Building a Landscape Perspective for the Delta: Lessons from Historical Ecology

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why historical ecology?

Research the **past** to understand the **present** and envision the **future**

- Links landscape pattern, process, and function
- Describes the conditions to which species are adapted
- Challenges assumptions about past landscapes
- Aids interpretation of the contemporary landscape
- Identifies opportunities and constraints

*(not about recreating the past)*
“The lake was situated far out in an impenetrable tule swamp of immense extent…it was a sort of “sanctuary” to which birds came…”

“nothing but tule, without a tree under which the navigator may find shade”

“lagoons...whose waters flowed back swiftly into the Sacramento with the ebbing tides”

“In a grass-covered area between the forest and swamp”

“the river was filled with drift wood, forming a raft”
Sacramento-San Joaquin Delta Historical Ecology Investigation: Exploring Pattern and Process

- Funded by Ecosystem Restoration Program (CDFG, NOAA, US FWS)
- Collaboration with KQED QUEST and Stanford’s Bill Lane Center for the American West: science.kqed.org/quest/delta-map/
key points

- Multiple landscapes
  - Habitat mosaics arranged in distinct patterns
  - Expressed across broad physical gradients
Landscapes reflect physical gradients

**SACRAMENTO RIVER**
5.6-48.4 (21.6 average) MAF/yr
High sediment
Rainfall-event driven
(high peaks, winter)

**SAN JOAQUIN RIVER**
1.1-19.0 (6.2 average) MAF/yr
Low sediment
Snowmelt driven
(low peaks, late summer)
Conceptual models of historical landscapes

Different characteristics

- Habitat types (proportion, size, position)
- Connectivity
- Complexity
- Temporal variability
Central Delta: where tides dominate
Central Delta: where tides dominate

- Low banks
- Frequent tidal inundation
- High connectivity between land and water

"The water reached our blankets at the turn of the tide"
- October 1811, Abella and Cook 1960
Central Delta: where tides dominate

- Numerous sinuous tidal channels of different sizes

“The number and intricacy of the winding sloughs and channels that traverse this...low marshy land is worthy of notice.”

- US War Department 1853
Central Delta: where tides dominate

- Numerous sinuous tidal channels of different sizes
- Organized into networks branching into wetland

![Bar chart showing length distribution of tidal channels, with high concentration in low order channels.](image)

![Map showing changes in tidal channel networks from early 1800s to early 2000s.](image)

San Joaquin River
Central Delta: where tides dominate

- Diverse vegetation community including willow-fern swamp
• Diverse vegetation community including willow-fern swamp

"Their edges are not so elevated, nor are they so covered with vegetation, while their interior parts the **tule** is thinner and shorter. **Willows** here grow *in bunches.*"

- USDA 1874
North Delta: where flood basins flank rivers
North Delta: where flood basins flank rivers

- Gradual transition along tidal-fluvial gradient
- Relatively isolated by natural levees
North Delta: where flood basins flank rivers

- Floods connected components
- Seasonal and inter-annual variability

"the great basins...act as enormous regulating reservoirs...to cut down the crest of the great flood waves”
- Dabney Commission 1905
North Delta: where flood basins flank rivers

- Different features depending on position along gradients

Courtesy of California State Library

Courtesy of Solano County Surveyor
North Delta: where flood basins flank rivers

- Dense and structurally complex riparian forest
North Delta: where flood basins flank rivers

- Riparian forest on natural levees bounded flood basins

[Sycamore bearing trees: 6 m and 18 m distant, 61 cm and 91 cm diameter]

“Along margin of tule [Sycamore bearing trees: 67 m, 73 m, 3 m, and 47 m distance; 46 cm, 61 cm, 101 cm, and 76 cm diameter]”

“Left bank of Sutter Slough, navigable stream. Slough [65 m] wide”

“Sycamore [76 cm] diameter on right bank of Sutter Slough”

“Low and wet.”

“Timber sycamore and oak. Dense undergrown of oak and briars.”

William J. Lewis, November 1859
South Delta: where floodplains meet tides
South Delta: where floodplains meet tides

- Broadening floodplain with no large basins
- Wet late into summer

“Inundated during the high water of the rivers, which is in the summer.”
- Viader 1810

Courtesy of The Bank of Stockton
“These discharge into small lakes or spread out in the tule, and are drained off by the slues”
- Gibbes 1850

- Complex flows across topographically variable landscape
South Delta: where floodplains meet tides

- Lakes and ponds connected to rivers

“Along the edge of the lowland...a string of lakes connected by sloughs extend throughout the greater part of the area.”

- Sweet et al. 1908
Salmon Slough: “The stream bed is full of logs and the boats grounded two or three times.” (Abella 1811)

“I came to a raft of large timber, and after some hard work in cutting and sawing logs, we succeeded in dragging our boat through.” (Gibbes 1850)

…”great many old logs and an immense amount of driftwood and rubbish in Old River” (Tucker Field Notes 1879)

South Delta: where floodplains meet tides

- Channel complexity
South Delta: where floodplains meet tides

- Diverse suite of habitat types at local-scale

Laura Cunningham 2010

“Pond with water, which extends [302m] and about [60m] wide.”

“Cross to tule.”

“To grass.”

“To tule”

“To open ground.”

“To dry bed of slough, course S.”

“Continue in small opening in tule…”

“To strip of grass with trail.”

“…Small spot of grass.”

“Cross the same [slough].”

1 mile

Ralph W. Norris, October 1851
summary

- Floods wetted and connected landscape
- Different features along gradients
- Dense riparian forest bordering tule basins

- High degree of tidal influence
- Networks of branching channels
- Tidal wetland of tule and willow-fern swamp

- Floods interacted with complex landscape to meet the tides
- Side-channel systems connected to rivers
- Habitat type diversity at local scale
“Restore large areas of interconnected habitats within the Delta and its watershed by 2100”
- Water Code section 85302

“Restoration of the health of the Delta’s ecological systems by addressing ecological functions and processes at a broad landscape scale”
- Bay Delta Conservation Plan draft

“Management plans and decisions need to be informed by a landscape perspective that recognized interrelationships among patterns of land and water use, patch size, location and connectivity, and species success.”
- Delta Plan draft
parting thoughts

- Large and interconnected habitats may mean different things for different places.
- Manage and plan with current and future expected physical gradients in mind.
- Think at the large scale and in the long term.
- The future will be different from both the present and the past, but emphasizing certain patterns and processes over others may yield a healthier ecosystem.
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