Elements of Comparison between Estuaries

Estuaries are highly variable ecosystems comprised of numerous different and unique habitats. Estuaries are often defined as places where rivers meet the sea. Consider the wide range of characteristics of an estuary: from fresh water to salt water, from relatively warm surface water to much cooler bottom water, and from being submerged underwater to being high and dry just hours later. Also, consider that these conditions change frequently and on a regular basis. What a difficult environment in which to survive! Other features of this estuarine home are a plentiful supply of nutrients and safe places in which to live as you develop from larva to a young adult. Estuaries possess a plentiful variety of characteristics, enough to spark anyone's interest; yet there is much we have yet to learn about these places where terrestrial and aquatic life melds.

Estuaries are highly variable ecosystems, providing habitat for a wide variety of organisms. Estuaries are extremely productive areas that serve as a nursery for up to 90% of commercially important species. Humans have established civilizations along estuaries for thousands of years. We can all benefit from learning to appreciate these places where terrestrial and aquatic life melds.

We will investigate some of the physical, chemical and biological characteristics of estuaries in order to compare them. Most of these parameters occur on a continuum. For example, the salinity or saltiness of water ranges from 0-35 parts per thousand (ppt). Fresh upstream water has a salinity of approximately 0 ppt. and open ocean water is about 35 ppt. salt. In geographic areas where rivers meet the sea, salinity can fall anywhere along the continuum of 0-35 ppt. This is dependent on several factors such as rainfall, tidal flows and evaporation. Often, one of these parameter affects another. For example, the salt concentration of water affects its density. Below is an outline of some basic estuarine characteristics offered with the hope of making these complex ecosystems easier to understand and appreciate.

PHYSICAL

Types **(geomorphology)**

- Lagoon: oriented parallel to the coast, with a large fraction of surface area in water, little in marshes *(For example: Indian River Lagoon, Florida)*
- Fjord: formed by glaciers moving seaward, shallow sill at mouth restricts exchange of water *(For Example: coasts of Alaska, British Columbia, Norway, Chile)*
- Coastal plain estuary (drowned-river valley): broad, flat and shallow water mass, salt marshes form along low-lying coastal areas *(For example: Chesapeake Bay, Pamlico Sound many east coast estuaries)*
- Tectonic estuary: caused by faulting, volcanic eruption *(For example: San Francisco Bay)*

WATER BALANCE

- Positive estuary: fresh water input from ground water, rivers and rainfall exceeds evaporation; most estuaries are positive (a net flow of fresh water into ocean exists)
- Negative estuary: evaporation exceeds fresh water input. This can occur in tropical lagoons with little fresh water input (salinity>35ppt.) In Indian River Lagoon (FLA), 42ppt has been recorded.
- Neutral estuary: fresh water input = evaporation

MORE VARIABLE PARAMETERS

- Salinity: fractional measure of salt (predominantly NaCl) in water; range: 0-35 parts per thousand (ppt.)
- Temperature: surface waters tend to warm via the sun; warm water, being less dense than cold, tends to remain at surface, resulting in thermal stratification (separated layers of water based on temperature differences)
- Dissolved Oxygen: fully saturated water contains 5.7% oxygen; range: 0(anoxia) - 5.7% (Note: our atmosphere when saturated contains 21% oxygen). Lower temperature and lower salinity waters are able to contain more oxygen.
- Light/Turbidity: amount of sunlight affects photosynthesis (primary production); amount of turbidity (suspended particles) affects the amount of sunlight reaching certain depths
- Wind: provides mechanism for mixing, can influence tidal flows
- Tides: water movement caused by gravitational pull of sun and moon on Earth; provides mechanism for mixing; most US estuaries have semi-diurnal tides (two high and two low tides each day)

CHEMICAL

- Nutrients: tend to flow downstream from nutrient-rich river basins and are slowly processed (consumed, degraded) in estuary This process occurs with beneficial and harmful compounds. Nitrates and phosphates are often limiting factors for primary production. Too high of a nutrient composition (eutrophication) can upset food web balance, causing major problems in ecosystem.

BIOLOGICAL (in brief)

- Terrestrial: many microorganisms, many plants, insects, many invertebrates, amphibians, reptiles, birds, mammals
- Aquatic: many microorganisms, algae, submerged aquatic vegetation (SAV), plankton, many
- invertebrates, fish, marine mammals
- Food Webs: a network of whom feeds on whom; energy and chemical elements are thus transferred from organism to organism
- Habitats: a certain set of physical, chemical and biological parameters can define

a particular habitat; Note: any combination of parameters produces a unique habitat, which benefits some organisms more than others

- Salt Marshes: communities of emergent plants rooted in soils alternately inundated and drained by tidal action
- Mud Flat: a near-shore area where organic matter accumulates providing abundant potential food supply for many invertebrate organisms (such as diatoms, worms and other burrowing animals)
- Tidal Creeks: natural or channelized ravine areas which are subject to tidal conditions

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* Comparison Chart