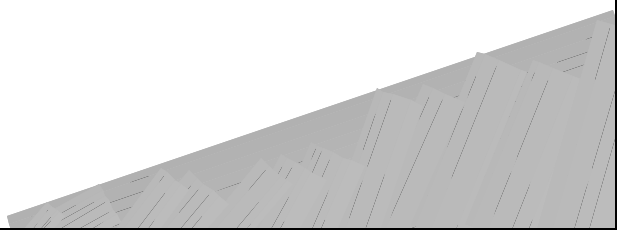
Types of Wetlands

Tidal Systems



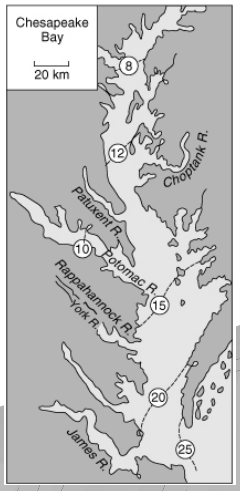
COASTAL WETLAND ECOSYSTEMS

- Tidal Salt Marshes
- Tidal Freshwater Marshes
- Mangrove Wetlands

Tidal Estuarine Wetland

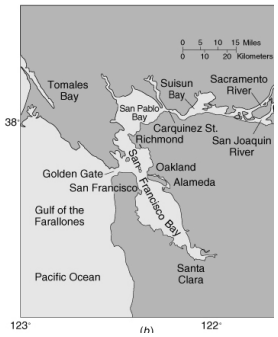
Definition and Formation of Estuaries

- **Estuary**: partially enclosed coastal embayment where salt & fresh water mix
- Formation Types
  - **Coastal plain estuary**: rising sea level invaded coastal river valleys (most common)
    Ex. Chesapeake Bay/
    Columbia River

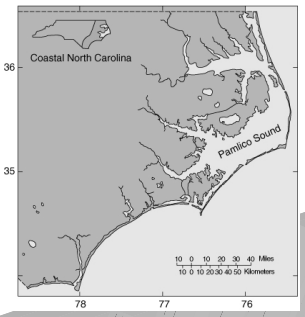


Formation Types

- **Tectonic estuary**:
  land subsides,
  sea floods.
  E.g., San Francisco Bay



- **Semi-enclosed bay**:
  sand bars build,
  partially block sea,
  shallow lagoon forms
  & collects freshwater.
  Along Gulf coasts, NC



Formation Types

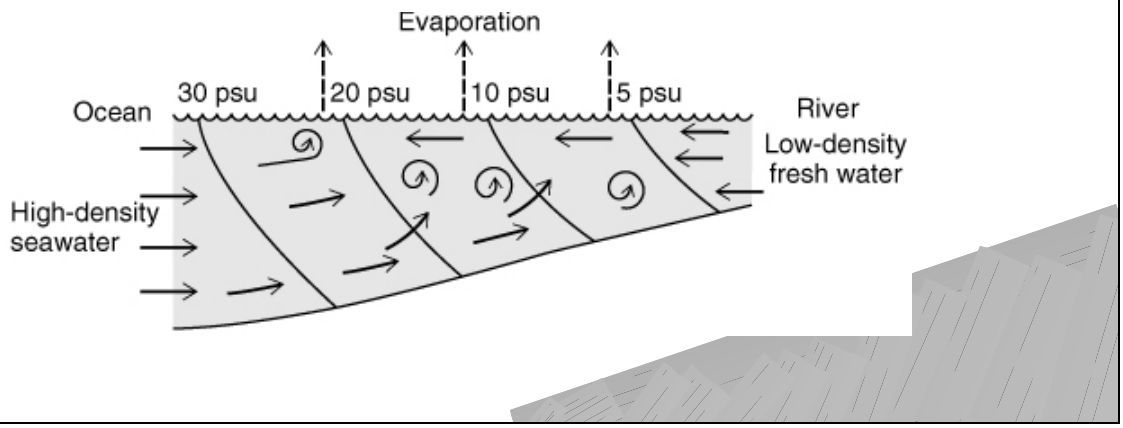
Fjord: valley deepened by glacial cutting, opened to sea; shallow mouth restricts deep-water exchange
Norway, Chile, Scotland, AK, New Zealand

Salinity Gradient & Mixing

- Salinity gradient from saltwater at mouth to freshwater in upper reaches
- Freshwater floats on top
- Mixing from contact, wind, flow
- Extent of mixing varies with basin shape, tidal range, river flow, rainfall

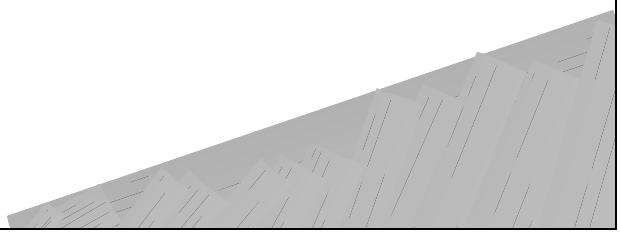
Salinity Gradient Types

- **Salt wedge (AKA positive, stratified, river-dominated) estuary**:
  high river flow, mixing only in top layers → freshwater lens near top, saline below.
- Common, typical in temperate zone.



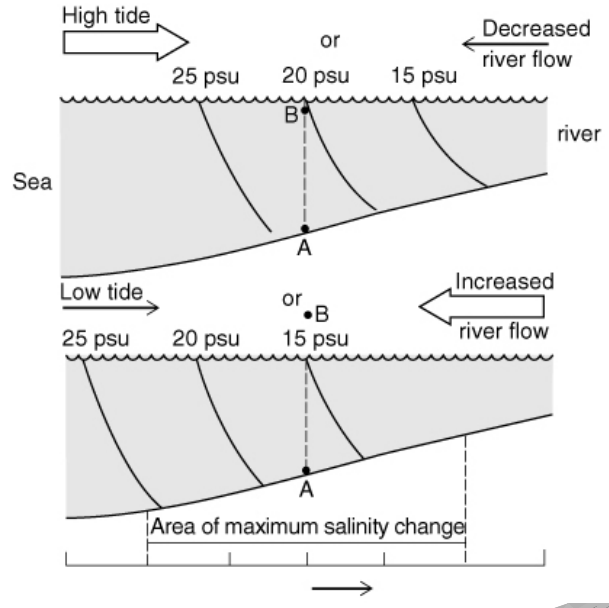
Salinity Gradient Types

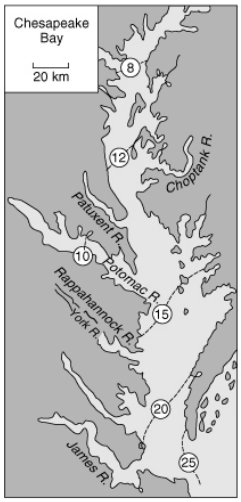
- **Homogeneous (neutral, marine-dominated) estuary**: complete mixing or high evaporation equal to freshwater input → similar salinities from surface to bottom
- Galveston Bay (TX), Alligator Harbor (FL)
- Rare
- Continuum between salt wedge & homogeneous type estuaries



Physical Characteristics: salinity

High salinity flux from tides





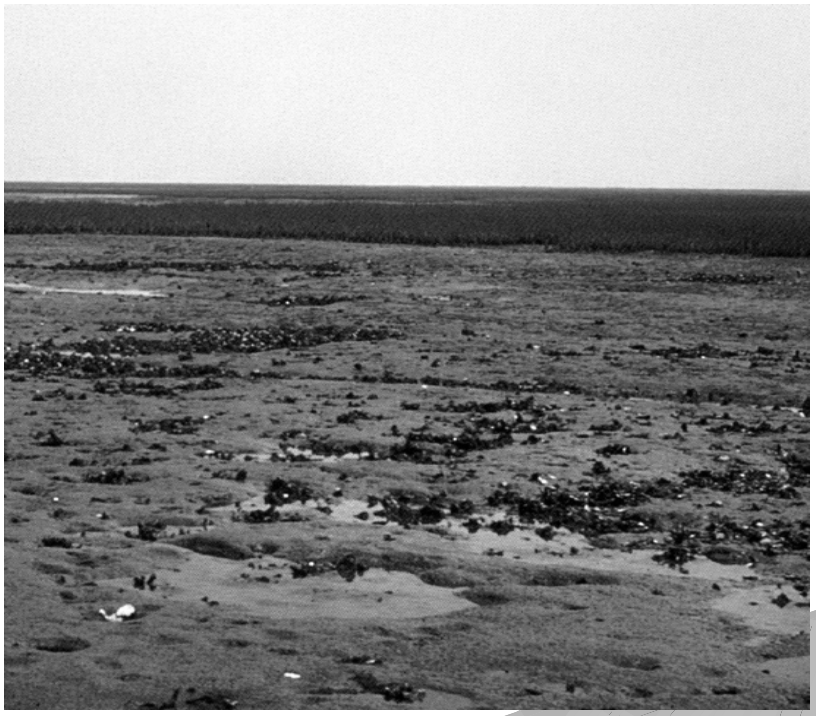
Characteristics - Waves & Currents

- Narrow, shallow mouth
  → dissipated waves, currents
- Small fetch, so only small waves form
- Currents from tidal & river flow; confined to channels
- Highest flow: mid channel, by partial barrier
- Long **flushing time** (time for fresh water to be discharged) → retains estuarine plankton community

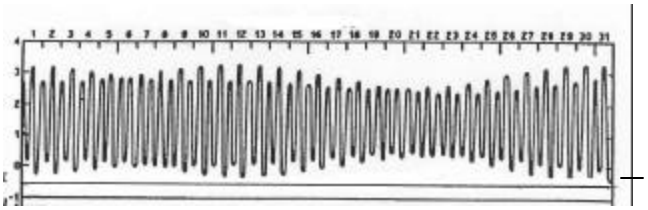
Characteristics - O_2

- Salt wedge estuaries in summer: strong thermocline, low O_2 solubility, high biological activity, salinity stratification $\rightarrow$ depletes O_2 in bottom waters & mud
- Fine particle size restricts water exchange $\rightarrow$ anoxic below a few cm unless have burrowing animals (ghost shrimp, hemichrodate worms, fiddler crabs…)

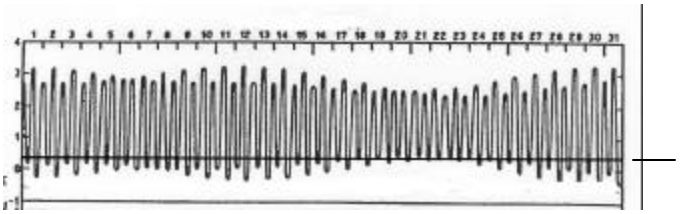
Tidal Wetland at Low Tide



Subtidal & Irregularly Exposed Tidal Wetland Hydroperiods

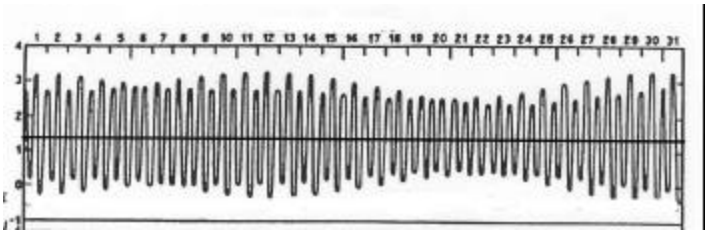


Subtidal – permanently flooded with tidal water

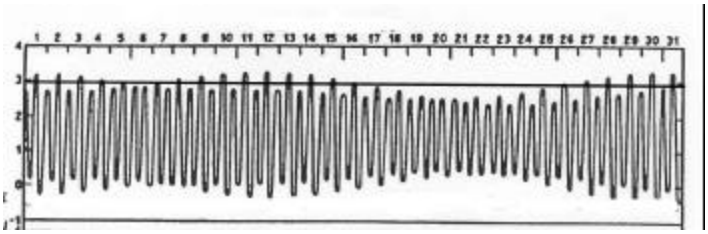


Irregularly exposed – surface exposed by tides less often than daily

Regularly & Irregularly Flooded Tidal Wetland Hydroperiods

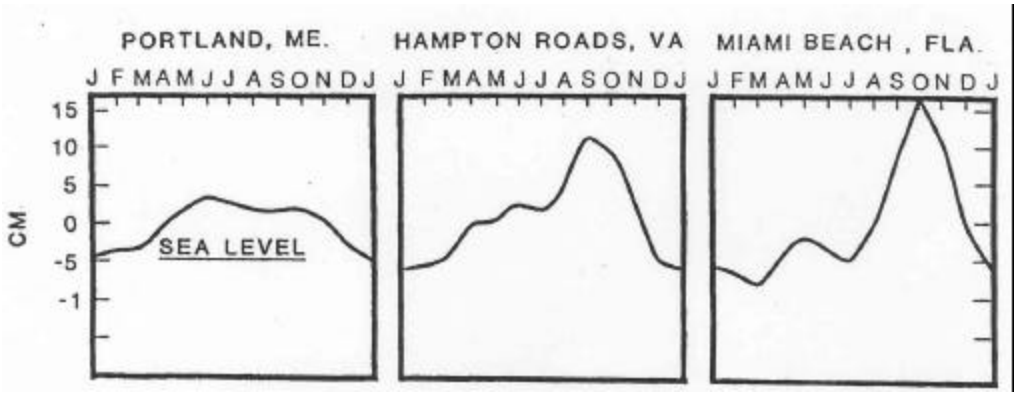


Regularly Flooded – flooded and exposed daily



Irregularly Flooded – flooded less often than daily

Tidal Cycles



Cross Section of Tidal Wetland

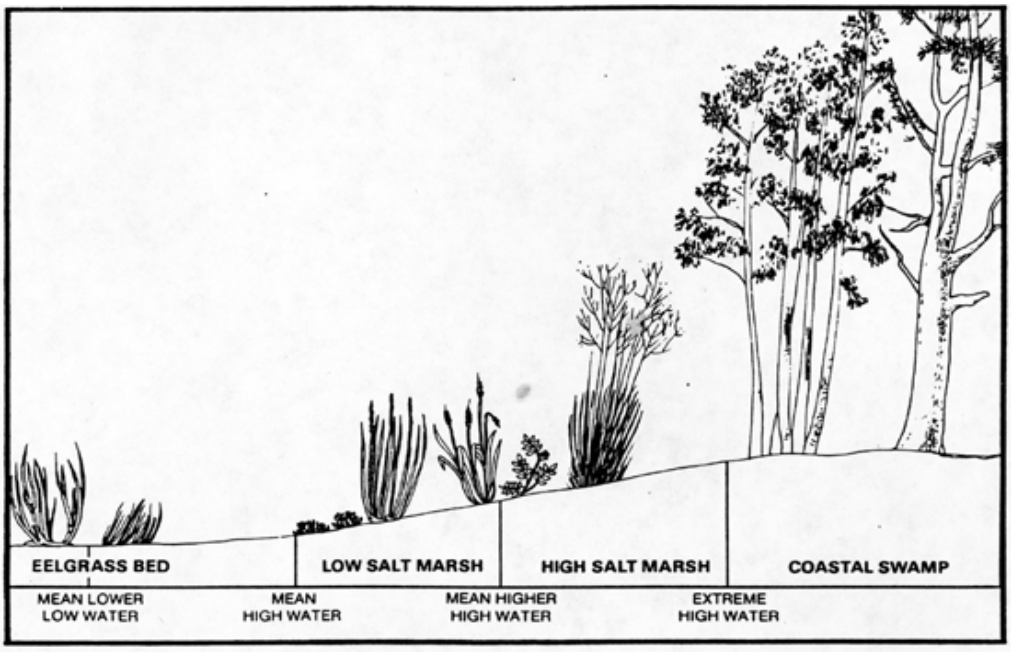
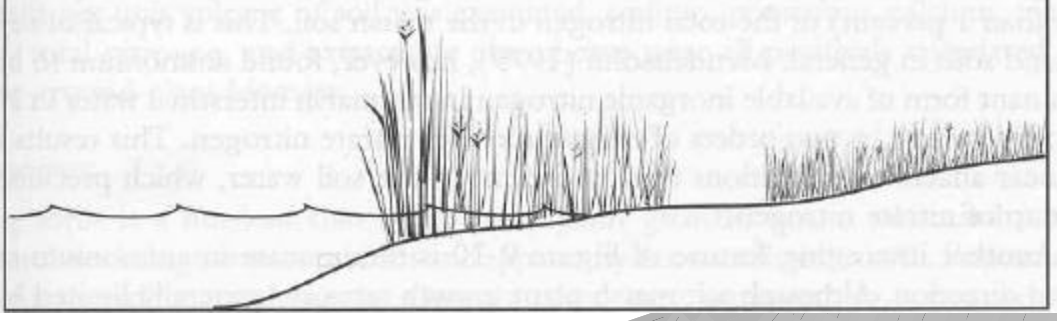


FIGURE 1: IDEALIZED CROSS SECTIONAL VIEW OF SPATIAL AND VERTICAL RELATION OF ESTUARINE WETLAND TYPES.

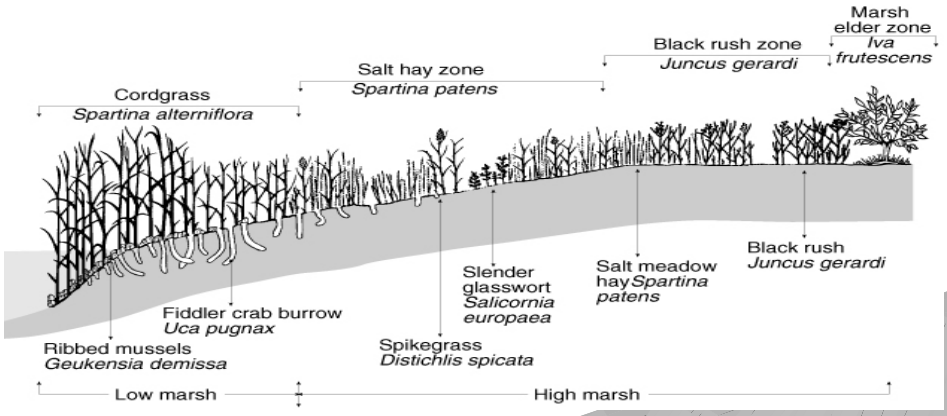
Lateral Salinity

Vegetation zones	Tidal creek	*Spartina alterniflora*		Salt flats	*Salicornia, Batis*	*Juncus*
		Tall	Short			
Frequency of flooding, %	100	80-100	40-80	5-10	4-8	2-5
Interstitial salinity, ppt	20	23	33	127	41	24.5



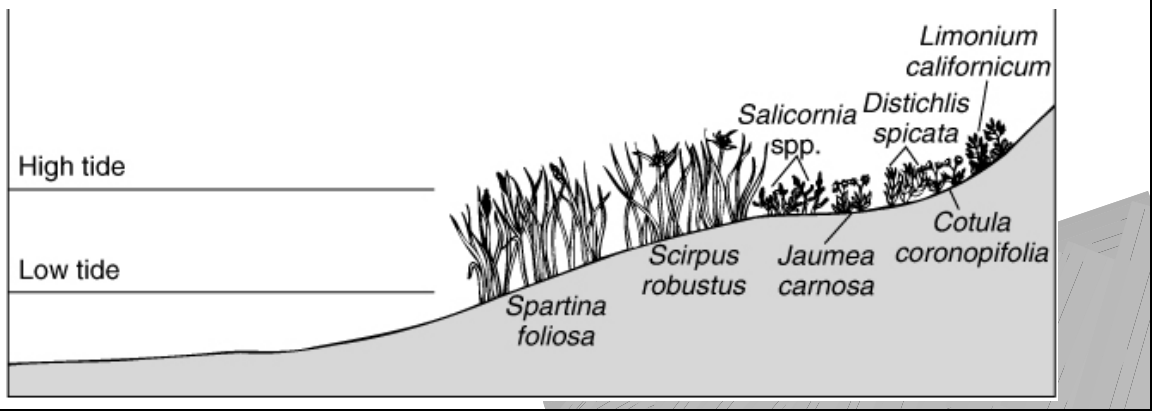
Marsh Zonation (Atlantic US)

- Each higher zone less tolerant of salt flooding, shorter, more in root
- High marsh built atop peat of former low marsh, cut by tidal creeks

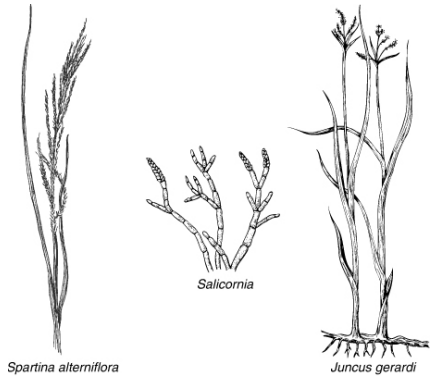


Marsh Zonation (Pacific US)

- Narrow *Spartina* zone,
- then broad *Salicornia* zone through midtidal
- Highest: *Jaumea, Distichlis, Limonium*
- Upper boundaries set by competition, lower by physiological tolerances



Marsh Diversity



- Species poor
  - anoxic soil (High productivity → soils w/ high organic content → high microbial activity → depletes sediments of oxygen)
  - high soil salinity

Salt Marshes

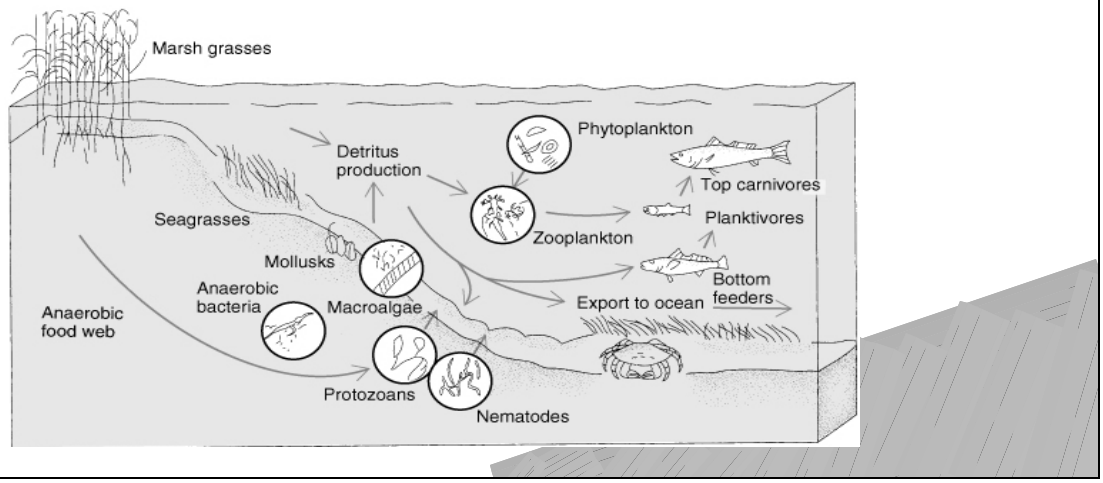
Salt marsh =

- Plant associations of emergent halophytic herbs, grasses, & shrubs
- In estuaries & other protected shores
- Alternately inundated & drained - high tidal

- Oregon: 7000 acres of saltmarsh, ~17% of its estuarine area

Estuarine Food Webs

- Detritus based (but consumers important too)
- Bacterial decomposition - critical to deposit feeders
- Protists & nematodes eat bacteria



Marsh Foodwebs

- Dominant plants: *Spartina, Juncus, Salicornia*
- Dominant animals: *Uca, Hemigrapsus, Sesarma* crabs, amphopods, shrimp; *Geukensia* mussels, *Littorina, Cerithidea*, *Melampus* snails

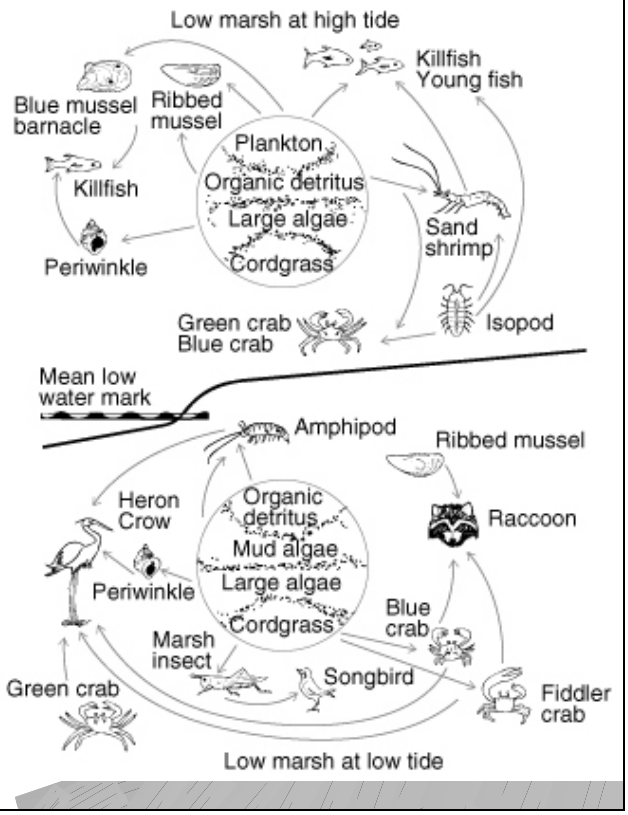


Diagram of Tidal Cycling

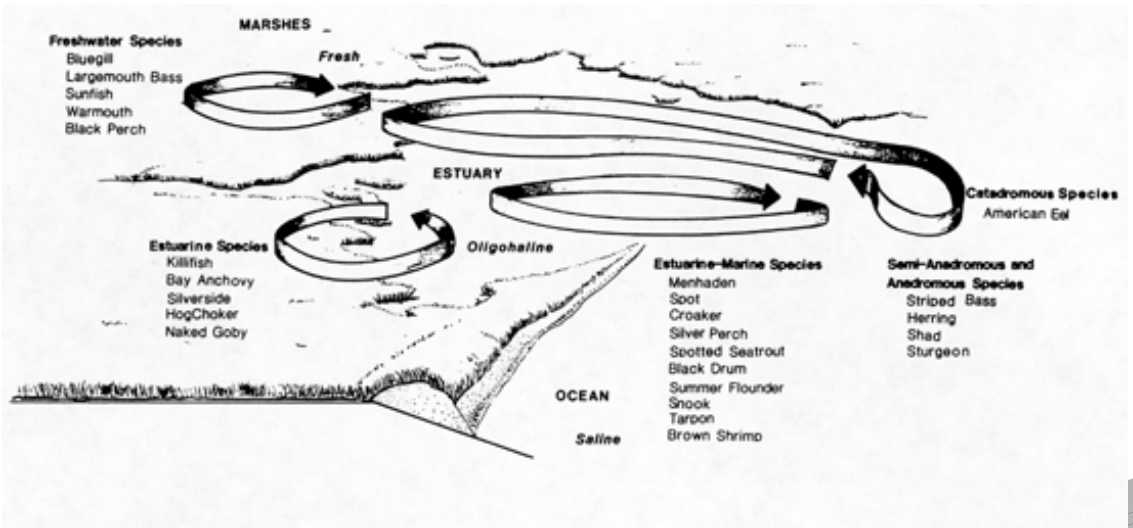


Figure 9–4. Fish and shellfish that use tidal freshwater marshes can be classified into four groups: freshwater, estuarine, anadromous and catadromous, and estuarine-marine.

Tidal Energy Flow

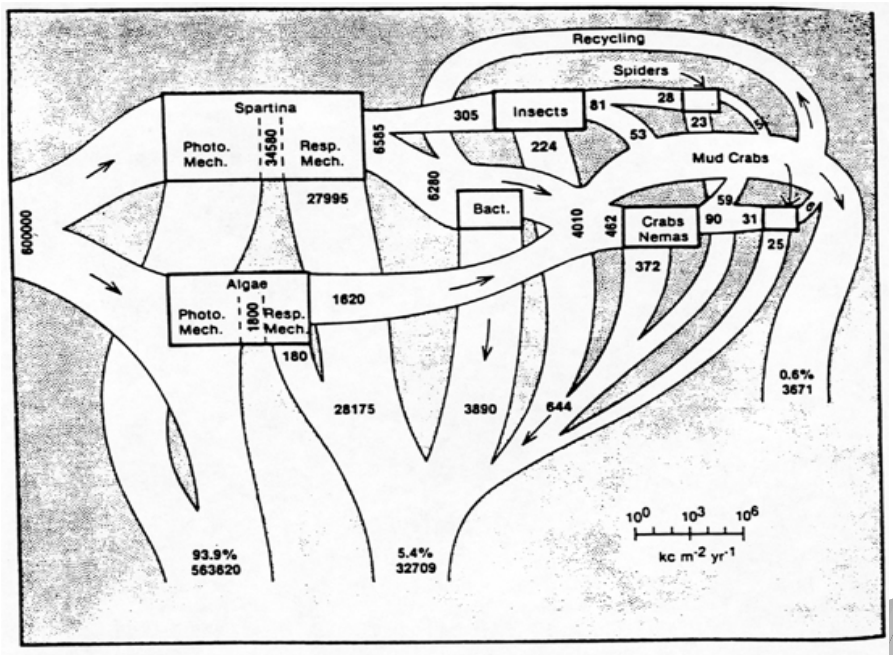


Figure 8-8. Energy flow diagram for a Georgia salt marsh. *(From Teal, 1962, p. 622; Copyright © 1962 by Ecological Society of America, reprinted with permission)*

Tidal Salt Marsh Functions

- Gross and net productivity are high
- Marsh is a major producer of detritus for salt marsh and adjacent estuary
- Detrital decomposition is the major pathway for energy utilization
- Source and sink of nutrients
- Marsh provides benthic, aquatic and avian habitat

Tidal Freshwater System

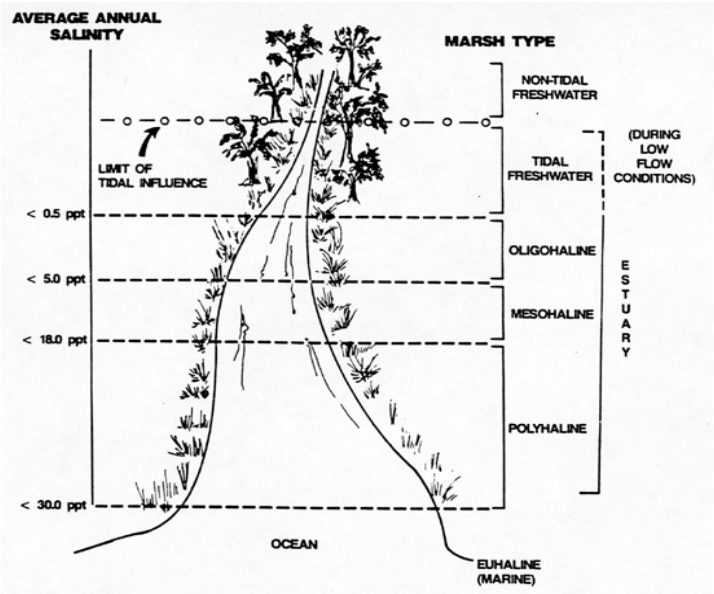
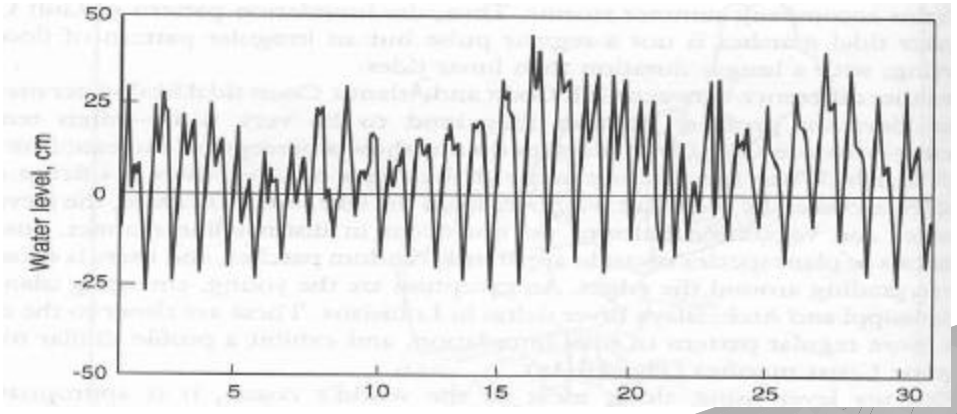


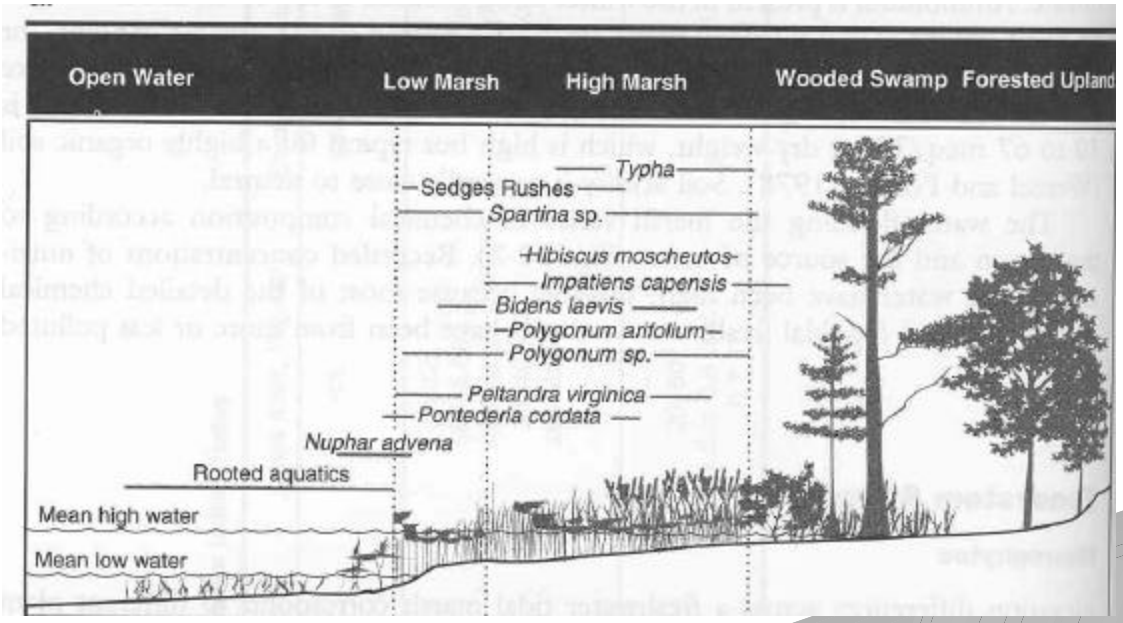
Figure 9-1. Coastal marshes lie on gradients of decreasing salinity from the ocean inland. Tidal freshwater marshes still experience tides but are above the salt boundary. Further inland, marshes experience neither salt nor tides. *(From W. E. Odum et al., 1984, p. 2)*

Hydrology

- Same of tidal salt marsh except salt concentration is lower
- Generally smaller tidal range



Freshwater Tidal Wetland Cross-section



Tidal Freshwater Energy Flow/ Source / Transfer

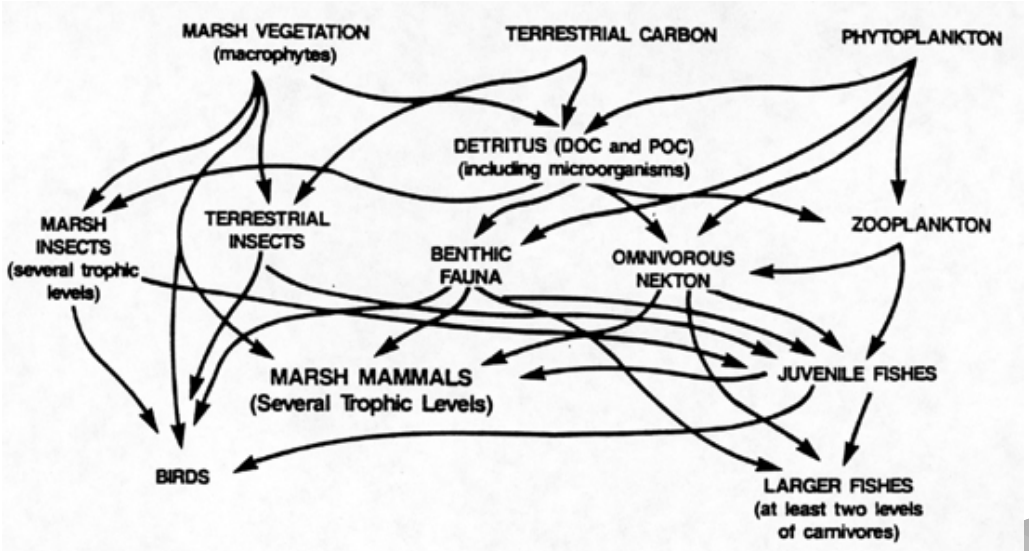


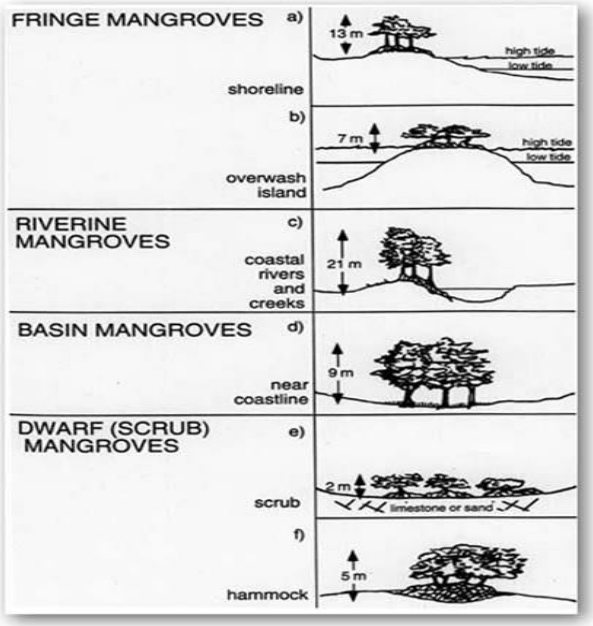
Figure 9-6. Energy flow diagram for a tidal freshwater marsh, showing the major groups of organisms and energy pathways. *(From W. E. Odum et al., 1984, p. 48)*

Tidal Freshwater Functions

- Gross and net productivity are high
- Detrital decomposition is the major pathway for energy utilization – 60 to 90%
- Direct consumption by grazers – 10 to 40 %
- Source, sink and transfer of nutrients
- Marsh provides benthic, aquatic, herptile and avian habitat

Mangroves

Major Types of Mangrove Wetlands



Zones of Mangrove Vegetation

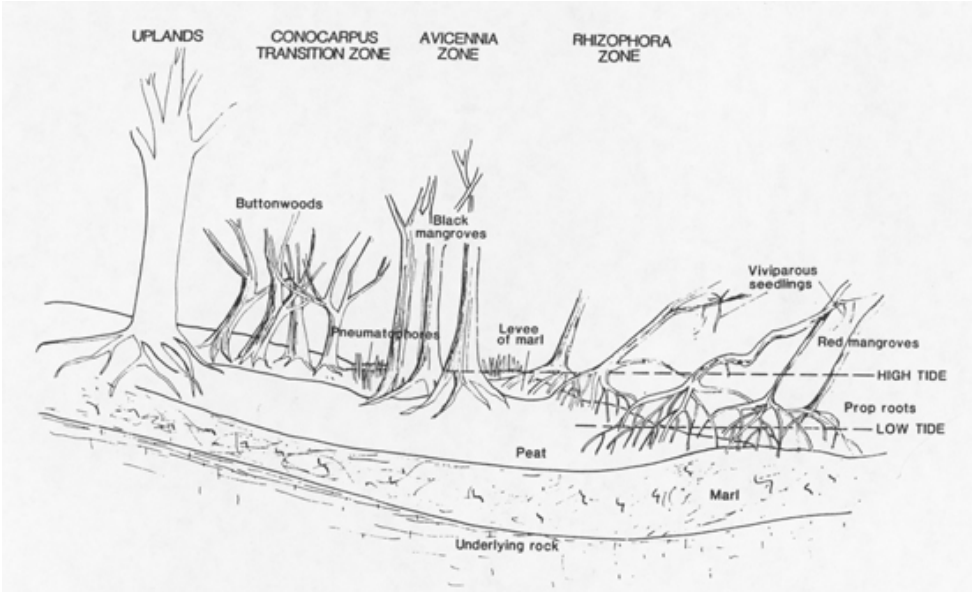
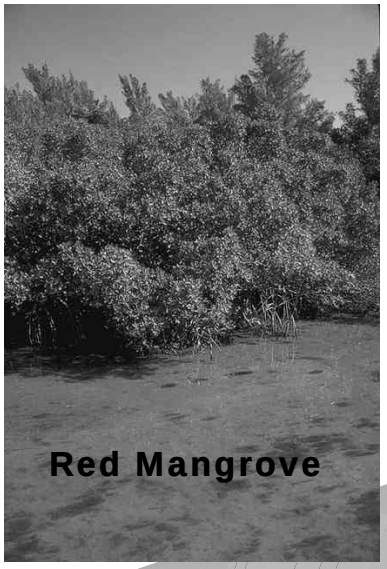


Figure 10-4. Zonation of Florida mangrove wetlands. Note adaptation of mangroves such as prop roots, viviparous seedlings, and black mangrove pneumatophores. *(After Davis, 1940)*

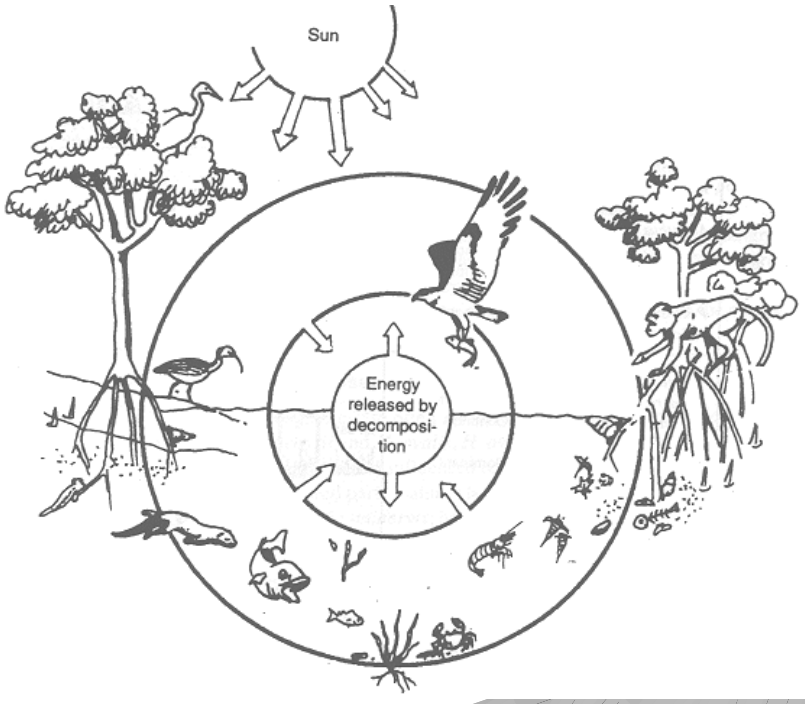
Zones of Vegetation

Black Mangrove



Red Mangrove

Energy Flow in a Mangrove



Mangrove Ecosystem Function

- Productivity dependent on tidal/runoff factors
- System is producer of detritus for river and adjacent estuary
- Detrital decomposition is the major pathway for energy utilization
- Transformer of nutrients
- Provides benthic, aquatic and avian habitat