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# An aspect of functional groups of zooplankton in oceanic ecosystems

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# Functions of zooplankton as a whole

1. Link between primary producers and higher trophic levels
2. Nutrient regenerator in surface layer
3. Deliverer of organic matter to underlying layers
4. Smoothing annual food supply to higher trophic levels in subpolar seas

**Prof. H.B. Bigelow said:**

**“the most important fact about the ocean is that it is full of water”**

**during his seminar at the Woods Hole Oceanographic Institution (*fide* Clarke, 1954).**

**This is, though easily forgotten, the most important background of the evolution of the oceanic ecosystem that has selected plankton as the primary and secondary producers.**

# Phytoplankton:

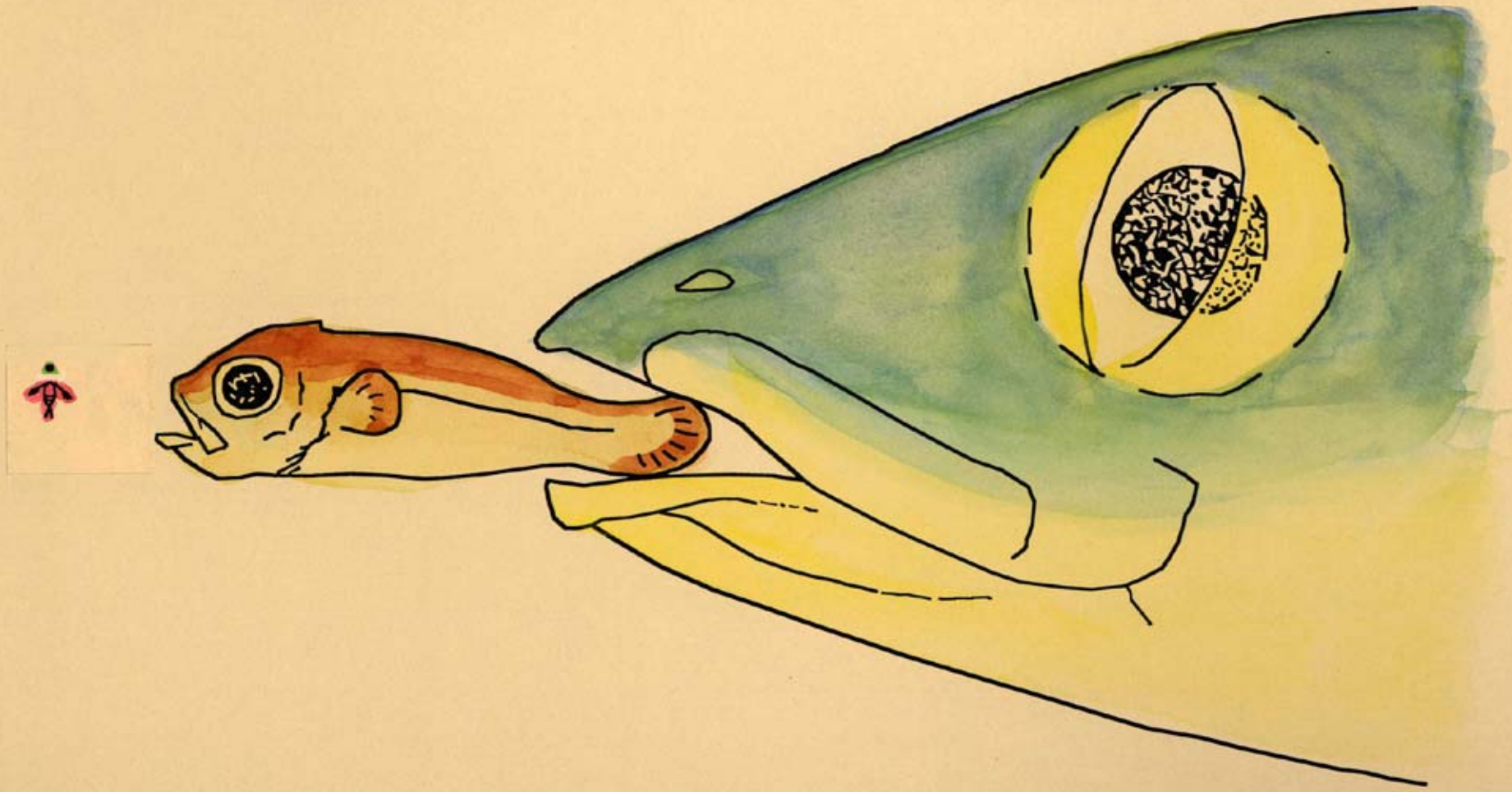
Only possible producers in the ocean

Water is **dense** and **viscous** so that nutrient-rich deep water hardly mixes up with surface water. Surface layer is oligotrophic.

Water is **light-absorptive** so that photosynthesis is possible only in the surface layer.

Photosynthetic organisms must keep afloat and uptake nutrients of low concentration.

Small phytoplankton with large surface-to-volume ratio is advantageous in getting larger frictional resistance against water and wider windows to uptake nutrients.



**The oceanic food chain transforms organic particles from tiny phytoplankton to large fish in a step-like fashion.**

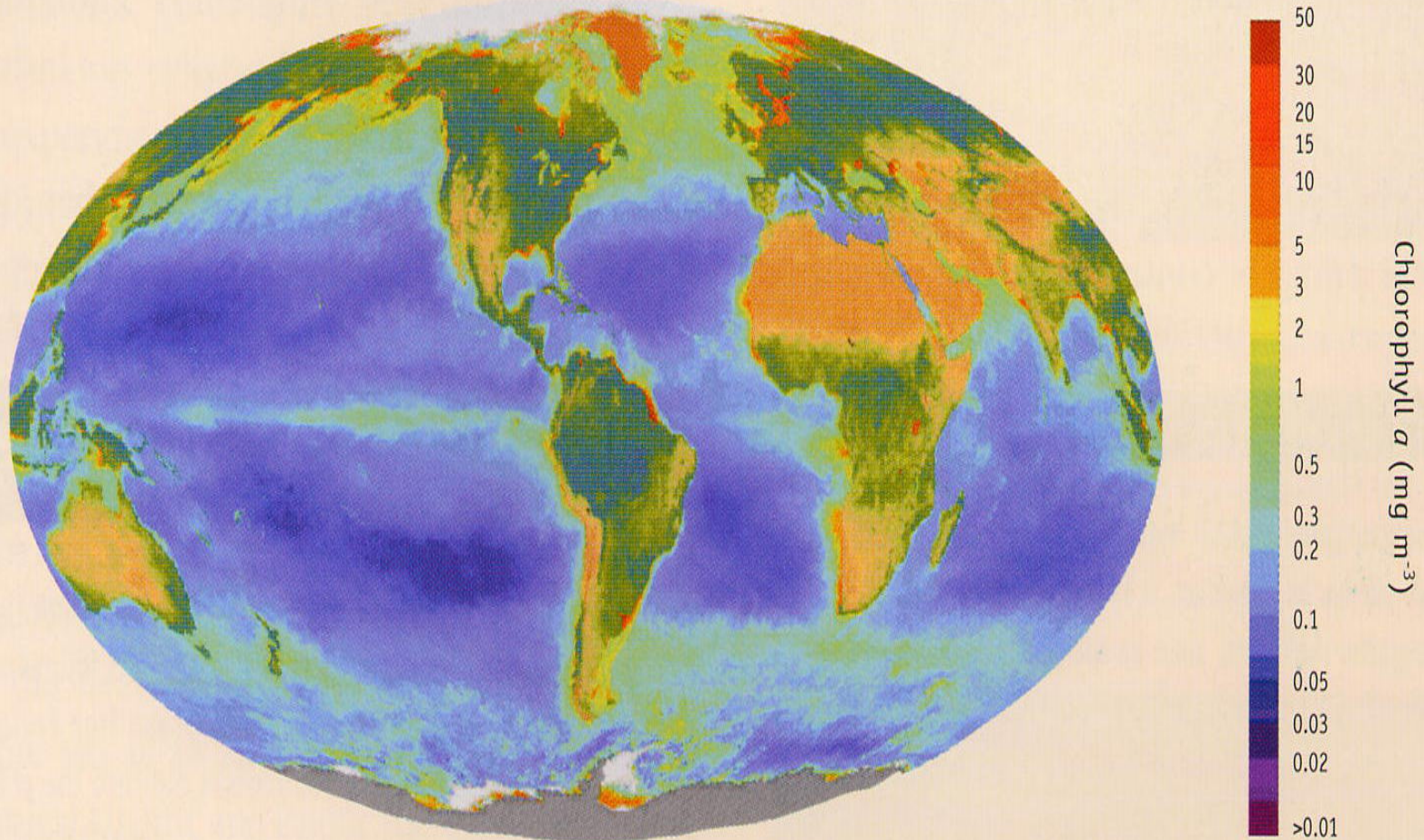
## 2. Nutrient regenerator in surface layer

Since surface water is too oligotrophic, zooplankton must work as an effective nutrient regenerator in surface layer.

This function is performed by their small body size enhancing metabolic activity, which accelerates excretion and shorten longevity. Their corpses will be decomposed shortly and finally release nutrients into water.

# Phytoplankton chlorophyll stock in the world oceans

Oceanography From Space

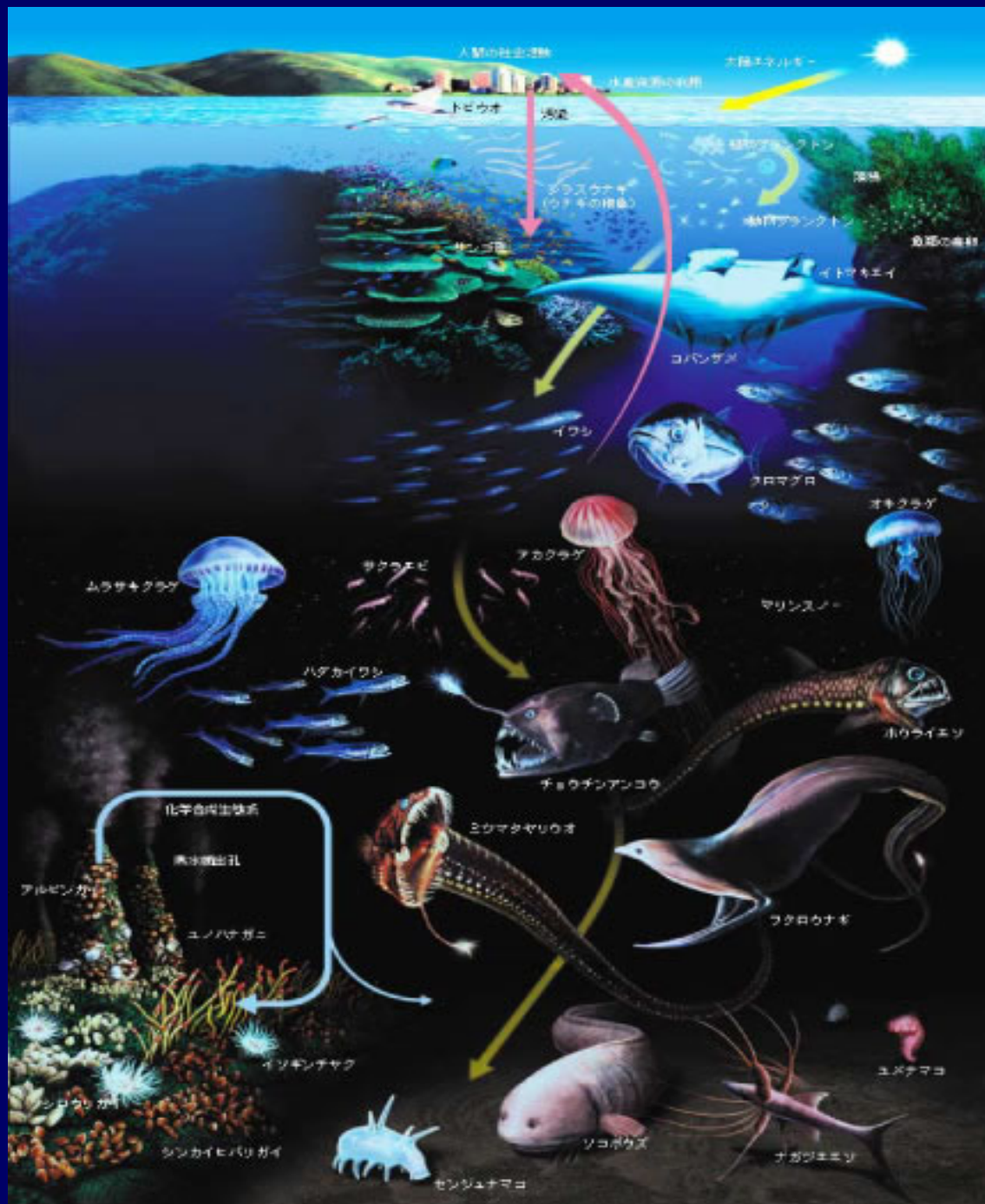


### **3. Deliverer of organic matter to underlying layers**

Since ocean is deep, zooplankton must work as a rapid deliverer of the primary products into deep layers.

They send the products in forms of discarded shells, houses and fecal pellets and of their own body (live/dead). Therefore, behaviors relating this function are defecation, ecdysis, diel vertical migration and their own death.





## **4. Smoothing annual food supply to higher trophic levels in subpolar seas**

Since primary production is too low during winter, zooplankton wintering in the water column is an important food store for higher trophic levels in subpolar seas.

Zooplankton performs this function by fat accumulation during spring and summer and hibernation during winter. Therefore, life history study will give answer to this item.

# **1. Link from phytoplankton to fish**

Grazing, predation, position in grazing food chain, mostly of mesozooplankton

# **2. Nutrient regenerator in surface layer**

Excretion, natural death and death by e.g. viral infection, contribution to microbial loop, mostly of small-sized copepods and short-lived gelatinous plankton including microzooplankton

### **3. Deliverer of organic matter to depths**

Defecation, ecdysis, house building/ discarding, diel vertical migration, natural death and sinking of corpse of mesozooplankton including gelatinous species.

### **4. Winter food store in high latitudes**

Fat accumulation, seasonal vertical migration, life history of mesozooplankton

# **Structural change of ecosystems under climate change**

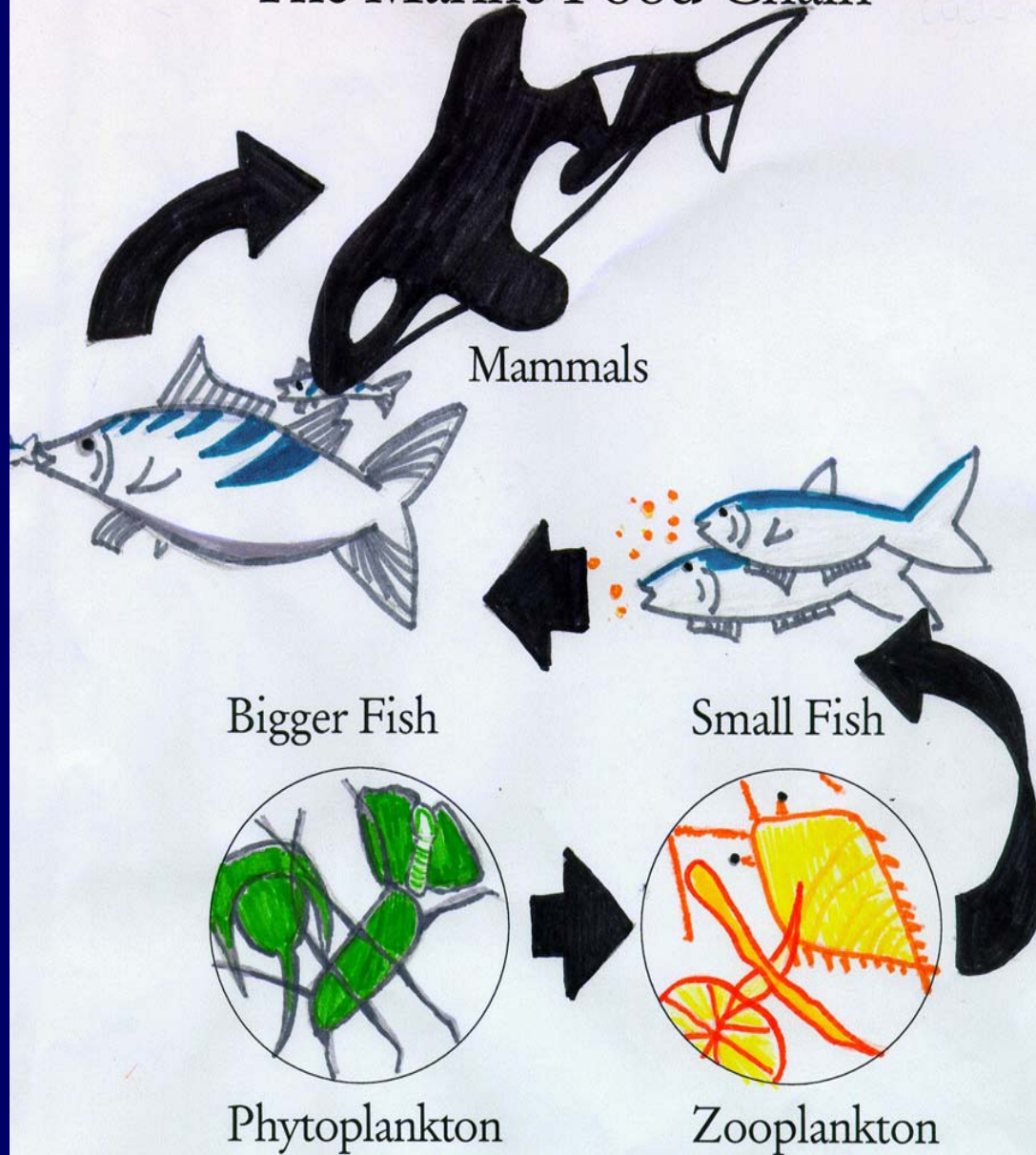
Life history patterns, in addition to physiological characteristics

# **Response of fish populations to climate change**

Prey-predator relationships among zooplankton populations and species/developmental stages of fish populations



# The Marine Food Chain



**Ryan Fie, Sasha Gross &  
Jamie Phillips**  
ROCK program at Sir  
Francis Drake Highschool  
California, U.S.A.