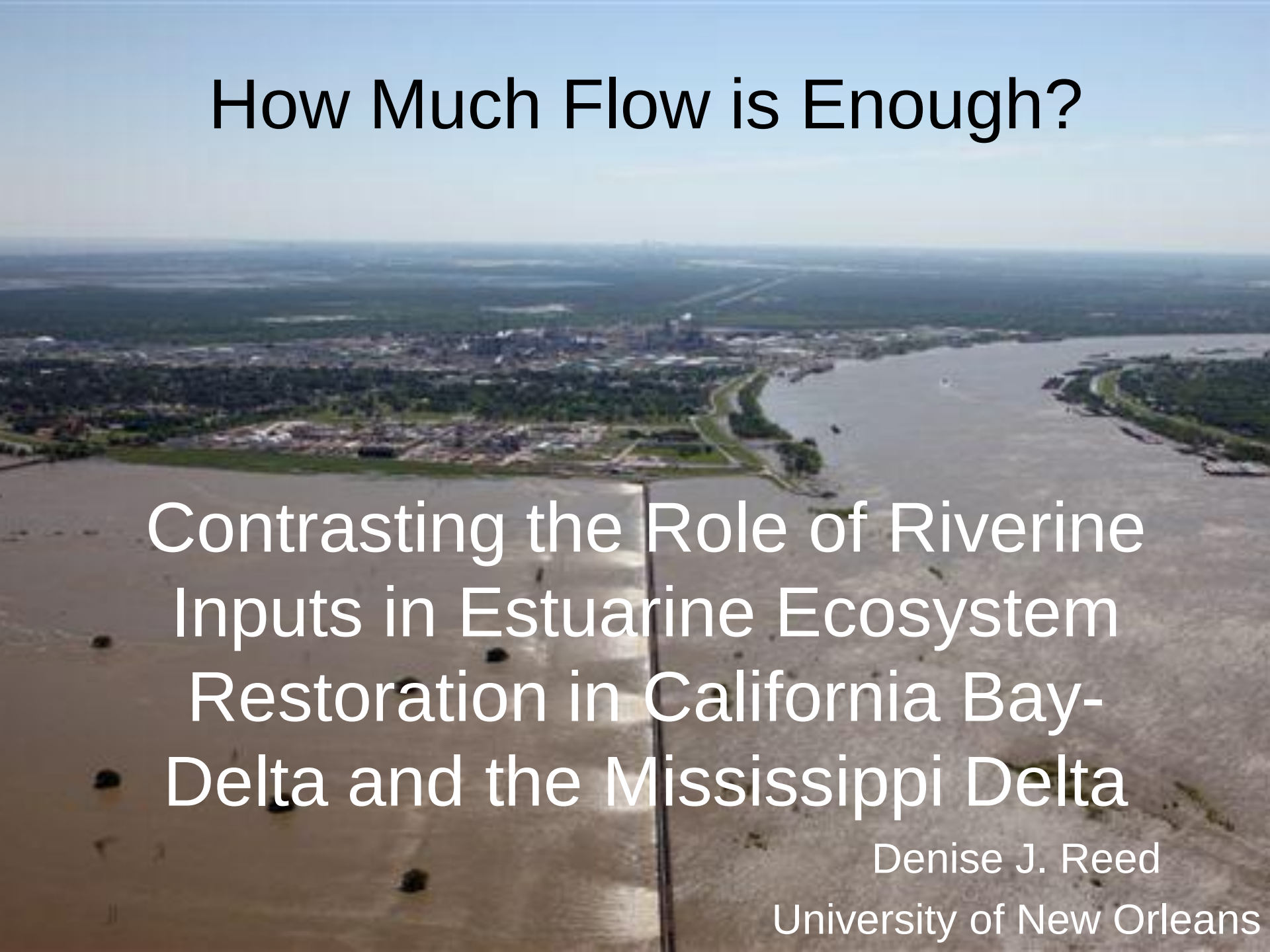
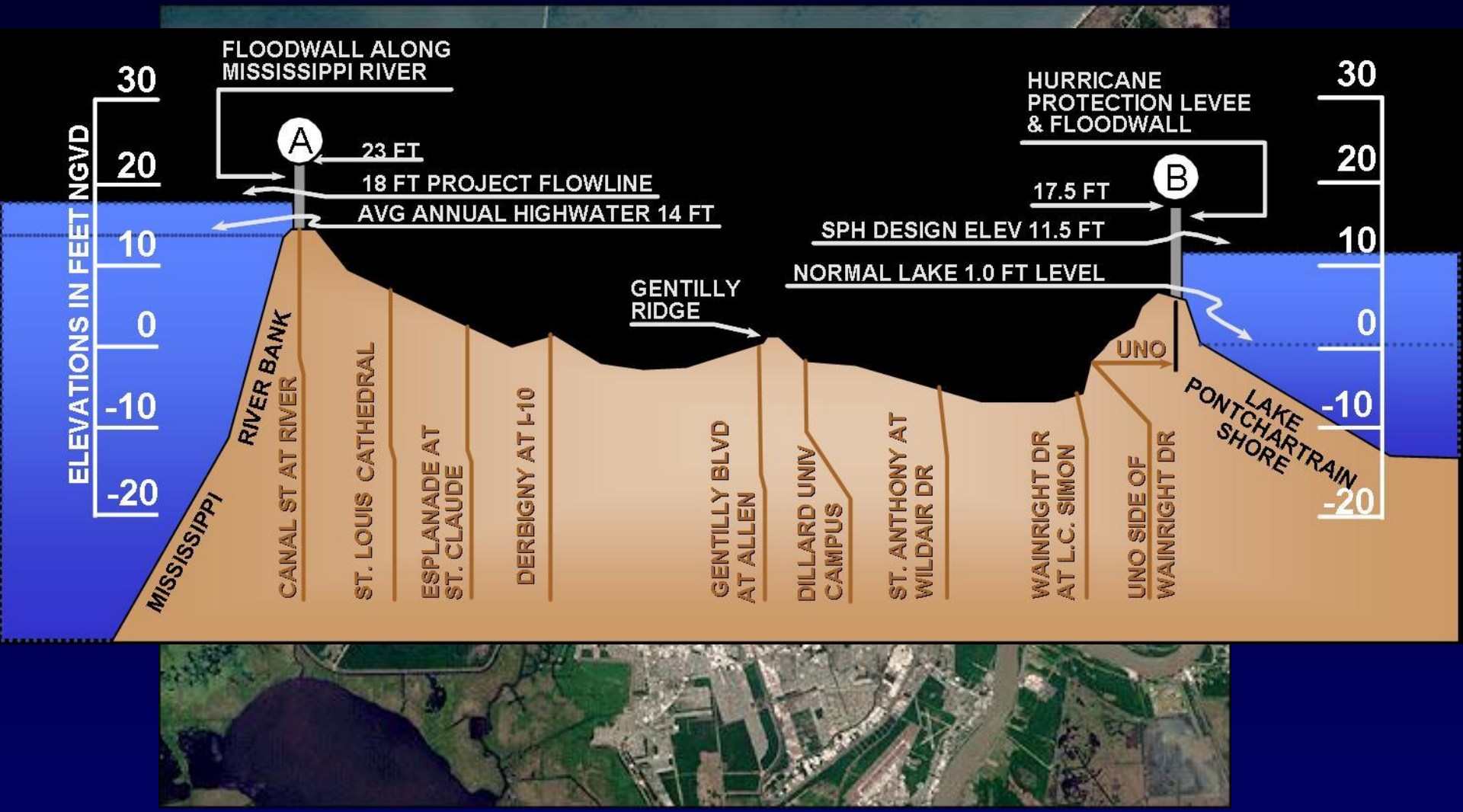
How Much Flow is Enough?



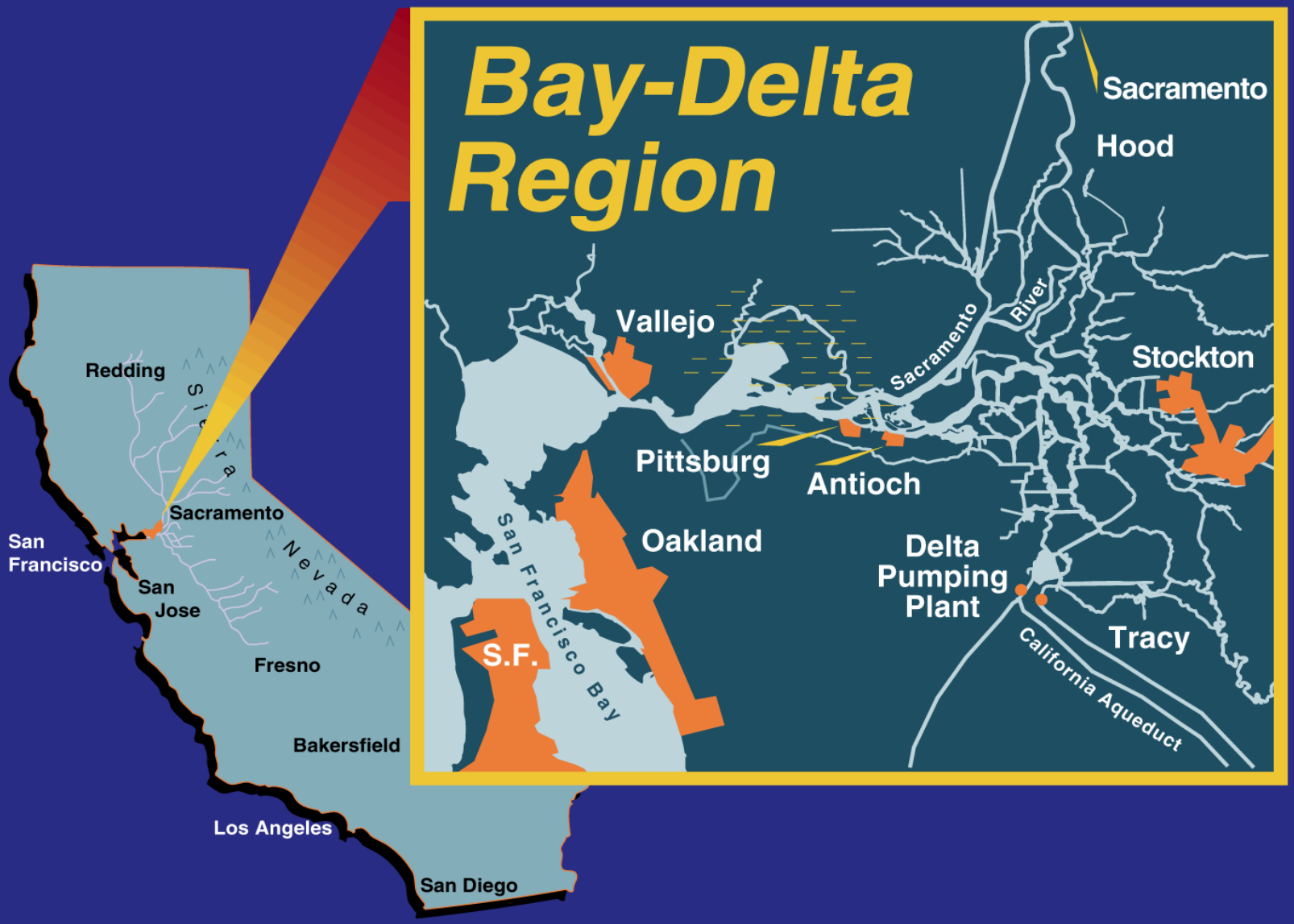
Contrasting the Role of Riverine Inputs in Estuarine Ecosystem Restoration in California Bay-Delta and the Mississippi Delta

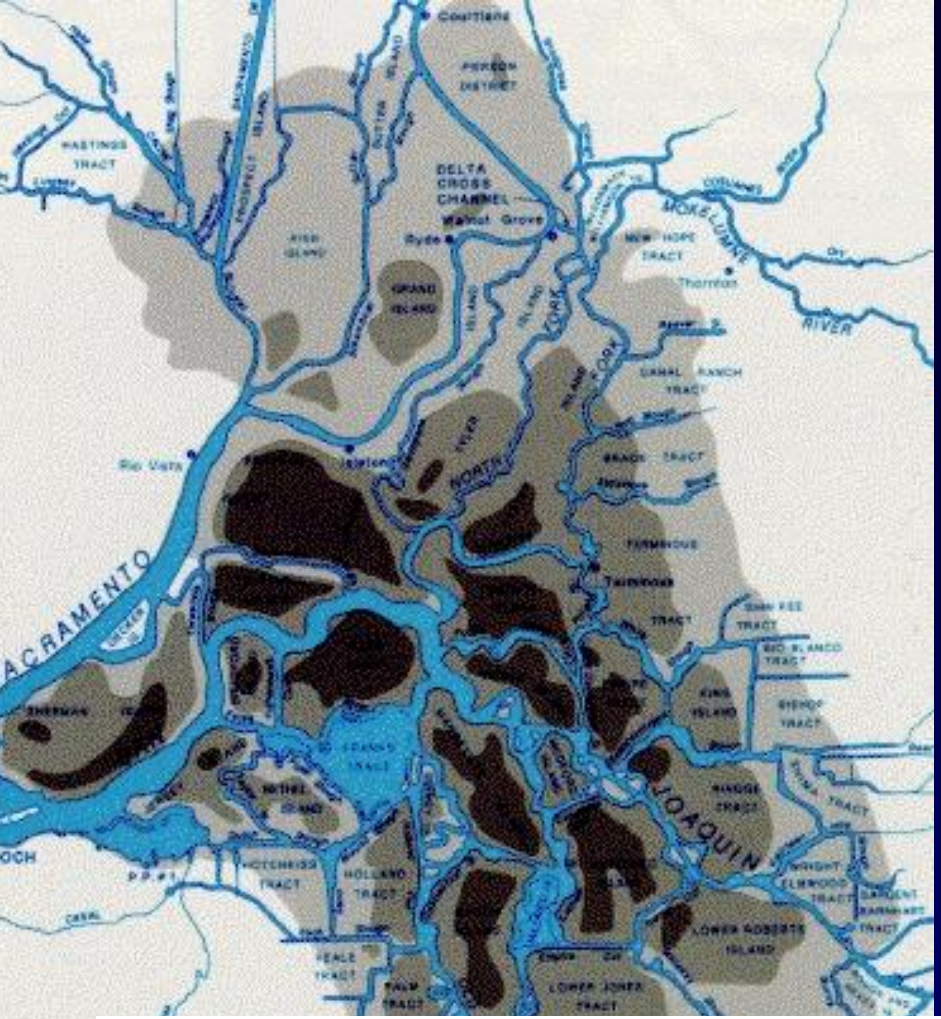
Denise J. Reed
University of New Orleans


Coastal Louisiana



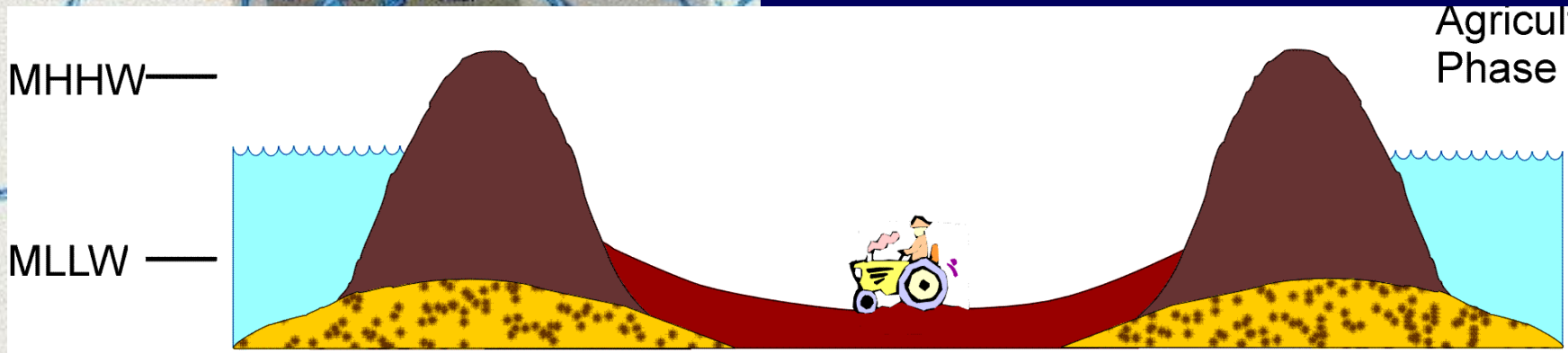
Vulnerable from the North and South


Bay-Delta Region
Sacramento
Hood
Vallejo
Sacramento River
Stockton
Pittsburg
Antioch
Oakland
San Francisco Bay
S.F.
Delta Pumping Plant
Tracy
California Aqueduct
Redding
Sierra Nevada
Sacramento
San Francisco
San Jose
Fresno
Bakersfield
Los Angeles
San Diego



Sacramento-San Joaquin Delta

Vulnerable from North and South



Water Levels change….

Protection systems fail…

Montegut, LA

McCormick-Williamson 1986

Flooding…

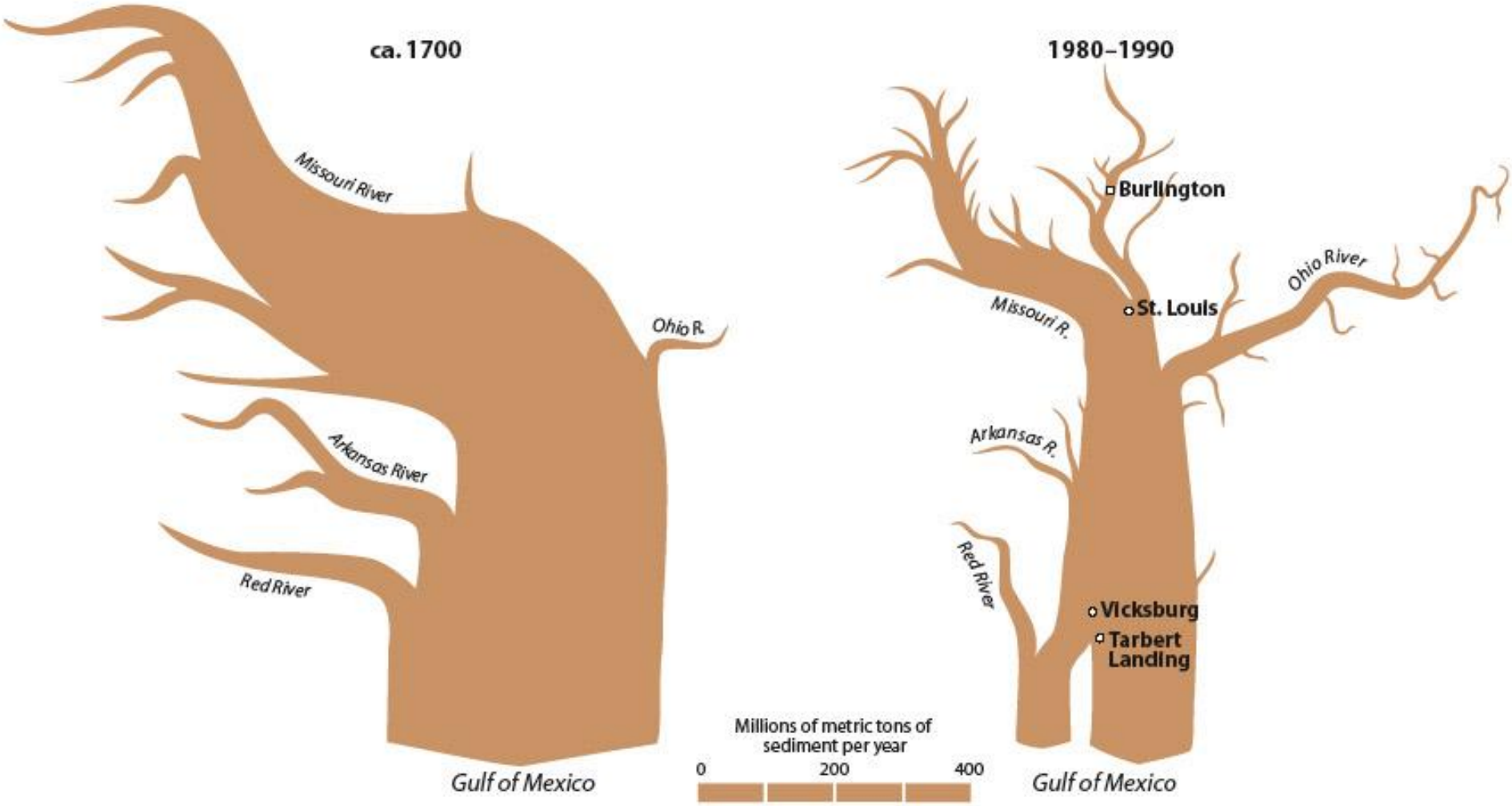
Things
get moved…

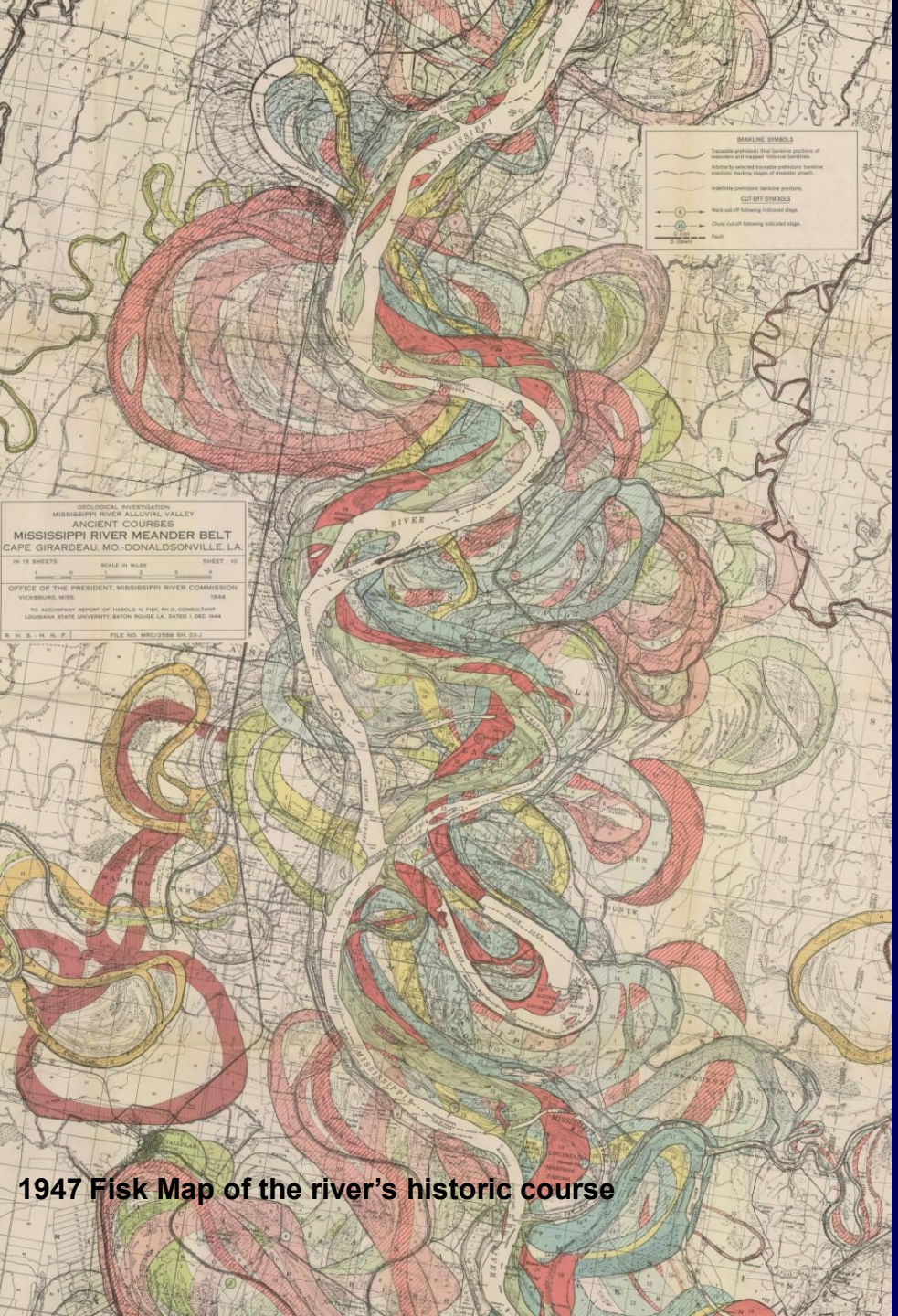
We fix things up and move on….

Fundamental Changes in Plumbing

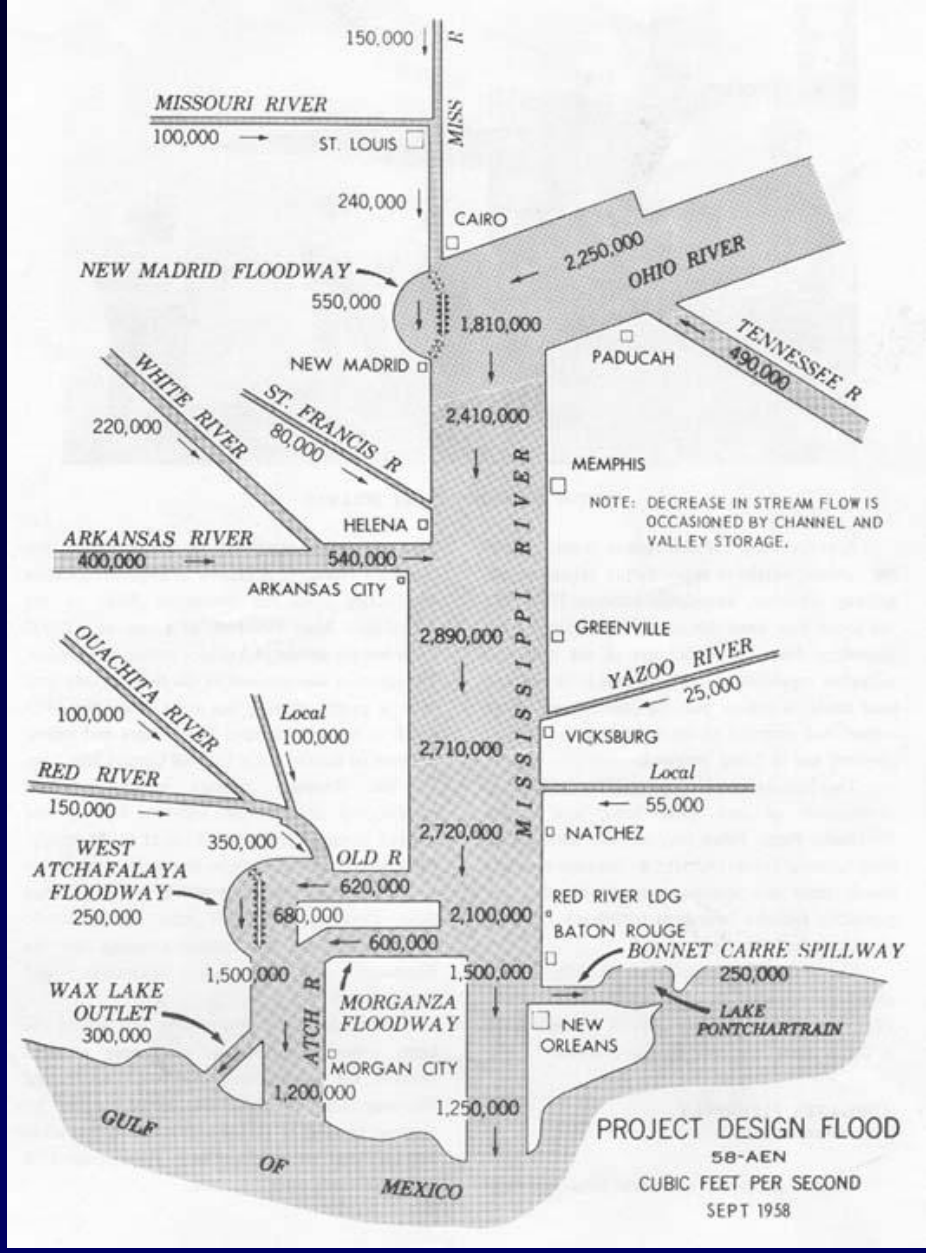
- Upriver
- Within Delta

Upriver changes → sediment load to Delta decreased by 50%



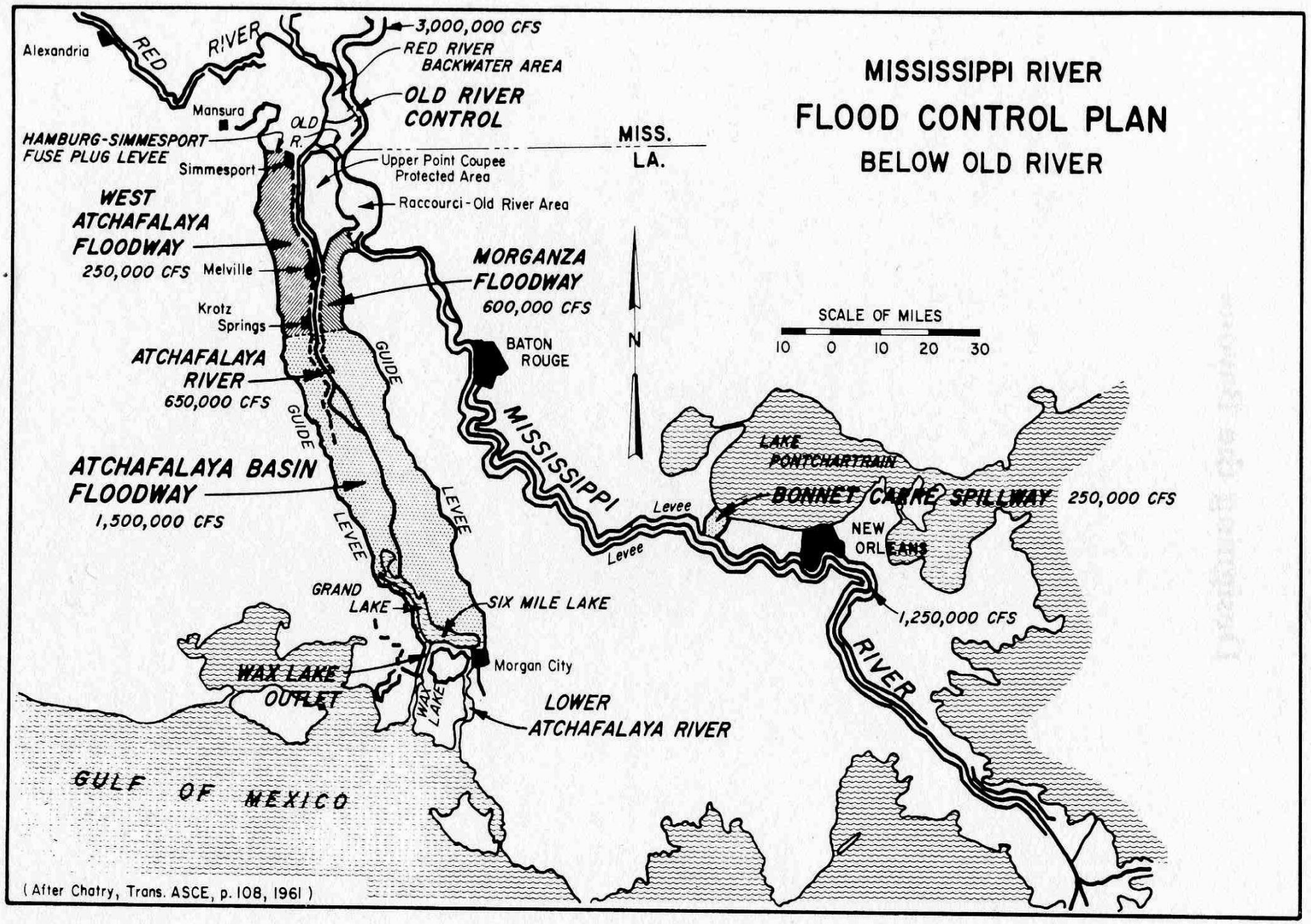


1947 Fisk Map of the river's historic course

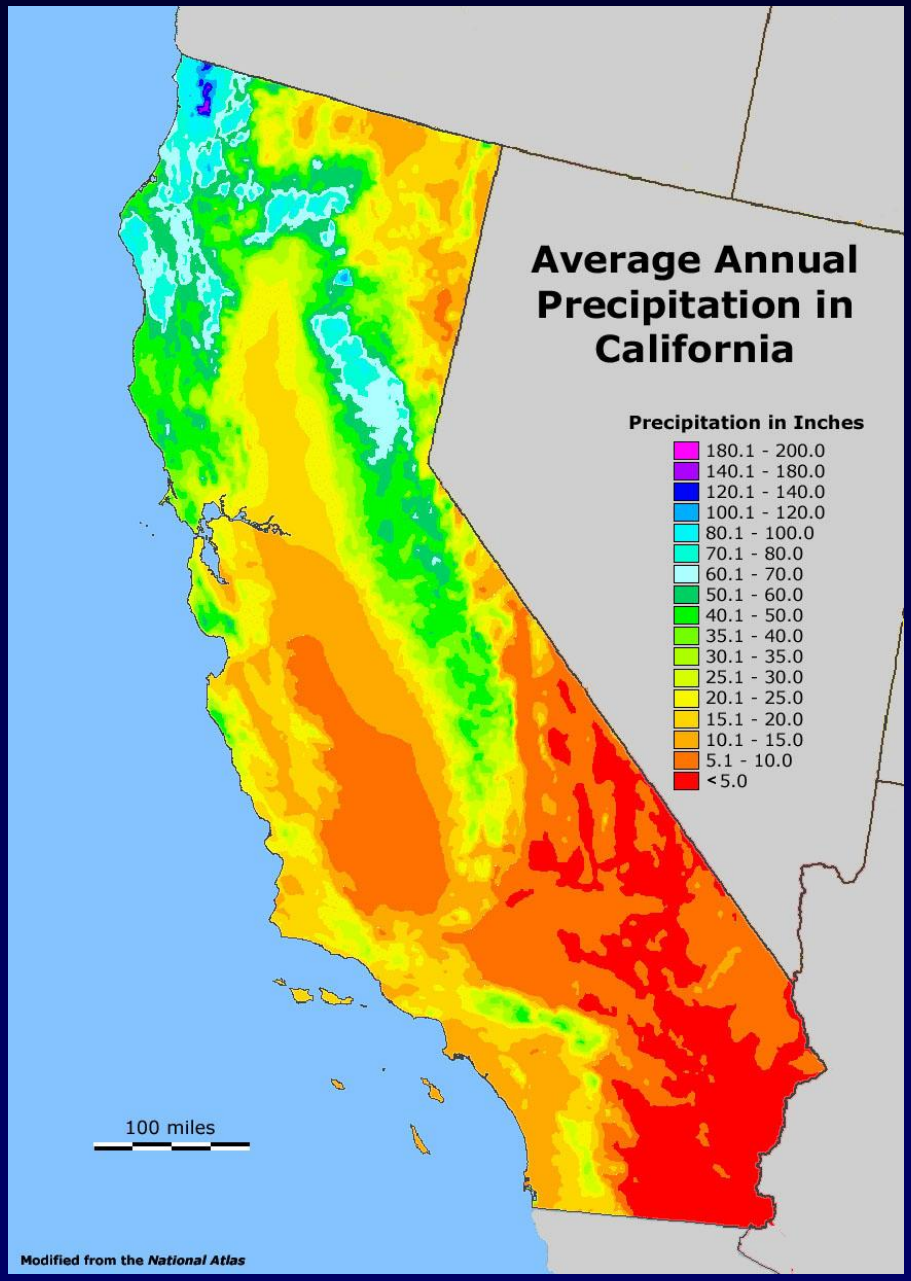


1958 River Flood Capacity Diagram

1947 Fisk Map

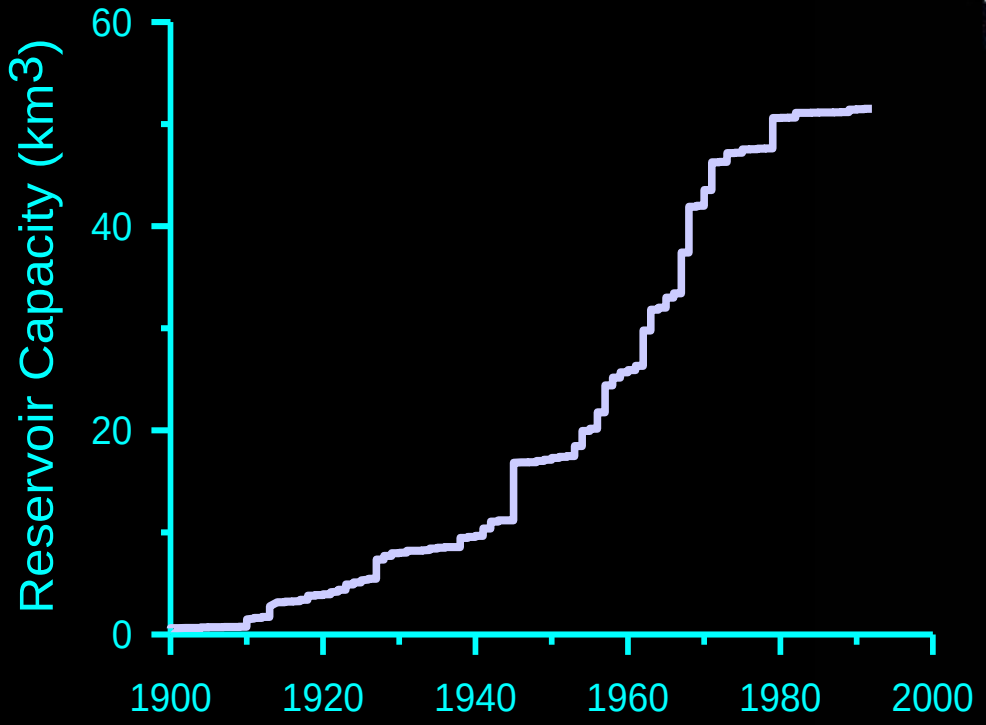


(After Chatry, Trans. ASCE, p. 108, 1961)

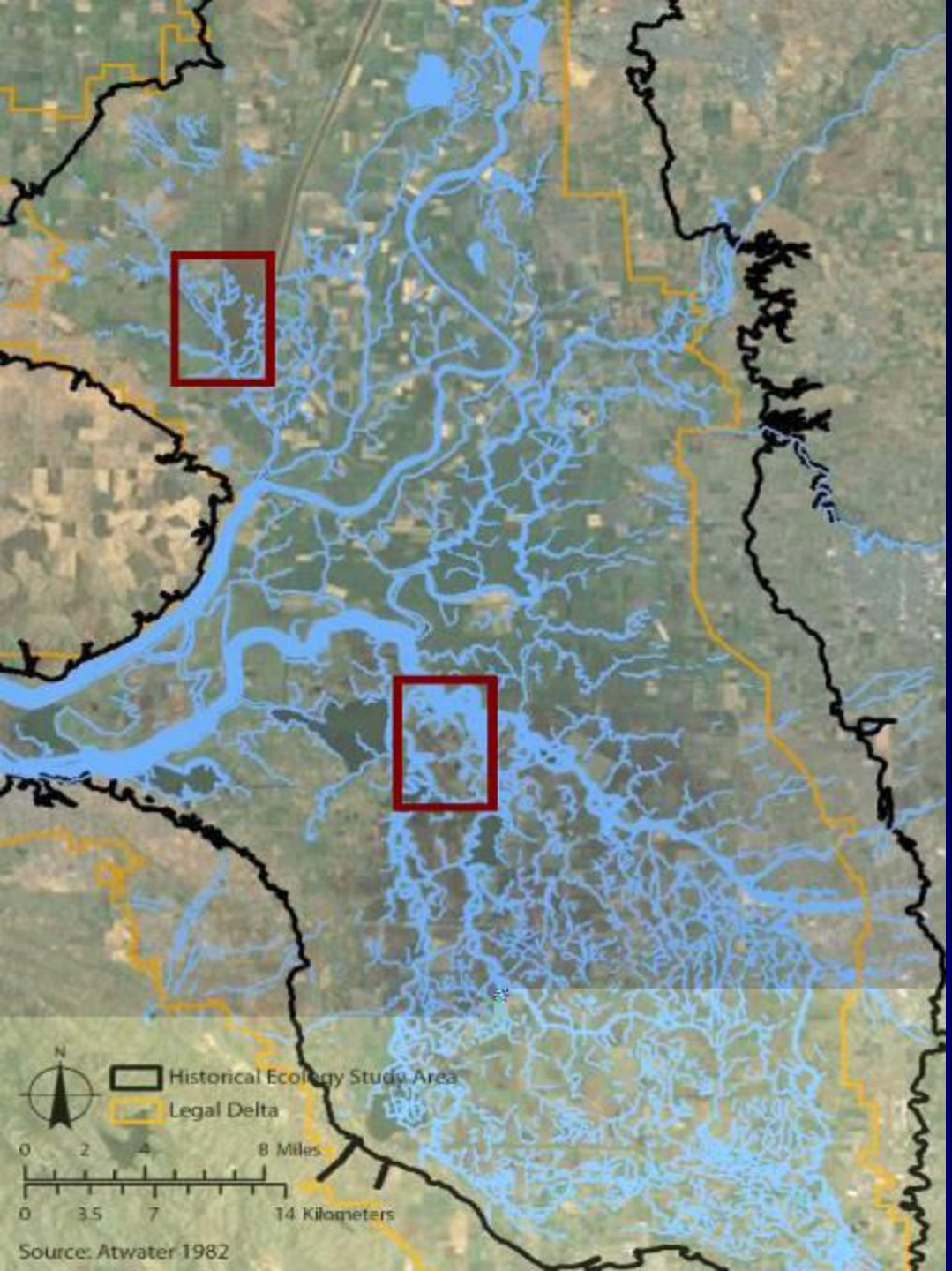

Average Annual Precipitation in California
Precipitation in Inches
180.1 - 200.0
140.1 - 180.0
120.1 - 140.0
100.1 - 120.0
80.1 - 100.0
70.1 - 80.0
60.1 - 70.0
50.1 - 60.0
40.1 - 50.0
35.1 - 40.0
30.1 - 35.0
25.1 - 30.0
20.1 - 25.0
15.1 - 20.0
10.1 - 15.0
5.1 - 10.0
<5.0
100 miles
Modified from the National Atlas


Redding
San Francisco
Fresno
Los Angeles
San Diego

All large rivers are dammed



Robin Grossinger and Alison Whipple
San Francisco Estuary Institute



19th Century Delta Landscape:

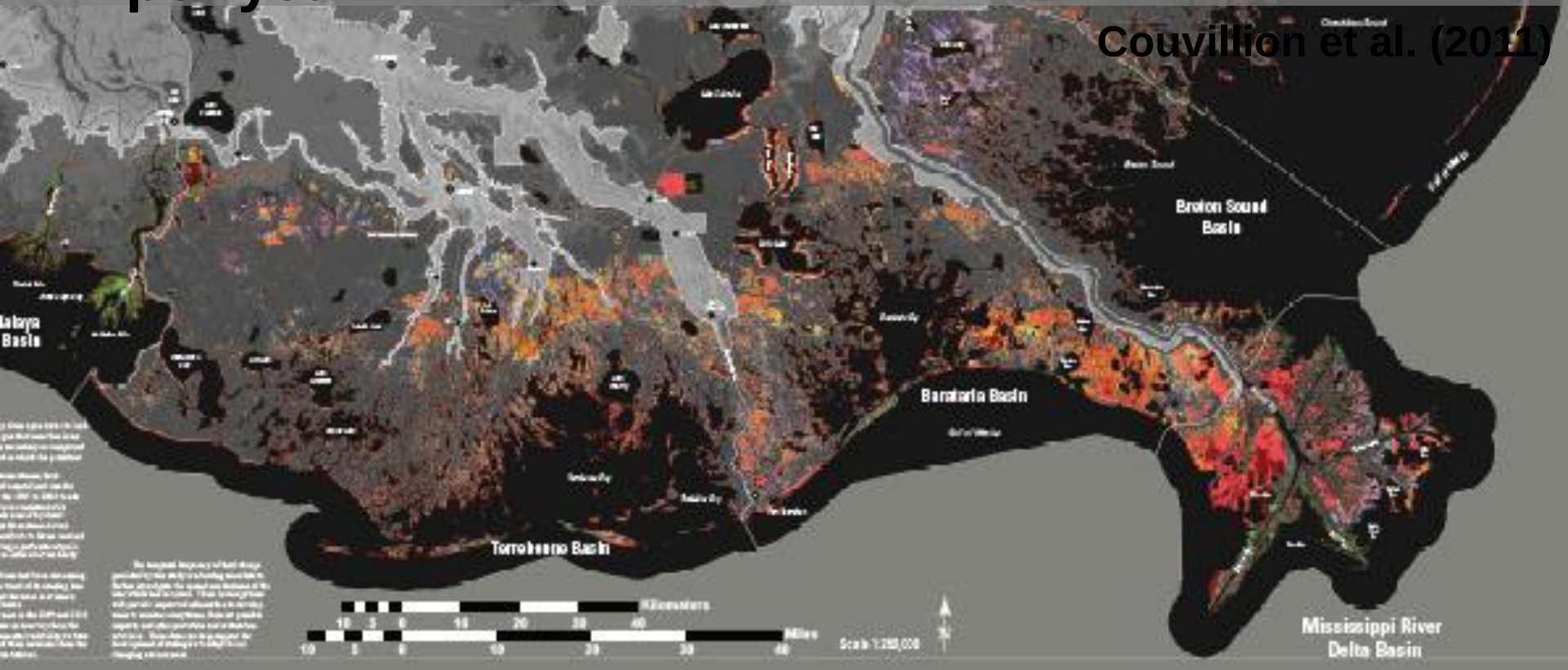
1400-km² wetland
Complex habitat mosaic
Gradients of residence time
Diversity of ecosystem functions
Very high productivity

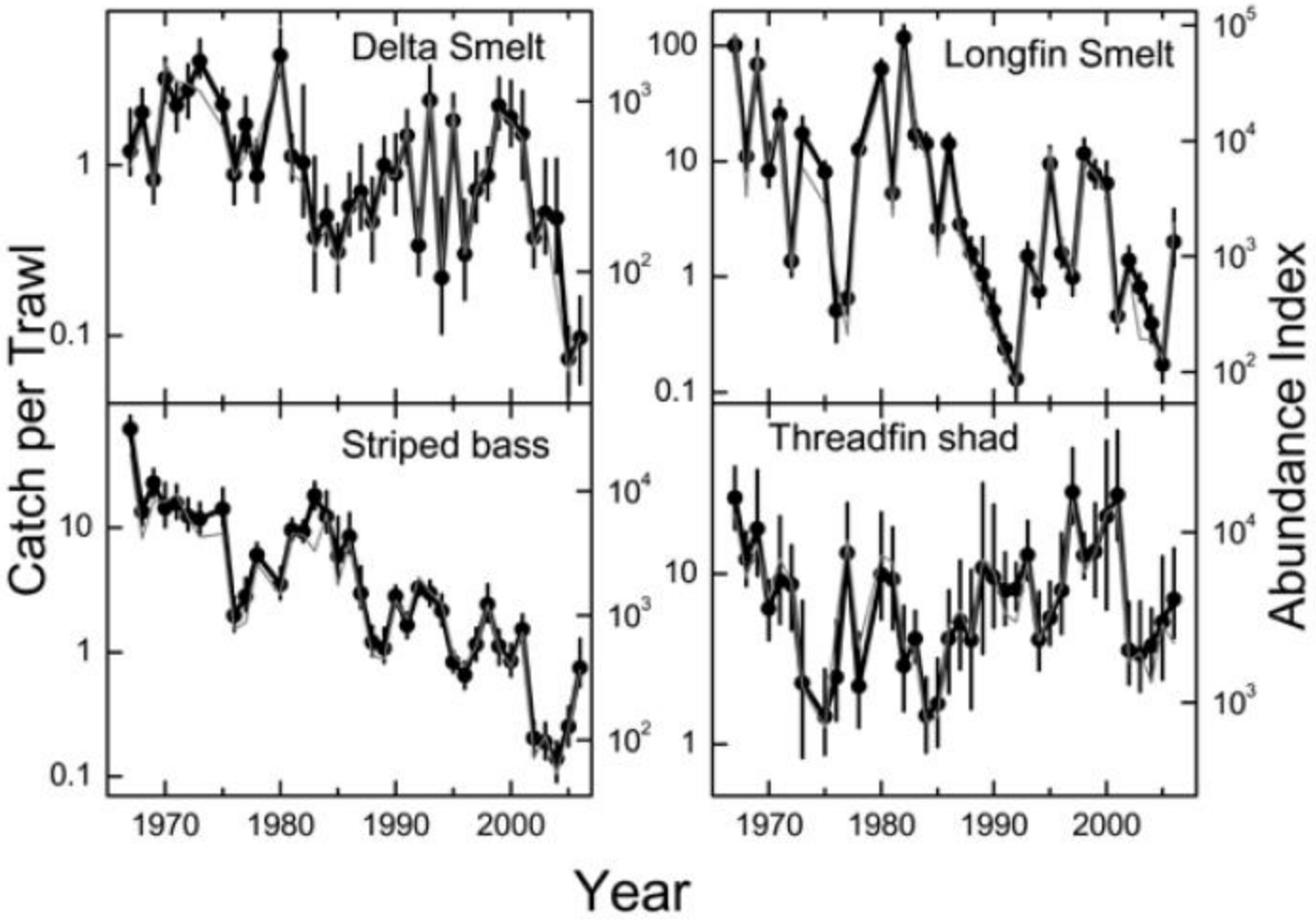
400 g C/m²-y

Atwater et al. (1979)

Consequences

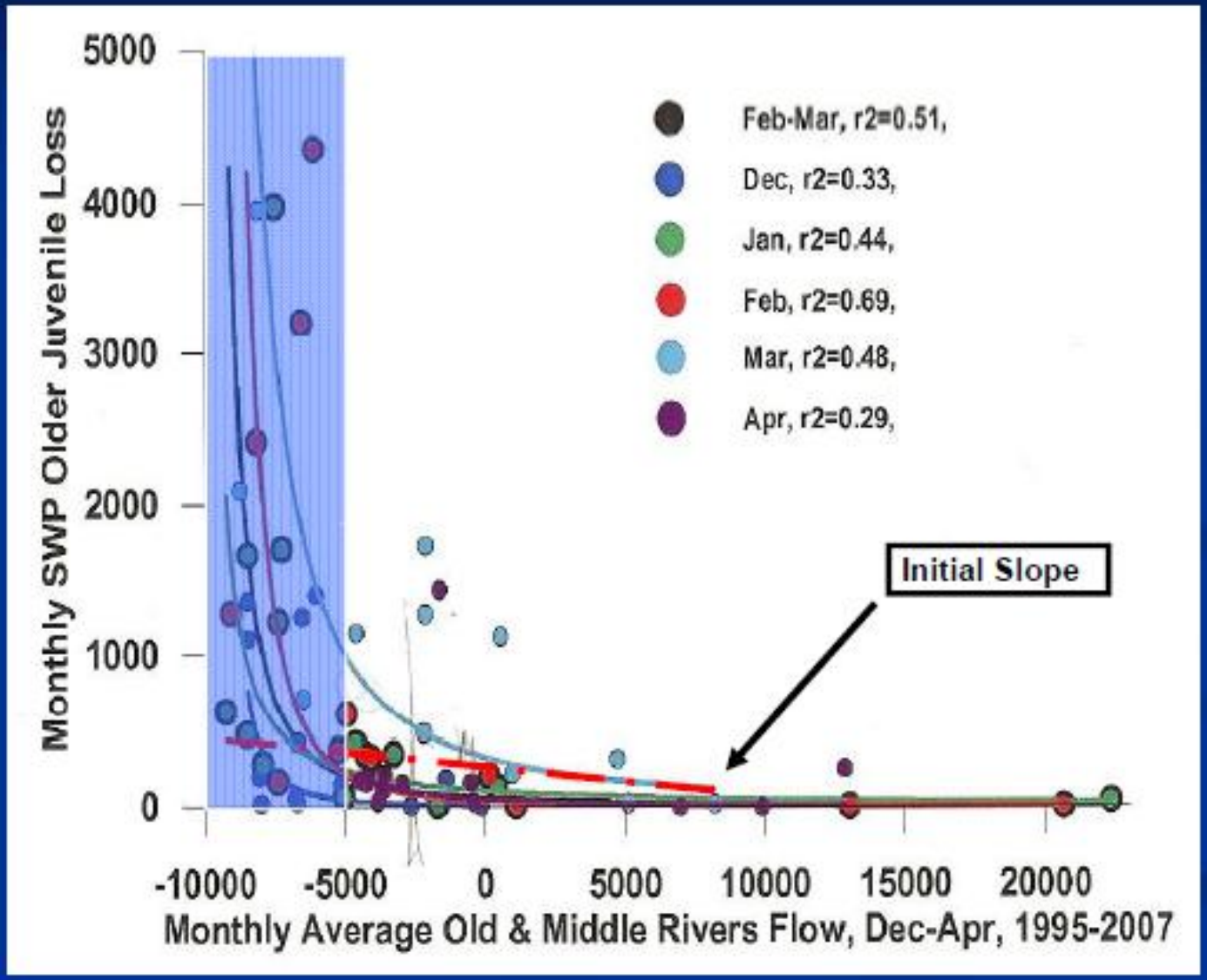
These analyses show that coastal Louisiana has undergone a net change in land area of about -1,883 square miles (mi²) from 1932 to 2010. This net change in land area amounts to a decrease of about 25 percent of the 1932 land area. ….Trend analyses from 1985 to 2010 show a wetland loss rate of 16.57 mi² per year.





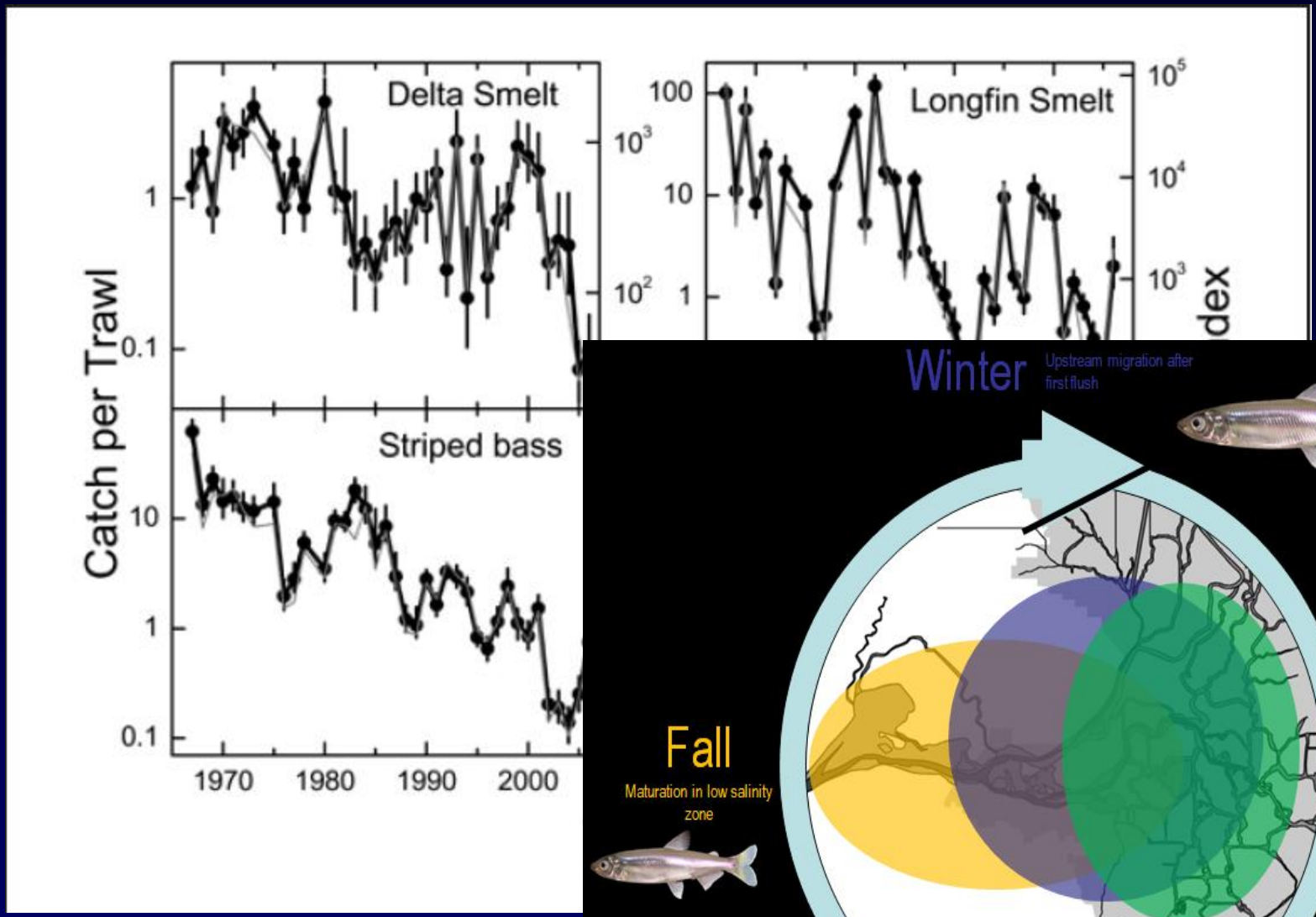
Sommer et al., 2007

SWP Loss vs. OMR flows



Managing the River Flow for a Better Future

- Water?
- Sediment?
- Or both…….


Delta Smelt
Longfin Smelt
Striped bass
Catch per Trawl
1
0.1
10
100
10^3
10^2
10^5
10^4
10^3
dex
1970
1980
1990
2000
Winter
Upstream migration after first flush
Fall
Maturation in low salinity zone
Spring
Spawning in freshwater
Summer
migration to and rearing in low salinity zone

Flow moves Low-Salinity Zone

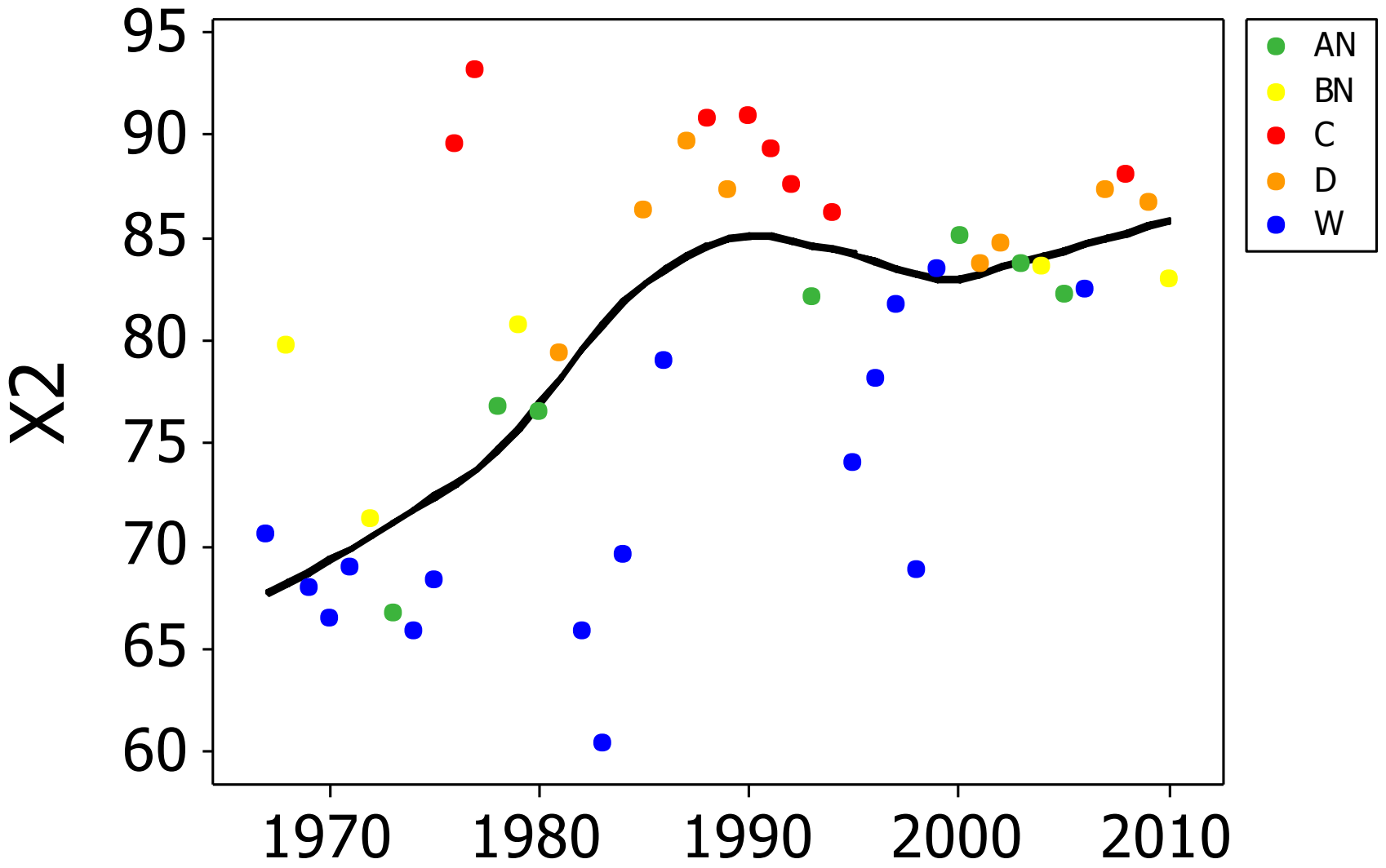
100 m^3 s^{-1}

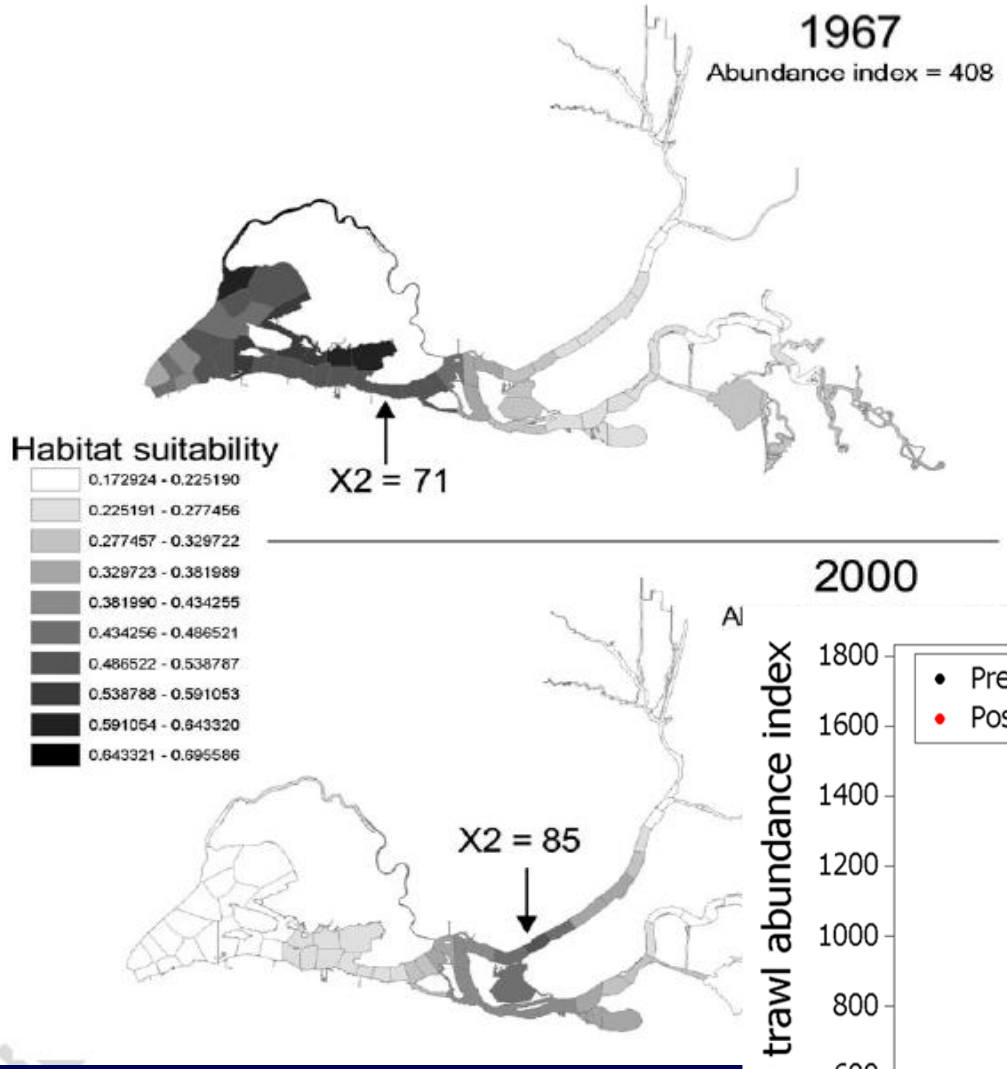
X_2

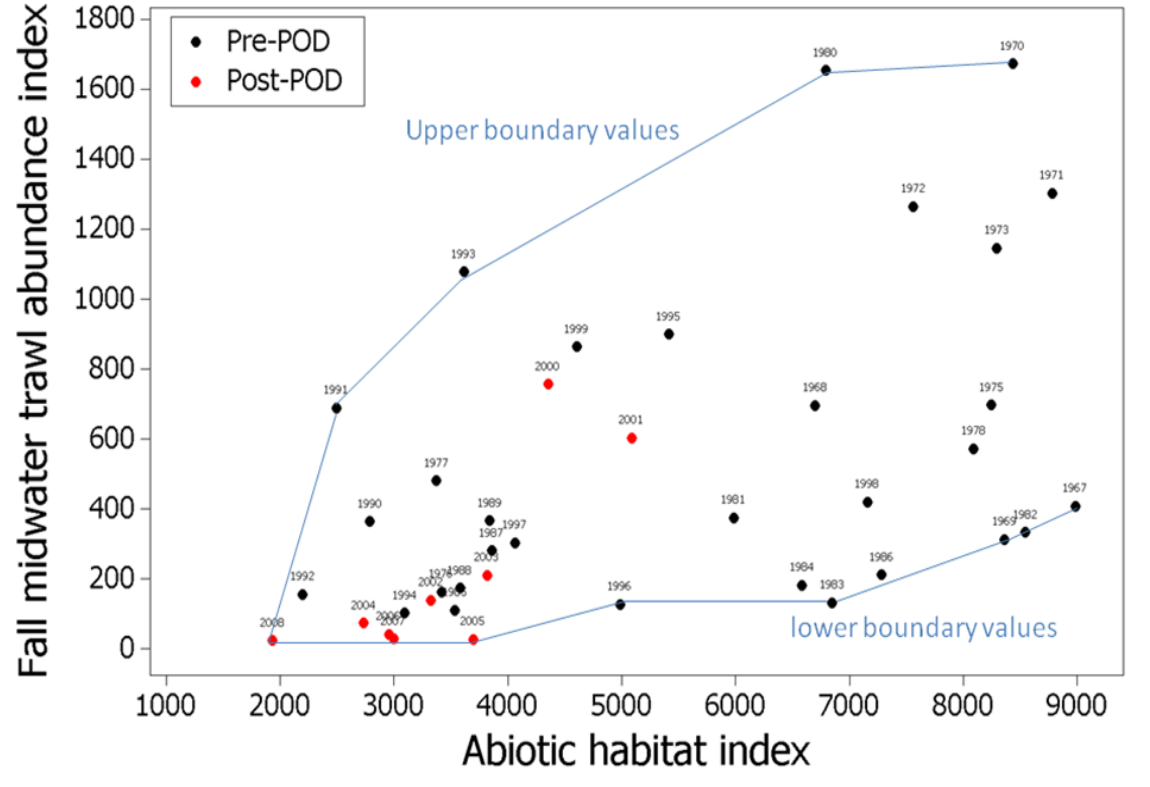
1000 m^3 s^{-1}

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

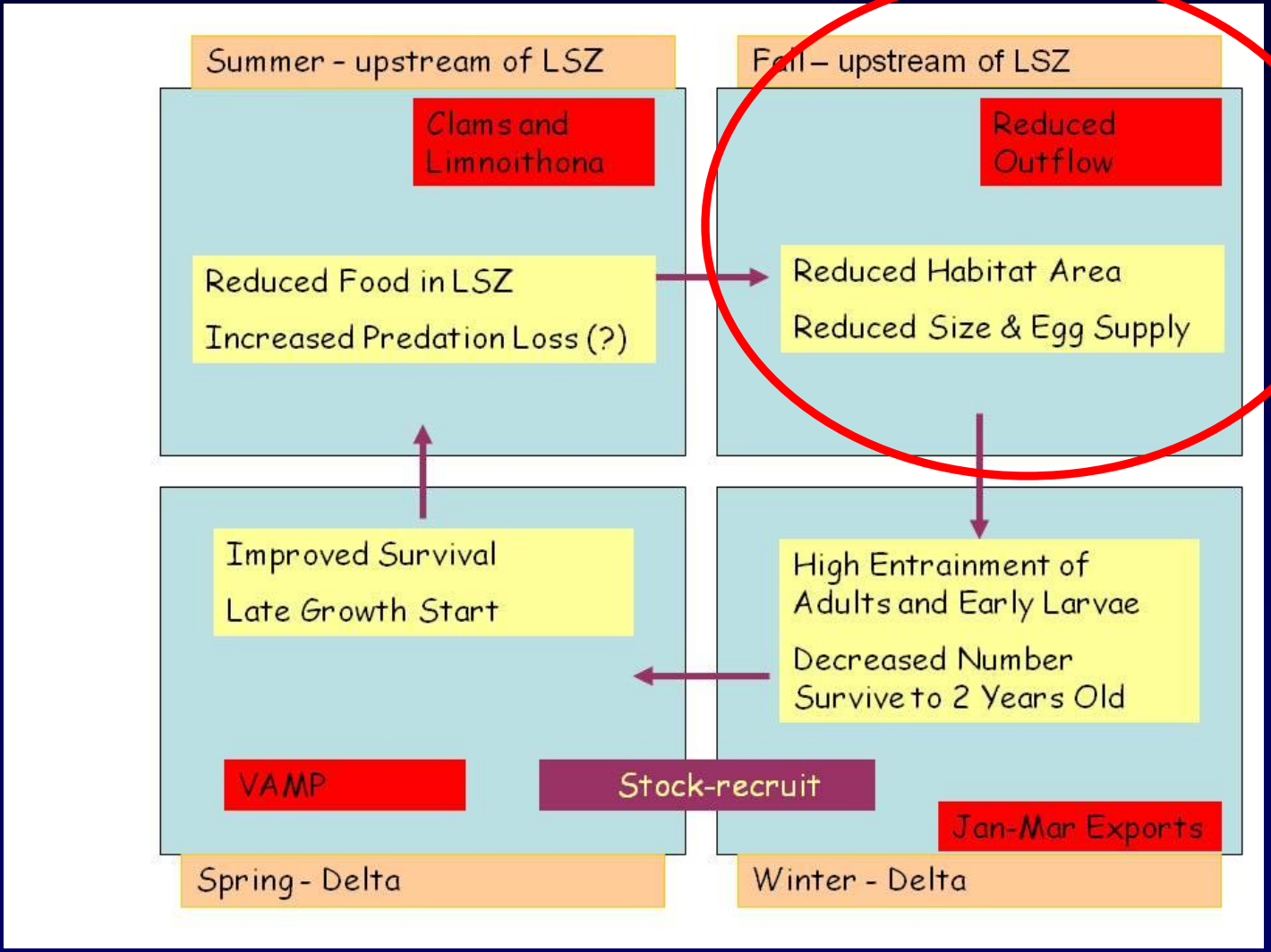
Source:
Monismith et al. 2002


X2
95
90
85
80
75
70
65
60
1970
1980
1990
2000
2010
AN
BN
C
D
W


1967
Abundance index = 408
Habitat suitability
0.172924 - 0.225190
0.225191 - 0.277456
0.277457 - 0.329722
0.329723 - 0.381989
0.381990 - 0.434255
0.434256 - 0.486521
0.486522 - 0.538787
0.538788 - 0.591053
0.591054 - 0.643320
0.643321 - 0.695586
X2 = 71
2000
X2 = 85


Pre-POD
Post-POD
Upper boundary values
lower boundary values
Fall midwater trawl abundance index
Abiotic habitat index
0
200
400
600
800
1000
1200
1400
1600
1800
1000
2000
3000
4000
5000
6000
7000
8000
9000

Fall 2011 - Outflow experiments

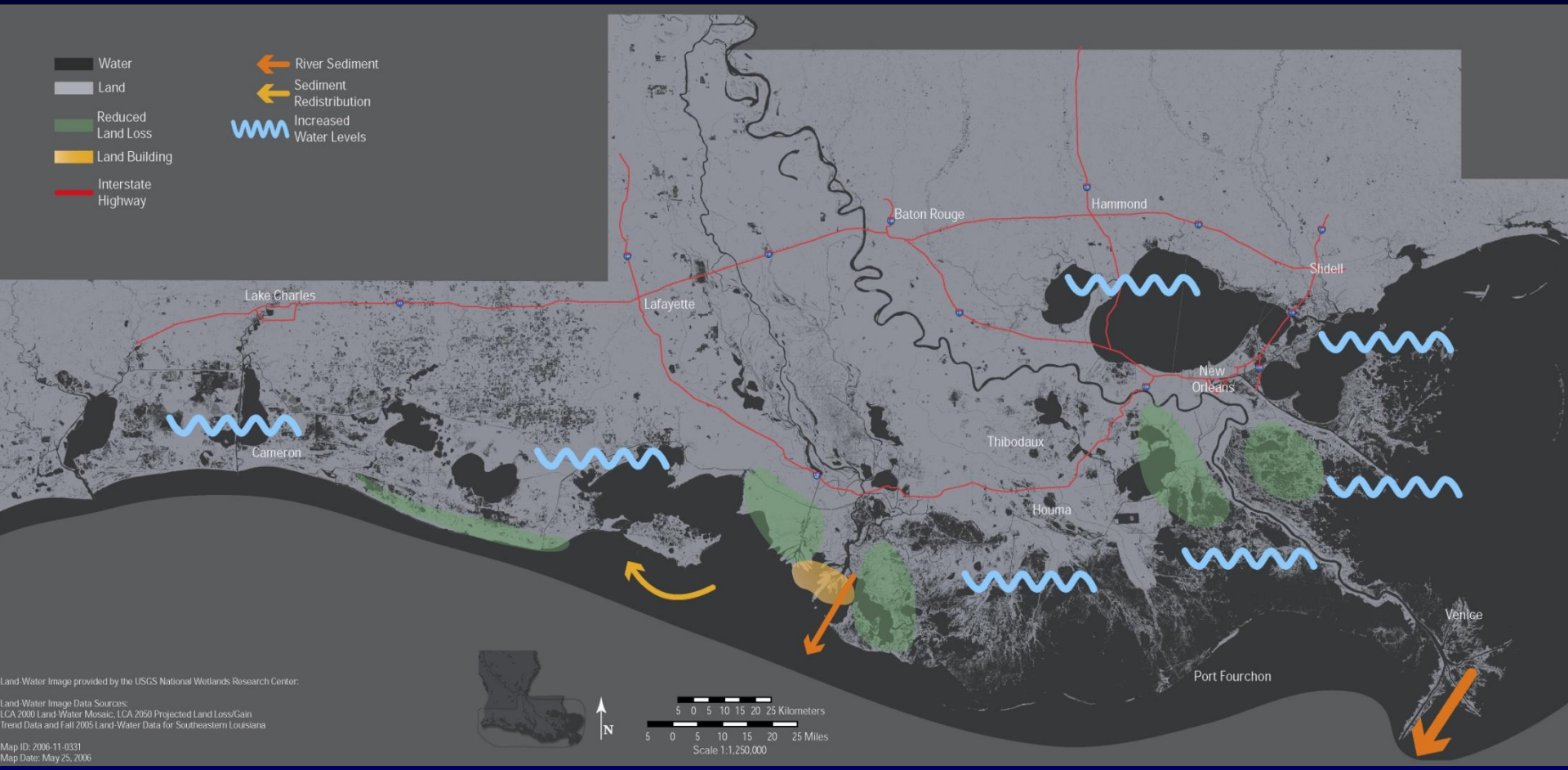



Current river management stops sediment load getting to coastal wetlands and limits new delta growth

June 1, 2006
New Orleans, LA

FINAL REPORT AND FINDINGS
From Technical Group
Envisioning the Future of the Gulf Coast Conference

Continuing Current Management

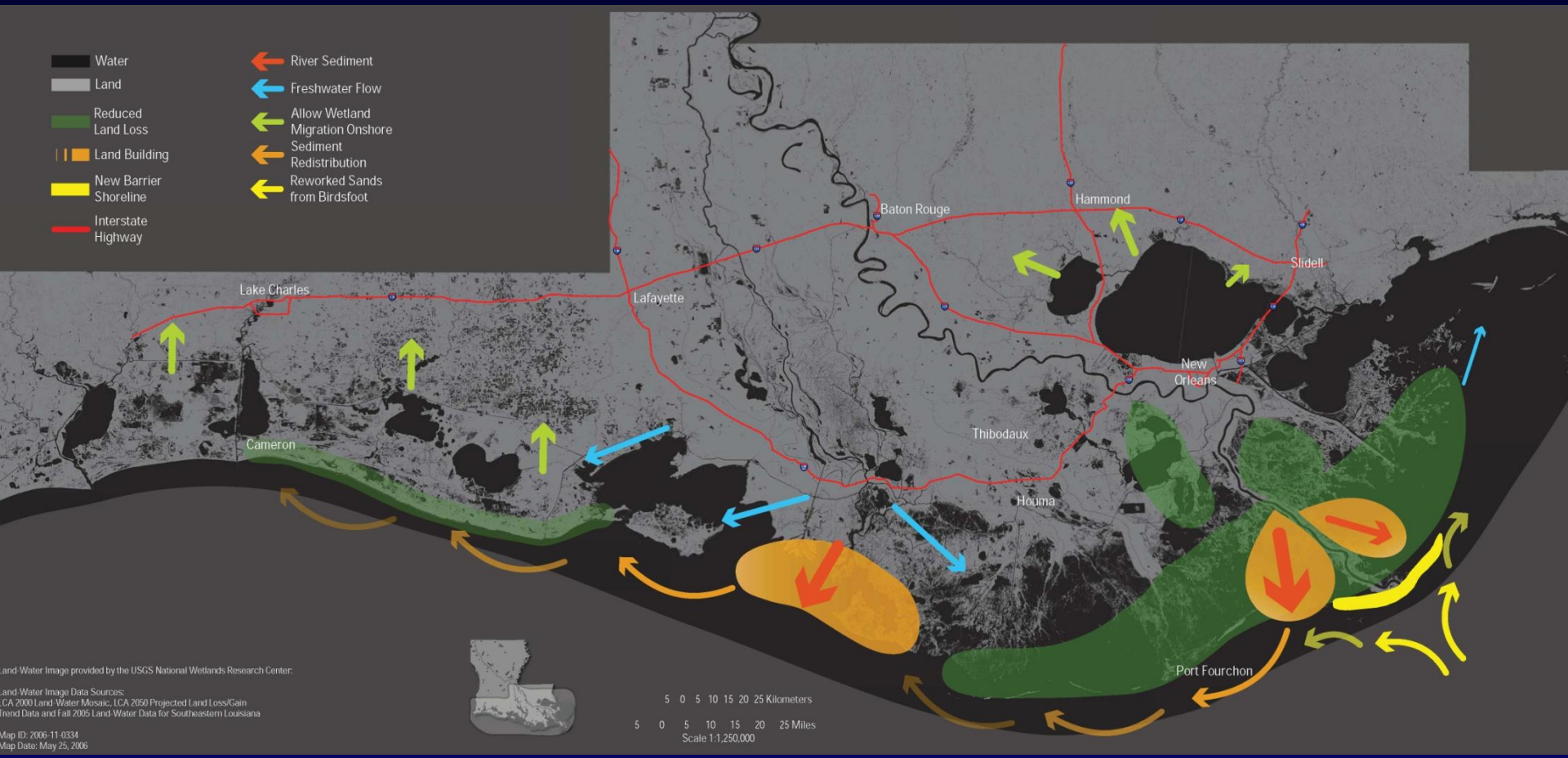


USGS science for a changing world

Louisiana Department of Natural Resources

America's WETLAND Campaign to Save Coastal Louisiana

Achieving Sustainability



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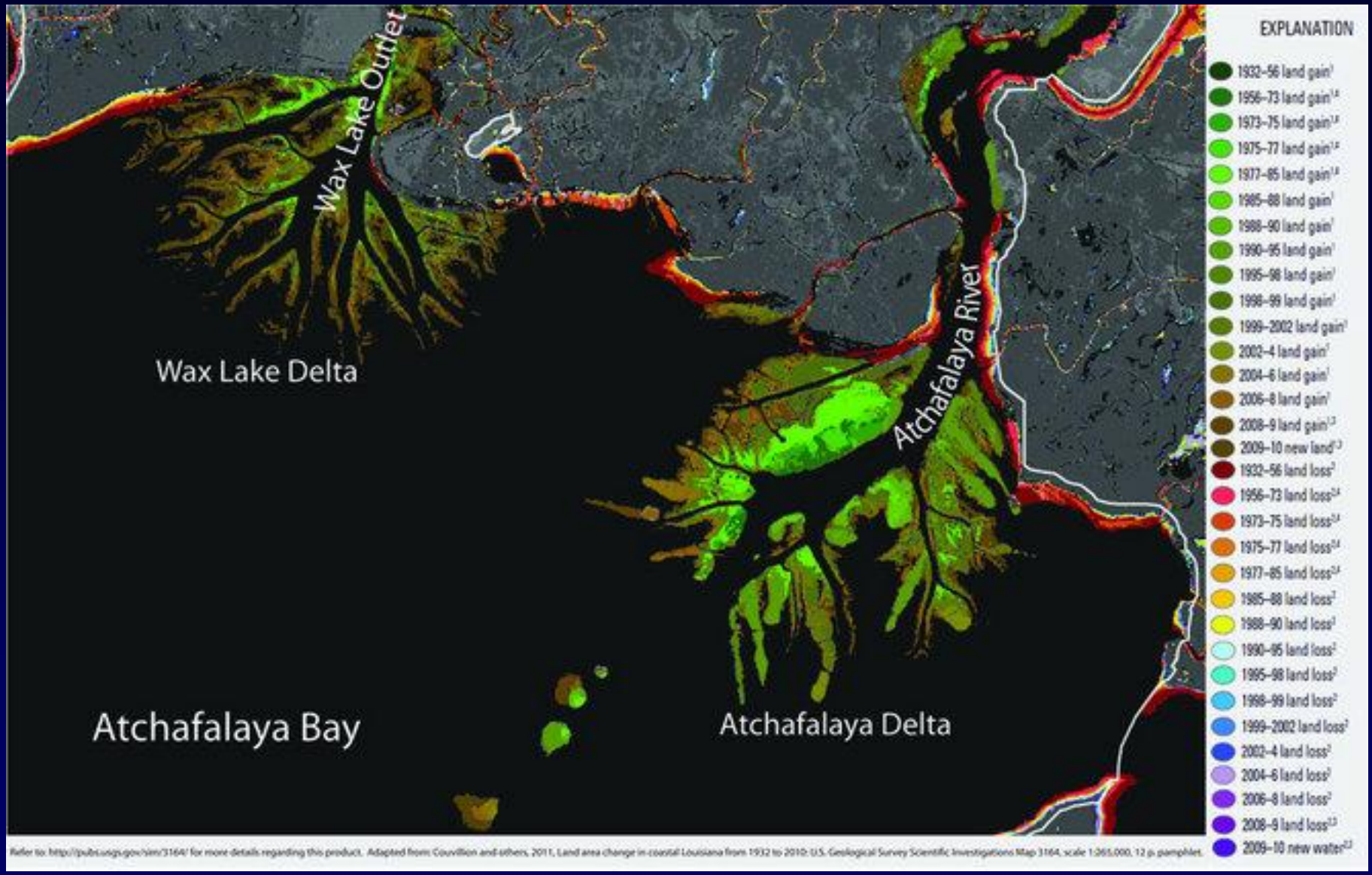
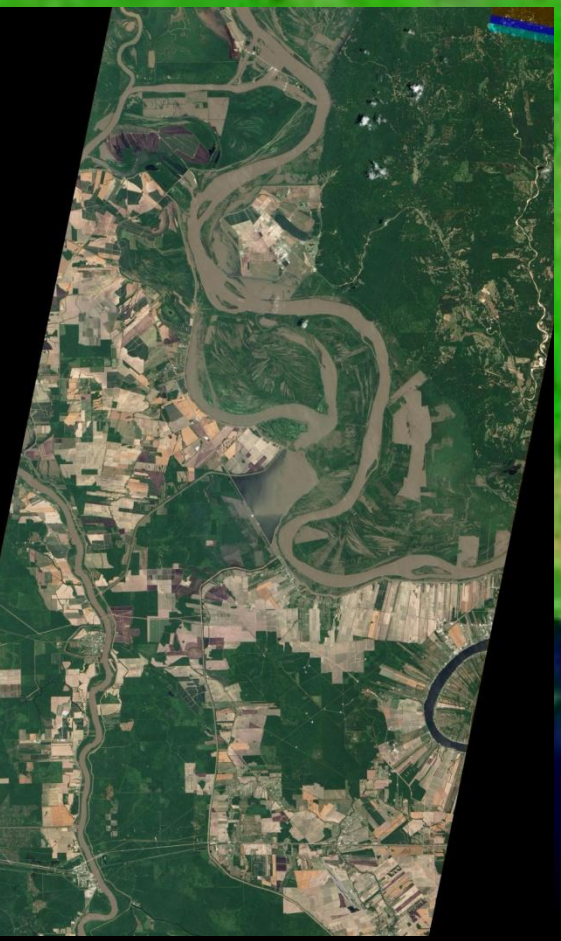


Refer to: http://pubs.usgs.gov/sim/3164/ for more details regarding this product. Adapted from: Couvillion and others, 2011, Land area change in coastal Louisiana from 1932 to 2010: U.S. Geological Survey Scientific Investigations Map 3164, scale 1:265,000, 12 p. pamphlet.

How much is enough?
Gated or Open?



Morganza –
1st time since 1973

Bonnet Carre Spillway - ~ 1 yr in 10

Managing the Flood in Louisiana

Flood of 2011

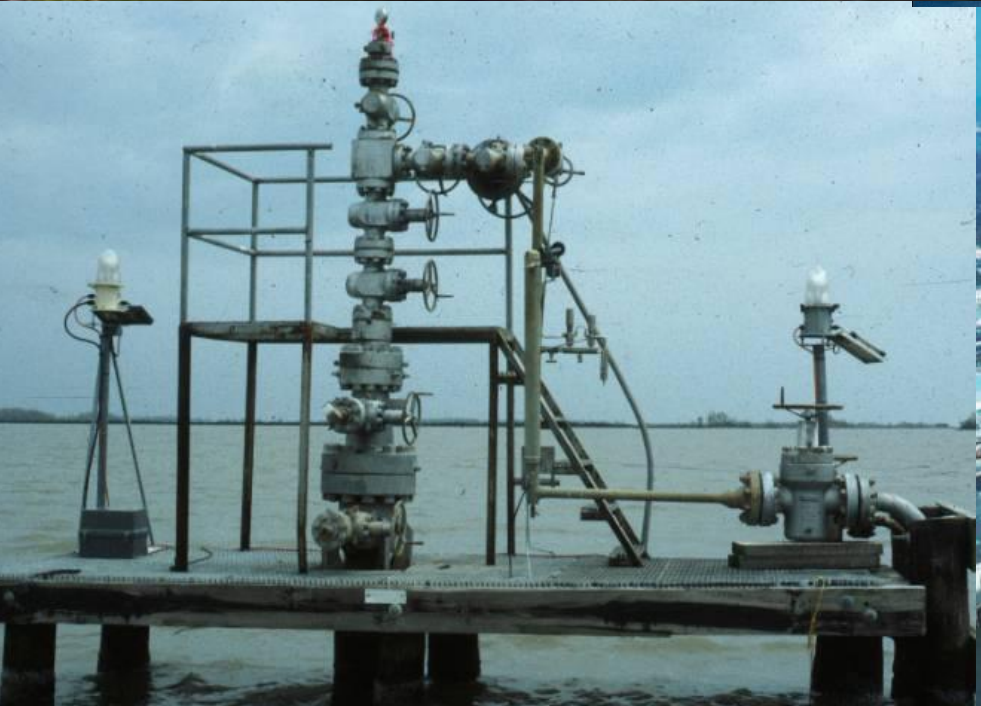
- Operation of structures not seen in > a generation
- Routing of floodwaters into lakes and bays
- Effective management of water
- Sediment management = dredging
- Delta plain largely isolated from flood water and sediment

Managing a Flood to Maximize Land Building?

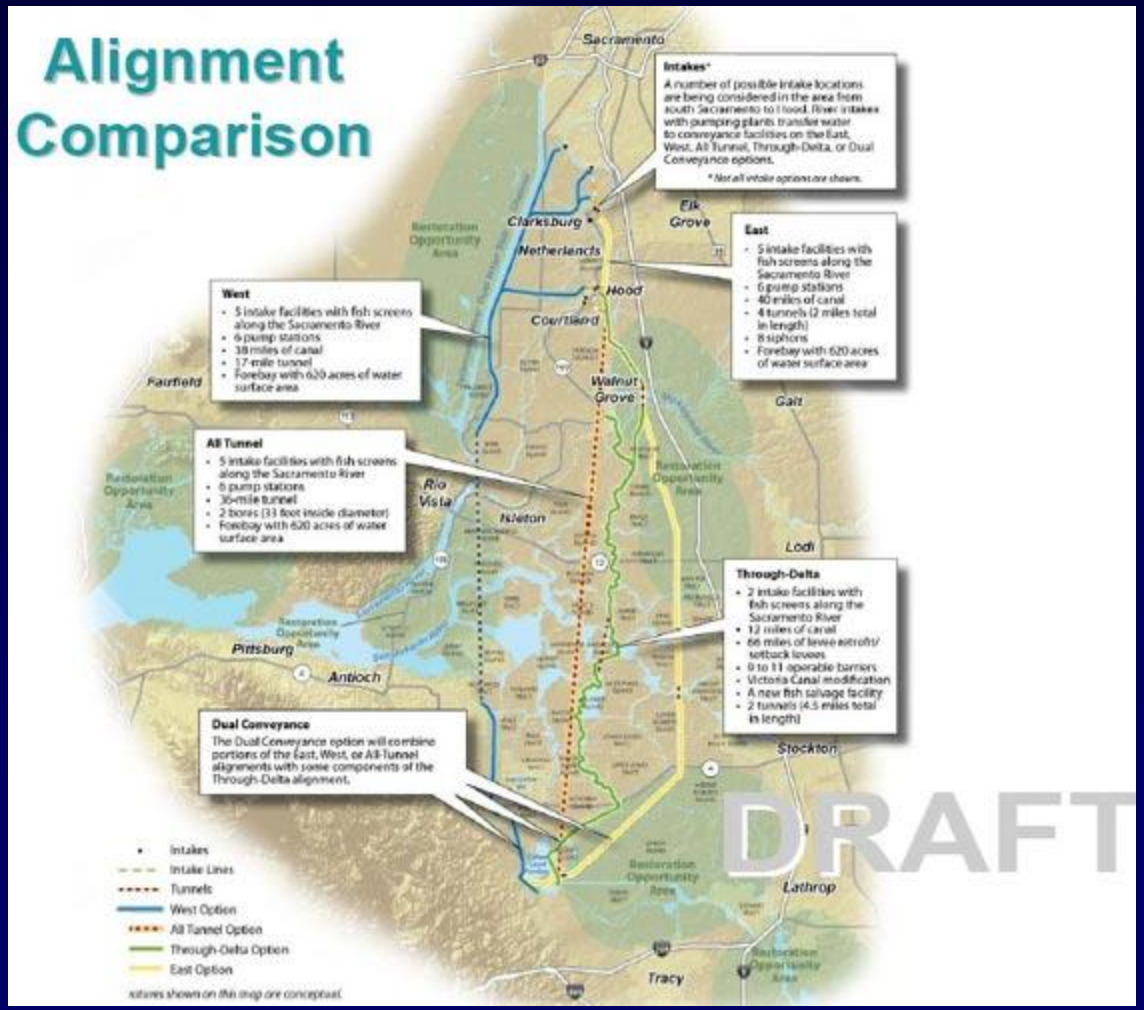
A New Approach to River Management for the 21st Century

World's Apart?

Working systems



Ecosystem and water supply - co-equal goals




Navigation, flood risk
management and ecosystem?