

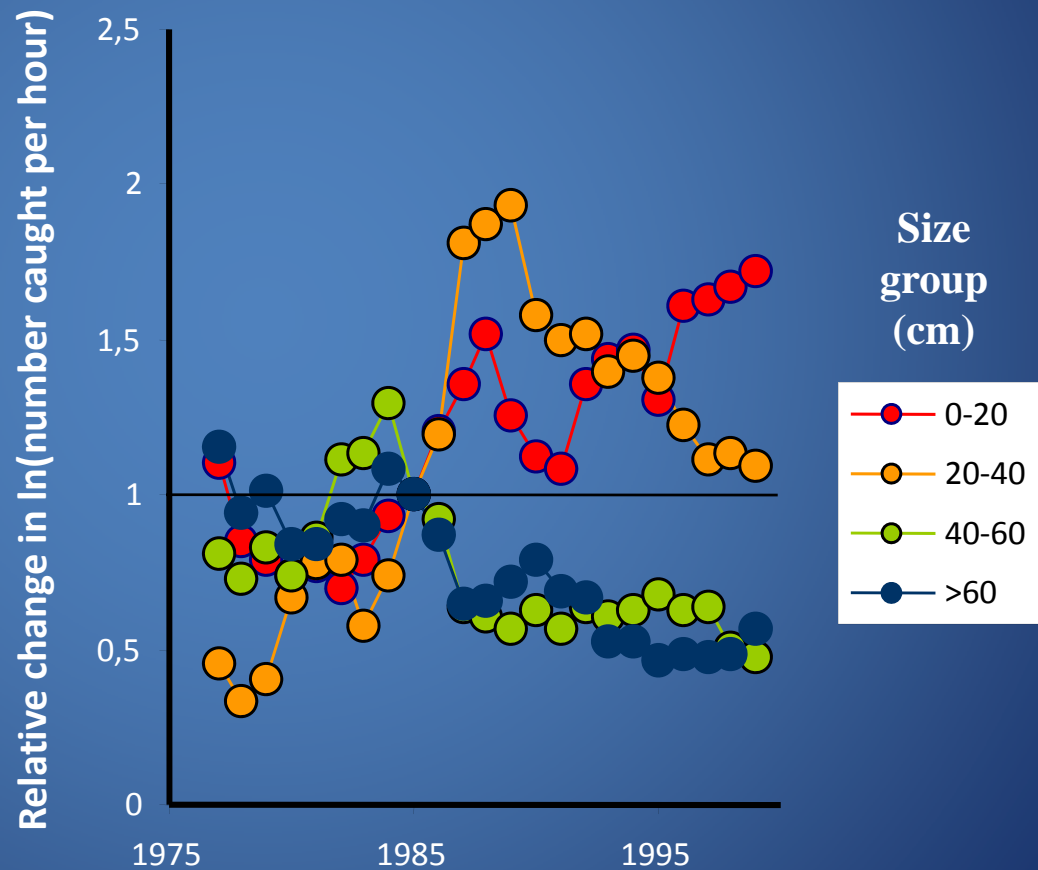
Trophic cascades in models of marine communities



Ken H. Andersen, Aqua, Technical University of Denmark
Martin Pedersen, Lund University, Sweden

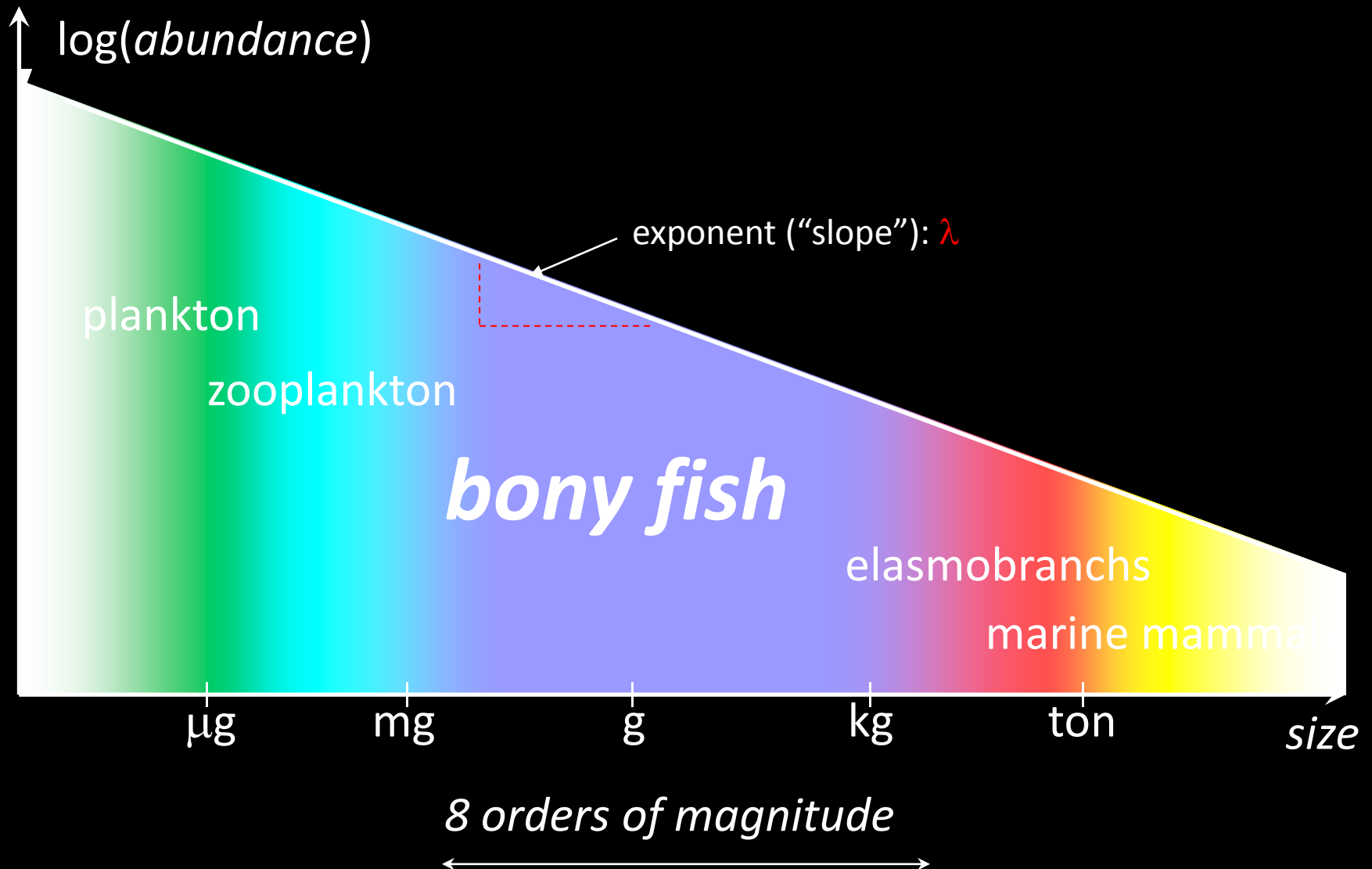
Number of fish caught in different size groups in the North Sea 1977-99.

Data from the Int. Bottom trawl Survey

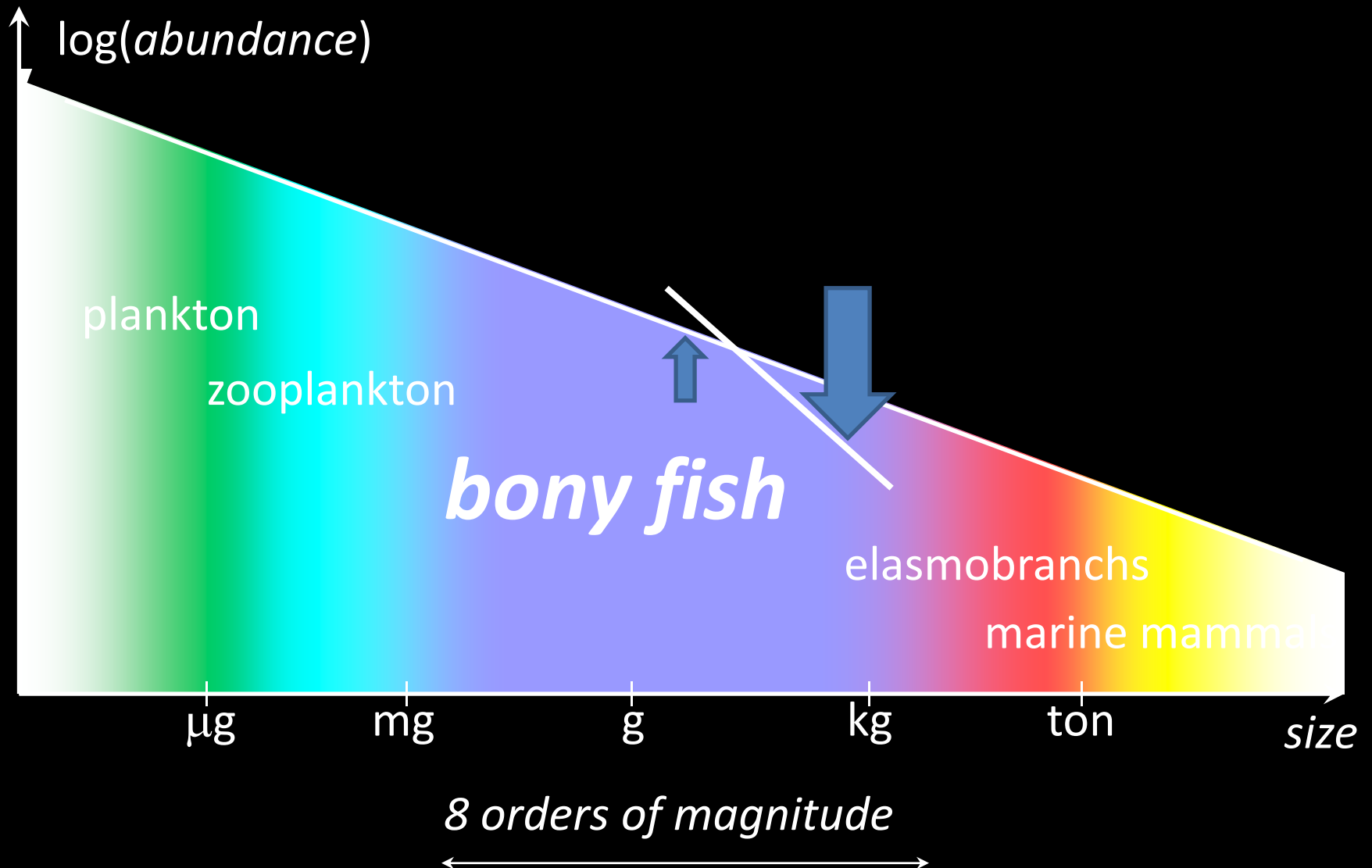


Daan, Gislason, Rice &
Pope (2005)

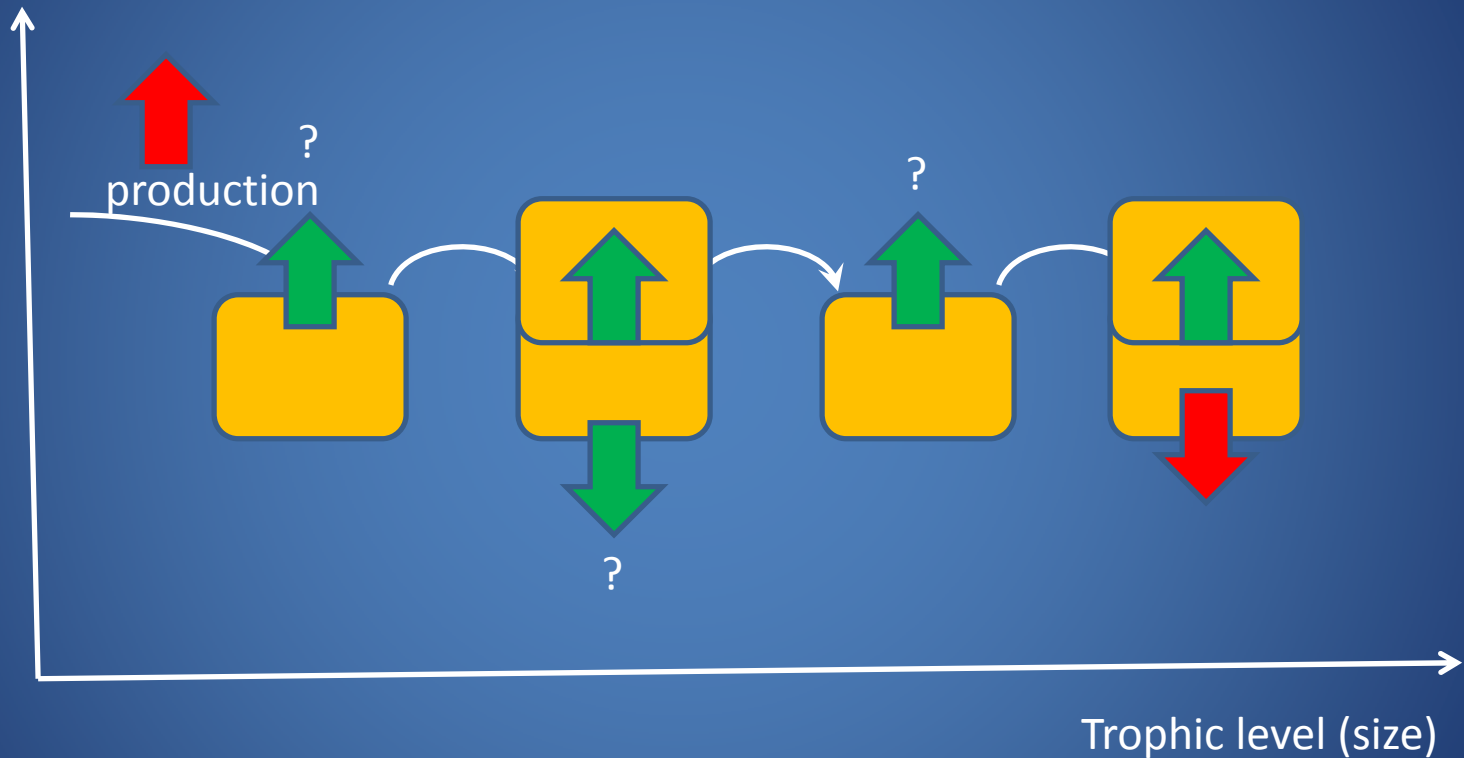
The Marine Size Spectrum



The Marine Size Spectrum

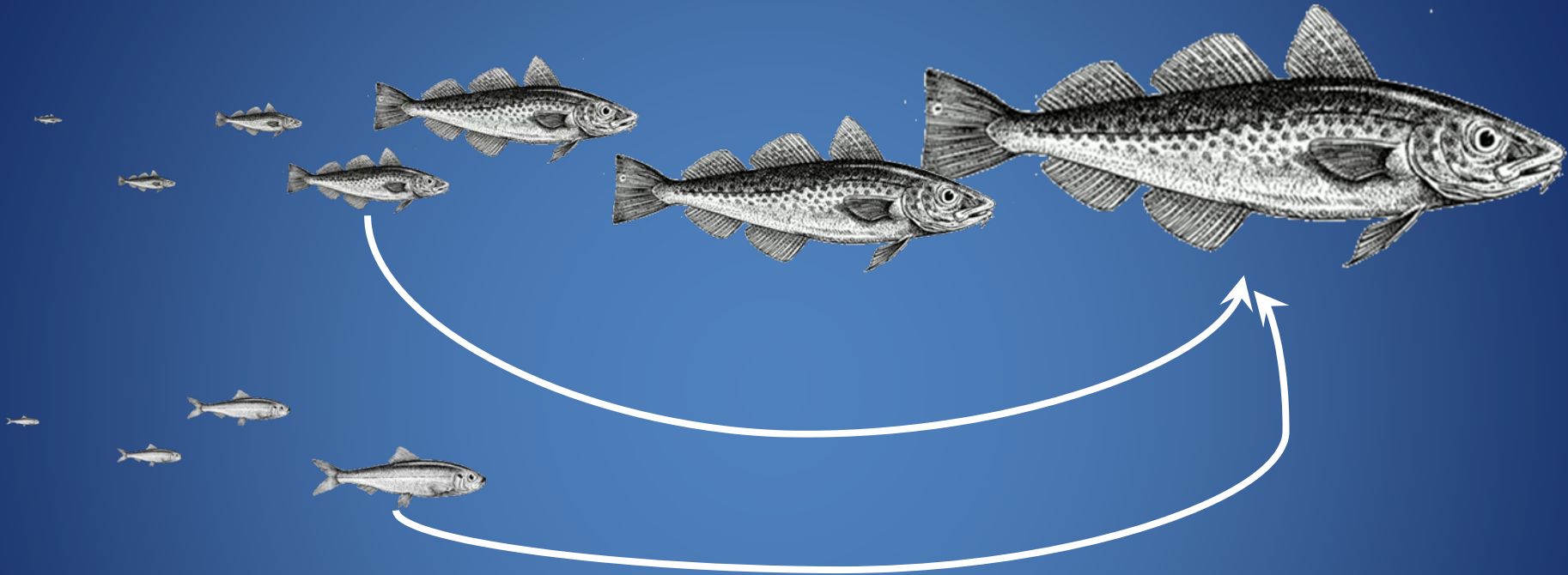


Linear food chain



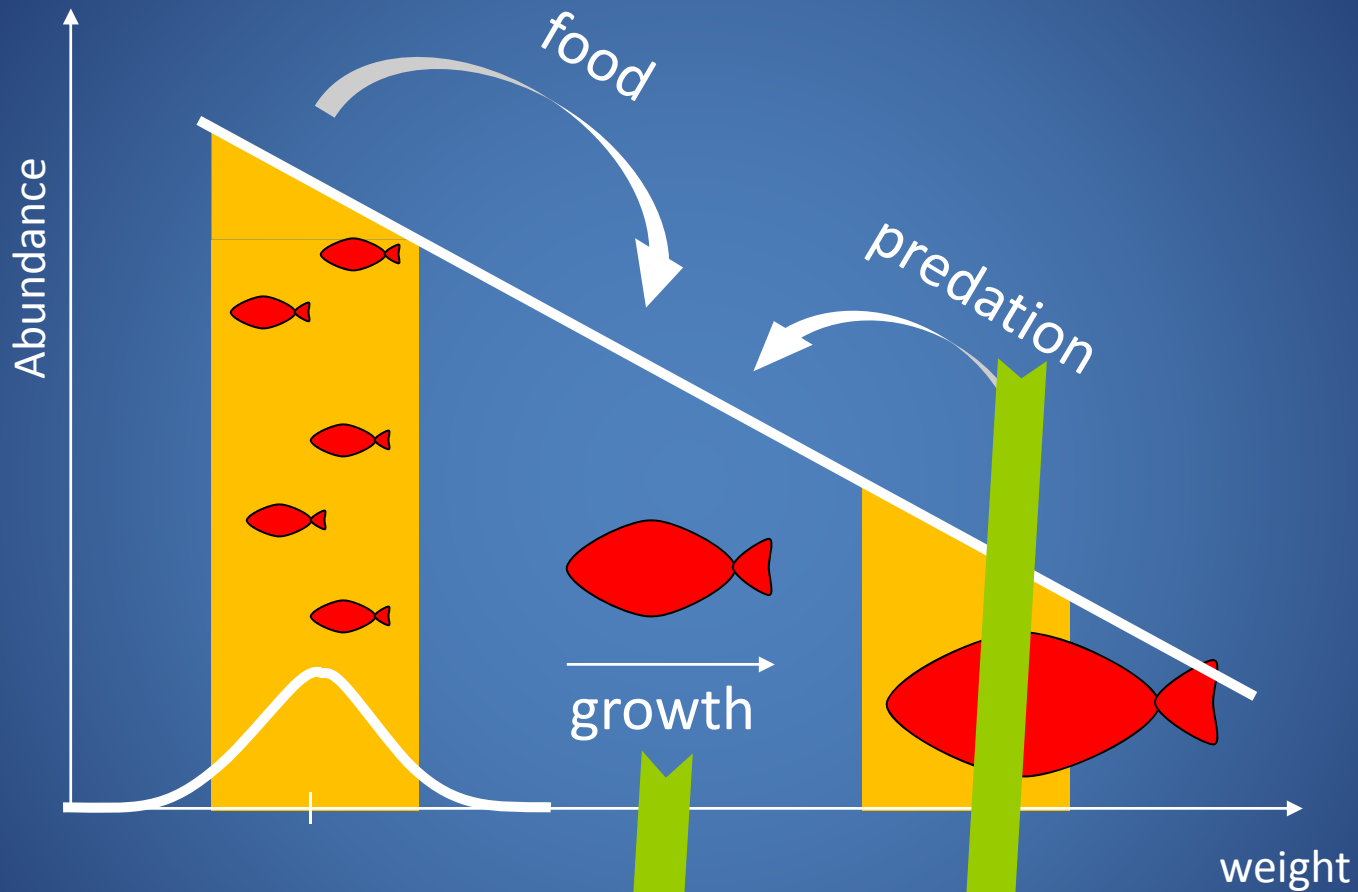
What about fish life history?

Model principles



- 1) Resolve life history from egg to adult
- 2) Size based encounters: big fish eat smaller fish
- 3) Trait based: size at maturation (asymptotic size)

Basic principles



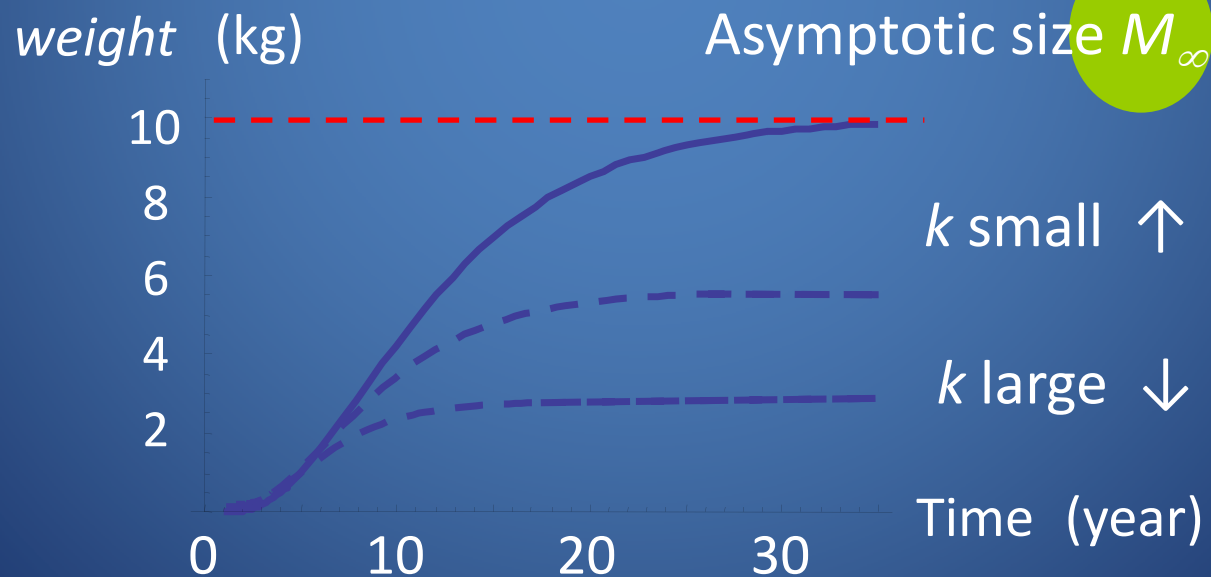
$$\frac{\partial N}{\partial t} + \frac{\partial}{\partial w} [gN] = -\mu N$$

Output: size spectrum

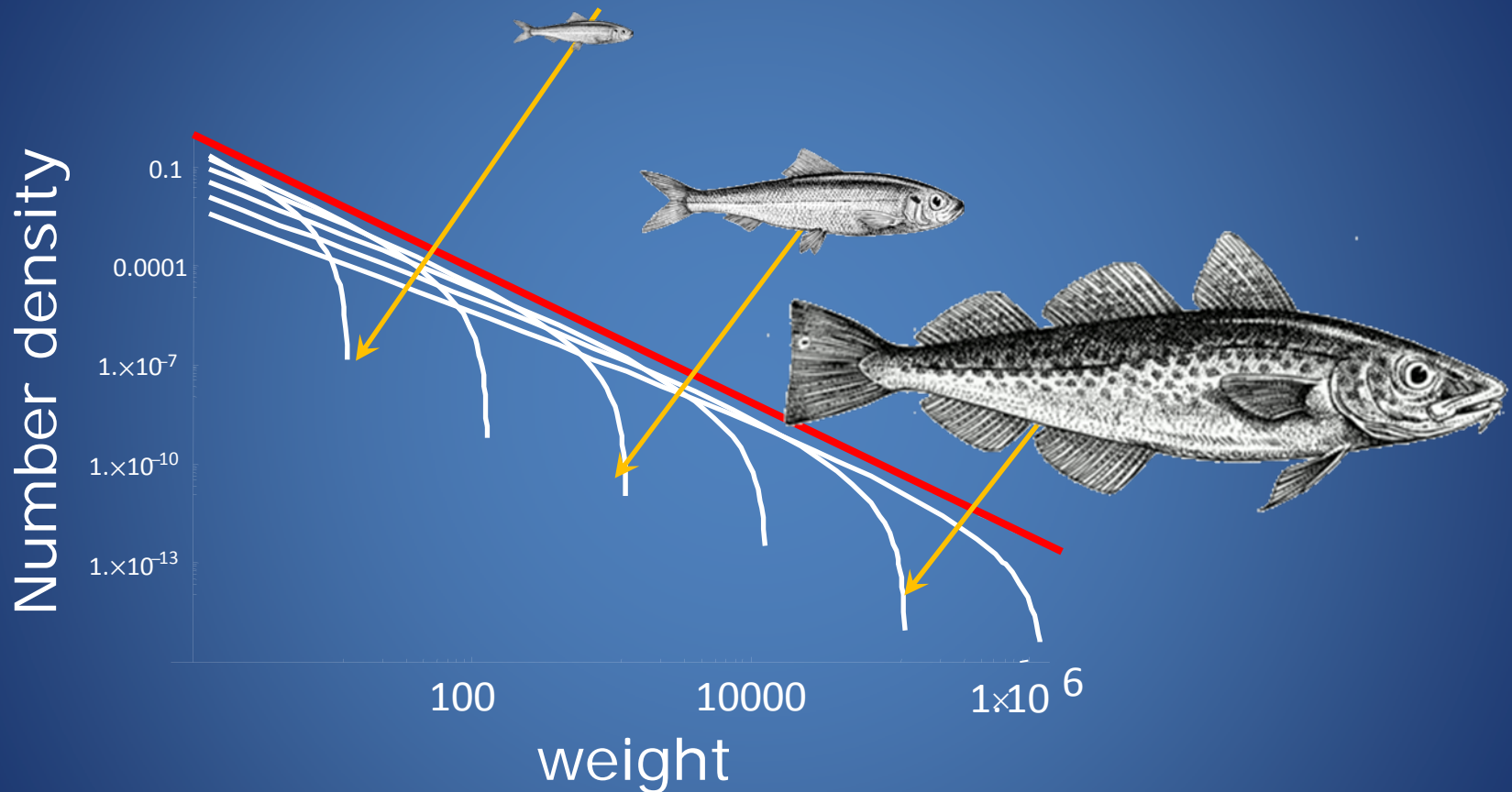
Silvert & Platt (1980); Benoît & Rochet (2004)

Trait model

$$\text{Growth} = \alpha \cdot \text{consumption} - k \cdot w$$

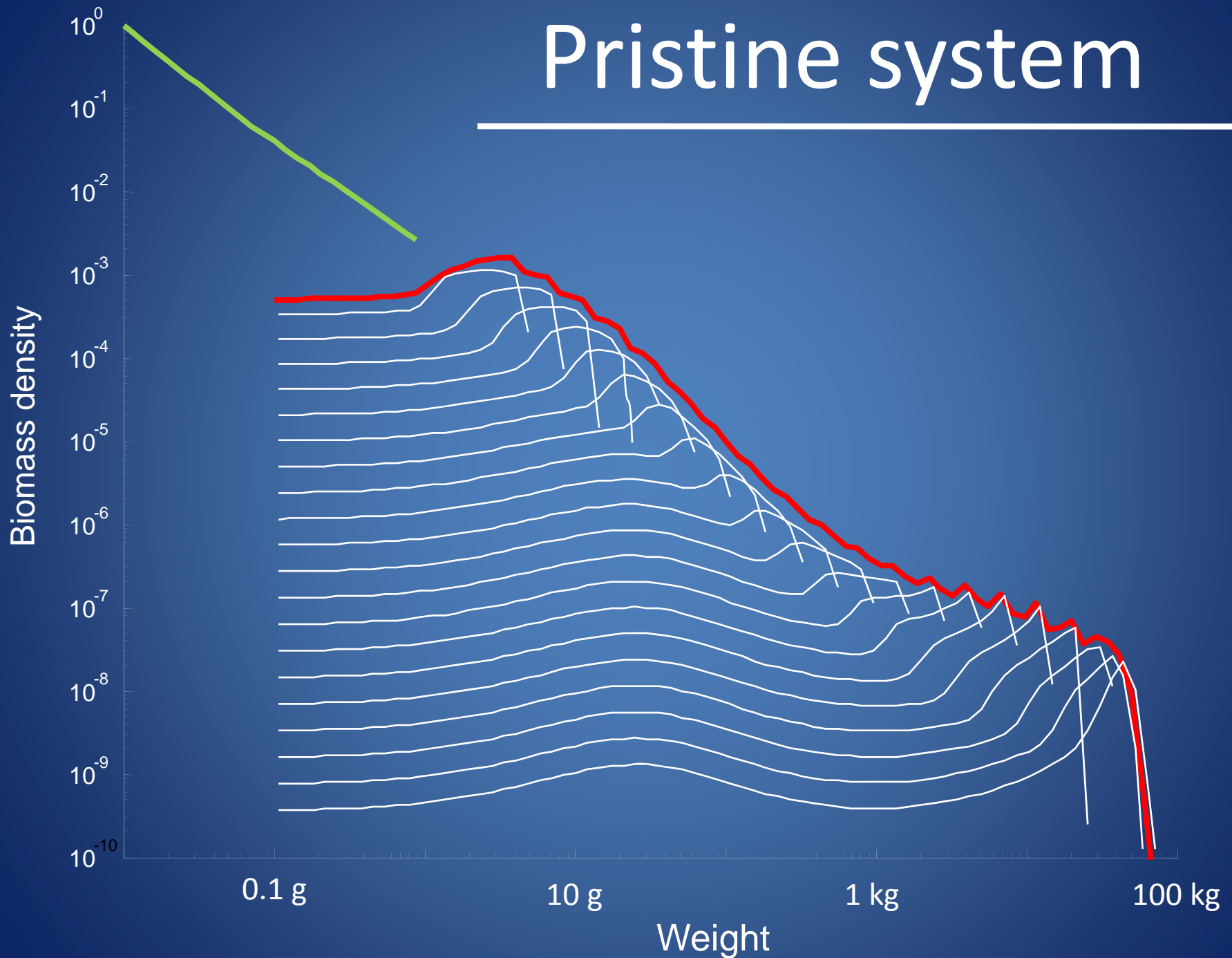


Equilibrium spectrum

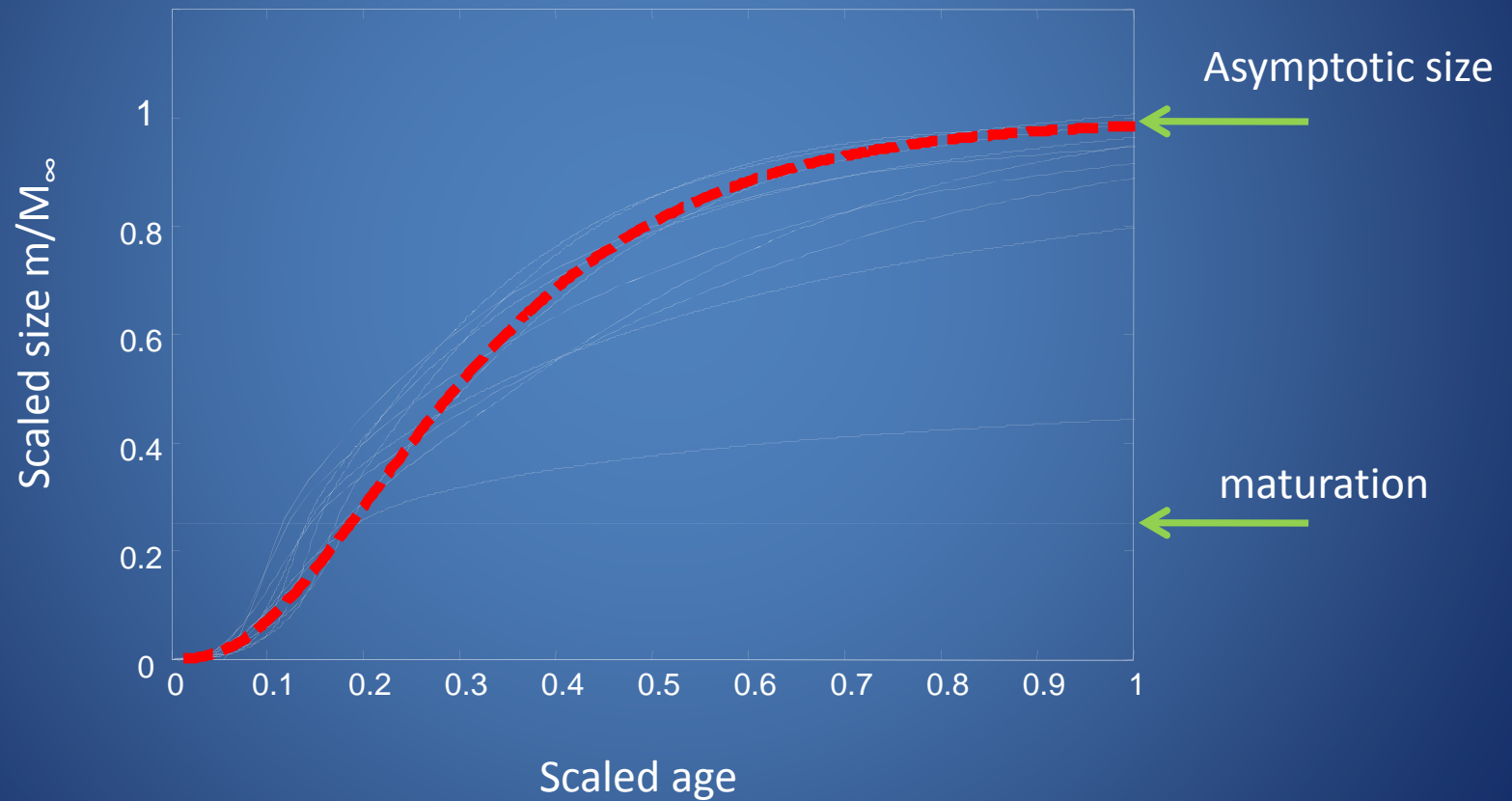


Result: $N(\text{size, maturation size})$

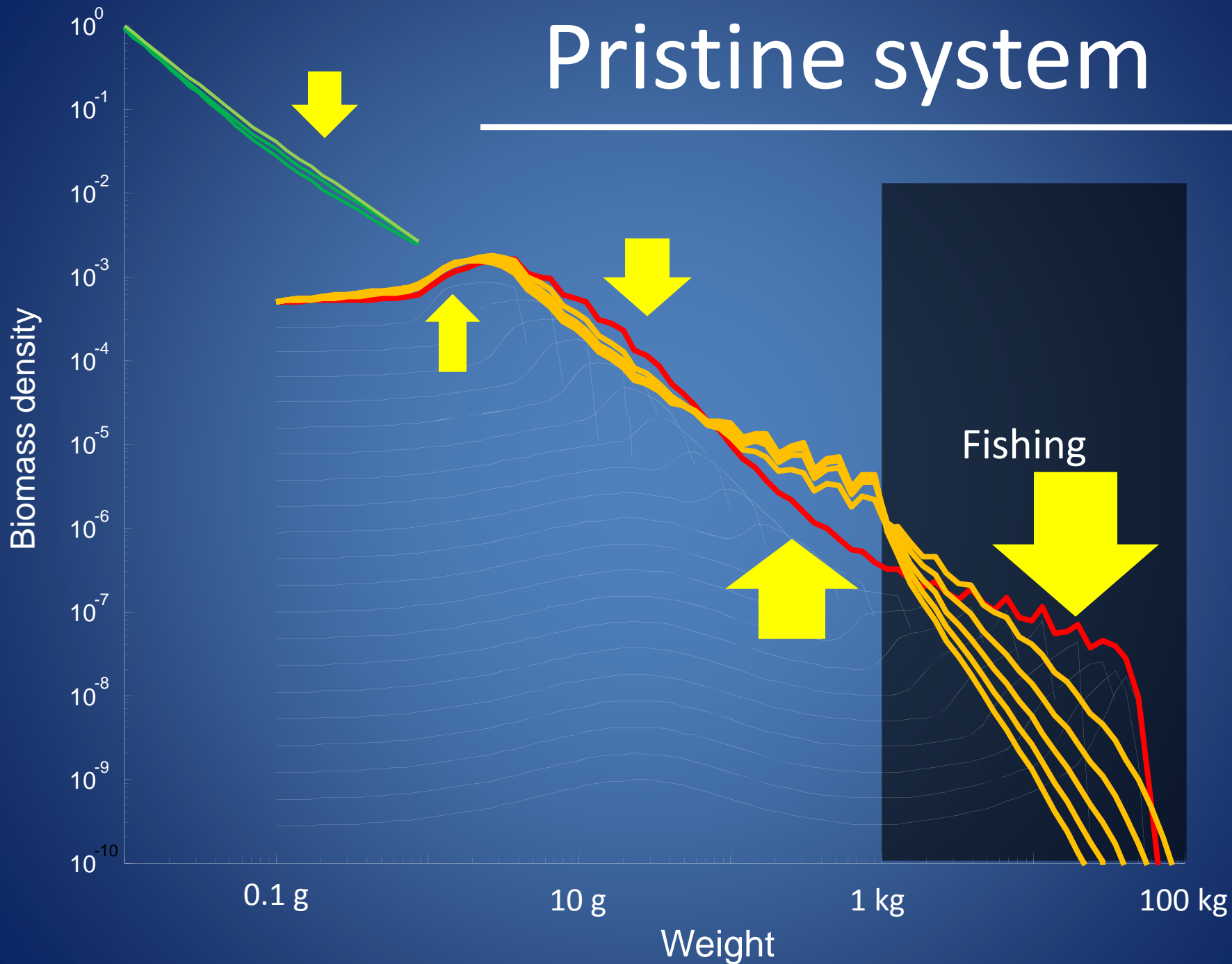
Pristine system

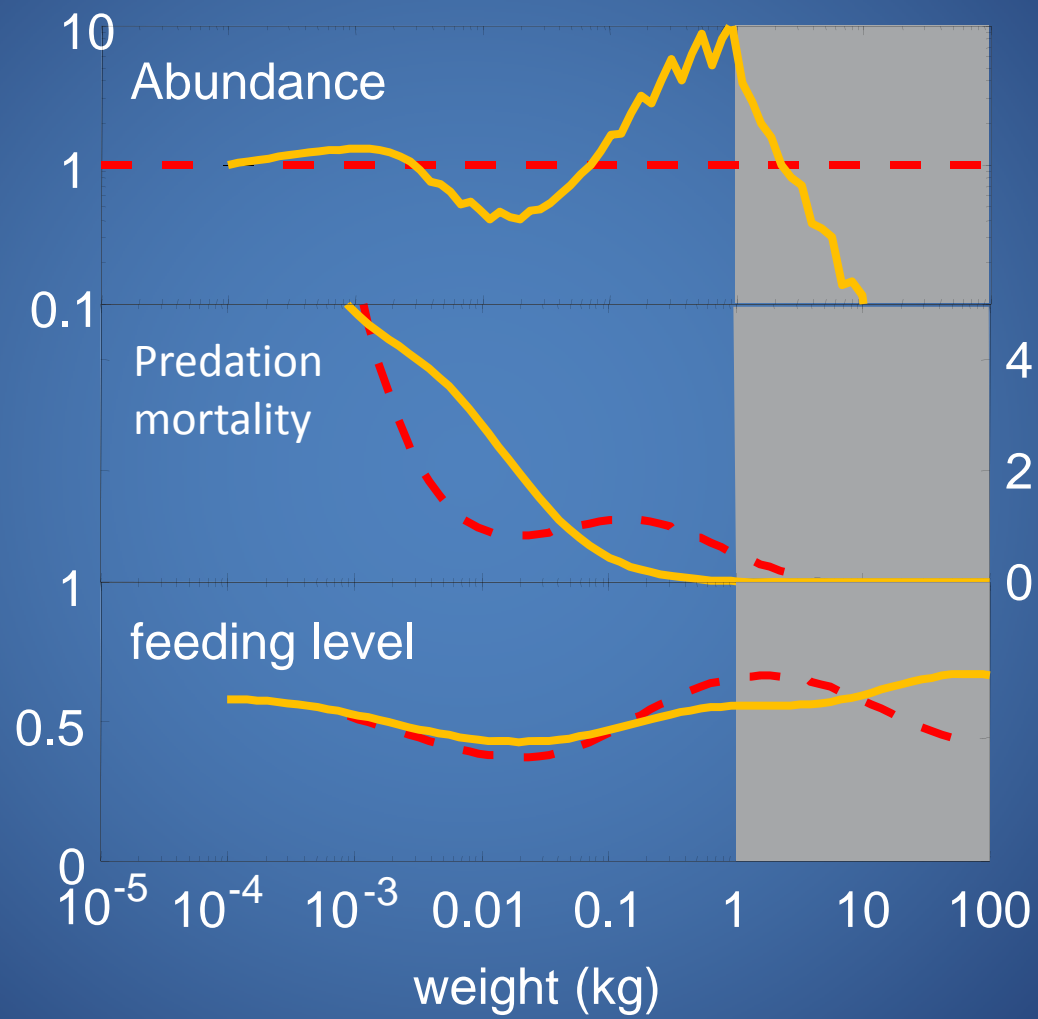


Results: growth



Pristine system

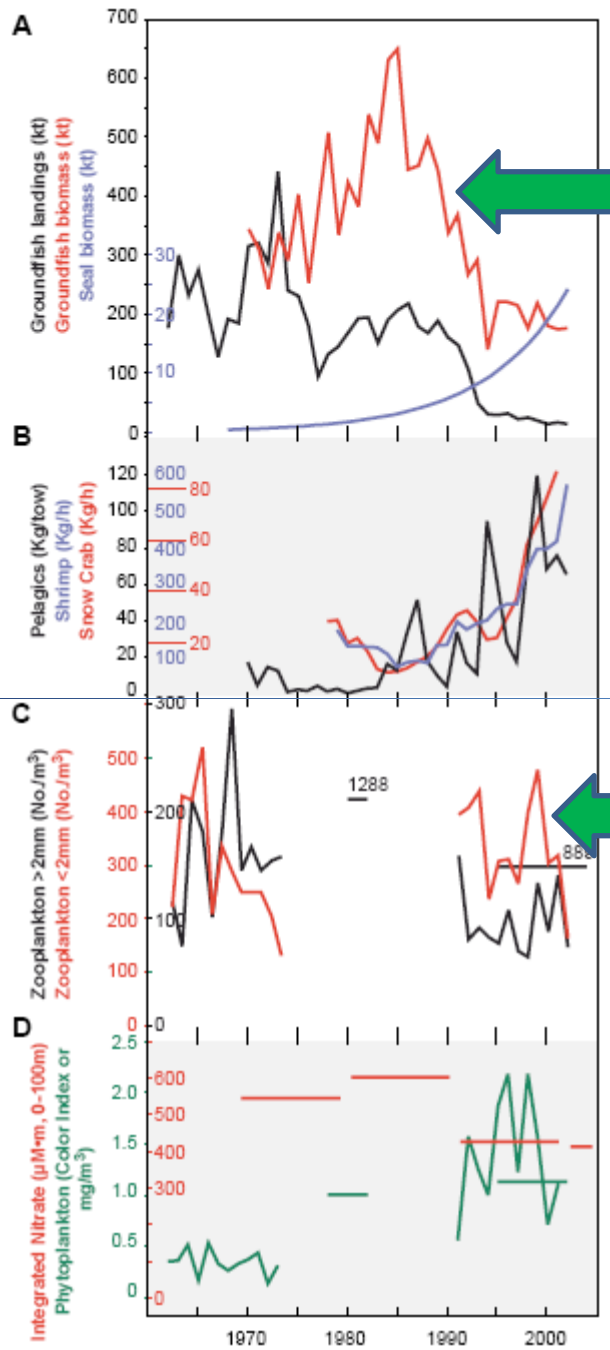




Effects of fishing



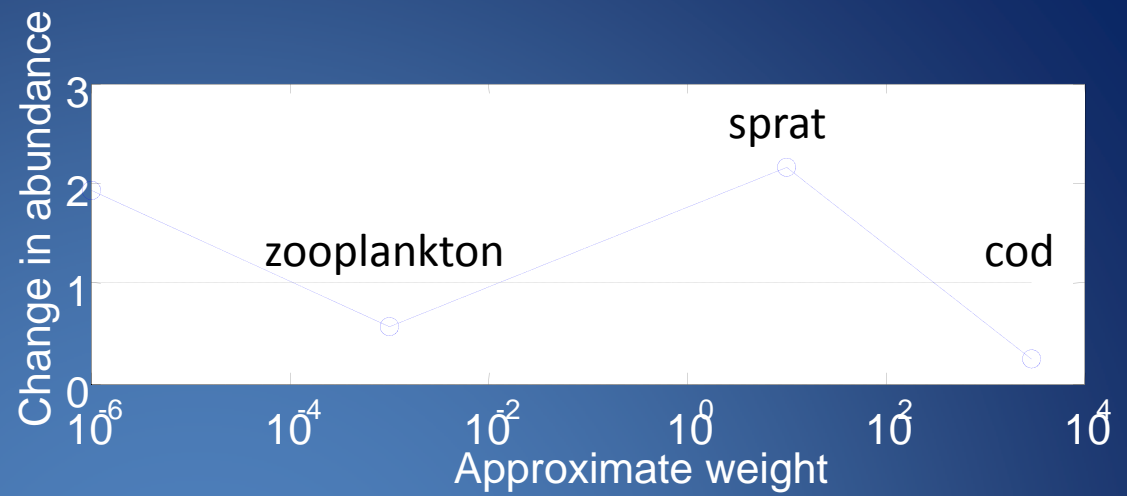
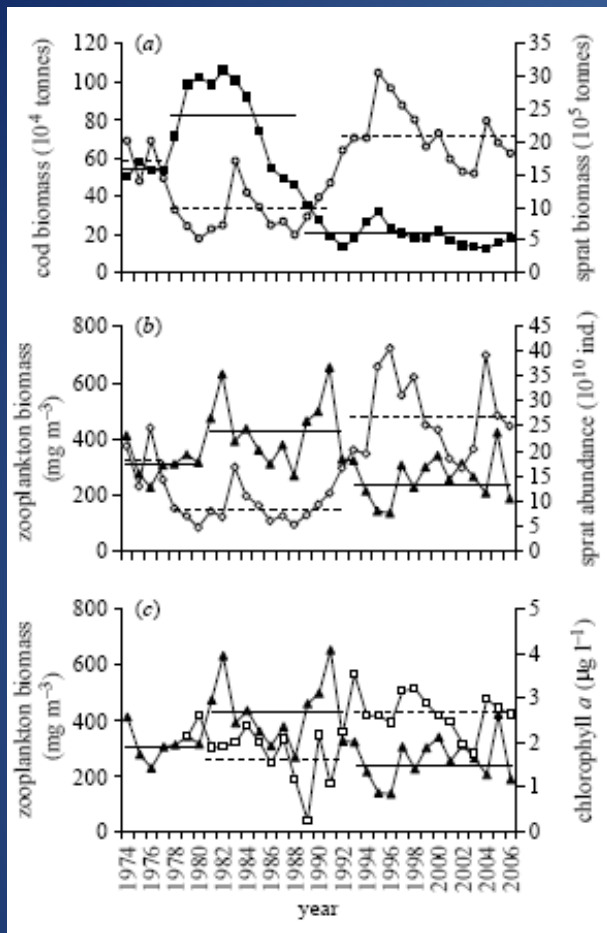
- ⇒ Two-way trophic cascades
- ⇒ Cascades are *damped*
- ⇒ Fishing on all life histories removes cascades



Cod biomass decreased by a factor 2

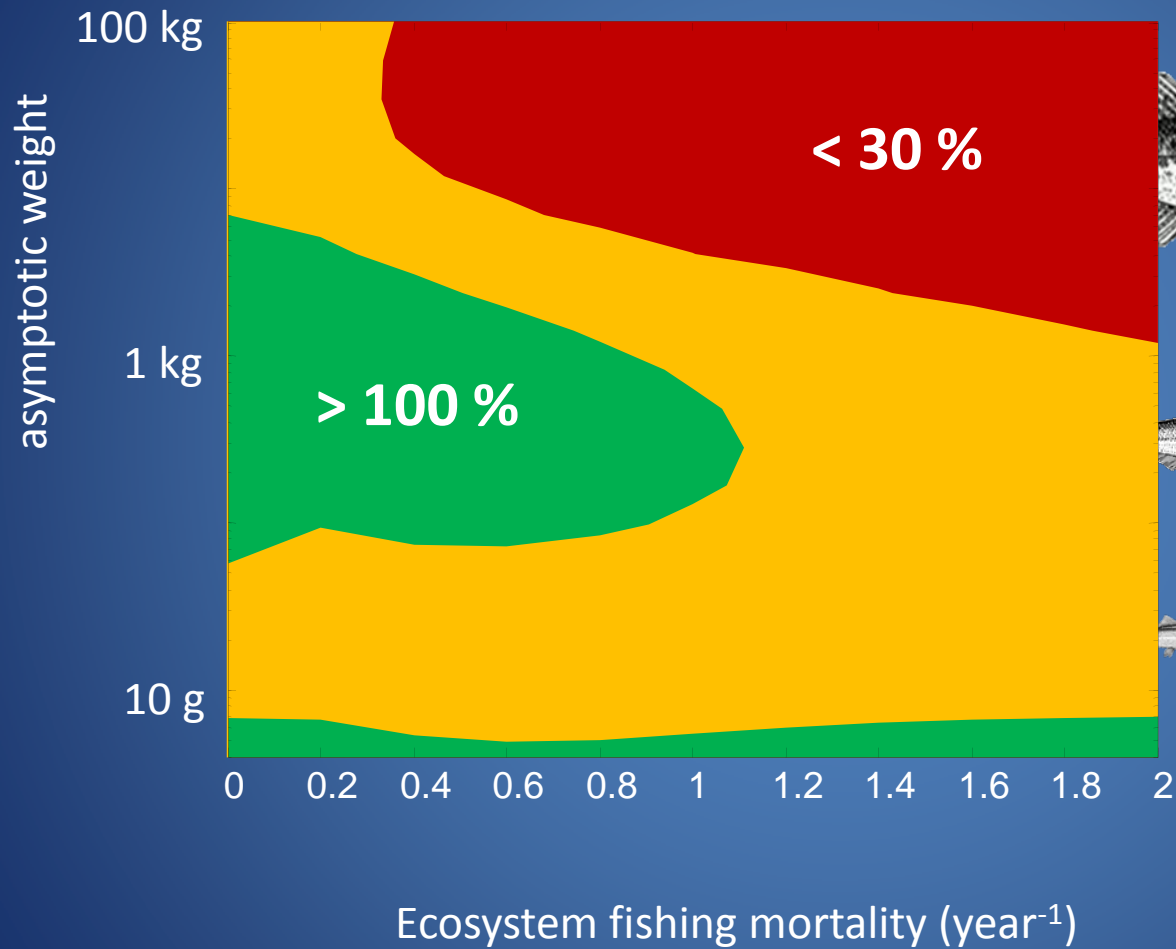
Large zooplankton decreased by a 30 %

*North-west Atlantic
Frank et al (2005)*



Baltic Sea
Casini et al (2007)

Indicator: relative drop in SSB



Conclusions

- Trait-based model: focus on function
- Framework for evaluating consequences of strategic ecosystem oriented management
- Damped trophic cascades
- Signature of cascade depends on fishing pattern
- **Questions:**
- Are trophic cascades inherently damped?
- To which degree can we decouple function from species?

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