

Exam 4

Friday, April 10, 2015

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Part 3 - Survey of Marine Ecosystems

3/25/15

- A. Coastal Ecosystems
 - 1. Estuaries
 - 2. Intertidal
 - 3. Coral Reefs
 - 4. Continental Shelf
- B. Open Ocean Ecosystem
- C. Special Marine Ecosystems
 - 1. Deep Sea
 - 2. Polar
- D. Humans and Marine Ecosystems

- 1. Estuaries
 - A. What is an Estuary?
 - B. Physical Characteristics
 - C. Types of Estuaries
 - D. Productivity
 - E. Challenges for Life in an Estuary
 - F. Communities Associated with Estuaries

- A. What is an estuary?
 - Where rivers meet the sea
 - Constant environmental change
 - Mixing of FW and SW
 - Often highly productive
 - Shallow, sunlight, nutrients
 - Ecological roles
 - Nutrients to sea
 - Nursery for many young animals
 - Humans benefit greatly
 - 85% of commercial fish and shellfish of world spend all or part of lives in estuaries
 - Oysters, shrimps, flounder, fluke, tarpon, striped bass
- B. Physical Characteristics
 - Inlet in the ocean that extends into a river valley as far as the upper limit of the tide
 - Often form in embayment's partially cutoff from the sea
 - Rivers, streams, carry from FW from land and mixes with SW
 - All estuaries:
 - Partially isolated from the sea by land
 - Diluted by FW

C. Types of Estuaries

- There are a variety of ways that freshwater and sea water are mixed along the ocean edge- i.e. forming estuaries
- Estuaries can be categorized according to their **geologic history**- how they were formed
 - Coastal plain, tectonic, fjord, bar built
- Can be categorized according **to the pattern of FW and SW mixing**
 - Salt wedge, well-mixed, partially mixed

1. Coastal plain- drowned river valley

- Between glacial periods
- Water floods low- lying plains and river basins
- Chesapeake Bay, Long Island Sound, Narragansett Bay

2. Tectonic estuary

- Earthquake causes land to sink & SW covers
- San Francisco Bay

3. Fjord

- Glaciers cut deep valleys in coast
- Filled with water forming fjords
- Scandinavia

4. Bar- built

- Currents and tides deposit sediment on seaward side
- Barrier island - Cape Hatteras, Texas coast

*** Satellite images of three types of estuaries: (a) two coastal- plain estuaries on the US East Coast, (b) several bar-built estuaries, and (c) steep- sided fjords.

- Gradient of increasing salinity moving from river to sea
- Salinity & mixing patterns variable among estuaries
- **Tidal overmixing**
 - Dense SW sinks as lighter FW rises causes mixing
 - FW flow seaward over the top of more dense SW
 - Most estuaries are "positive" estuaries of this type
 - "Negative estuary" FW evaporates more quickly than replaced and inward flow of SW over the top of FW

- Types of estuaries by mixing:

1. Salt Wedge

2. Well-mixed

3. Partially mixed

1. Salt wedge estuaries

- Mouths of rivers flowing into SW
- FW flows rapidly out to sea at surface
- SW flow upstream along river bottom
- FW flow rapid and prevents SW from entering further

- Wedge moves in and out of river basin with rising/ falling tide
- One way exchange from SW to FW

2. Well mixed

- River flow low, tidal currents major role in circulation
- Seaward flow of water and uniform salinity at all depths
- Salinity decreases as water approaches river
- Delaware Bay

3. Partially mixed

- Strong surface flow of FW and strong flow inward of SW

D. Productivity

- High productivity of estuaries long known
- Freshwater runoff brings nutrients (N, Si)
- SW brings other nutrients (P)
- Light, nutrients for not that high of primary productivity
- Most of input into trophic webs is as **detritus**
- Organic matter in estuaries may be 100x of open ocean
- Detritus in estuarine mudflat can support 10 times more biomass than offshore sediments
- Sediments and organisms have high capability and retain nutrients and organic matter
- Estuaries as nurseries
 - Excellent habitat for young of many spp
 - High level of nutrients
 - Lower number of predators
 - All of those commercially and recreationally valuable fish and shellfish
- Bluefish:
 - Young feed in estuaries-
 - Most of life spent in SW
 - Striped bass: spawn at border of FW and salinity
 - Move to SW to develop

E. Challenges for Life in an Estuary

- Estuaries characterized by two types of organisms- those from FW and those from sea water (SW)
- Highly productive ecosystem - good place to live
- However, organisms inhabiting estuaries face two major challenges resulting from the dynamic nature of the environment:
 1. Highly variable salinity
 2. Challenge to osmoregulate
- 2. Water movement (Strong river and tidal currents)
 - Challenge to maintain position

1. Highly variable salinity

- Salinity of most of the ocean fairly constant
- The salinity of estuarine water can change very quickly
- FW invaders must tolerate elevated salinity and marine invaders must tolerate low salinity