How Much Flow is Enough?

Contrasting the Role of Riverine Inputs in Estuarine Ecosystem Restoration in California Bay-Delta and the Mississippi Delta

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Coastal Louisiana
Vulnerable from the North and South
Sacramento-San Joaquin Delta
Vulnerable from North and South
Water Levels change....
Protection systems fail...

Montegut, LA

McCormick-Williamson 1986
Flooding...
Things get moved...
We fix things up and move on....
Fundamental Changes in Plumbing

- Upriver
- Within Delta
Upriver changes $\rightarrow$ sediment load to Delta decreased by 50%
1947 Fisk Map of the river's historic course

1958 River Flood Capacity Diagram
All large rivers are dammed
19th Century Delta Landscape:

1400-km² wetland
Complex habitat mosaic
Gradients of residence time
Diversity of ecosystem functions
Very high productivity

$400 \text{ g C/m}^2\text{-y}$

Atwater et al. (1979)
Consequences
These analyses show that coastal Louisiana has undergone a net change in land area of about -1,883 square miles (mi$^2$) from 1932 to 2010. This net change in land area amounts to a decrease of about 25 percent of the 1932 land area. ....Trend analyses from 1985 to 2010 show a wetland loss rate of 16.57 mi$^2$ per year. 

Couvillion et al. (2011)
Managing the River Flow for a Better Future

- Water?
- Sediment?
- Or both…….
Flow moves Low-Salinity Zone

The salinity response to flow is “stiff” – i.e., it takes a lot of flow to change $X_2$.

Source: Monismith et al. 2002
Fall 2011 - Outflow experiments

Summer - upstream of LSZ
- Clams and Limnoithona
- Reduced Food in LSZ
- Increased Predation Loss (?)

Climate - upstream of LSZ
- Reduced Habitat Area
- Reduced Size & Egg Supply

Spring - Delta
- Improved Survival
- Late Growth Start
- VAMP

Winter - Delta
- High Entrainment of Adults and Early Larvae
- Decreased Number Survive to 2 Years Old
- Jan-Mar Exports

Stock-recruit
Current river management stops sediment load getting to coastal wetlands and limits new delta growth.
Continuing Current Management
Achieving Sustainability
How much is enough?
Gated or Open?
Managing the Flood in Louisiana

Morganza – 1st time since 1973

Bonnet Carre Spillway - ~ 1 yr in 10
Flood of 2011

- Operation of structures not seen in > a generation
- Routing of floodwaters into lakes and bays
- Effective management of water
- Sediment management = dredging
- Delta plain largely isolated from flood water and sediment
Managing a Flood to Maximize Land Building?
A New Approach to River Management for the 21st Century
World’s Apart?
Working systems
Ecosystem and water supply - co-equal goals

Alignment Comparison

West
- 5 intake facilities with fish screens along the Sacramento River
- 6 pump stations
- 36 miles of canal
- 17-mile tunnel
- Forebay with 420 acres of water surface area

All Tunnel
- 5 intake facilities with fish screens along the Sacramento River
- 6 pump stations
- 36-mile tunnel
- 2 barrier (33 feet inside diameter)
- Forebay with 420 acres of water surface area

Dual Conveyance
The Dual Conveyance option will combine portions of the East, West, or All Tunnel alignments with some components of the Through-Delta alignment.

East
- 5 intake facilities with fish screens along the Sacramento River
- 6 pump stations
- 23 miles of canal
- 4 tunnels (2.3 miles total in length)
- 2 siphons
- Forebay with 620 acres of water surface area

Thru-Delta
- 2 intake facilities with fish screens along the Sacramento River
- 12 miles of canal
- 12 miles of barrier (66 miles total)
- 6.4 injection wells
- 1 5,000-foot barrier
- A new fish salvage facility
- 2 tunnels (4.5 miles total in length)

Intakes
- A number of possible intake locations are being considered in the area from south Sacramento to Hood River intake with pumping plants transferring water to conveyance facilities on the East, West, or All Tunnel, or Dual Conveyance options.

*Note all white squares are shown.*
Navigation, flood risk management and ecosystem?