

Dynamics of Marine Ecosystems

Recitation 1. Wednesday, September 14, 2011 **ANSWERS**

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1. Definitions (20 minutes)

- a. Thermocline – region of rapid temperature change with depth
- b. Pycnocline – region of rapid density change with depth. Density is a function of temperature, salinity, and depth; temperature is the major driver. This provides a physical barrier between the mixed layer and deep ocean. Mixing across this barrier is provided by winds, waves, currents, & buoyancy differences
- c. Nutricline – region of rapid nutrient concentration decline with depth. Nutrients are used in the mixed layer above. New nutrients get up by mixing across the pycnocline (seasonal) & molecular diffusion (really slow)
- d. Stratification – build-up of layers. Less dense (warmer, less salty) on top. Denser (cooler, saltier) underneath.
- e. Mixed Layer – region near the surface of constant density (usually temperature) that is stirred by winds
- f. Photosynthetically Active Radiation – portion of the electromagnetic radiation spectrum from which photosynthetic organisms can derive energy. Overlaps with visible spectrum. 400-700 nm.
- g. Irradiance – LIGHT. The power of EM radiation that hits a surface. Expressed as units of energy per units of area. Time is usually assumed.
- h. Conservative element – constant concentration with depth. Major salts. Abundance is much higher than that needed for biology.
- i. Bio-intermediate element – Some drawdown of concentration at the surface, but not to zero.
- j. Bio-limiting Nutrient – So much is needed for biology relative to what is available that the concentration is drawn down to zero at/near the surface. Is typically in molecule, not element, form. NO_3^- , PO_4^- , $\text{Si}(\text{OH}_4)$
- k. Biological Pump – movement of nutrients from the surface to the deep ocean. Not all nutrients end up here. Active microbial loops keep some (small amounts) nutrients in the surface waters.
- l. Deep Ocean Circulation – Sinking of dense water in the N. Atlantic that travels to the S. Atlantic, Indian, S. Pacific, & N. Pacific. Remember that the pipe is leaky. This is why deep nutrient concentrations are higher in the Indian & Pac than in the Atlantic.

- m. Phytoplankton – photolithoautotrophs. Not animals. But some can have heterotrophic qualities. Drift.
- n. Zooplankton. Animals that drift & consume phytoplankton & heterotrophic plankton. Less than 1 m long. Anything larger/can swim against the currents is called nekton.
- o. New Production – Primary production that results from nutrients upwelled from deep ocean waters below the pycnocline or from newly fixed nitrogen near the surface.
- p. Gross Primary Production, Respiration, Net Primary Production, Biomass – $GPP = \text{rate of total fixed carbon in units mass/area or volume/time}$. $Resp = \text{rate of carbon lost through metabolism in same units}$. $NPP = GPP - R$ – also a rate in same units. Biomass – typically the amount of chlorophyll present in mass/volume.
- q. Chlorophyll – a pigment. all plants have pigments. Harvests the energy from sunlight to split water & then drive the carbon fixation cycle.
- r. Compensation Depth – depth at which GPP & R are equal. Where NPP AT THAT DEPTH is 0. Everything above this has GPP compensating for R .
- s. Critical Depth – depth for which the integrated NPP is greater than 0. If this is above the mixed layer depth, then there is some area below where there can be net loss of fixed C to respiration. If this is below the mixed layer depth, all of the water that photos spend their time in will have $NPP > 0$.
- t. Autotroph versus Heterotroph – make own food versus eat food that someone else created.
- u. Eutrophic versus Oligotrophic – high nutrients & productivity versus low nutrients & productivity.
- v. Trophic Transfer Efficiency – how much energy gets from one trophic level to the next.