



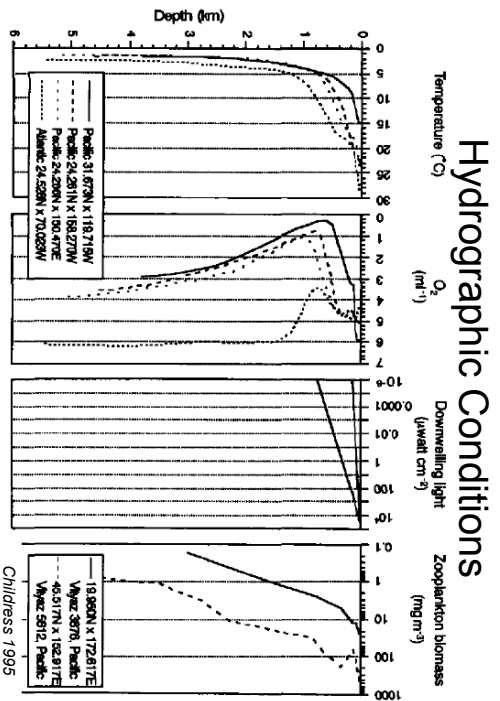
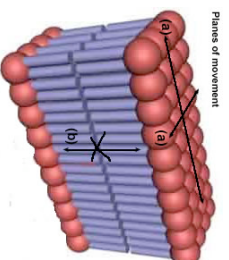
Physiological Ecology of the Deep Sea

- Pressure
 - 101.3 kPa (1 atm.) for each 10m depth
- Very low or no ambient light
- Temperatures below 10°C
 - Estimated deep sea has been cold for 50 million years
- Increasing distance from phytoplankton food source
 - Decreasing biomass with depth
- Low Oxygen
 - Oxic for at least an estimated 90 million years

What Affects Physiology?

Resistance Adaptations

- Adaptations that let organisms tolerate changes in pressure and temperature
- Increasing pressure + low temperature decreases membrane fluidity



Childress 1995

Resistance Adaptations

- % unsaturated fatty acids in membranes increases with depth
- Adaptation to pressure includes maintaining correct physical state of bilayer

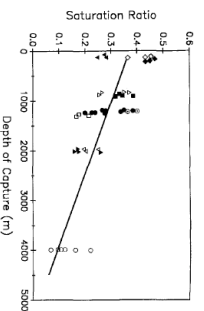


Figure 1. The change in saturation ratio (ratio of the weight percent of saturated fatty acids to unsaturated fatty acids) for the characteristic biogeographic component of ambient-sea-water organisms from different species. (Figure modified after Cowan and Madenjian '94)

Somero 1992

Resistance Adaptations

- Protein stability affected by temperature
- Deep sea fish have adaptations to maintain structural integrity of proteins at low temps

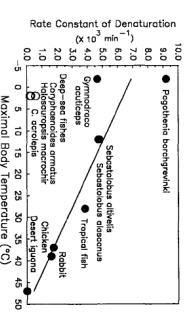


Figure 5. The relationship between adaptation temperature (maximal body temperature) and the thermal stability of *dhpsIII*. (S) Islets of social vertebrates: *Schizothorax adonum* and *Schizothorax affinis* are from the Antarctic; teleosts: *Coryphaenoides armatus*, *Coryphaenoides acrolepis*, and *Heterostichus macrurus*. (Data from Somero and Somero '91)

Somero 1992

Visual Interactions Hypothesis

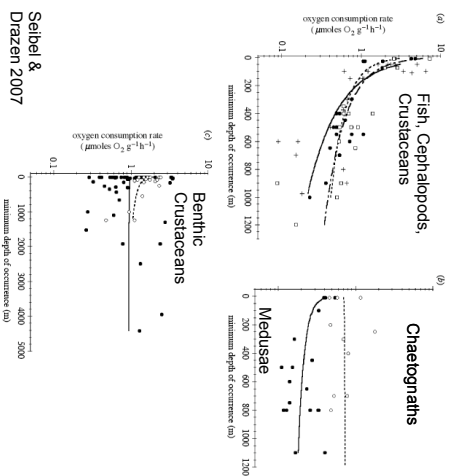
- “In the absence of light, the distances over which predators and prey interact are reduced resulting in relaxed selection pressure for rapid locomotory capacity for pursuit and evasion”
- Siebel & Drazen 2007
- Light influences predator-prey interactions
→ locomotor capability

Metabolic Rates

Food for thought

- Most work is done on Fish, Cephalopods, some Gelata and some Crustaceans
 - What about echinoderms? What patterns do we see in sessile fauna? Any differentiation between larval and adults forms?
- The “burglar alarm” effect
- Lower metabolic rates are functionally adaptive and not necessary evolutionary adaptations to lower food availability

Visual Interactions Hypothesis



- Metabolic rate decline with depth only strongly seen in taxa with image forming eyes
- Explains the trade-off between efficiency and speed in midwater fish and squids
- Strong association between image-forming eyes and activity level