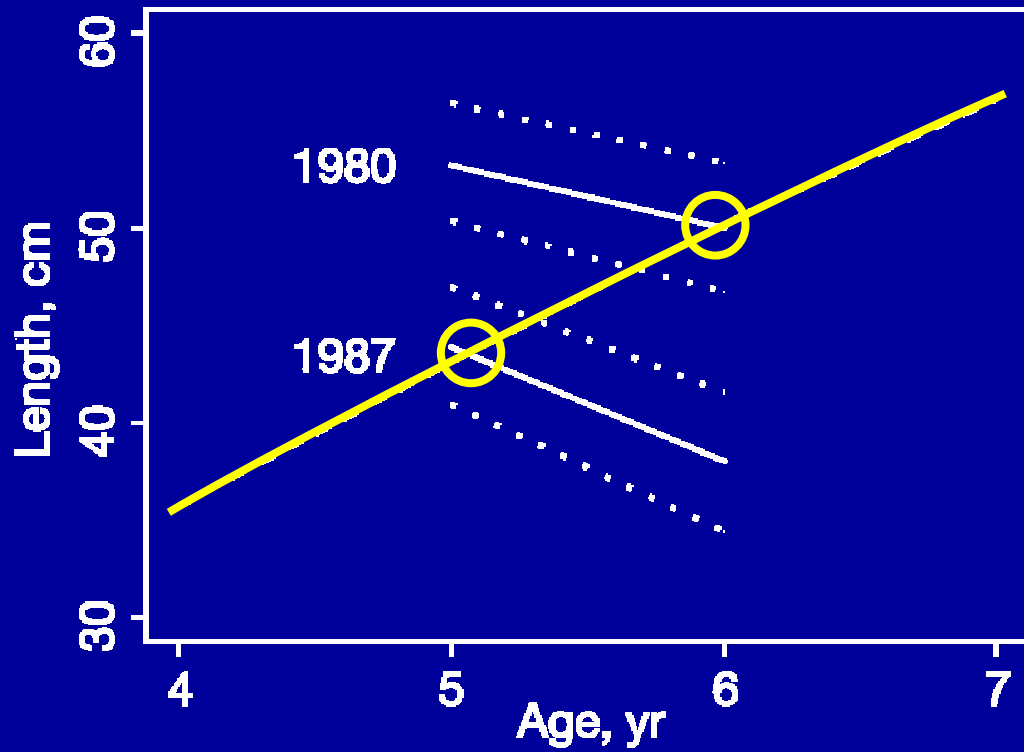


Variable food intake and models of the Northeast Arctic cod

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Norway



VALES
LES



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

NATURE | VOL 428 | 29 APRIL 2004 |

Jac

70



Human harvest changes the targeted species - within decades

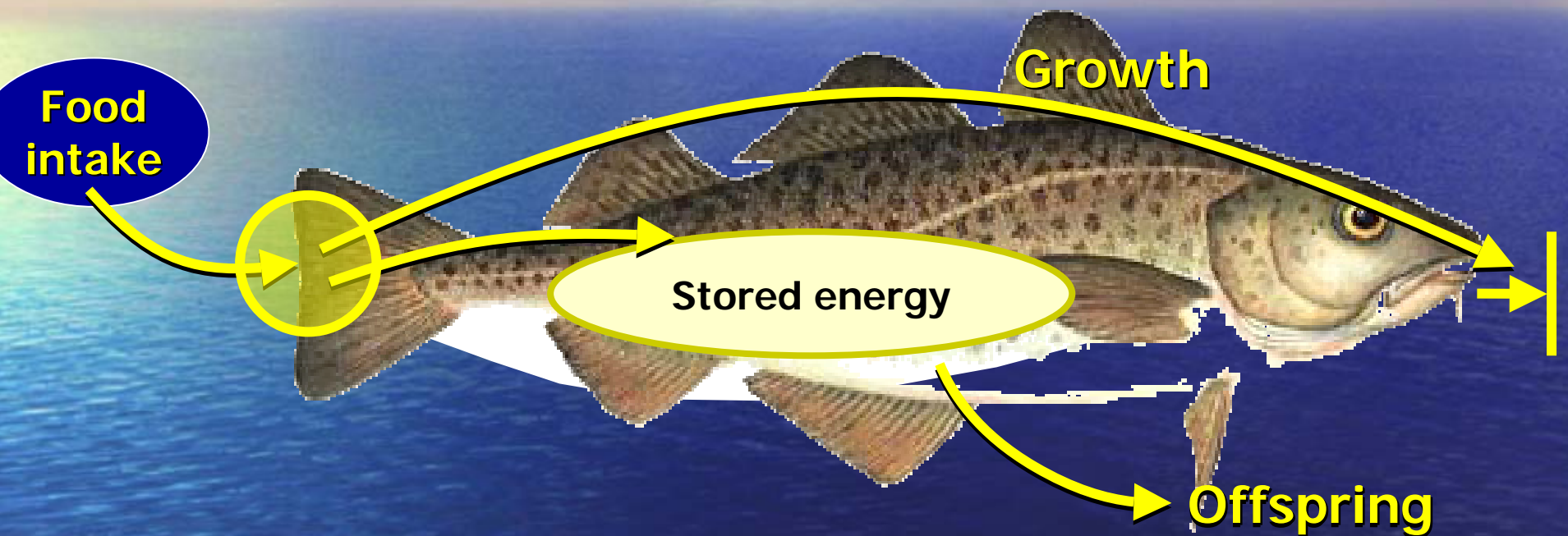
Climate and evolution?

- 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

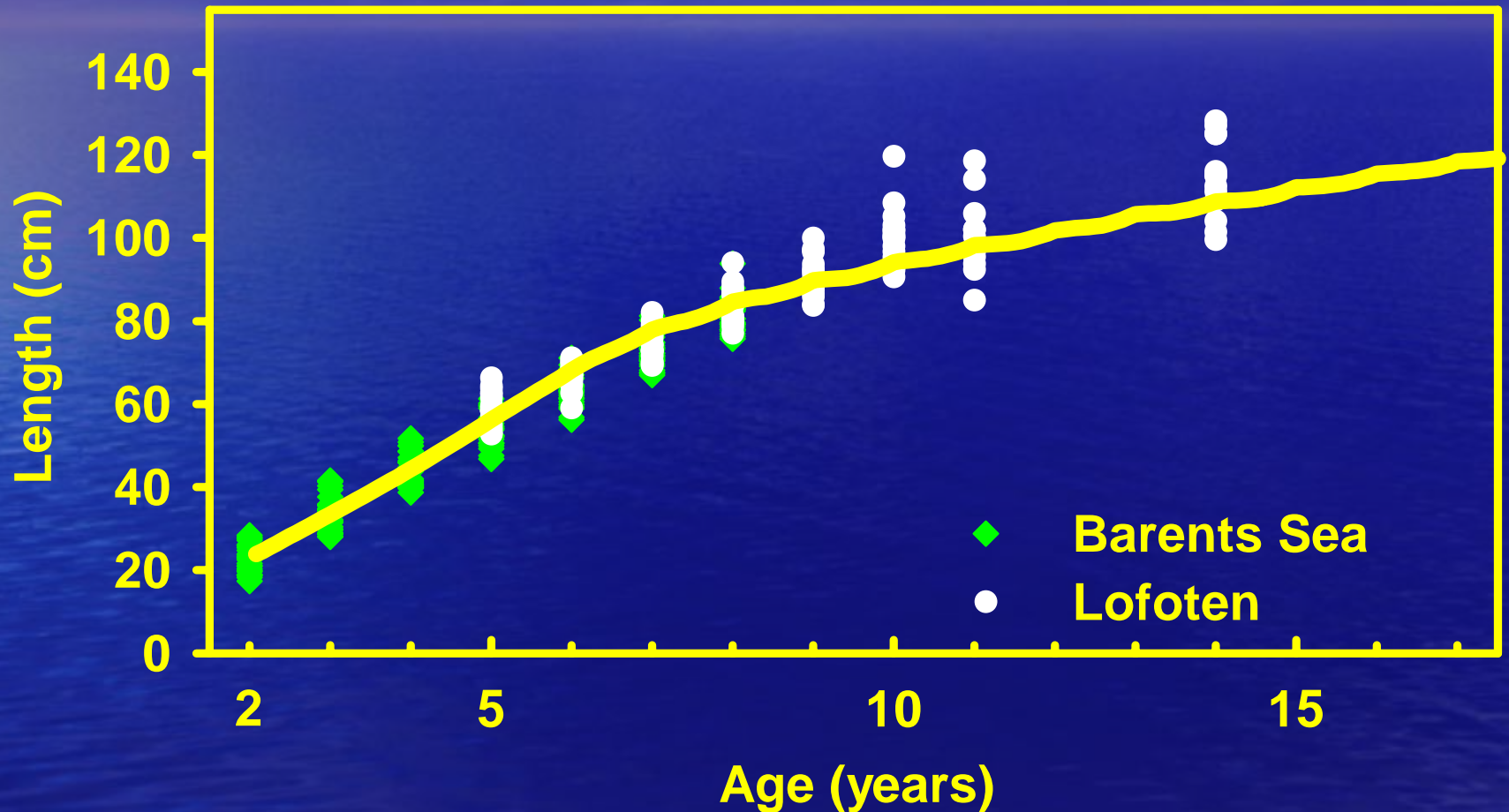
16 equations, 27 parameters

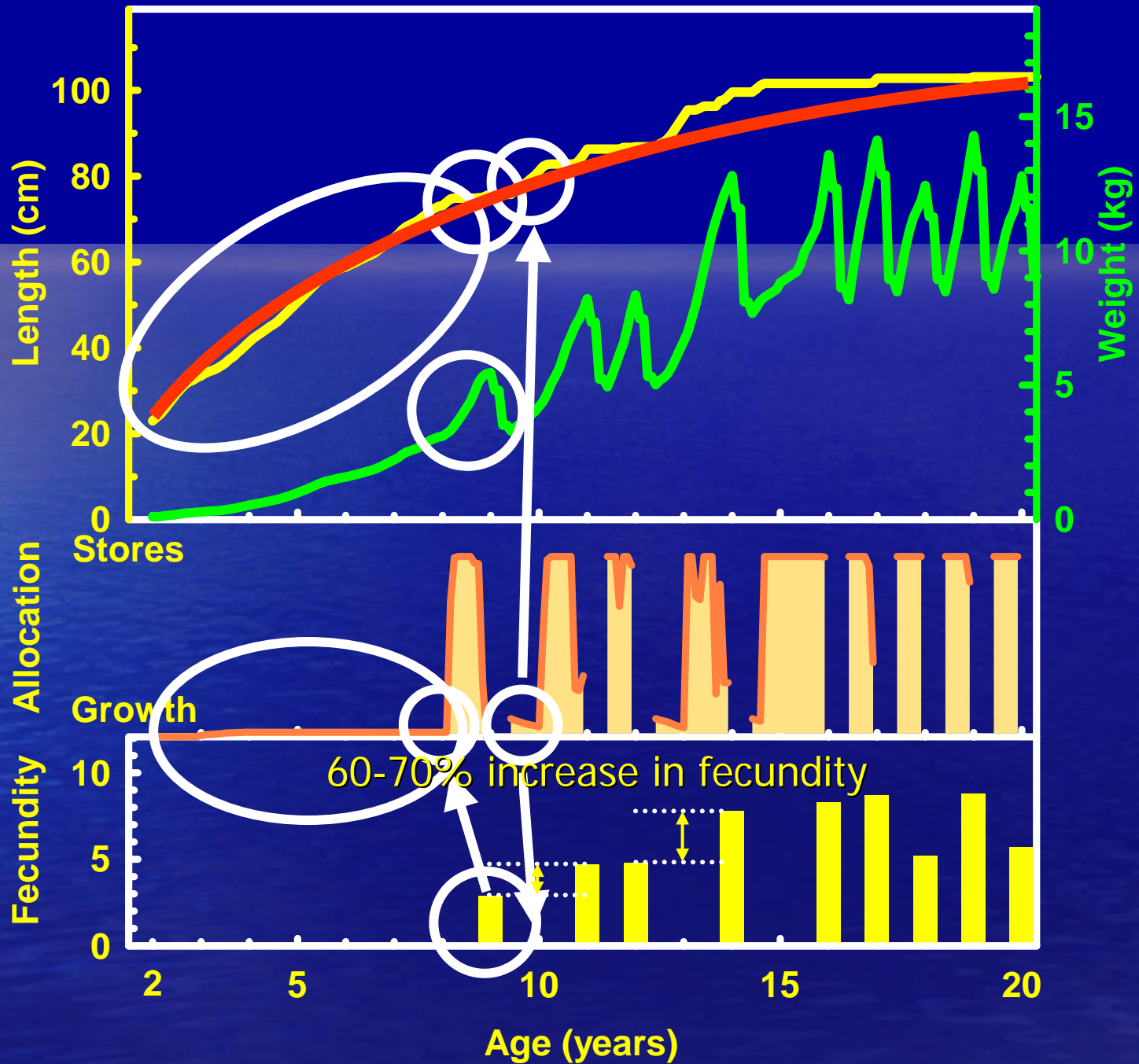
A state-dependent model

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

Optimized using dynamic programming

Fit with field data





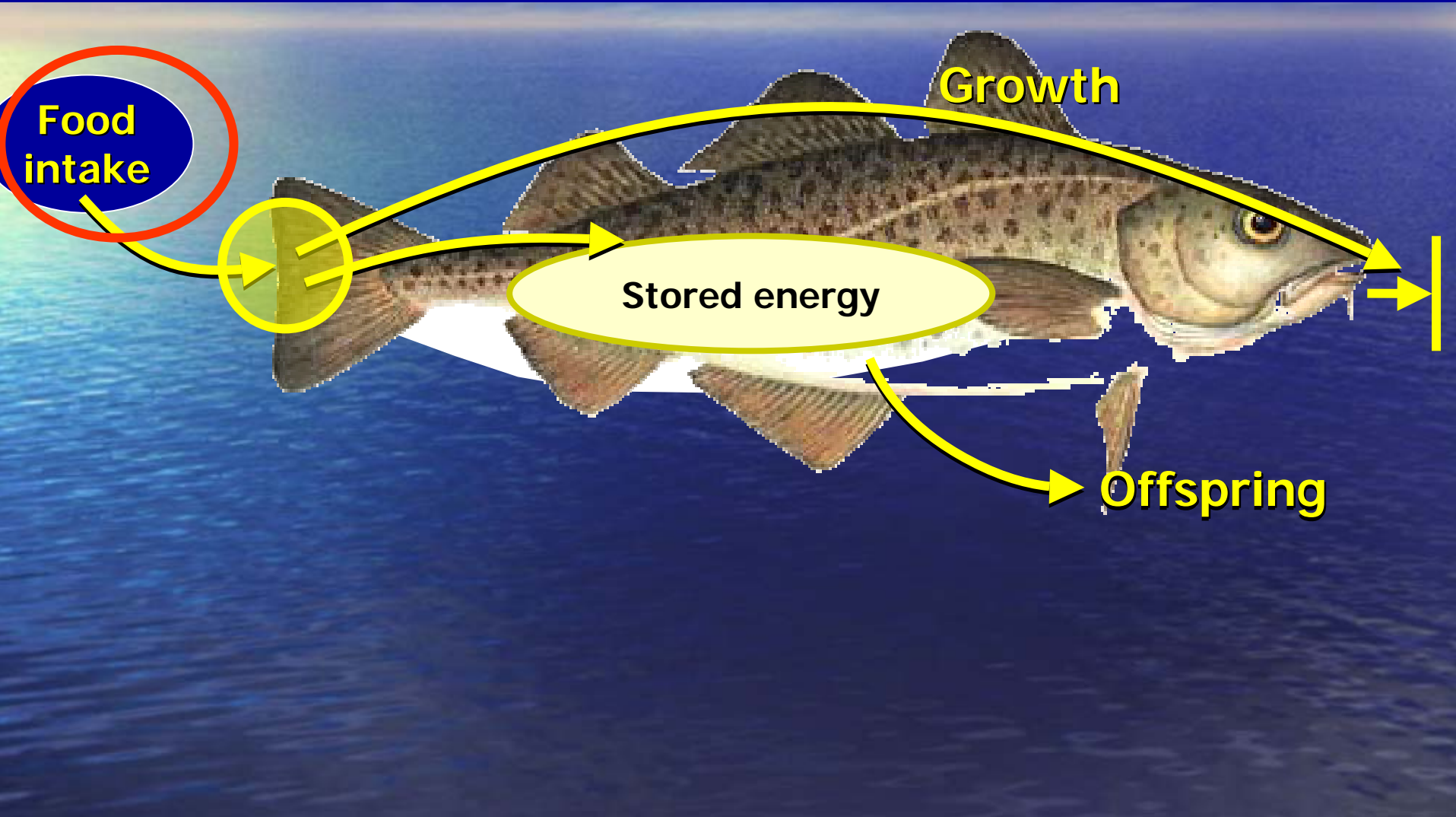
Food intake



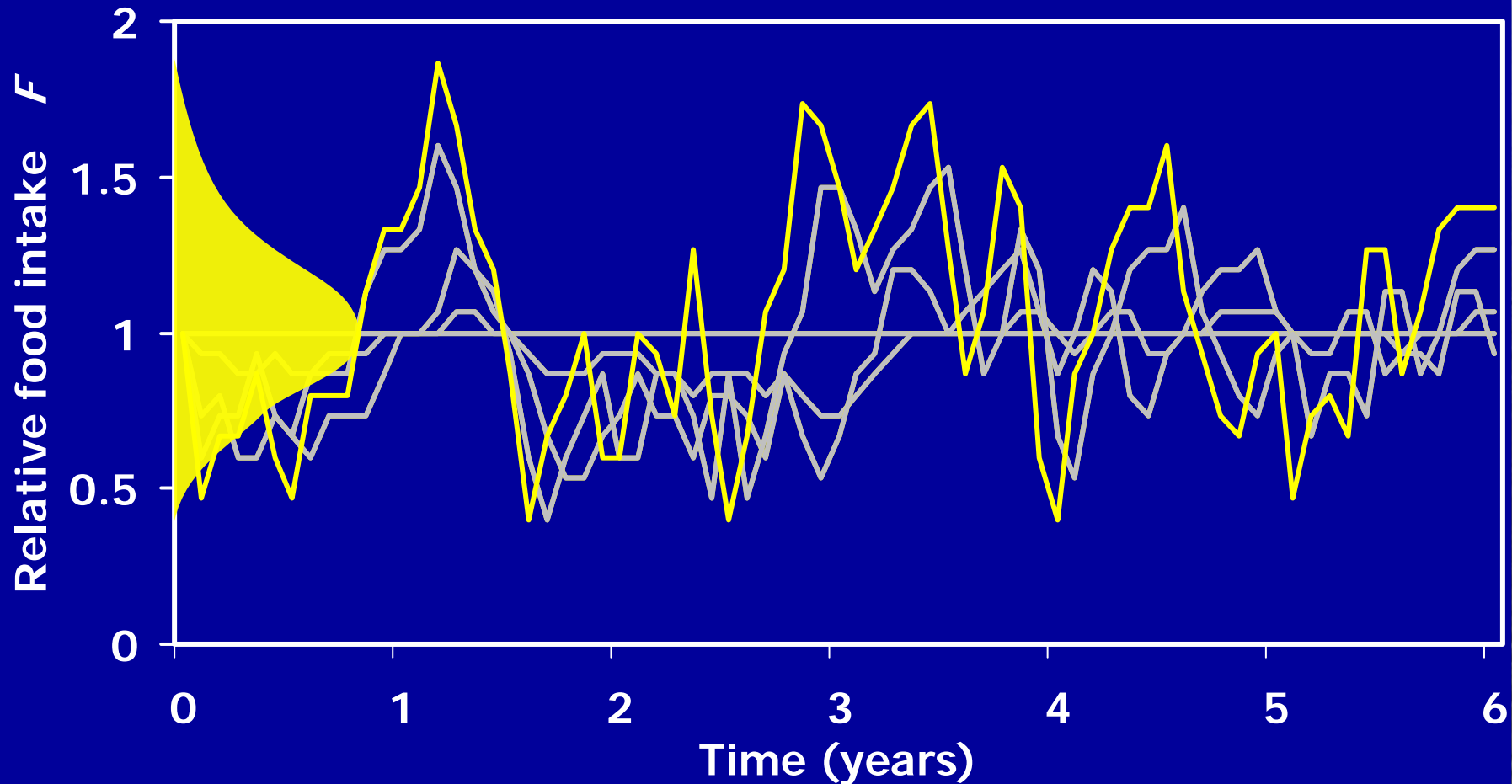
Growth

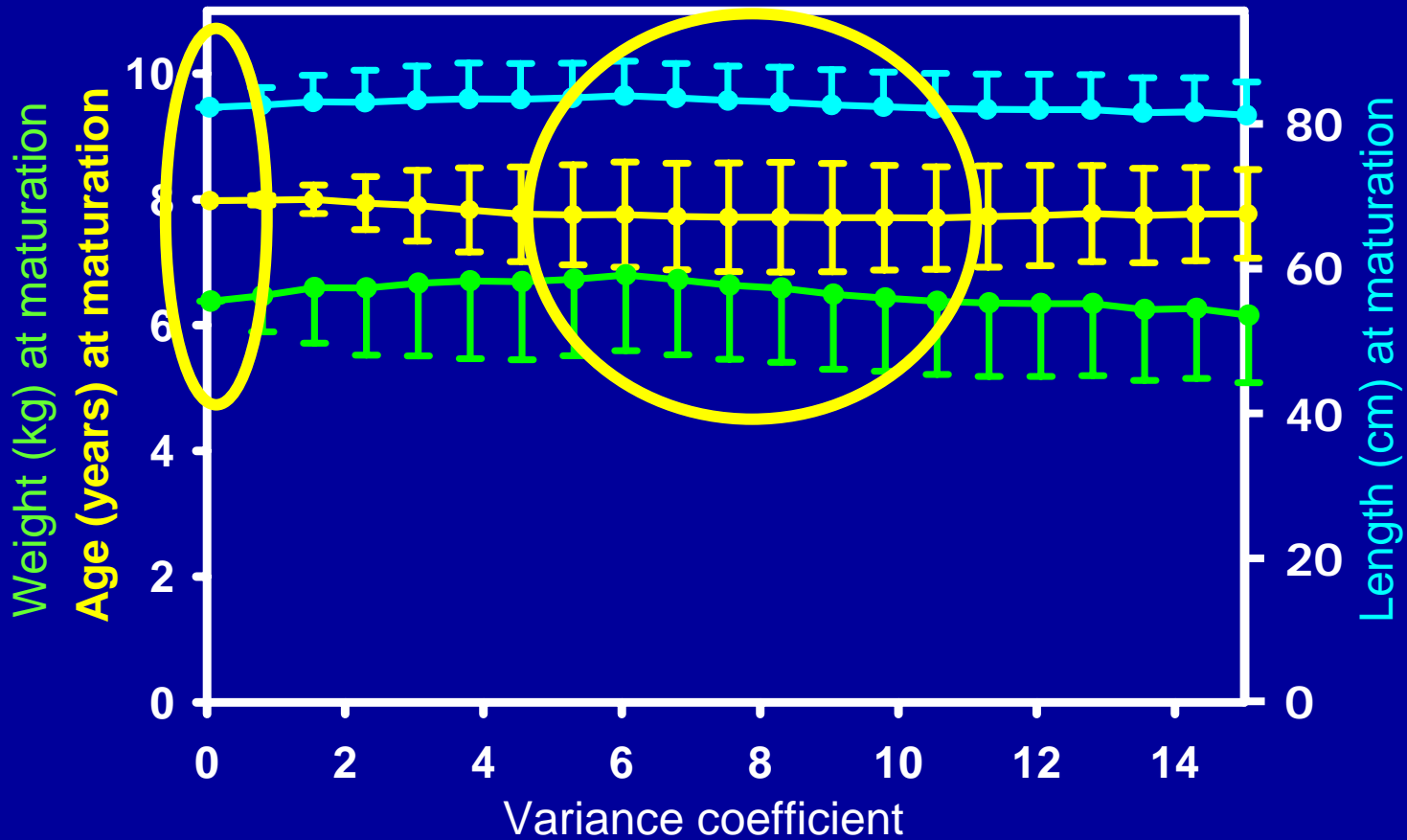
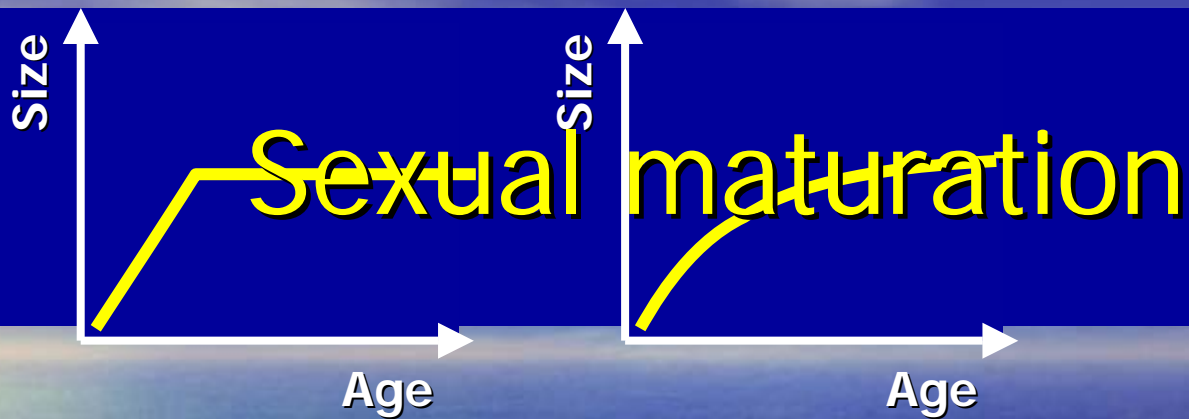
Stored energy

Offspring



Autocorrelated food intake



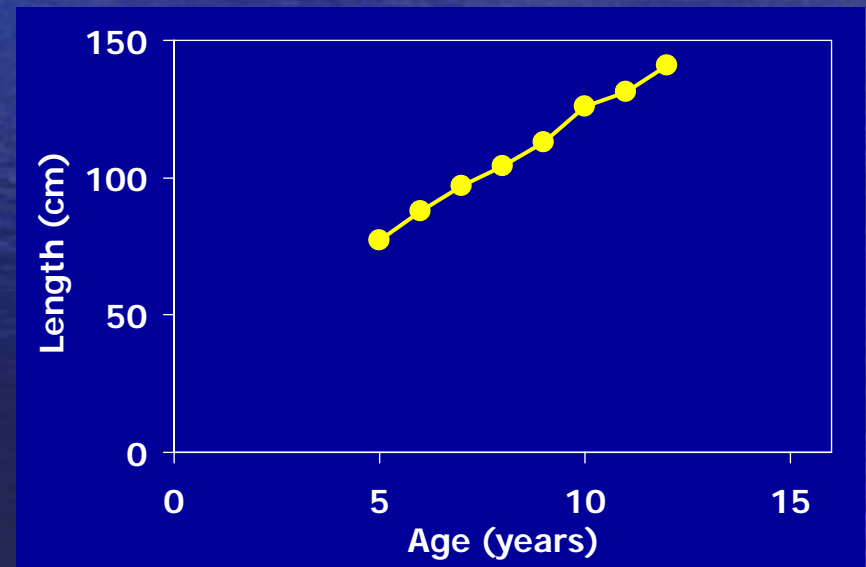
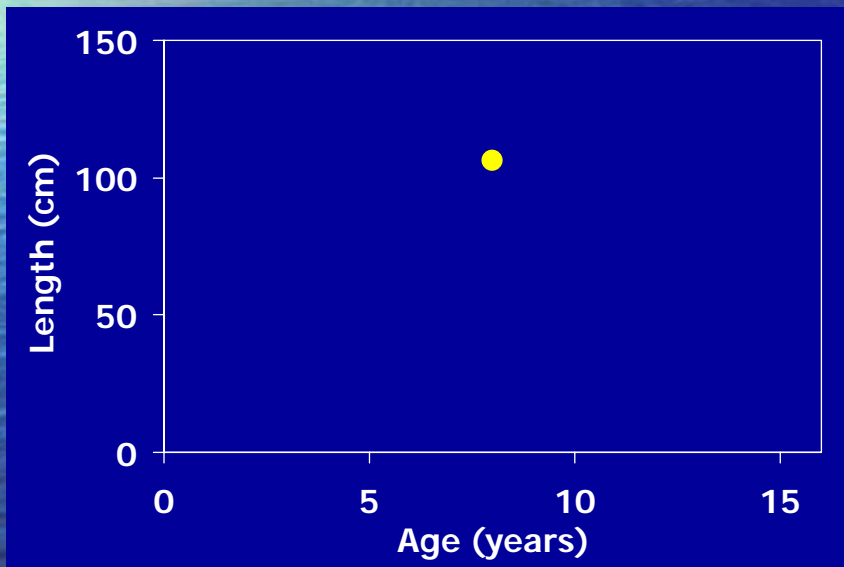


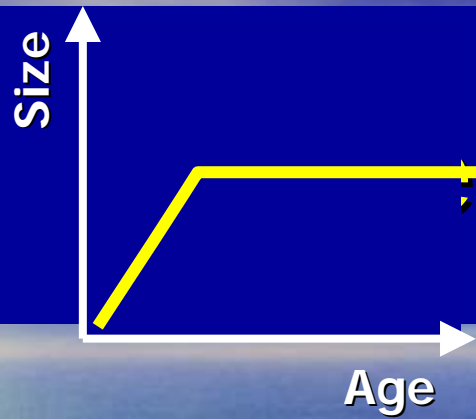
Maturation reaction norm

Food intake variability

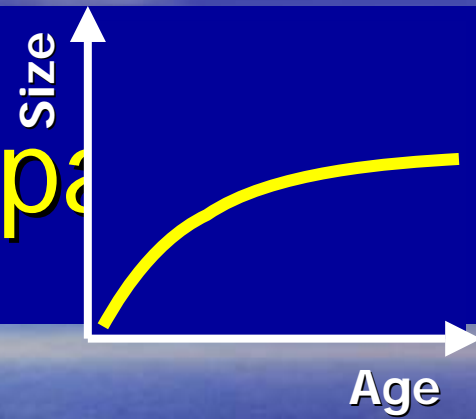
No

Yes

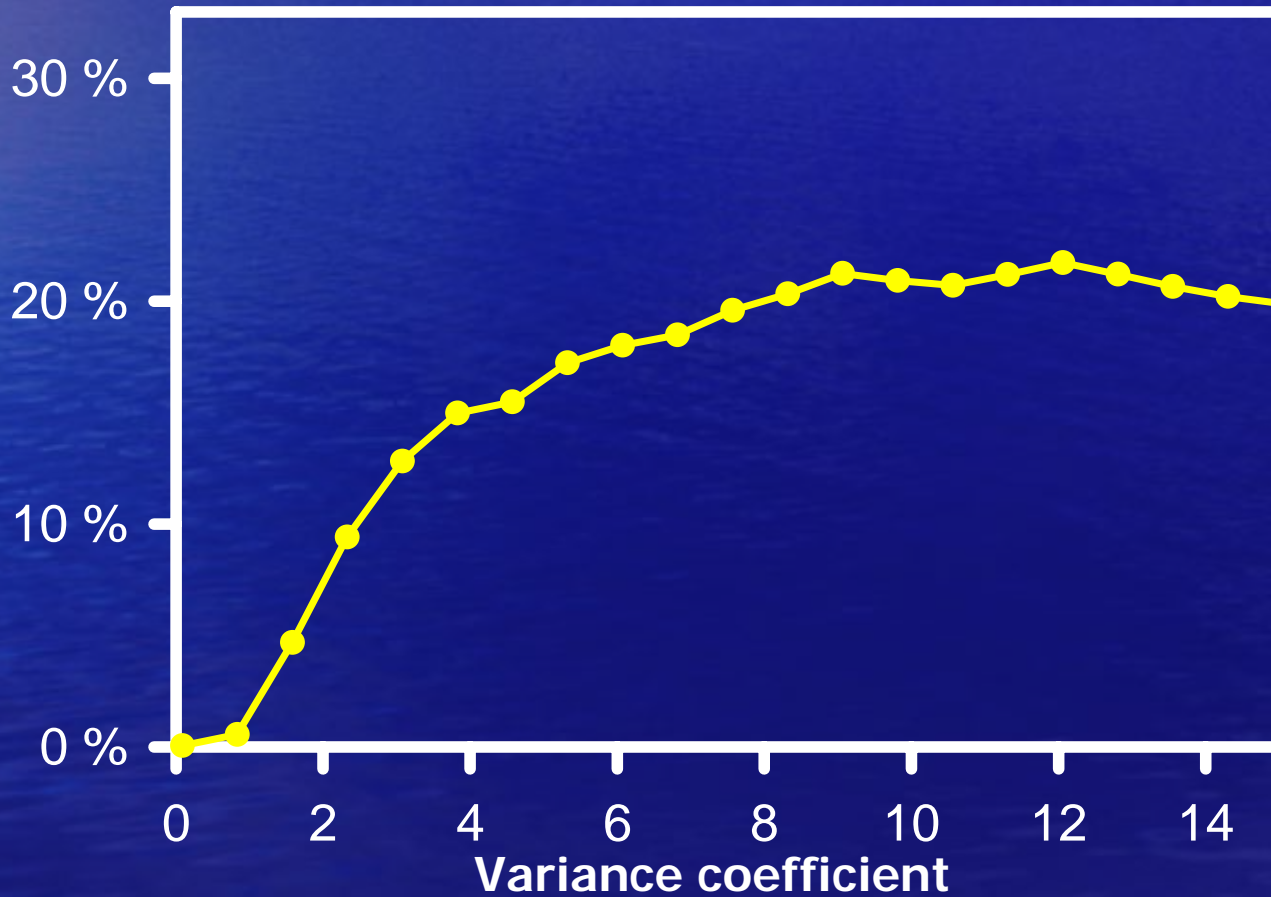




and space



Potential repeat spawners
that skip spawning



Conclusion 2:

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