A Hierarchical Approach to the Classification of Bays and Estuaries in Southeast Alaska

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The Alexander Archipelago in southeastern Alaska represents one of the largest and most complex estuarine ecosystems on earth. The purpose of this project is to develop a spatial framework to characterize the diversity and distribution of estuarine and nearshore habitats that reflects hierarchical relationships among ecological processes in the region. These range from climatic factors affecting large areas, hydrologic forces that affect large and intermediate bays down to local habitat characteristics that influence individual shoreline segments and estuarine stream channels.

Key to Symbols:

A Heirarchy of Coastal Ecological Units

- Zones of Climate / Maritime influence
- Coastal Marine Basins
- Coastal Marine Sub-Basins
- Coastal Watersheds
- Shoreline Units

Depth: -200m -150m -100m -50m -25m -5m

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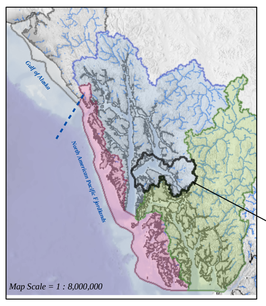
A Hierarchical Spatial Framework for Classification of Complex Estuarine Ecosystems

To describe the hierarchical nature of estuarine systems, and spatial complexity of waterways in Southeast Alaska, we developed a framework to characterize ecological systems at a range of spatial scales as have been developed in terrestrial (Cleland et al. 1997) and freshwater realms (Maxwell et al. 1995; Higgins et al. 2005).

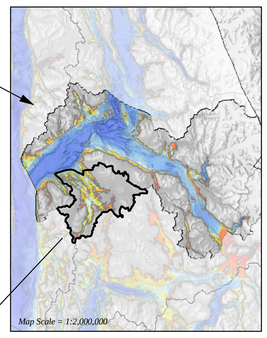
1. Marine Zones

The North American Pacific Fjordlands and Gulf of Alaska marine ecoregions are divided into zones based on temperature and salinity, including outside coast (warmer, higher salinity), northern inside waters (colder, lower salinity), and southern inside waters (warmer, lower salinity).



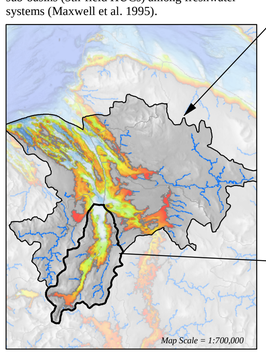
2. Coastal Basins

Coastal Basins represent primary waterways and form the structural conduits of freshwater to the Pacific Ocean. North and south inside marine zones reflect 2 basin sub-systems in which Lynn Canal, Stephens Passage and Frederick Sound all flow out through Chatham Strait, and the Stikine River that divides between Sumner Strait and Clarence Strait that ultimately flows into Dixon Entrance.



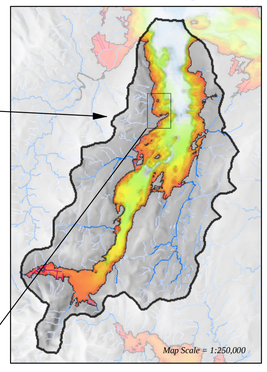
3. Coastal Sub-Basins

Coastal Basins are further divided into sub-basins representing sets of adjacent watersheds with similar coastal morphology, glacial and marine influence, and a common salt water basin. This scale of the hierarchy is analogous to, and was informed by, ecological subsections (Nowacki et al. 2000) and sub-basins (5th-field HUCs) among freshwater systems (Maxwell et al. 1995).



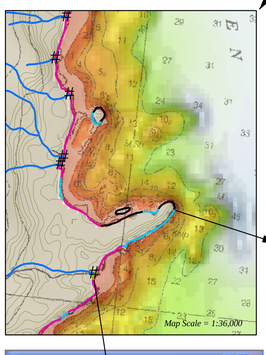
4. Coastal Watersheds

Coastal watersheds represent terrestrial, freshwater and coastal systems occurring with a common bay or estuarine outlet. This level of the heirarchy represents a classic estuarine system with characteristic patterns of circulation, nutrient retention and productivity.



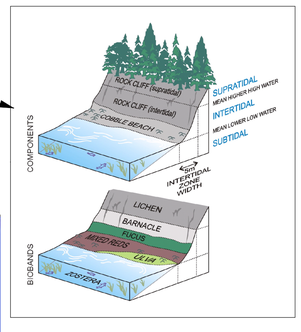
5. Shoreline Units (along shore)

Coastal watersheds will typically contain a variety of shoreline marco-habitats including rocky types, gravel and mixed sediment, as well as tide flats, eel grass beds and salt marshes. Wave exposure and fluvial energy controls deposition and transport of sediments, which is one of the primary determinants of habitat associations and biotic composition within a shoreline unit (Ricketts et. al 1985)



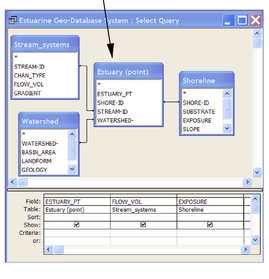
6. Tidal Zones (across shore)

Finally, within a single shoreline unit a diversity of conditions (micro-habitats) reflect the vertical position relative to meantide lines. Habitat characteristics include both the physical substrate and biological composition (biobands).



7. Integrated Estuarine Database

Based on this framework, we have a model for an integrated geo-database where existing watershed and stream characteristics are spatially linked to shoreline and nearshore habitats values based on the point location of freshwater systems entering the salt water. This is the basic estuarine unit that informs physical and ecological processes at all higher levels in the heirarchy.



Location Map

Credits and sources:
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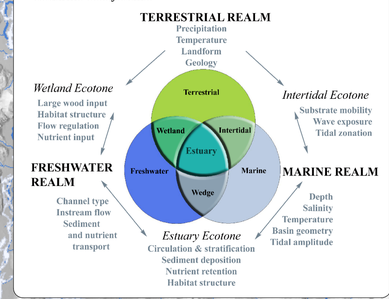
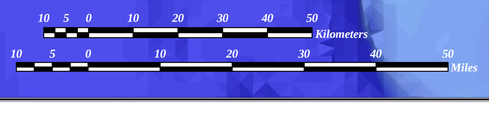
Estuary Ecosystem Complex

The estuarine complex is charaterized by interactions among terrestrial, freshwater and marine realms, as well as zones of transition between intertidal, freshwater wetlands, and along hydrologic gradients between fresh and salt waters. Key processes within each zone (shown in gray) influence the physical characteristics and habitat functions of individual estuarine ecosystems.





Cartography by David Albert, The Nature Conservancy, Juneau Alaska.