Oceanography Chapter 14

Plankton – Ocean wanderers

- Drift or swim weakly
  (Wekton – swimmers)
- Describes a lifestyle
- Contains members from many different animal groups

First study – Germans in 1925 - 26 (Meteor)

- Plankton nets (Figure 14.2)
- Smaller ones captured by fine filters

Phytoplankton – Autotrophs

- 35 billion metric tons of C converted to sugars
  every year – 40 % of food made by photosynthesis on Earth
- At least 8 types

1. Diatoms- began to dominate in K, 100 MYA
   - Increased proportion of free oxygen in the atmosphere
   - Figure 14.3
   - Dia (through) tomos (to cut)
   - Frustule- cell wall – consists of silica
   - Cell wall consists of 2 valves
   - 55% of the energy of sunlight absorbed can be converted to carbs
   - Excess O_2 is released through frustule
   - Xanthophylls – yellow or brown pigment
   - Chlorophyll – main photosynthetic pigment
   - Store energy as fatty acids and oils, which are lighter than water – helps them float
   - Some don't float – benthic – always enough to or pennate in shape.
   - Reproduce by dividing in half (may be as fast as a few days) – actually get smaller with cell division, since they become too glassy after several divisions, they develop auxospores (naked cell)
   - Diatoms die skeletons form ooze – diatomite

2. Dinoflagellates – single celled autotrophs
   - Majority live in the open ocean, but a few live within the tissues of other critters (zooxanthellac)
   - Flagella – whip-like, and have two – rotate and move
   - Widely distributed solitary critters that reproduce by simple fusion.
   - Some are bioluminescent – use energy from a reaction to make light energy (may have evolved from an intrusion alarm)
   - Usually responsible for red tides (HAB)
     (Spring time – 6-8 million parts per liter or 23 to 29 parts/gallon)
     Box 14.1

3. Coccolithophores
   - Small single celled autotrophs covered with disks of $CaCO_3$ (coccoliths) fixed to the outside of their cell walls
   - Fig 14.6
   - Sargasso, Mediterranean Sea
   - Water will be milky or chalky
   - Hence – produce chalk – Cliffs of Dover in England

4. Silicoflagellates
   - Internal support is silica (like diatoms)
   - 1 or 2 flagella
   - seem more primitive – didn't know much

5. Picoplankton – pico 1 trillionth
   - Not much known
   - Including cyanobacteria and other bacteria
   - Smaller scale

   1980s – discovered viruses – no metabolism
   Bacteriophages
   Phycophages

Measuring Primary Productivity

$$\text{Rate of Production} = \frac{(R_L - R_P) \times M}{R \times t}$$

R_L = radio active count in "Light" sample
R_P = count in the dark sample
M = total mass
T = number of hours of incubation

Use radio active ^{14}C
Several ways to do it: Light dark variety Figure 14.7

Factors That Limit Productivity

1. Availability of Nutrients
   a. Non conservative nutrients – change in concentration with biological activity.
   - Plankton Bloom – rapid phytoplankton growth
   - Big Blooms – upwelling zones – Antarctica

2. Availability of light
   - Too much or too little effects productivity

Figure 14.8

Compensation Depth – Production of carbohydrates and oxygen by photosynthesis through a day's time will exactly equal the consumption of carbs and oxygen by respiration

- Corresponds to the depth to which about 1% of surface light penetrates (bottom of the euphotic zone)
- Changes with sun angle, turbidity, surface turbulence, etc

Global distribution of Plankton /Productivity

- Distribution of phytoplankton corresponds to the distribution of macronutrients.
- Because of coastal upwelling and land runoff, nutrient levels are highest near the continents.
- Productivity is highest there

1. Tropics
   - Deficient in surface nutrients
   - Coral reefs are the exception
   - Dinoflagellates live within the tissues of corals

2. Polar Regions
   - Spectacular plankton blooms during 24 hour days
   - Arctic is lower

3. Temperate and Subpolar Zones
   - Temperate Pro – 120 $gC/m^2/yr$
   - Subpolar 250 $gC/m^2/yr$

Greatest open ocean – Ekmin transport upwelling along Equator

Phytoplankton by season – Figure 14.10

Zooplankton – the Heterotrophs

- Heterotrophic – 10% of Phyto population

Most abundant (70%) – Copepods – shrimp-like

Biggest – Cyanea – 12 foot dome jellyfish
(Macro Plankton)

Holoplankton – spend their whole life in the plankton community

Meroplankton – temporary visitors – Juveniles

<u>Zooplankton</u>
Krill – Antarctic ecosystem (Fig 14.12)

Jellies – Fig 14.13

Forams (related to amoebas)
(Fig 14.14) - $CaCO_3$ shells

O_2 minimum zone below the well – lit surface zone

<u>Larger Marine Producers</u>
Autotrophs (Marine) are Algae
Algae – autotrophs possessing chlorophyll (P.S.), but lacking vessels to collect sap

1. Unicellular – Diatoms, Dino Flag
2. Multicellular – seaweed

Seaweed Structure – Figure 14.15
Blades (or Fronds) - leaves
Stapes – stems
Holdfast – root
Gas Bladder
<u>Thallus</u> – Body

1. Chlorophytes – Green algae Figure 14.16
   - ancestor of green plants?
2. Phaephytes – Brown algae
   - Kelp
   - Fucoxanthin – pigment
3. Rhodophytes – Red algae - Fig 14.17

Marine Angiosperms – flowers
1. Sea Grasses - Figure 14.18
2. Mangroves - Figure 14.19