

Changing ecosystems: a brief ecological history of the Delta ¹

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The San Francisco Estuary is a young estuary, about 6-10,000 years old in its present location. It became established during periods of high climatic variability (reflected in extreme floods and long droughts) compared to the relatively stable past 150 years. The Delta was formed as a huge freshwater marsh through the interaction of river inflow and the slow rise of sea level with the growth and decay of tules and other plants. This interaction resulted in the deposition of large amounts of organic matter, creating layers of peat that kept pace with sea level rise. These peat layers formed the soils of most of the present Delta 'islands', which were actually complex patches of floodable marsh. The channels among the islands were historically shifting, winding distributaries of the entering rivers that moved inflowing water through the Delta, providing access to upstream areas for large runs of migratory fish. The movement and quality of water in these channels was strongly affected by tidal action. These attributes also created a complex of diverse and shifting habitats that supported a wide variety of functions for an ecological system in which there was no clear separation between aquatic and terrestrial components.

Imposed on this complex of physical structures was a highly variable hydrologic flow regime, both seasonally and across years. The basic seasonal pattern had high flows in winter and spring, with variability resulting from the timing of rain storms and of snow melt from the surrounding mountains. Inter-annual variability was generated by natural variation in precipitation, including long periods of drought and occasional years with huge floods. The natural system of wetlands, riparian terraces, and floodplains in the Central Valley helped mute the effects of variation in stream flow, while the Estuary's immense marshlands muted tidal energy, keeping much of the Delta a freshwater system through which the tides gently pulsed. The pre-modern estuary would have had a strong upstream-downstream gradient in salinity and other water quality variables, from the freshwater Delta interior to the saltwater Bay. However, long periods of drought (decades, unlike any experienced in modern times) would presumably have favored movement of salt water farther into the eastern Delta, while wet periods would have favored keeping more of the estuary fresh or brackish.

The Delta ecosystem is noted in historical records for having a high abundance of organisms, many of them highly migratory to take advantage of seasonal abundances of food and habitat. Migratory fishes included at least 12 kinds of salmon, smelt, sturgeon, and lamprey, while resident fishes included Sacramento perch, thicktail chub, and other endemic fishes. The high (ca. 80%) endemism of the fishes reflected both the isolation of the Central Valley from other watersheds and unique adaptations to local conditions. The abundance of these fishes resulted in large 19th century and Native American fisheries. Likewise, large populations of both migratory and resident waterfowl took advantage of the extensive wetlands, especially in winter, including 26 species of ducks and geese. Arguably, the historical Delta was the centerpiece of the Pacific flyway, contributing heavily to the estimated 10 million or more

¹ For ease of reading no citations are provided in the text of this essay. Most of the information can be found in more detail in the suggested readings at the end. Scientific names of fishes mentioned can be found in these papers as well, or in Moyle (2002).