Lecture 18: Marine Communities

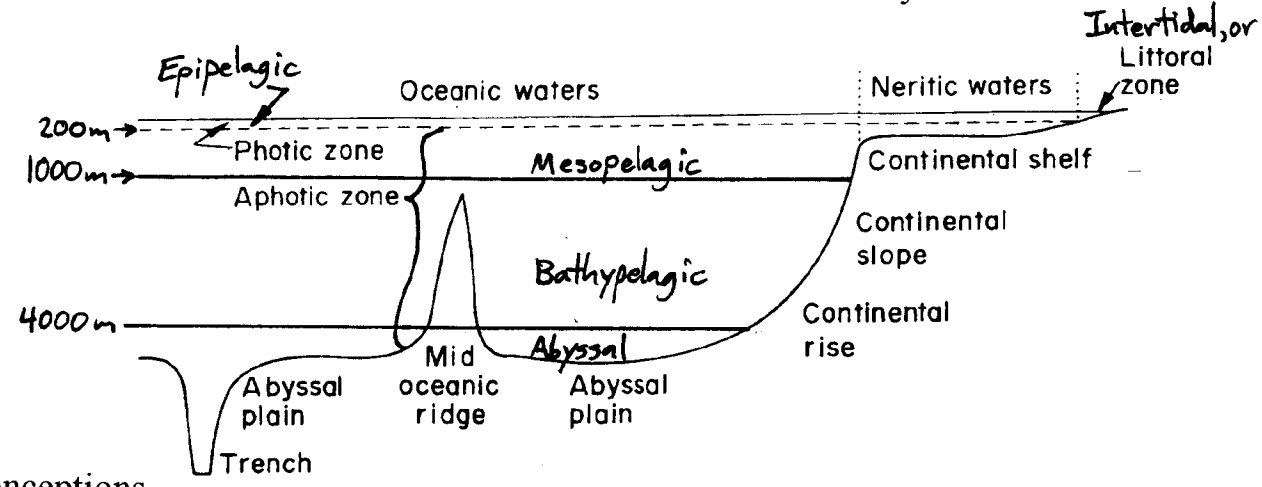
Outline

I. Background
II. Oceanography
III. Ocean zones and communities

I. Background

A. Dimensions

- Most of us have a pretty good idea of the size of the sea
- 70% of world's surface covered by sea water – 59% of which being ocean floor and 11% submerged continental margins (SEE FIGURE)
- 88% deeper than 1,000m; 58% deeper than 4,000m (about 2.5 miles)
- Generally inhabitable from surface down to deepest depths – over 11,000m
- Comprises 99% of the living space on our planet, yet we understand it relatively little – most information from deeper areas comes from trawl surveys



B. Misconceptions

- Despite its immensity, two commonly-held misconceptions have been that:
- 1) supply of fish in oceans is inexhaustible, and
- 2) oceans are capable of diluting and absorbing any inputs we add to them
- Both of these views, we are rapidly realizing, are untrue – discuss individually in next unit

C. Scope of today's talk

- Oceans as physical environments and the communities that live there
- We're not going to be able to talk about every oceanic community type, and certainly not every fish group
- Instead, we'll just talk about some general organizing themes

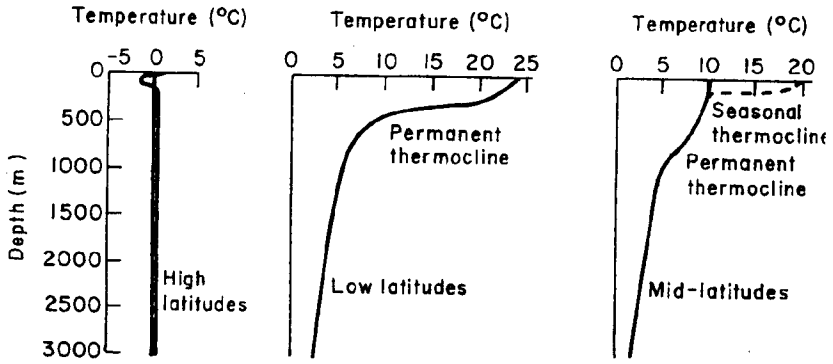
II. Oceanography

A. Light

- Penetration is less than you might think:
- In clearest oceanic waters (e.g., Sargasso Sea), photosynthesis only possible down to 250m
- Average ~150m in most of open ocean
- Only 30m in coastal waters
- Maybe only centimeters in highly turbid waters
- So?:

B. Temperature

- We've talked about temporary thermoclines in lakes
- There's a generally permanent thermocline below 1000m in temperate and tropical seas
- Also a seasonal surface thermocline in temperate regions (SEE FIGURE)
- Polar seas – unlike FW, SW density increases uniformly w/decrease in temp down to -2 degrees C, which creates nearly vertical profile w/insulating layer of FW ice on top



C. Currents

- A variety of water movements keep waters from becoming stagnant
- → Except in rare cases, oxygen is not limiting at any depth of ocean
- → Current redistribute nutrients and biota among geographic areas

1. Surface currents

- Surface currents are driven by winds and tides, which push water along course determined by topography of ocean basin and Coriolis effect
- Good example is Gulf Stream, huge mass of water pushed by wind from western Africa into Caribbean and through Straits of Florida – causes Florida to be very mild in winter, affects weather throughout Atlantic coast and western Europe (SEE FIGURE)

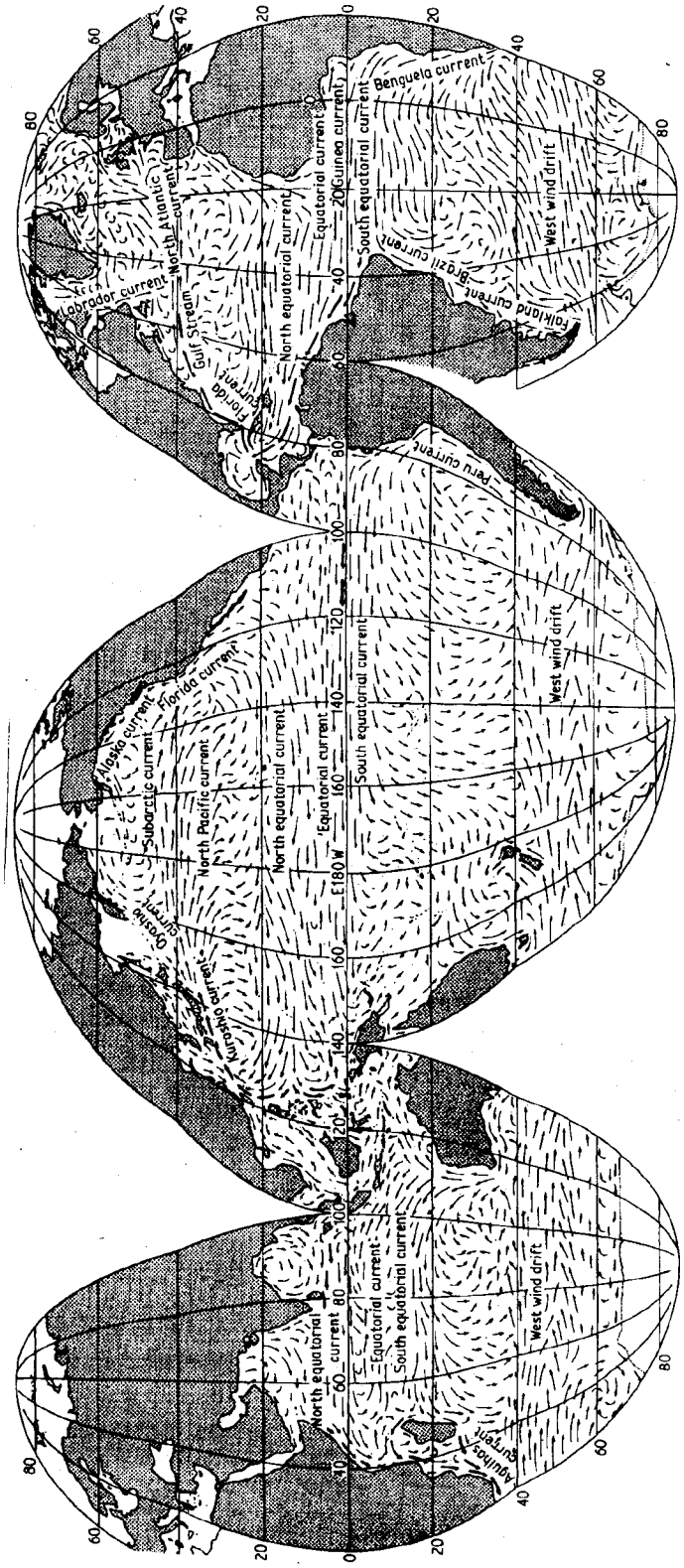


Fig. 39 Surface currents over the world in February and March (after Sverdrup *et al.*, 1942).

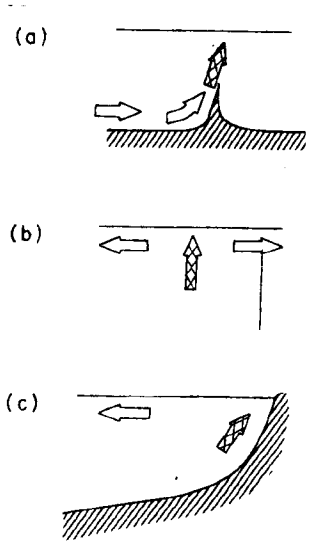
- Transports over 100x the volume of all rivers that empty into Atlantic Ocean
- Carries more heat than that produced by a million power stations

2. Deep currents

- Mainly due to temp/salinity/density differences in water that cause water to move toward/away from continents
- E.g., during winter, water adjacent to Antarctic ice masses gets extremely cold and saline, sinks below warmer water and along the continental slope, away from Antarctica – cold current can be traced as far away as 40 degrees north
- Similar current emanates from north pole
- Cold current returns cool water ~counter to Gulf Stream

3. Upwellings

- Movement of water from deep ocean to epipelagic zone, perpendicular to water surface
- May occur when 1) deep currents meet an obstacle like a ridge and are deflected upward, 2) two contiguous water masses move apart, such as at the equator, and deep water rises to fill the hole, or 3) most importantly, when wind pushes water away from coastline, and deep water rises to fill the hole, especially where continental shelf falls off near the shoreline (SEE FIGURE)



4. Downwellings

- Opposite processes of upwellings, i.e., where water masses converge, or wind blows toward coastlines

5. Tides
- Primarily affect coastal areas
- Caused by gravitational pull of moon on oceans as it revolves around the earth
- Periodicity of approximately 12.5 hours, gives two high and two low tides per day
- Water rushes into/out of marshes, tide flats, coastal rivers and lagoons
- Can inundate or desiccate vast areas over short period of time
- Some of the most dynamic environments on earth, in terms of rate and magnitude of physicochemical fluctuations

D. Salts
- Primarily Na^+ and Cl^-
- Salinity varies depending on FW inputs and evaporation, averaging around 35 PPM
- Believed to be so stable that it has little influence on marine ecology
- On other hand, dissolved nutrients N and P, though in minute concentrations, can be limiting in surface waters
- How so?:

E. Sediments
- On continental shelf, sediments are mostly sand/silt/clay of terrestrial origin
- In abyssal plain, sediment is calcareous ooze from decomposition of plankton
- In deepest areas, silica and inert red clay
- A lot of nutrients (esp. P) and organic matter tied up in sediments

Now we'll talk a bit about basic building blocks and patterns of marine communities

III. Ocean zones and communities
A. Intertidal (littoral) zone
- Region between high and low tide
- Certain portions of bed may periodically become exposed to air - unpredictable

1. Producers
- Shallow enough that light completely reaches sea floor
- Thus, high productivity of attached vegetation like sea grasses and mangrove swamps