Lecture 1: Introduction to Biological Oceanography

Definition

- Biological oceanography is the study of life in the sea.
- It studies the ecology and distribution of massive production in oceanic, marine, coastal, and estuarine organisms.
- It also studies viruses, bacteria, archaea, phytoplankton, zooplankton, fish, benthic invertebrates, shellfish, and other marine mammals.
- Biological oceanography aims to understand what controls the abundances, composition, and temporal variations of organisms in the sea.
- This study is genuinely interdisciplinary, thus involving bio to bio, bio to physics, bio to chem and bio to geo interactions.

The Importance of Biological Oceanography

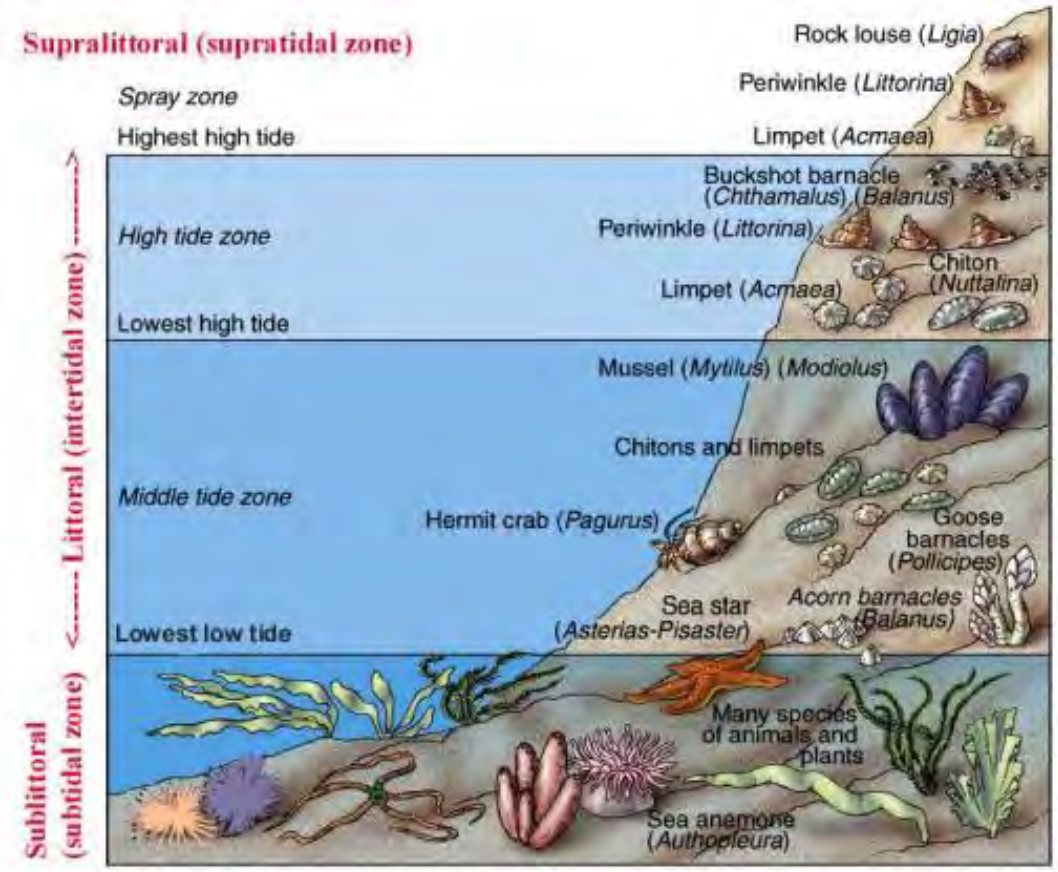
- It shows the importance of oceanic phytoplankton in fixing about 40 to 50 Gigatons of carbon per year, compared to the terrestrial systems on land, which fix 50 to 60 Gigatons of carbon in a year.
- About 5% to 25% of protein for food consumption by humans and other organisms is derived from fishing, dependent on the area.
- The study contributes to the regulation of global climate in both evolutionarily and climatically pathway.

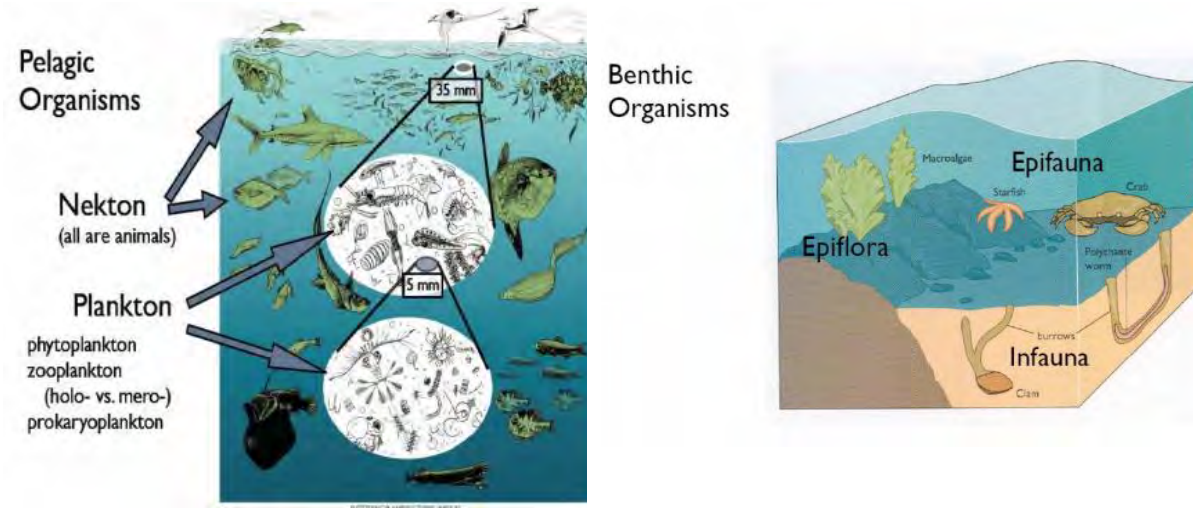
The Knowledge that a Biological Oceanographer Studies

- To learn about the chemical and physical factors that influence the distributions and activities of marine organisms.
- To study the physiological, behavioural, and biochemical adaptions to environmental variables, including natural variations in food, temperature, light, pressure, and the chemical environment.
- To investigate the ecology and food web dynamics in a marine environment.
- To learn about nutrient cycling and energy harvesting in a marine ecosystem.
- To be knowledgeable of ocean physics, chemistry, geology, and atmospheric process.

Classification of Marine Organisms Based on Habitat

- Pelagic (pelagius = of the sea)
  - Plankton (drifters and weak swimmers)
  - Nekton (swimmers)
- Benthic (benthos = bottom)
  - Infauna
  - Epifauna
  - Epiflora





Characteristic Lengths of Planktons

Length	Plankton
< 0.2μm	Femtoplankton (viruses)
0.2 - 2μm	Picoplankton (Eubacteria, Archaea, microscopic eukaryotes)
2 - 20μm	Nanoplankton (diatoms, dinoflagellates, protozoa)
20 - 200μm	Microplankton (diatoms, dinoflagellates, protozoa, copepod nauplii)
0.2 - 20mm	Mesoplankton (mostly zooplankton)
2 - 20cm	Macroplankton

Lecture 2: Phytoplankton Ecology

What is Phytoplankton?

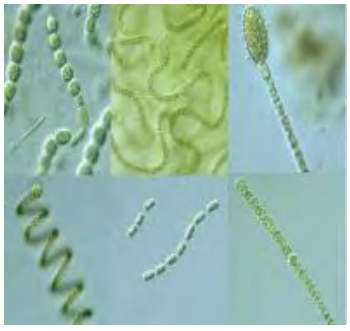
- Mostly live in the photic zone (sufficient sunlight)
- Cannot move against currents, only float or weakly move
- More than 40% of global primary productivity
- Autotrophs
- Form base of an ocean food web
- Produce oxygen for all life (about 70%)

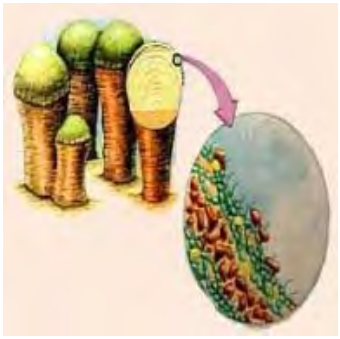
Plankton Classification Based on Size Categories

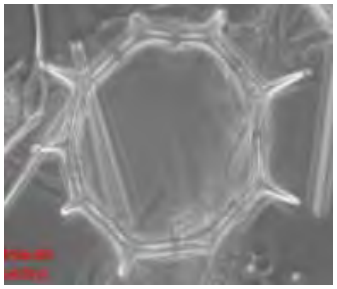
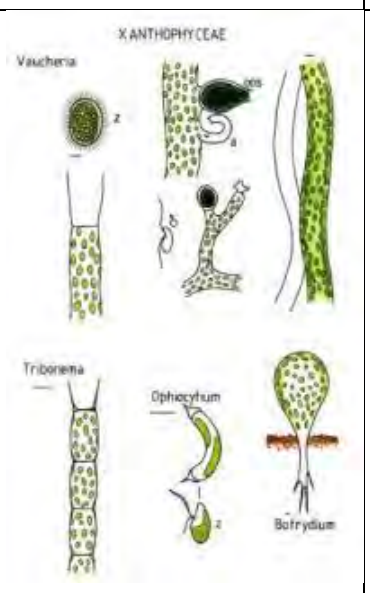
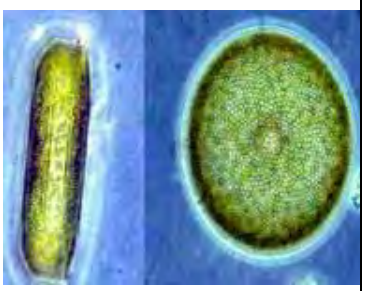
Picoplankton	< 2μm
Nanoplankton	2 - 20μm
Microplankton	20 – 200μm
Macroplankton	200 – 2000μm
Megaplankton	> 2000μm

Phytoplankton Classification

Kingdoms		
Monera (bacteria)	Protista (algae)	
Divisions (Phyla)		
Cyanobacteria	Chrysophyta	Dinophyta

Phylum Cyanobacteria (Blue-green algae)	
	• Photosynthetic bacteria (Use chlorophyll a) • Prokaryotic (No nucleus and has a few organelles) • Found in intertidal, estuaries, and coral reefs • Reproduced by cell fission • Nitrogen fixator (can convert nitrogen gas to nitrates or ammonia)

	• Some of them are symbiotic • Epiphytes on seagrass
Example: Stromatolites	
 	• The age of fossils are more than three billion years old • Help to increase the amount of oxygen gas in the Earth's early atmosphere • The photosynthesis byproducts are oxygen gas and calcium (Build limestone domes & grow vertically to process high rate of photosynthesis • For modern stromatolites, they are found in hypersaline lagoons(saltier than seawater), which are too extreme for animal grazers

Phylum Chrysophyta		
• Most with hardened cell walls / internal skeletons (silica/calcium carbonate) • Some have flagella for motility		
Class Chrysophyceae	Class Xanthophyceae	Class Bacillariophyceae (Diatoms)
 		 
• Most live in freshwater	• Known as yellow-green algae	• Most abundant phytoplankton