

# **Phytoplankton Zooplankton Interaction**

# ZOOPLANKTON



- Zooplankton are heterotrophic plankton. Plankton are organisms drifting in oceans, seas, and bodies of fresh water. The word "zooplankton" is derived from the Greek *zoon*, meaning "animal", and *planktos* meaning "wanderer" or "drifter". Individual zooplankton are usually microscopic, but some (such as jellyfish) are larger and visible with the naked eye.

# PHYTOPLANKTON



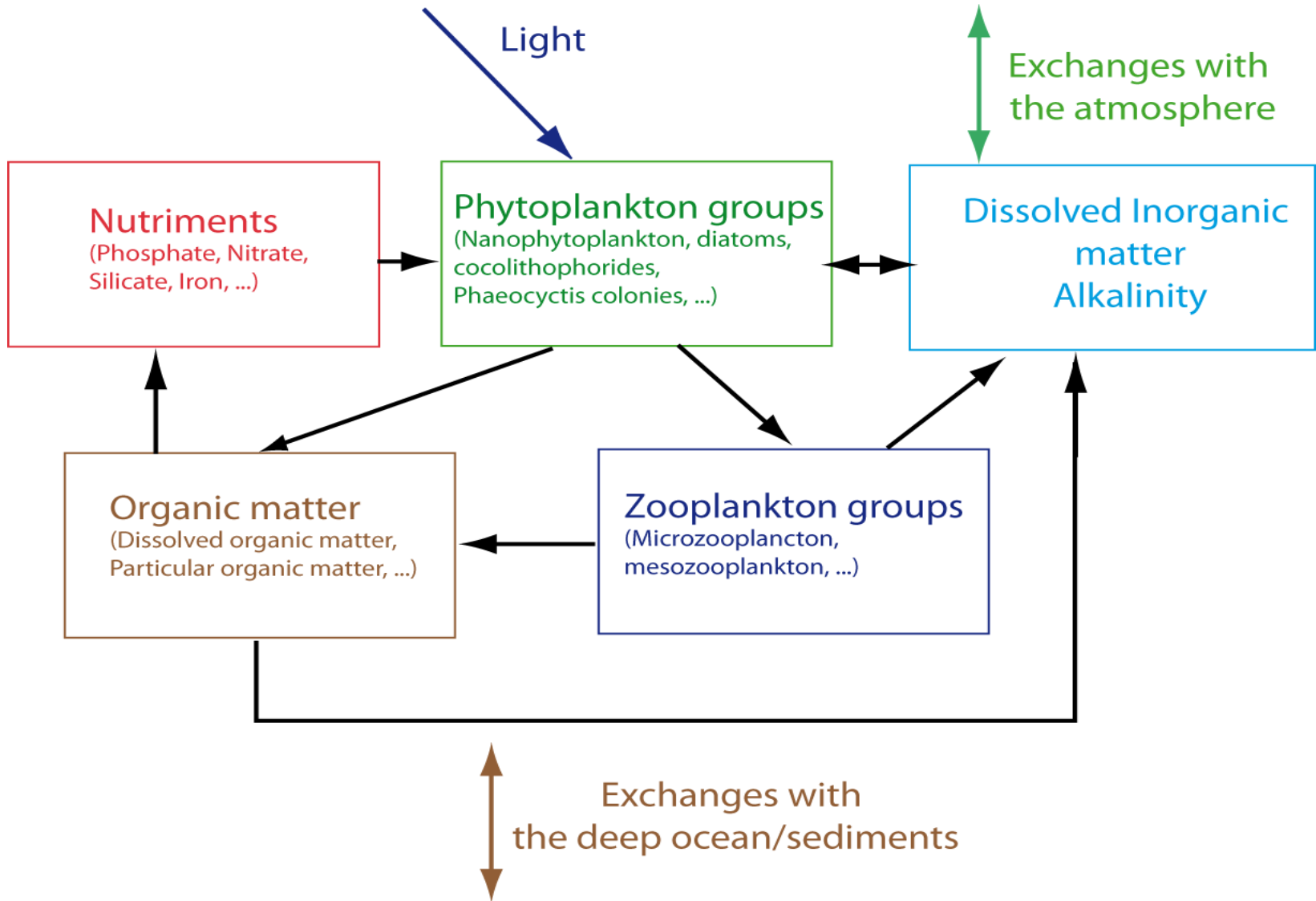
- Phytoplankton are the autotrophic components of the plankton community and a key part of oceans, seas and freshwater basin ecosystems.
- The name comes from the Greek words (*phyton*), meaning "plant", and (*planktos*), meaning "wanderer" or "drifter". Most phytoplankton are too small to be individually seen with the unaided eye.

- In the open sea, the relationship between phytoplankton and zooplankton is usually ascribed as inverse one, which is explained by two main theories; the animal exclusion and grazing.
- In the estuarine areas, pronounced variation would be expected in such relationship.
- The linkage between phytoplankton and zooplankton is a dynamic process controlled by several factors, including the environmental and biological factors which affect the growth of each community and the interaction between them.

- Strong relationships exist between phytoplankton and zooplankton. For instance, the main systematic groups of zooplankton include many taxa, which feed on phytoplankton.
- Selective grazing by zooplankton is an important factor affecting the structure of phytoplankton communities.
- However, phytoplankton structure also influences the taxonomic composition and dominance of the zooplankton.
- These animal components are mainly filtrators, sedimentators or raptorial predators

- Among them, filtrators usually exert the strongest effect on phytoplankton abundance in lakes.
- In *Daphnia*, the filtering rate is positively correlated with animal size, water temperature and phosphorus concentration in the seston.
- Grazing by cladocerans creates a selective pressure on the phytoplankton community, causing elimination of organisms that do not exceed a precisely defined size.
- As a result inedible large-sized algae dominate phytoplankton communities.

- In many cases, predatory copepods exert a strong influence on the phytoplankton composition.
- The copepods suppress large phytoplankton, whereas nanoplanktonic algae increase in abundance.
- The algal species that are resistant to grazing and predation are more likely to survive but also can make filter feeding more difficult.
- *Daphnia* species are particularly sensitive to disturbances of the filtering mechanism caused by large algae.
- Because of the constant feeding pressure of zooplankton on phytoplankton, the more resistant algae may become more and more abundant during the growing season.





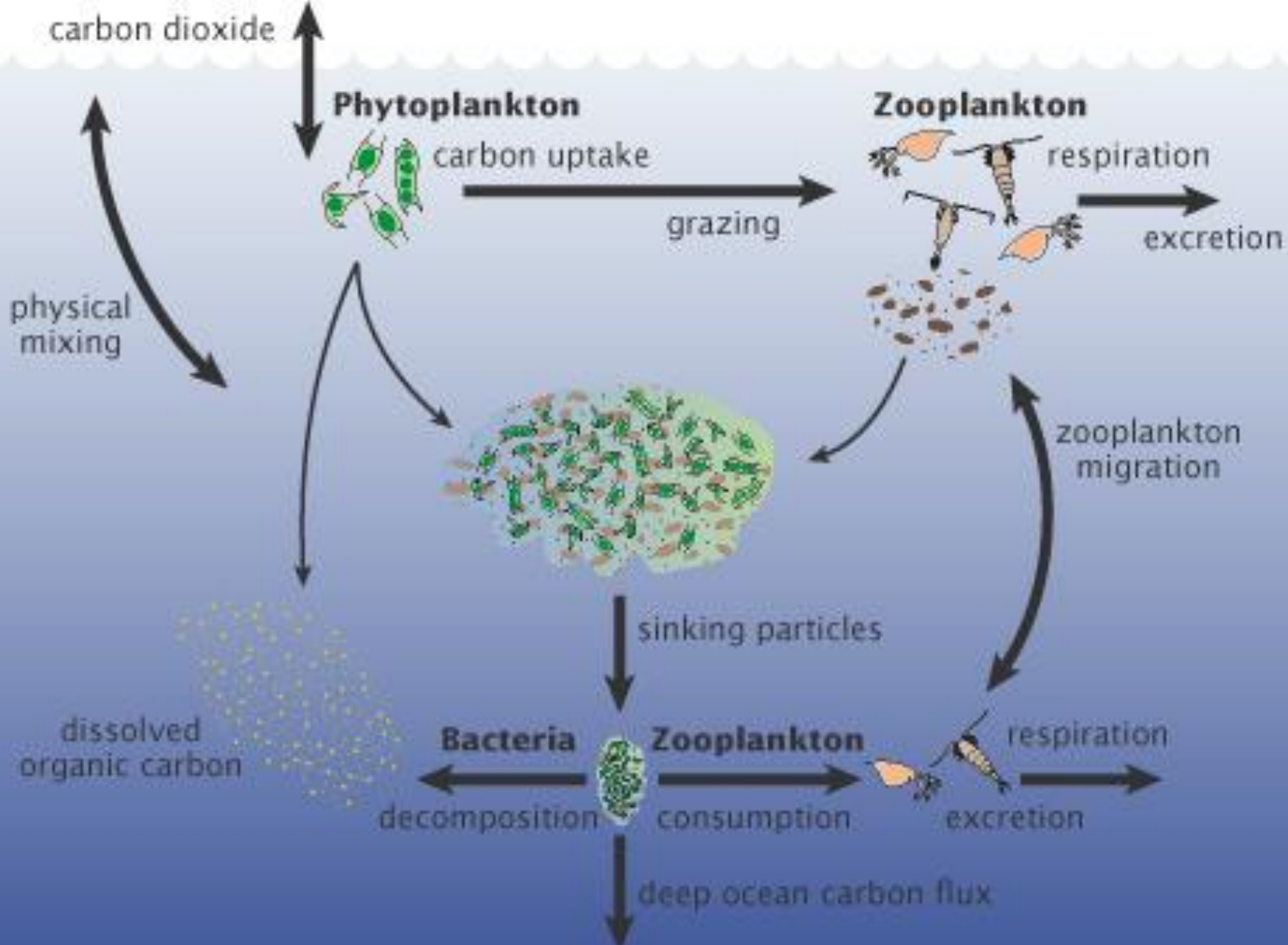


**The primary difference between the two is that zooplankton are animals and phytoplankton are plants.**

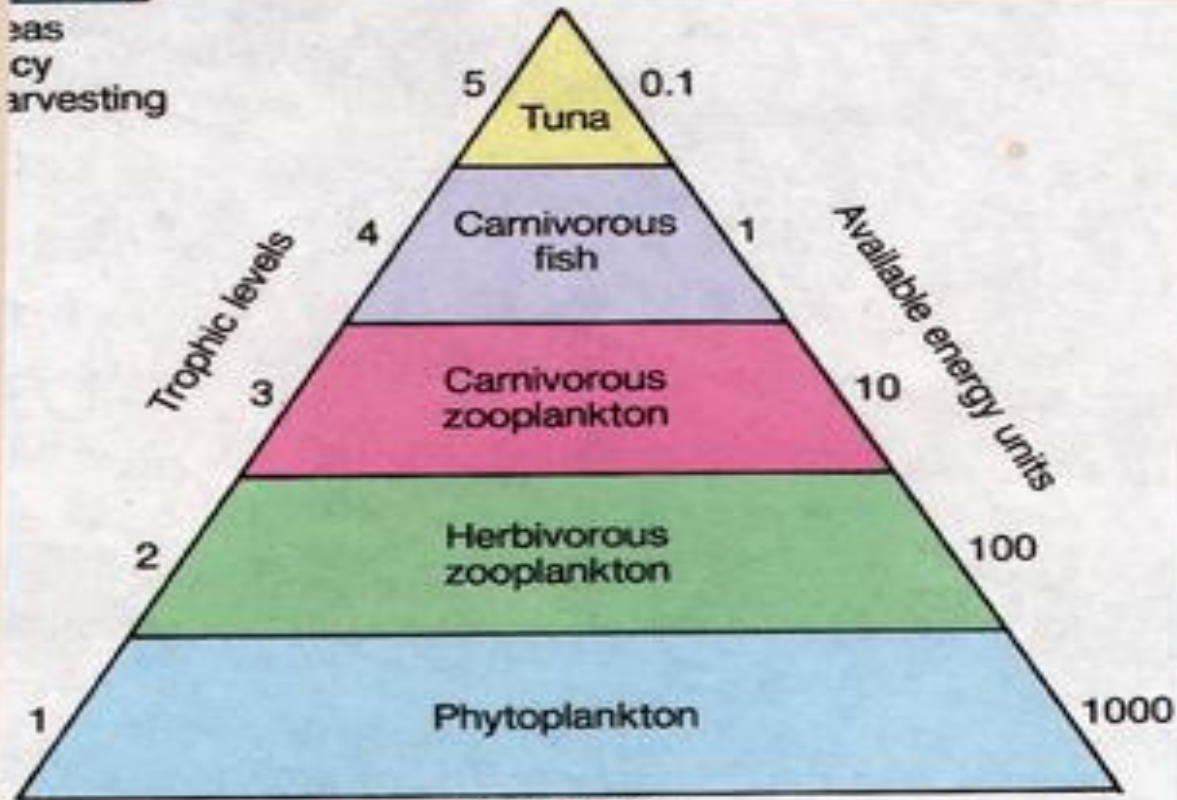
# Phytoplankton -Zooplankton Relationship

- Plants are the producers of food and animals are the consumers. This is the pattern of life every where.
- In accordance with the limitations imposed by solar illumination, microscopic marine plants evolved to take the maximum advantage of the conditions available in the surface layers of the sea.
- It is this community of microscopic plants which forms the pastures of the sea.
- The minute size of the food particles formed necessitated the evolution of small animals like copepods and euphausids, which are able to feed directly on these plants.

- These herbivores are small enough to effectively graze on the plants and are at the same time sufficiently numerous to provide adequate food of convenient size to primary carnivores.
- The large community of herbivores zooplankton organisms plays an important part in the economy of the sea by acting as a vital link in every food chain.
- As solar illumination is essential for photosynthesis, plants are confined to the surface water. On the other hand, animals live every where, even in the deep sea trench.
- This animals will have to come to the surface and feed directly on plants, subsist on what sinks down from the surface water.



as  
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harvesting



Open ocean  
10% efficiency  
(c) Fifth-level harvesting



- Because of the absolute dependence of zooplankton on phytoplankton for food, one can expect a concentration of zooplankton wherever there is a concentration of phytoplankton.
- With the help of the continuous plankton recorder, Hardy discovered comparative poverty or even virtual absence of zooplankton in areas of phytoplankton concentration.
- Hardy explained this inverse correlation by his theory of animal exclusion.

- Herbivores swim towards the surface to remain with the phytoplankton for part of the day. The duration of this stay is inversely proportional to the degree of concentration of the phytoplankton.
- If the concentration is high, less time is needed to take a full meal.
- If the concentration is low feeding time will have to be extended.
- The drifting apart or horizontal exclusion of the 2 plankton communities depending primarily on the degree of concentration of the phytoplankton.

- Harvey et.al (1935) observed that phytoplankton multiplication is kept under check by intense grazing by animals.
- Wherever animals are few, phytoplankton will be abundant and vice versa.
- Hence grazing can undoubtedly bring about an inverse correlation in the respective intensities of phytoplankton and zooplankton.
- Factors favoring phytoplankton growth are equally favorable for zooplankton production.
- But members of zooplankton have a definite life cycle and successful multiplication very much depends on the sexual maturity of the standing production.
- Zooplankton hence needs a longer time interval for attaining the peak of intensity.



- Even if both start multiplying simultaneously, phytoplankton will reach maximum intensity while zooplankton is only growing up.
- Zooplankton approaches maximum intensity depletion of the available nutrients especially the phosphates and nitrates.
- It will put a stop to further multiplication of the phytoplankton.
- This coupled with intense grazing by zooplankton that has reached its maximum by now, brings down the phytoplankton population considerably

- According to Harvey et.al zooplankton is mainly responsible for the inverse correlation.
- According to Lucas phytoplankton produces during intense photosynthetic activity by products called matabolites or ectocrines which adversely affect zooplankton.
- Wherever there is a rich diatom growth, zooplankton shows pronounced preference.
- Young actively growing colonies are grazed down, but disintegrating populations are generally avoided.
- This is because senescent colonies produce inhibiting substances which excluded animals.

- Some actively growing algae release in to the water extra cellular products like glycolic acid, carbohydrates, amino acids, peptides, vitamins, antibiotics, enzymes and toxic compounds.
- These have marked effect on animals, some of them being highly toxic.

# CONCLUSION

It is now definite that the inverse relationship in the comparative abundance of phytoplankton and zooplankton can result from intense grazing as well as animal exclusion due to the release of toxic substances by actively growing as well as senescent patches of phytoplankton.

# PHYTOPLANKTON:

*"King of Superfoods" helps:*

- Cell Regeneration*
- Liver Health*
- Brain & Heart Health*
- Increase Energy*
- Slow Aging*

