# Floodplains, History, Current Condition, Vision for Future

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35<sup>th</sup> Annual Salmonid Restoration Conference March 29-April 1, 2017 in Davis, CA Restoring Watersheds and Rebuilding Salmon Runs



## Geologic context for floodplains





Davies, N.S. and Gibling, M.R., 2011. Evolution of fixed-channel alluvial plains in response to Carboniferous vegetation. *Nature Geoscience*, 4(9), pp.629-633.

#### Trees & braided rivers

The widespread expansion of trees about 315 million years ago marked the widespread appearance of narrow fixed channels for the first time, as well as "braided" rivers containing vegetated islands. Over time, the appearance of woody debris led to log jams that promoted the rapid formation of new river channels, an idea supported by lab experiments





# Anthropocene Context:



### Fisk – COE - 1944

History of landscape hydromodification is poorly documented, scale of it is grossly under-appreciated.





North Central Nevada Edge of Arable Lands History of landscape hydromodification is poorly documented, scale of it is grossly under-appreciated.

superv Date: 7/20/2

Stage 2, 3 **South Central Idaho** Google ea

Stage 0, 1

9179

# History and Development

For 1-2 centuries in US and several more centuries in Europe there has been an all-out effort to maximize agricultural land





Oil-powered dredge digging a 30-foot-wide ditch to drain wetlands near Carroll, Iowa. (Photograph courtesy of National Archives, 8–D–2214–2570.)

Evidence from Europe - Upper River Rhine at Breisach



Anastomosed 1828 – Prior to river training

Anabranched 1872 – after re-alignment by Johann Gottfried Tulla

Meandering 1963 – fully canalised single-thread

Swamp Land Act of 1850 <sup>[1]</sup> essentially provided a mechanism for reverting <u>title</u> of federally owned <u>swampland</u> to states which would agree to drain the land and turn it to



Eel River, CA

DRAINING FLOODPLAINS - AND BUILDING DEFENSES FROM FLOODS.

LaGrand River, OR

Tile drain networks: 6m acres in mid-west.

......



- drain upper soil moisture zones,
- diminish aquifers,
- Makes the hydrosystem flashy and less resilient.

# Scale of hydromodification is difficult to grasp.



Figure 2. States with notable wetland loss, 1780's to mid-1980's. (Source: Modified from Dahl, 1990.)

- <sup>1</sup> U.S. Fish and Wildlife Service.
- <sup>2</sup> U.S. Geological Survey.

U.S. Geological Survey Water-Supply Paper 2425

### History of Valley Modifications

CA, formerly 4m acres wetland, Almost 3m accessible to fish



Figure 9. Wetlands of the Central Valley of California, circa 1820 (left) and 1990 (right). (Source: U.S. Fish and Wildlife Service, Status and Trends, unpub. data, 1994.)

Data from the SWFSC IP model (streams)

The Bay Institute "From the Sierra to the Sea -The Ecological History of the San Francisco Bay Delta Watershed" 1998 (floodplain)



Historical Central Valley with Intact Floodplain [4450 sq mi] and Connected Streams [17200 mi]



Historical Central Valley with Intact Floodplain and Stream Reaches currently accessible



Examine the Floodplain

Source: USGS California Geologic Map



Source: The Bay Institute Sierra to the Sea GIS Maps





Source: 2014 USDA Cropland Data Layer



### Sacramento / San Joaquin Rivers 9% of Historic Floodplain 7% of Historic River Length

Quantity and function: blue-line streams are misleading; floodplain remnants are misleading.



NOA/

Red Blut

#### History of Central Valley Floodplains

Historical Floodplain baseline graph from Meko et a. 2002 in Quaternary Science Reviews 25 (2006) 1570–1598 Holocene paleoclimate records from a large California estuarine system and its watershed region: linking watershed climate and bay conditions Frances P. Malamud-Roam, B. Lynn Ingram, Malcolm Hughes, Joan L. Florsheim





### History of Central Valley Floodplains

Floodplain Losses from "Battling the Inland Sea: Public Policy, and the Sacramento Balley Major Floodplain Losses: Robert Kelley 1989 1830 Mexican Land Grants-Riparian clearing for cattle & crops 4,450 SqMi 1848 Gold Discovery - population increased 10-fold 4500 1850 Statehood – Increased population and Settlements 4000 1850's-1880's Levee Construction for Flood Protection 3500 **Riparian clearing for Fuel** Square Miles of Floodplain Habitat Towns built on the Floodplain 3000 1900's Increased Levee Construction **Residential Development in Floodplain** 2500 Industrial Farming expansion 2000 1500 1000 500 414 SqMi 0



## Quality of Remnant Habitat:



### Watershed Process Domains Place Matters



### Watershed Process Domains Place Matters







# 1/3 Billion Years

# Current condition is unique since the rise of trees in the Carboniferous Period

### SALMON POPULATIONS NEED CONNECTED FLOODPLAIN;

### NEED TO IDENTIFY SPATIAL OPPORTUNITIES FOR SIGNIFICANT FLOODPLAIN HABITAT RESTORATION.



**Public Domain** 

Source: 2014 CA Protected Area Database 1999 BLM Land Ownership



**Public Domain** 

Source: 2014 CA Protected Area Database



Private Domain

Source: 2014 USDA Cropland Data Layer



Public and Private Domain

### History of Central Valley Floodplains





	Square Miles				
Category	Total square miles in CV (and at least have a portion that touches the floodplain boundary*)	Connected to River (a portion of entity within 1 kilometer of watercourse)	Disconnected from River (no portion of entity within 1 kilometer of watercourse)		
Rice Fields	441	396	45		
Consevation Easements	425	381	44		
Existing Wildlife Ares	410	406	4		
(NWR, WA, Preserve, Riparian Habitat)					
Existing Floodplain Habitat	295	295	295		
Perennial Water	120				
Total Floodplain Habitat counting Existing and Potential	1571	1478	388		

# Strategies to "undrain" the land:

- Plug the channels that drain the water table
  - Immediate results
- Re-establish alluvial fan deposition and recharge zones
- Levees: move, breach, etc.



Butano Creek – plug channel and lower levee

### Add wood or restore wood recruitment in incised channels



Wallerstein, N.P. and Thorne, C.R., 2004. Influence of large woody debris on morphological evolution of incised, sand-bed channels. *Geomorphology*, 57(1), pp.53-73.

# Fill Channels



*'Stage Zero Rehabilitation'* Paul Powers, Deschutes NF Regional Restoration Team Oregon AFS Meeting

![](_page_43_Picture_0.jpeg)

*'Stage Zero Rehabilitation'* Paul Powers, Deschutes NF Regional Restoration Team Oregon AFS Meeting

![](_page_44_Picture_0.jpeg)

![](_page_45_Picture_0.jpeg)

![](_page_46_Picture_0.jpeg)

Lost Cr- During Construction View of the Upper Meadow (HC#6) October 2012

![](_page_46_Picture_2.jpeg)

![](_page_46_Picture_3.jpeg)

8,000 cubic yards fill

![](_page_46_Picture_5.jpeg)

![](_page_47_Picture_0.jpeg)

### LEVEE SETBACK CROSS SECTION (CONCEPT ONLY)

![](_page_48_Figure_1.jpeg)

![](_page_49_Picture_0.jpeg)

### Beaver Dams in Incised Channels

"can reduce Stage 1 to Stage 7-8/0 recovery times by 1-2 orders of magnitude"

Recovery in years to decades instead of decades to centuries

Pollock et al., 2014. using beaver dams to restore incised stream ecosystems. *Bioscience*, 64(4).

![](_page_50_Picture_4.jpeg)

### Wisconsin, Anthropocene Fill Removed

![](_page_51_Picture_1.jpeg)

![](_page_52_Picture_0.jpeg)

![](_page_53_Picture_0.jpeg)

![](_page_54_Picture_0.jpeg)

Ruined Valleys have some really ruined land

# When the valley is completely developed, look for ruined land.

![](_page_55_Picture_1.jpeg)

Cathornes	Agusta Basi Deng perdikananai Visi Menine Distatasi Benisfikaniani Kenis Kimisfikanian <sup>2</sup> persi Visioni	Sheet # 7 of 13	Take: Existing Land Cover and Primary Vegetation Zones	Date Deswer July 13, 2015		
Reason	Upland Pilpadan Farad Brailled Carey Vialer Cyan Haler	Project: Hanson Russian River Ponds Floodplain Restoration Feasibility Study	Scale: 1 centimeter = 65 meters	Drown by: C. Gavette		8.
the Parson of Street		Location: Near Windsor, Sonoma County	Propertyle: California Coastal Conservancy & Sonoma County Permit and Resource Management Department	Checked By: B. Chaer	EHC	Hanson

![](_page_56_Picture_0.jpeg)

Figure 7.2. Stage II terrain concepts. The panels, left to right, are II-A, II-B, II-C, and II-D as described above.

### .....look for ruined land.

![](_page_57_Picture_1.jpeg)

Cacinonia	Contaur Elevation	Sheet # 6 of 13	Tale: Stage II-E Topography	Date Desure July 13, 2015		
C. Burn	80 Meters	Pageste Hanson Russian River Ponds Floodplain Restoration Feasibility Study	Scole: 1 centimeter = 65 meters	Drown by: C. Gavette		<b>HONDLES</b>
Norman State	0 Meters	Location: Near Windsor, Sonoma County	Property California Coastal Conservancy & Sonoma County Permit and Resource Management Department	Checked by: B. Chaer	EHC	Hanson

![](_page_58_Figure_0.jpeg)

Figure 4.2.12C. 2008 annual hydrograph used to assess hydraulics and sediment transport of Stage 1 Scenarios for an average water year.

![](_page_59_Figure_0.jpeg)

Figure 8.12. Cumulative juvenile rPages h36tat/at t74 project-site f@an av--age water year.

# 1/2 million acres of ag in wetland

![](_page_60_Picture_1.jpeg)