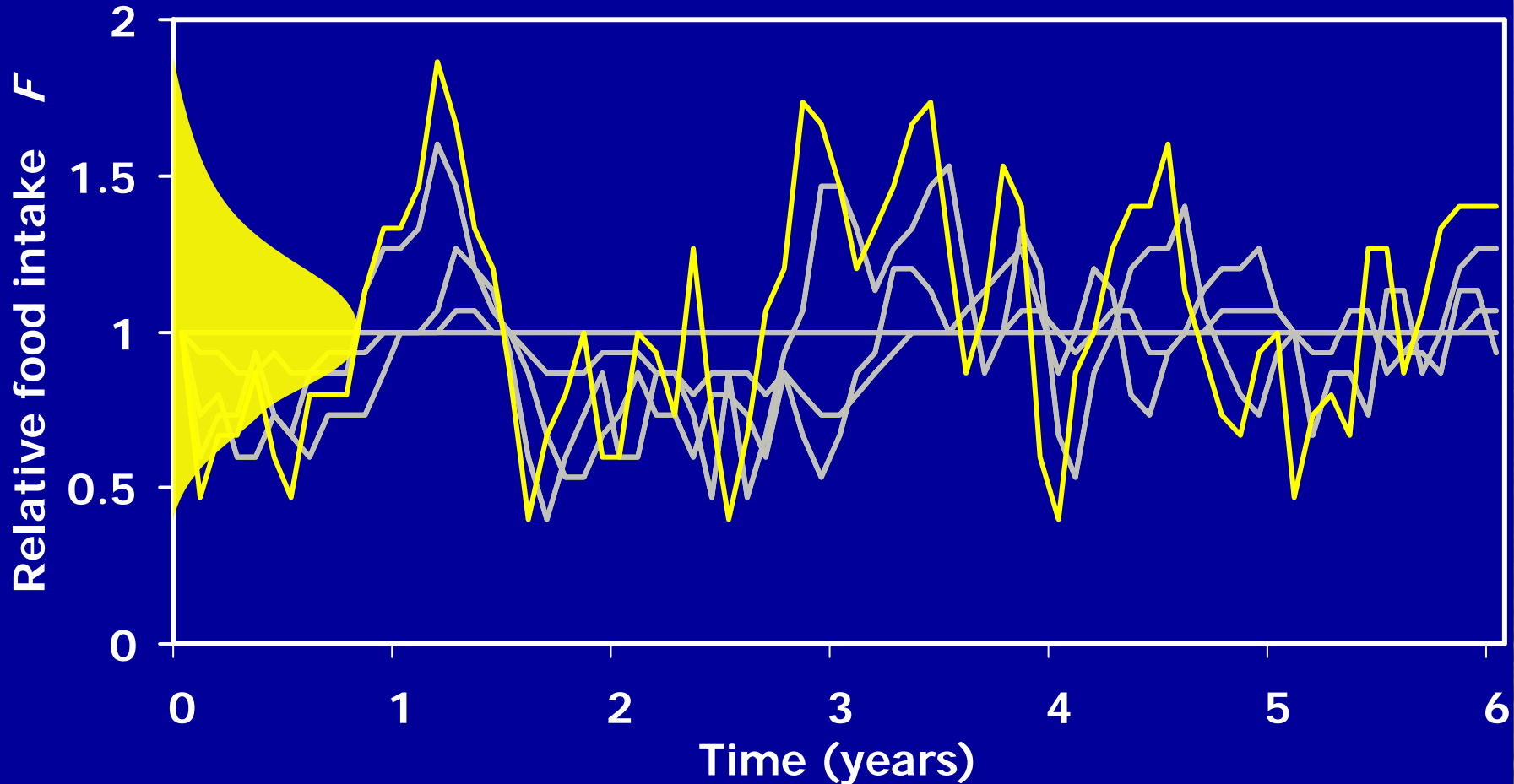
Food intake

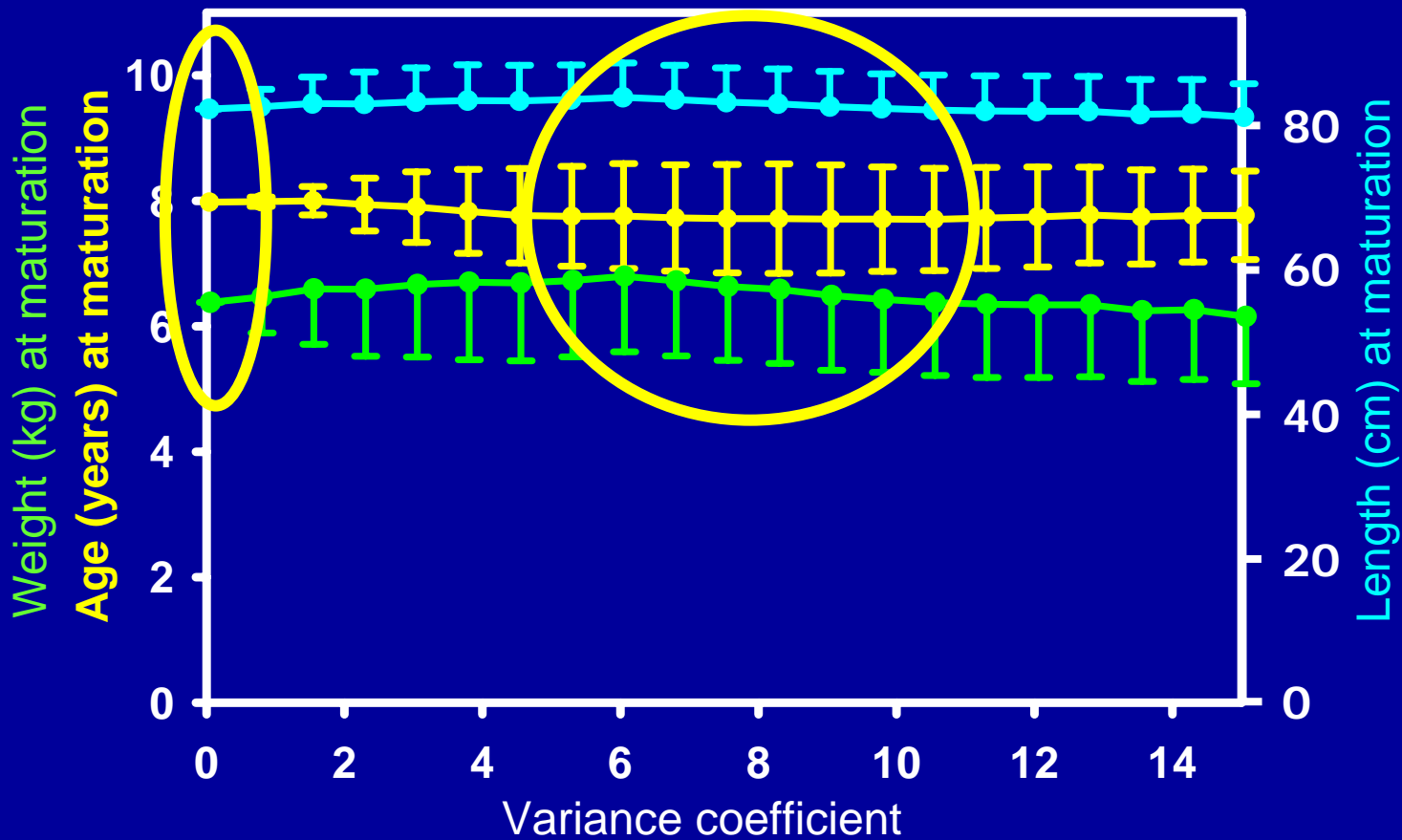
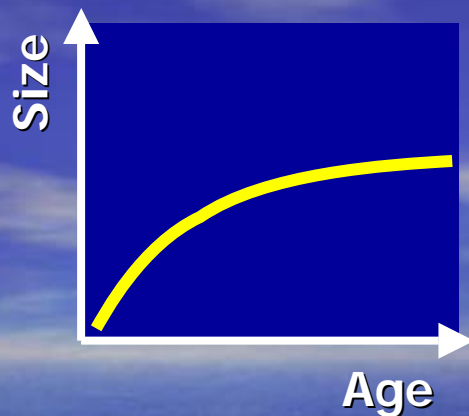
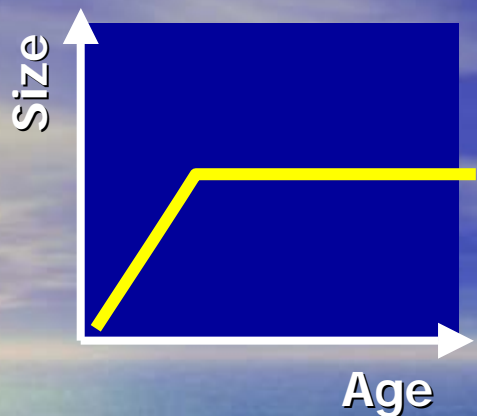
Growth

Stored energy

Offspring

Autocorrelated food intake



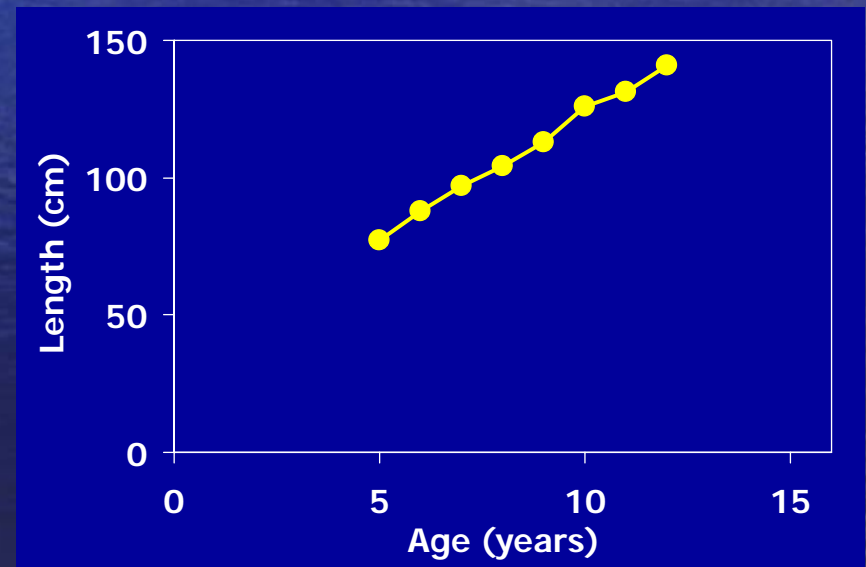
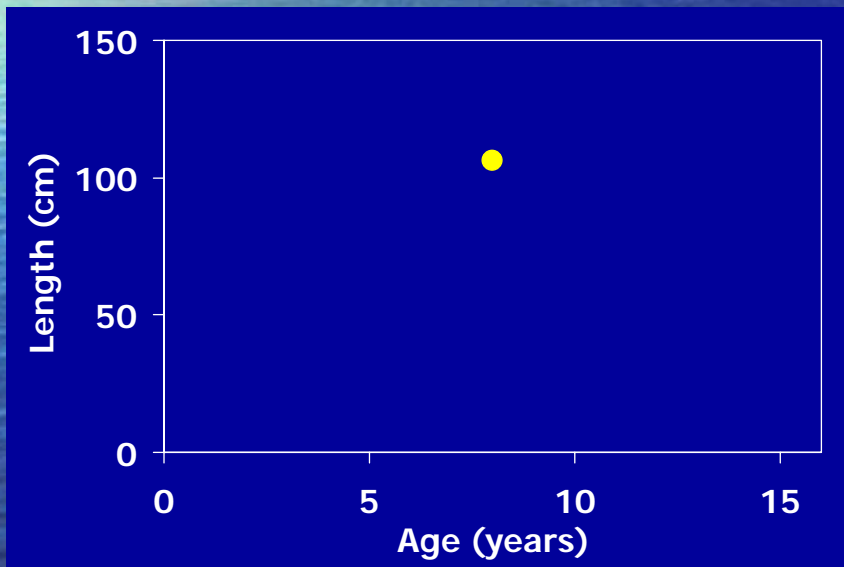


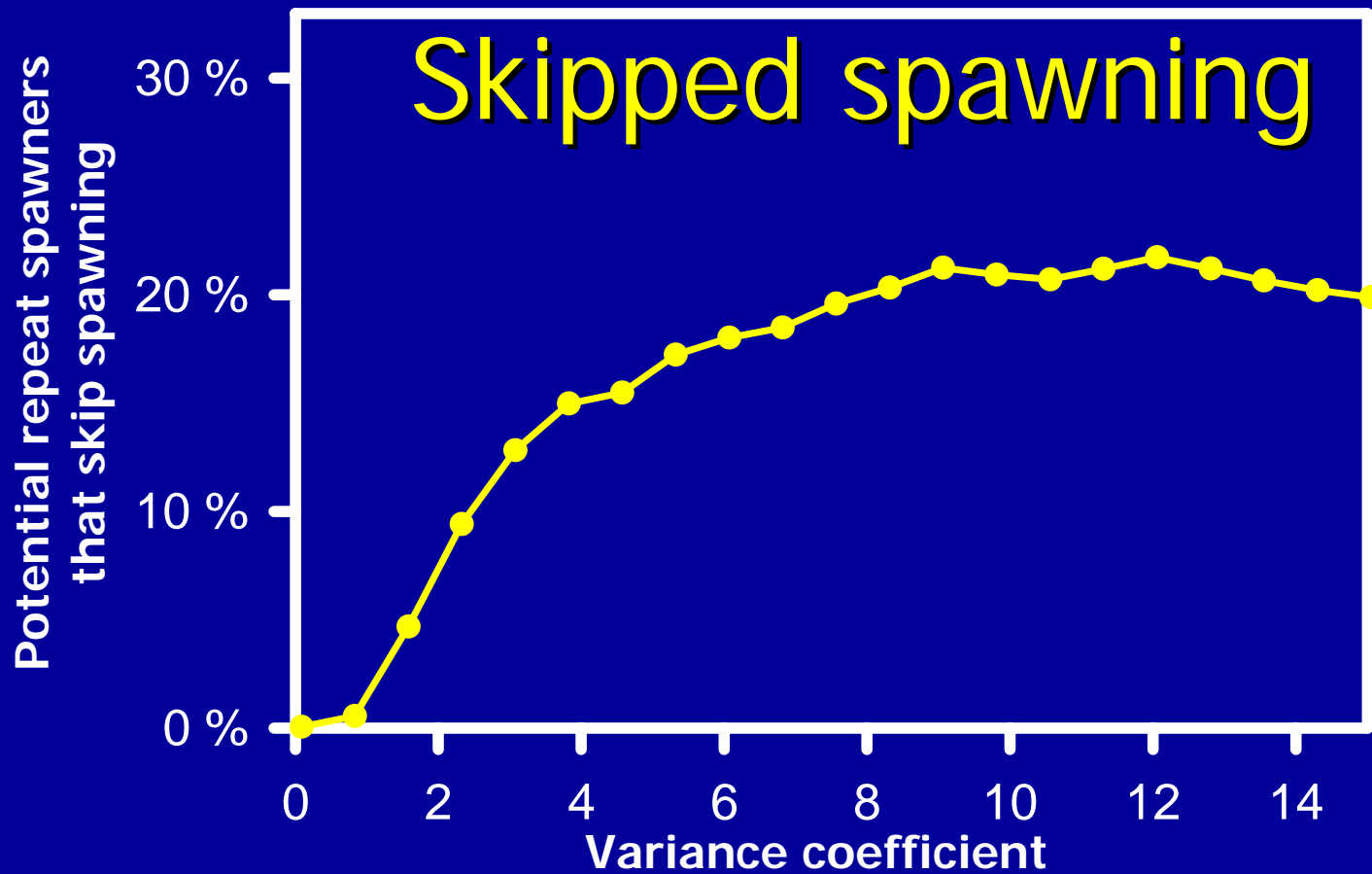
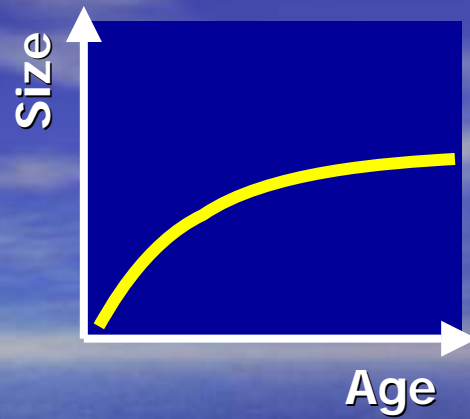
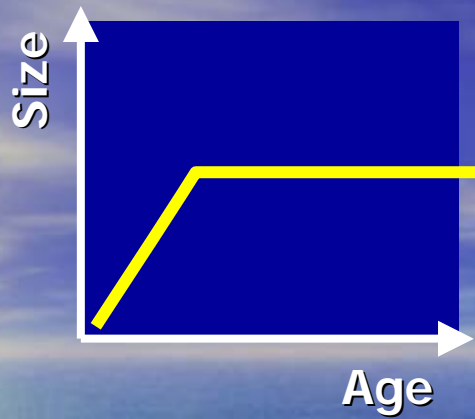
Maturation reaction norm

Food intake variability

No

Yes





Conclusion 2:

Life-history models
must incorporate
sufficient environmental variability
for biological realism to emerge.