

How to Fix a Problem

Bruce Herbold

Estuarine consultant/ USEPA ret.

Is this News?

Describe the Problem

Recognize Limits, Scope and Uncertainties

Set Goals

Establish Acceptable Costs

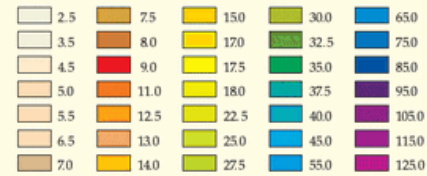
(use numbers)

Grandad's Problem

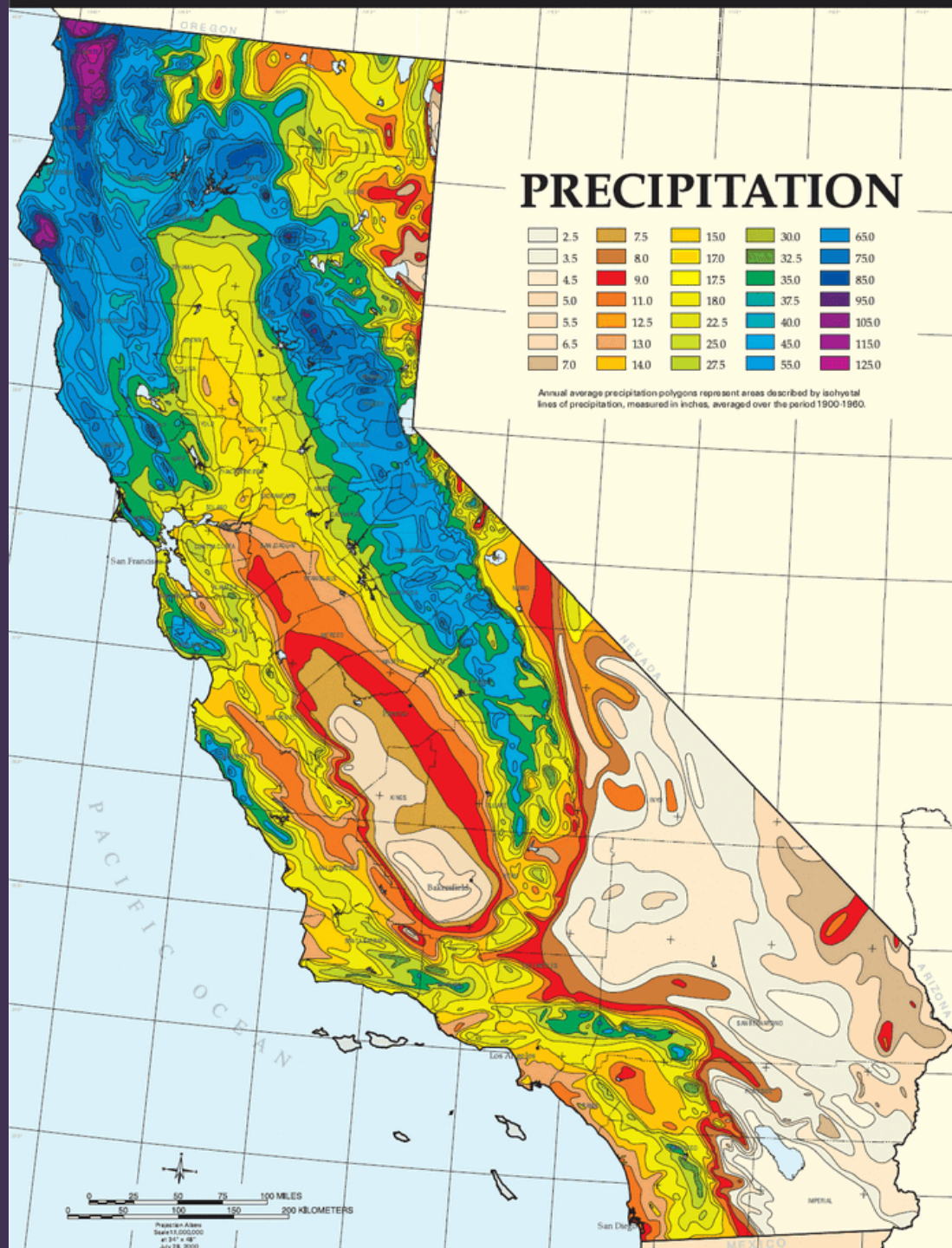
California is
temporally and
geographically diverse

(we solved this one pretty well for 40 years)

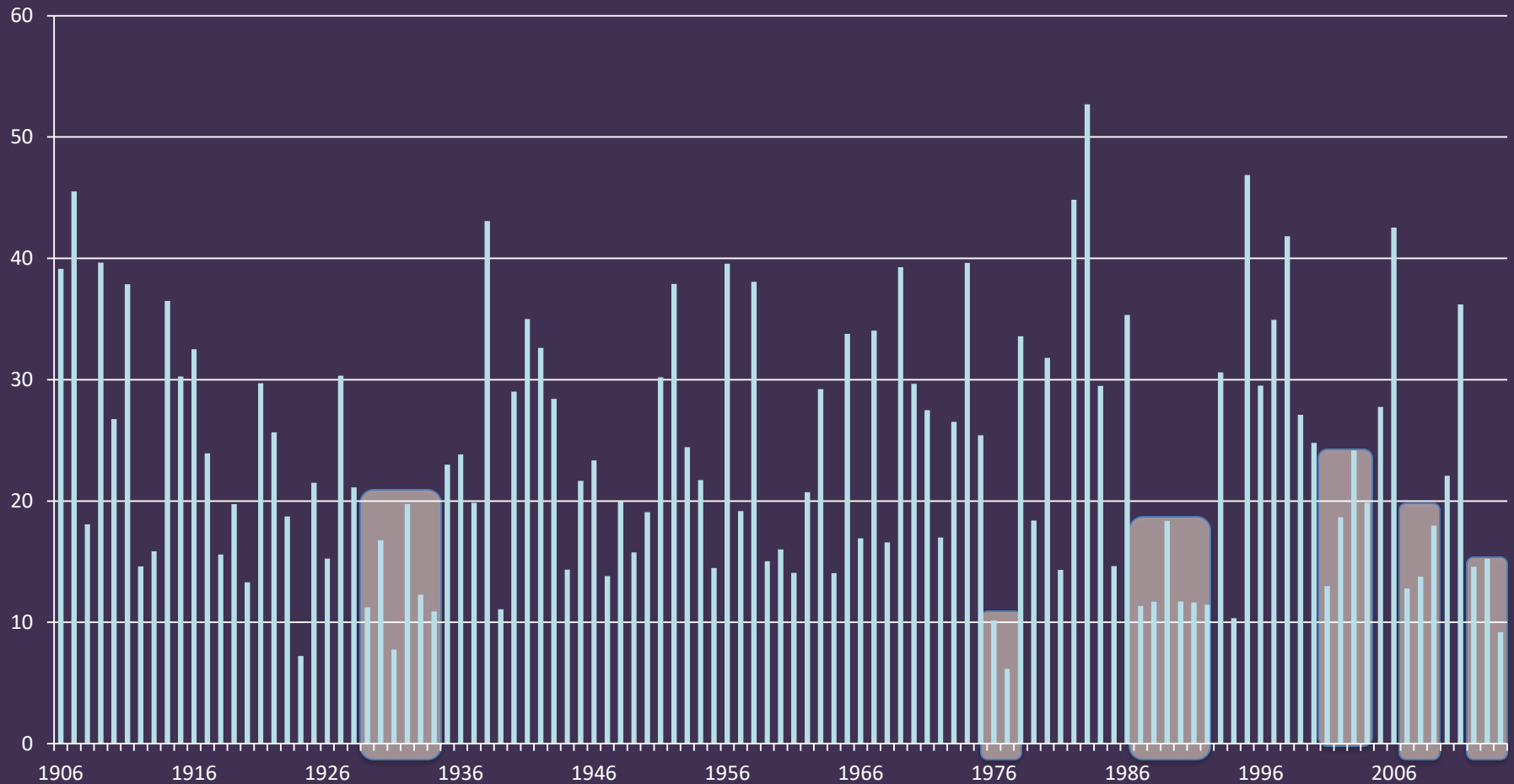
PRECIPITATION

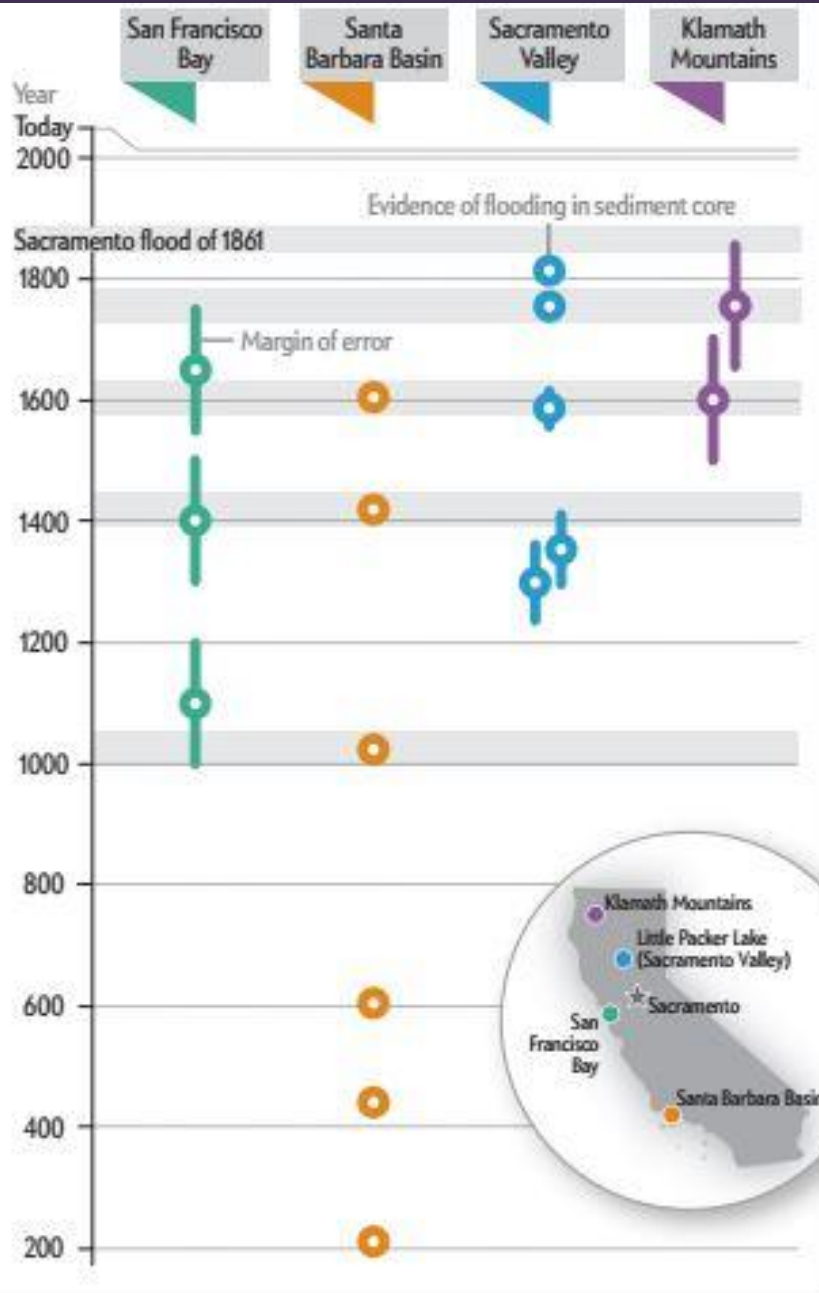


Annual average precipitation polygons represent areas described by isohyetal lines of precipitation, measured in inches, averaged over the period 1900-1960.



Central Valley Runoff MAF





How Did Fish Adapt?

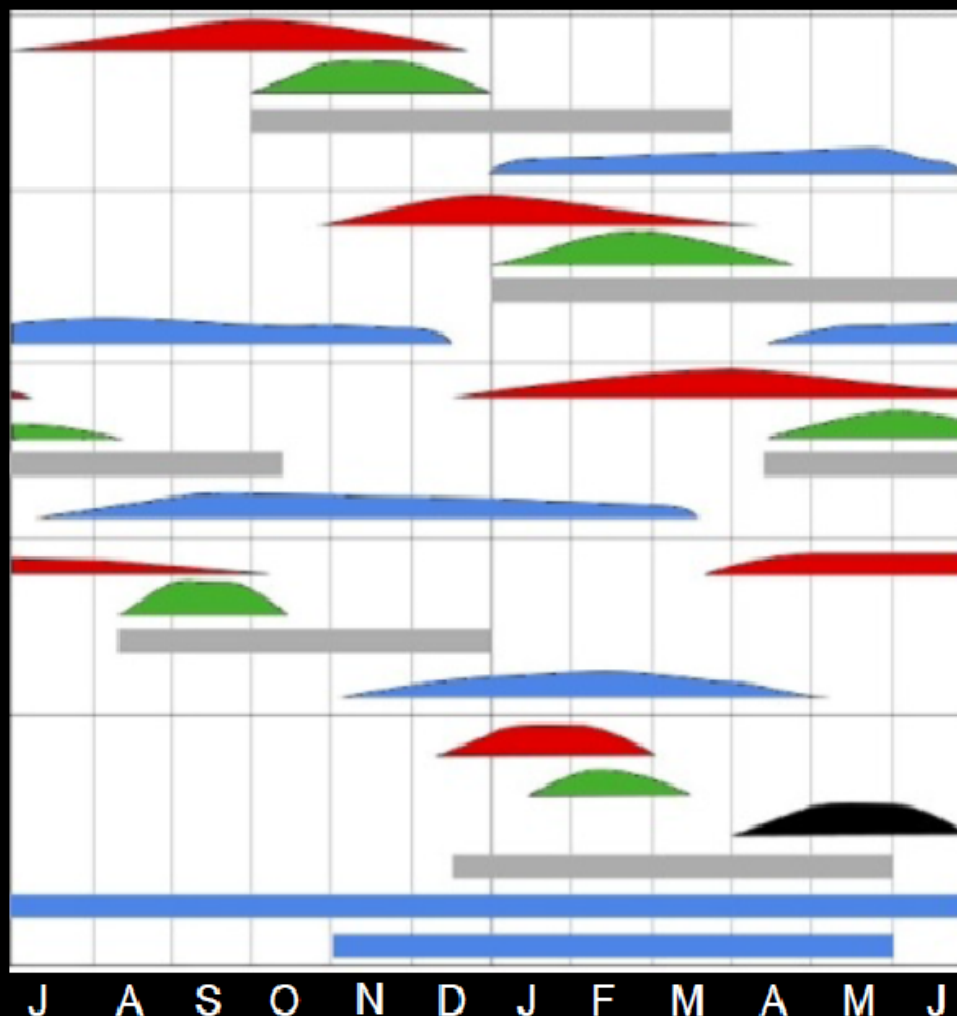
- Grow big
- Spread out in time and space
- Find reliable habitats
- Be tough, specialize



The Salmon Toolbox

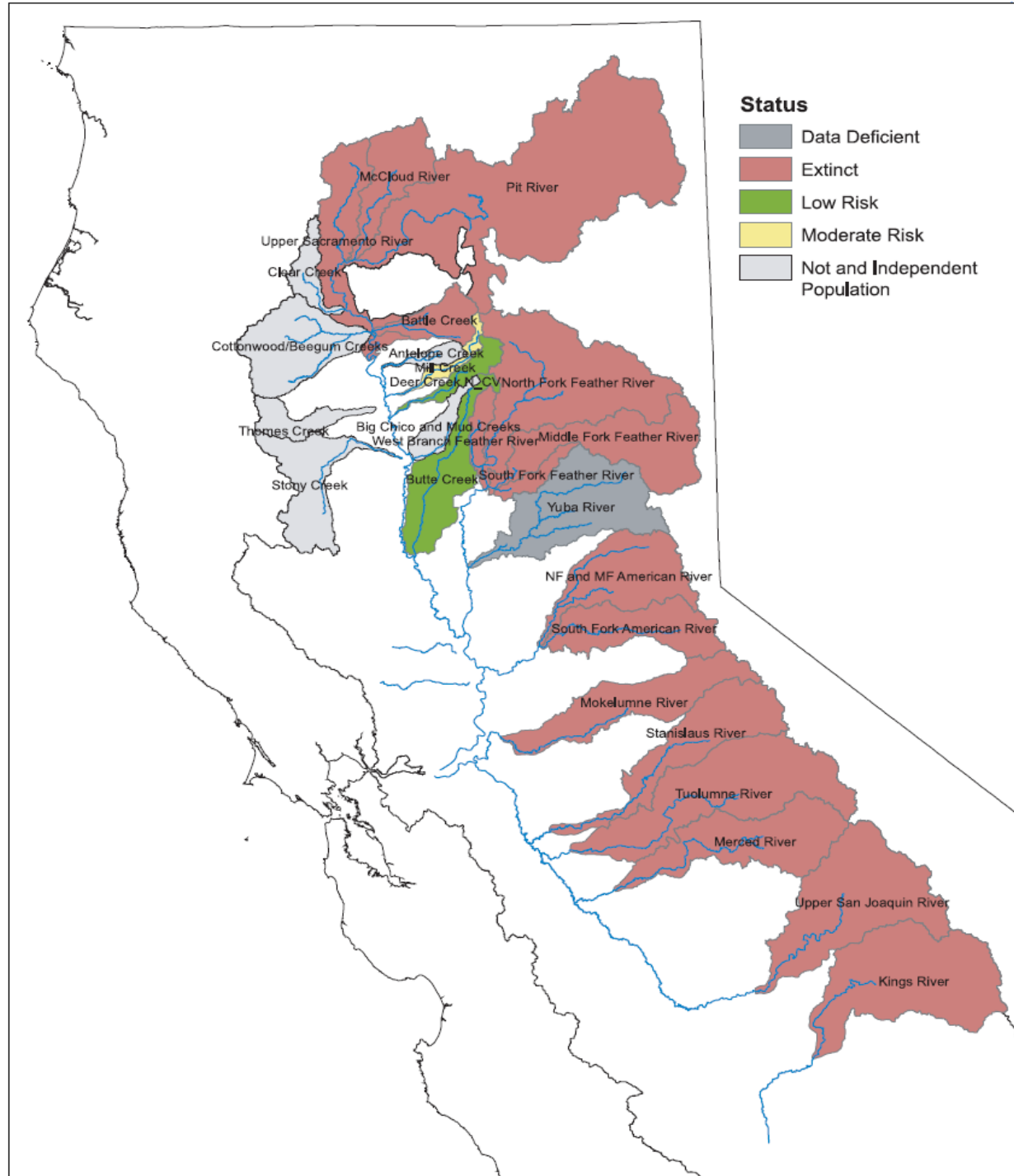
Diversity spreads risk in space & time

Fall run	Adult migration
	Spawning
	Incubation
	Rearing & migration
Late Fall run	Adult migration
	Spawning
	Incubation
	Rearing & migration
Winter run	Adult migration
	Spawning
	Incubation
	Rearing & migration
Spring run	Adult migration
	Spawning
	Incubation
	Rearing & migration
Steelhead	Adult migration
	Spawning
	Incubation
	Rearing & migration



Data sources: Vogel and Marine, 1991; Hallock, 1983; CDFG, 1993

Modified from California Rice Promotion Board by CH2MHill





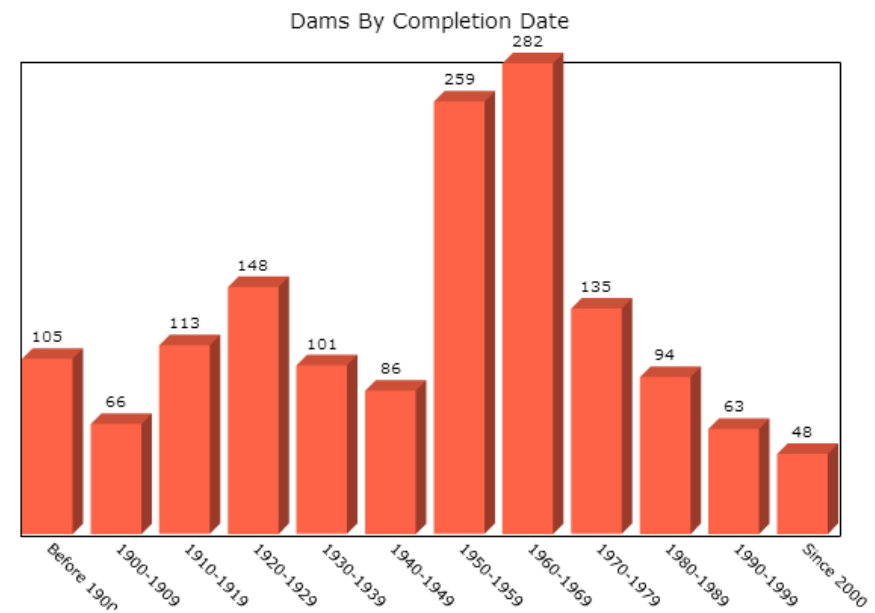
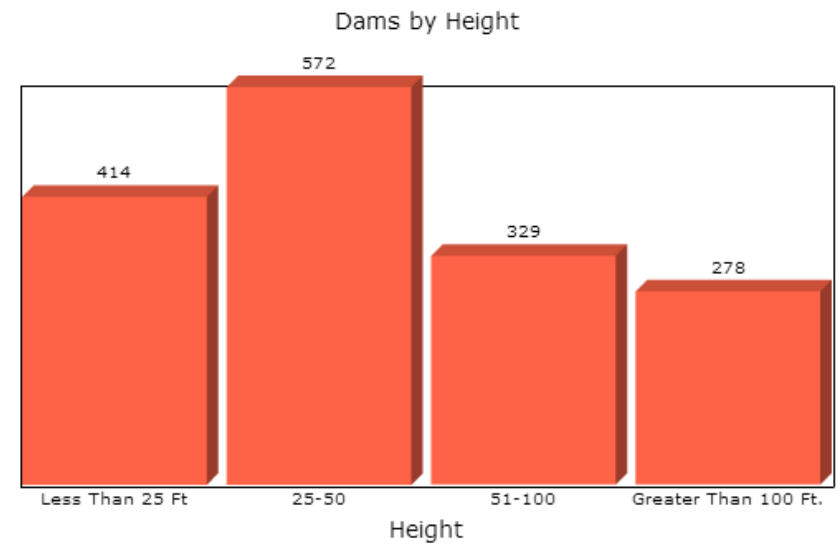


Wisconsin 183 species 65,498 sq mi

California 67 species 163,696 sq mi

What Did Our Grandparents Do?

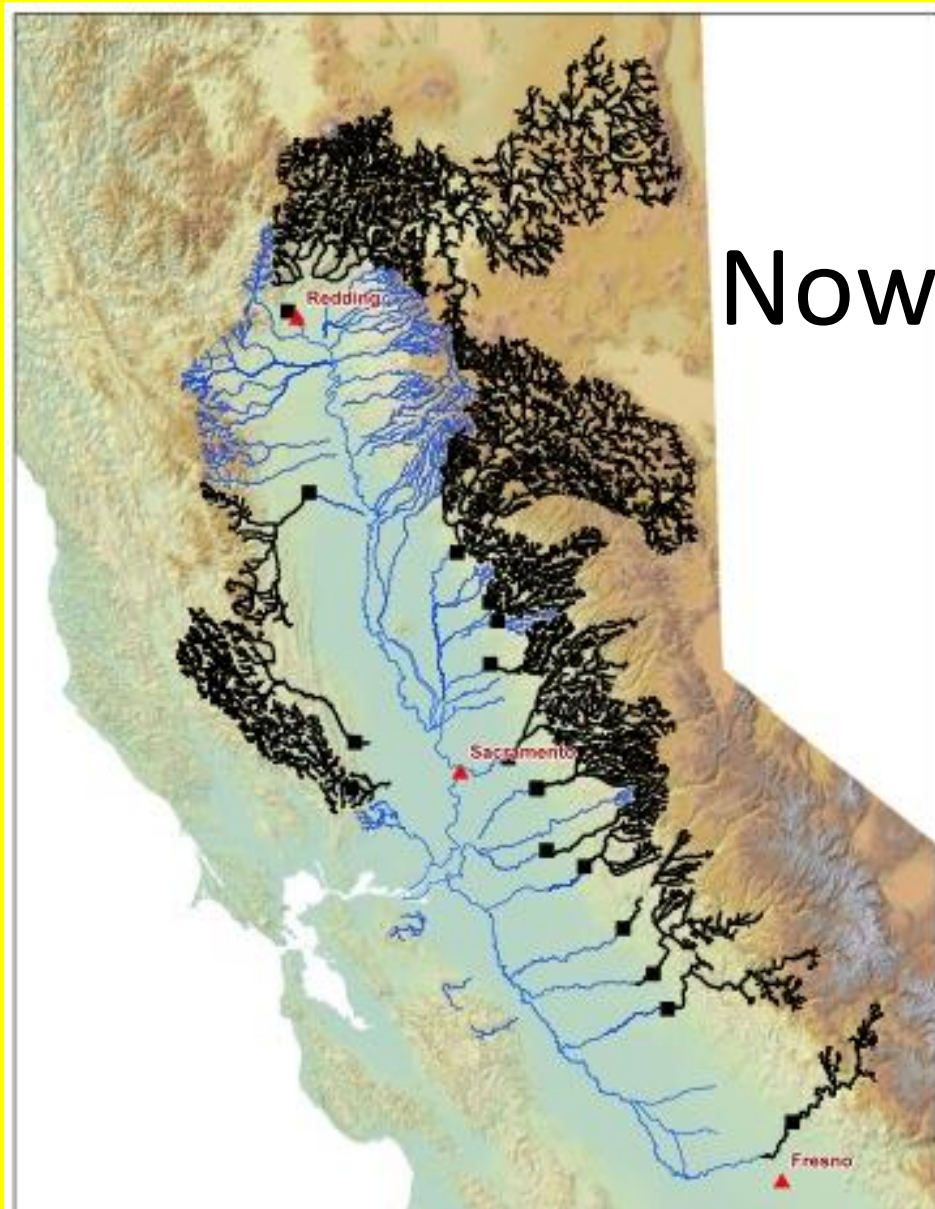
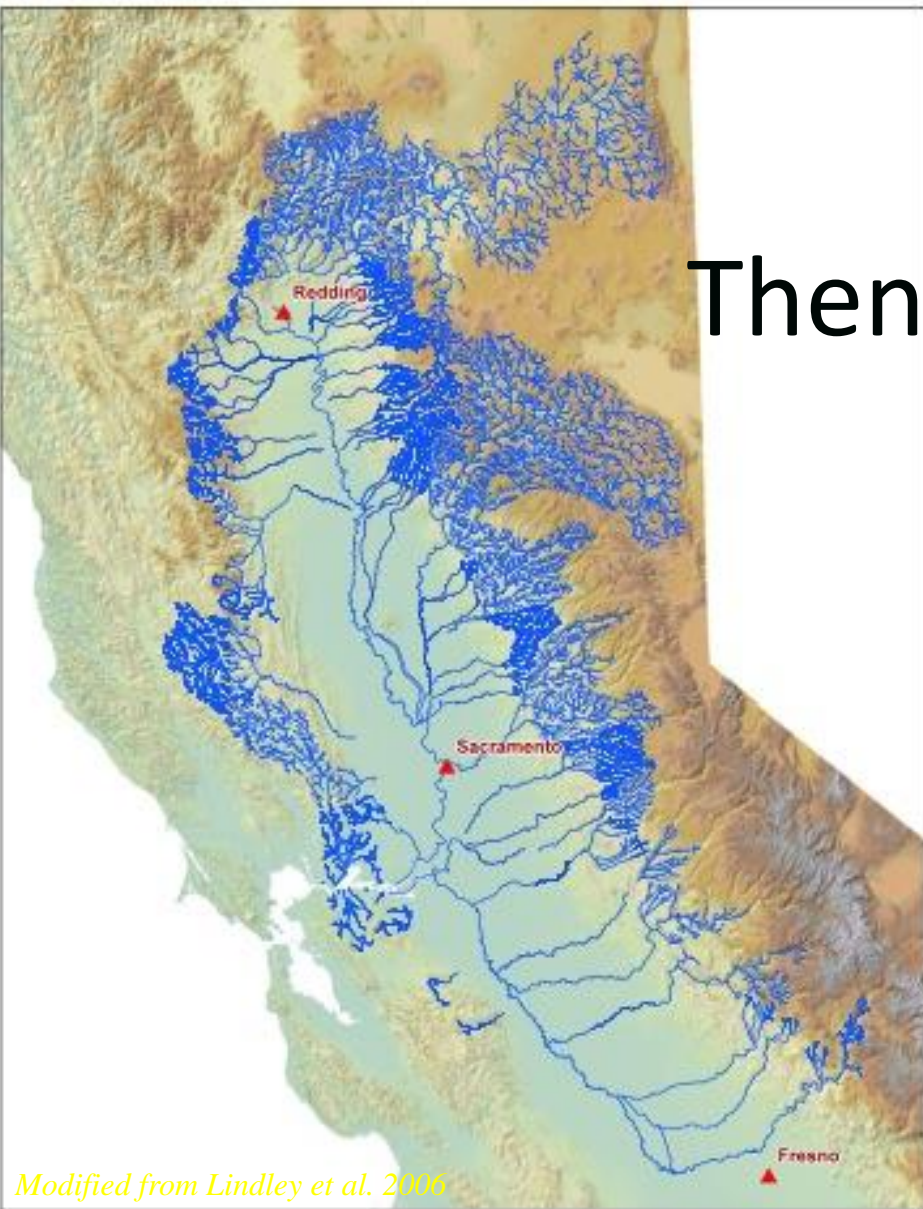
- Store and move water
- Simplify
- Cash out early/quickly
- Hope



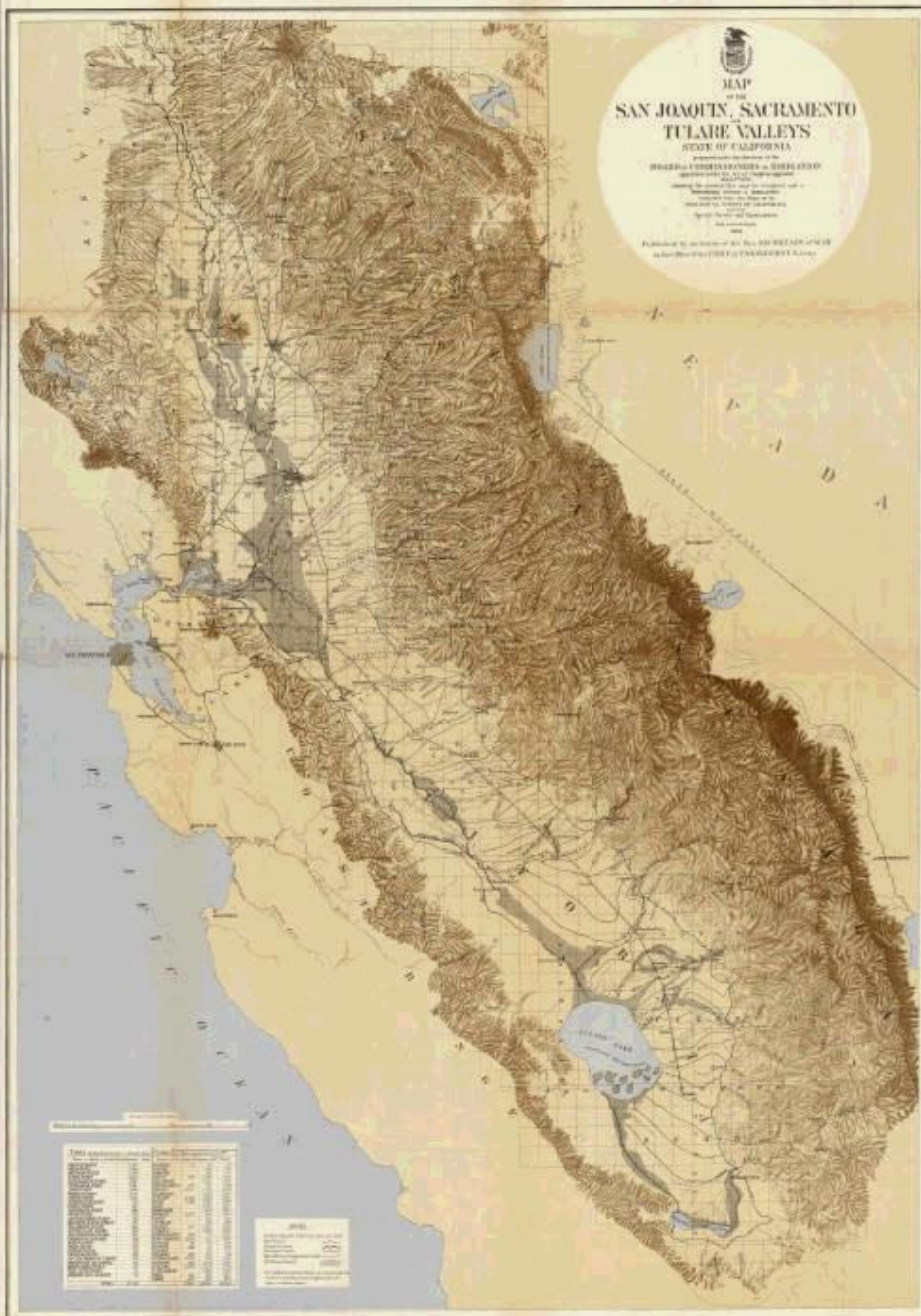
1594 Dams in California
 National Inventory of Dams, Army Corps

Then

Now



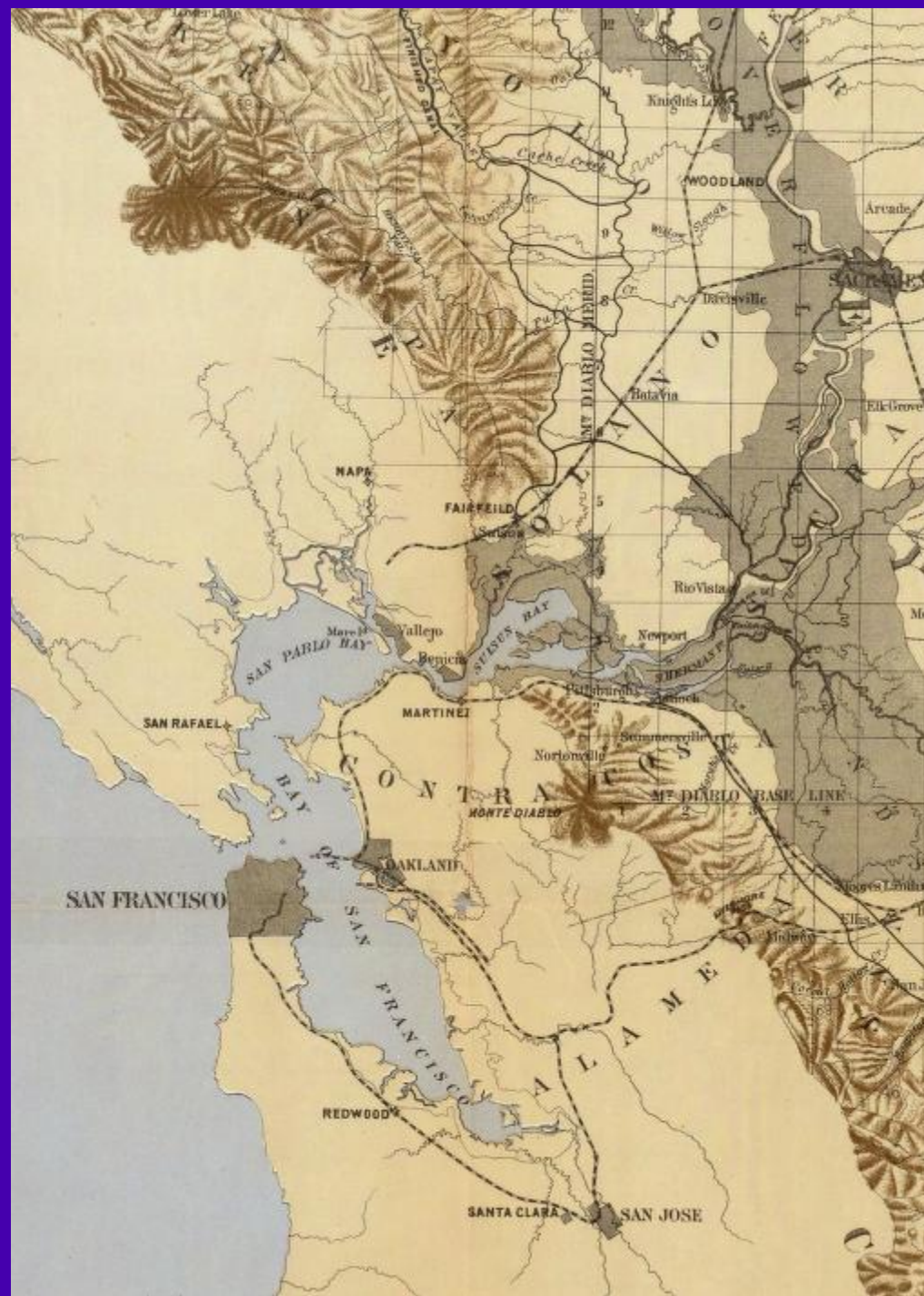
Modified from Lindley et al. 2006

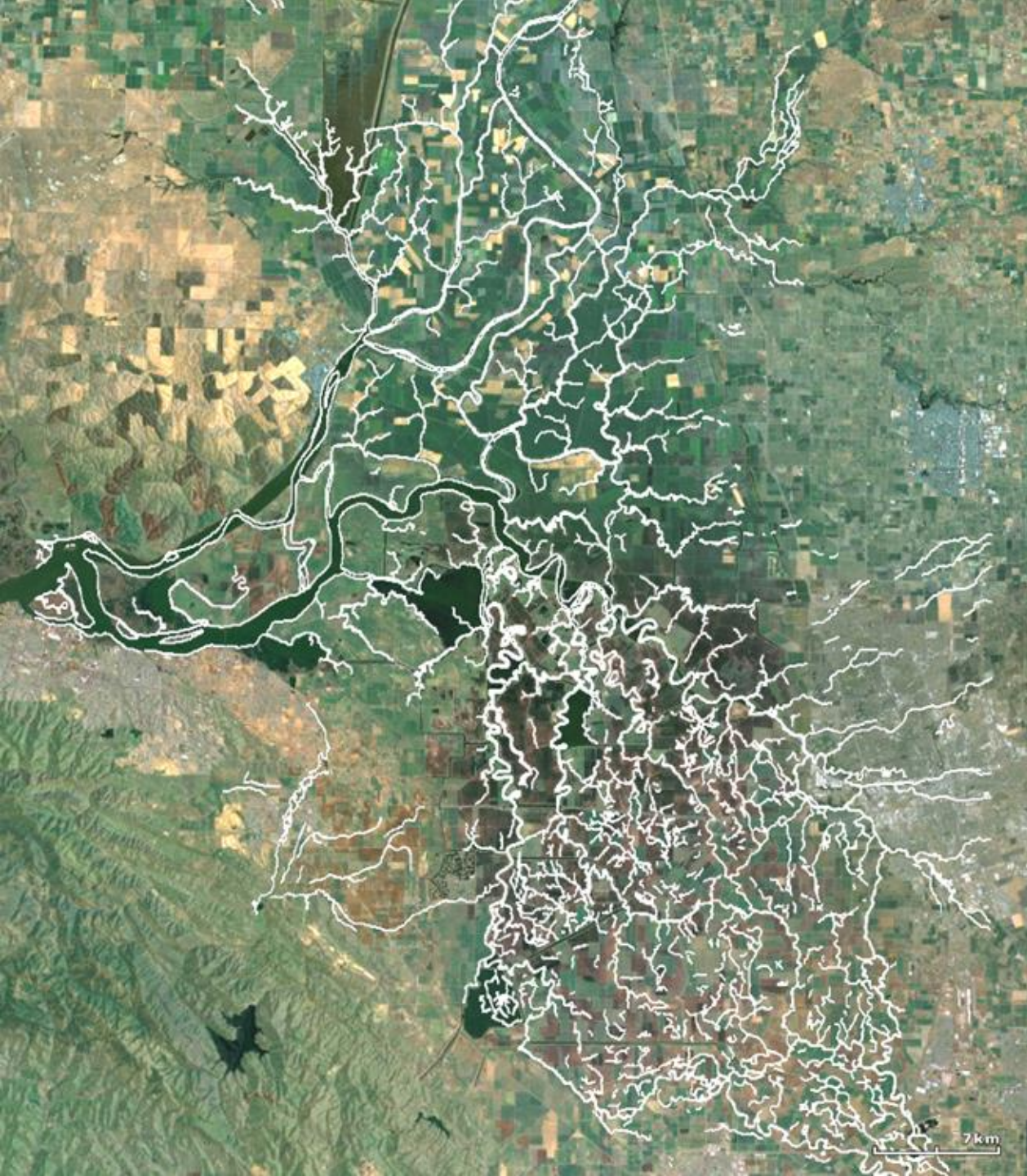


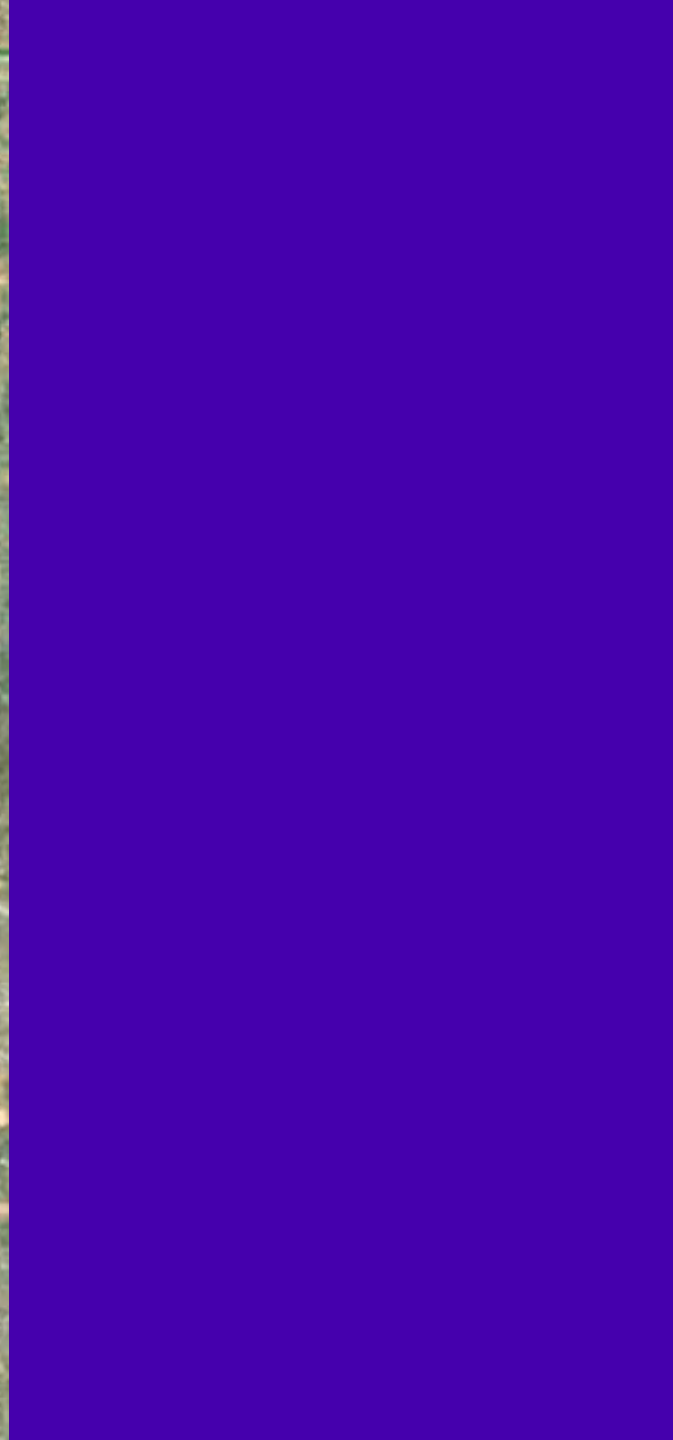
Select from the following Map Views

- Major Rivers
- State Projects
- Federal Projects
- Local Projects
- All Water Projects











Suisun Marsh



Sacramento River at
Decker Island



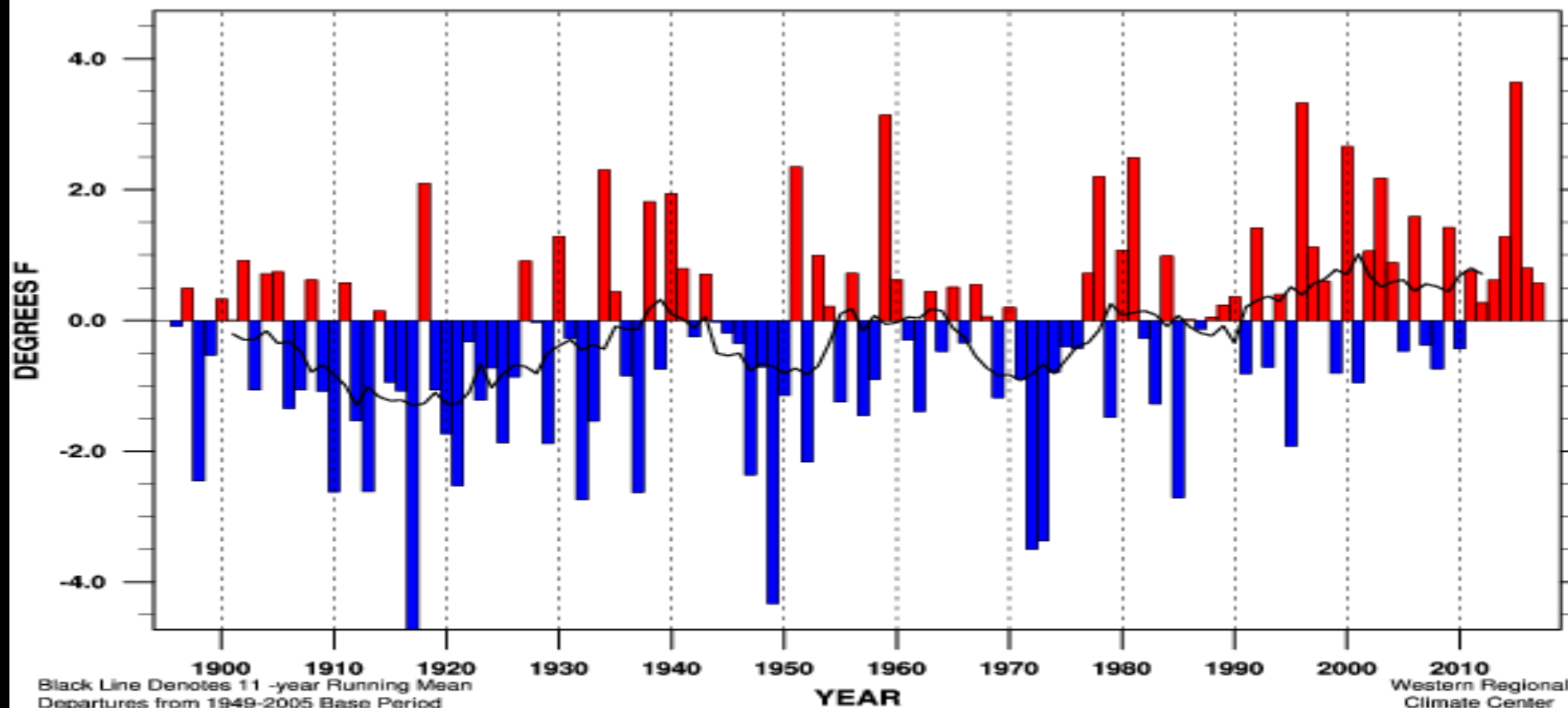
Our Problems

Climate change

Invasive species

Failing infrastructure

California Statewide Mean Temperature Departure Oct-Jan



Linear Trend 1895-present

+ 1.24 ± 0.73 °F/100yr

Linear Trend 1949-present

+ 1.94 ± 1.72 °F/100yr

Linear Trend 1975-present

+ 2.34 ± 3.41 °F/100yr

Warmest Year

51.1 °F (+ 3.6 °F) in 2015

MEAN 47.5 °F

Coldest Year

42.7 °F (- 4.7 °F) in 1917

STDEV 1.46 °F

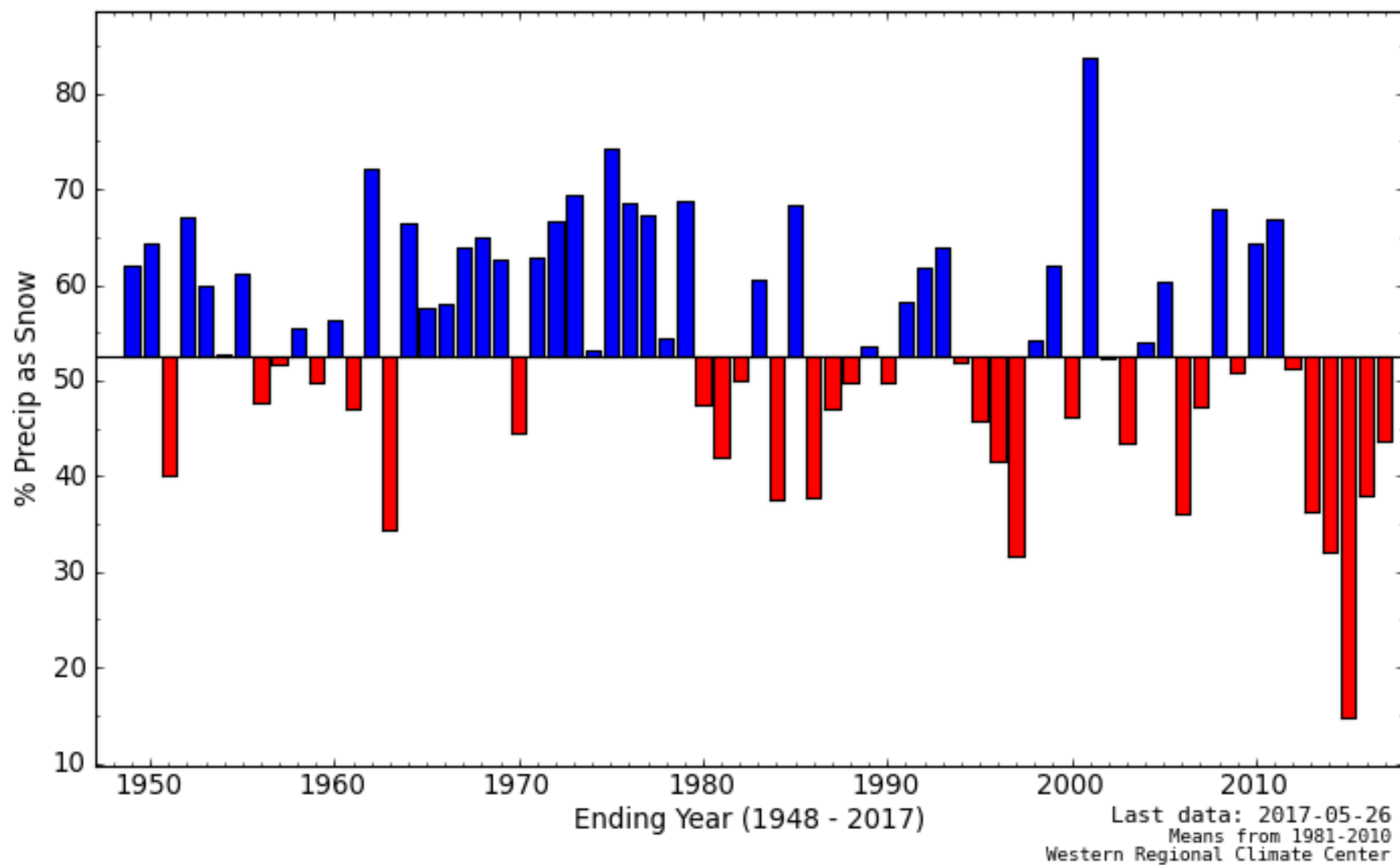
Oct-Jan

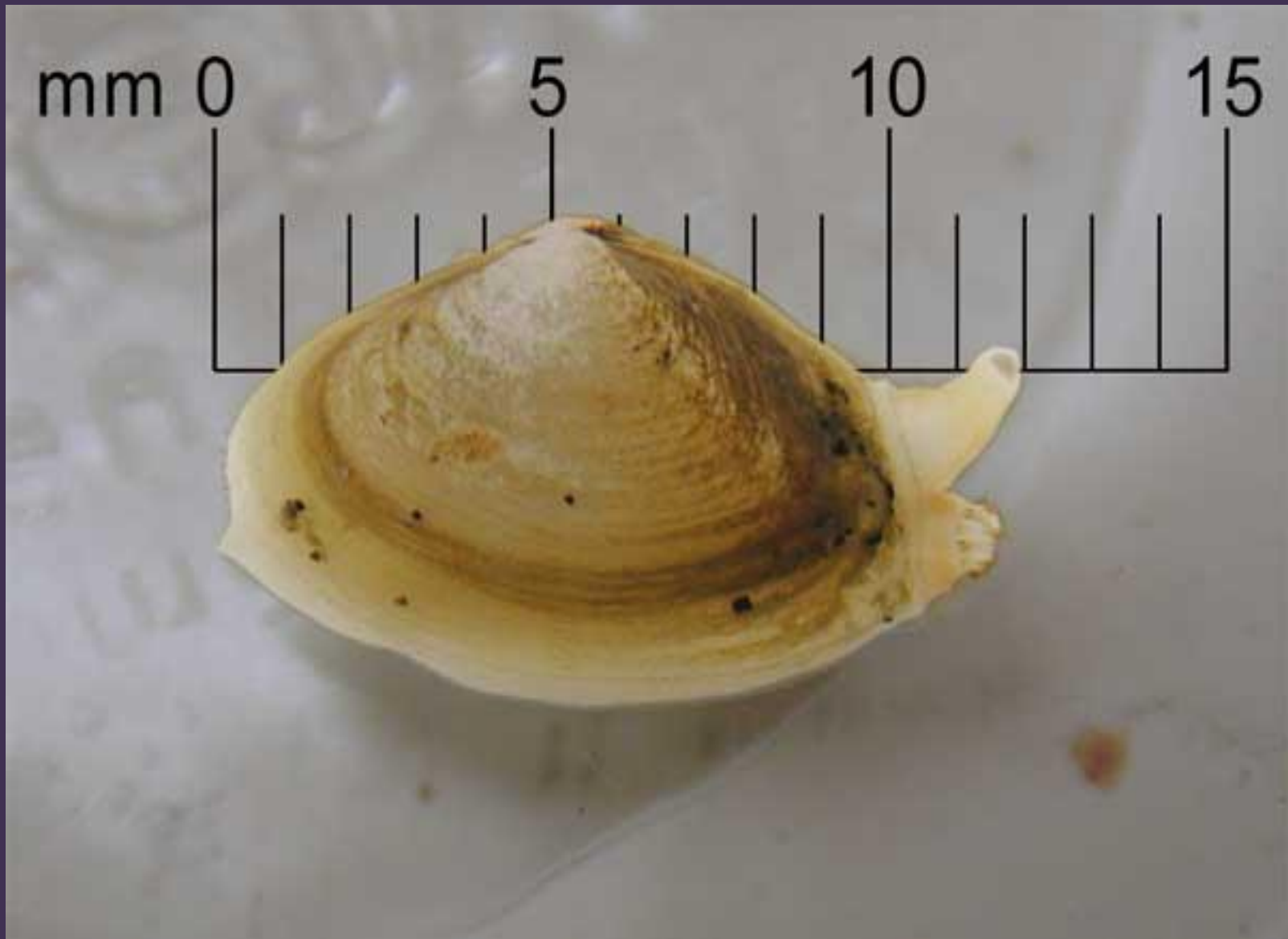
2017

48.0 °F (+ 0.6 °F)

RANK 84 of 122

7 Months Ending in May % of Precip as Snow 39.28°N, 120.37°W 2200m









Water Hyacinth, San Joaquin River @ Connection Slough; December 2014.

Photo: Roger Kelly for Bay Nature Magazine



**South American Sponge Plant @ Brannon Island
2011 Lars Anderson**

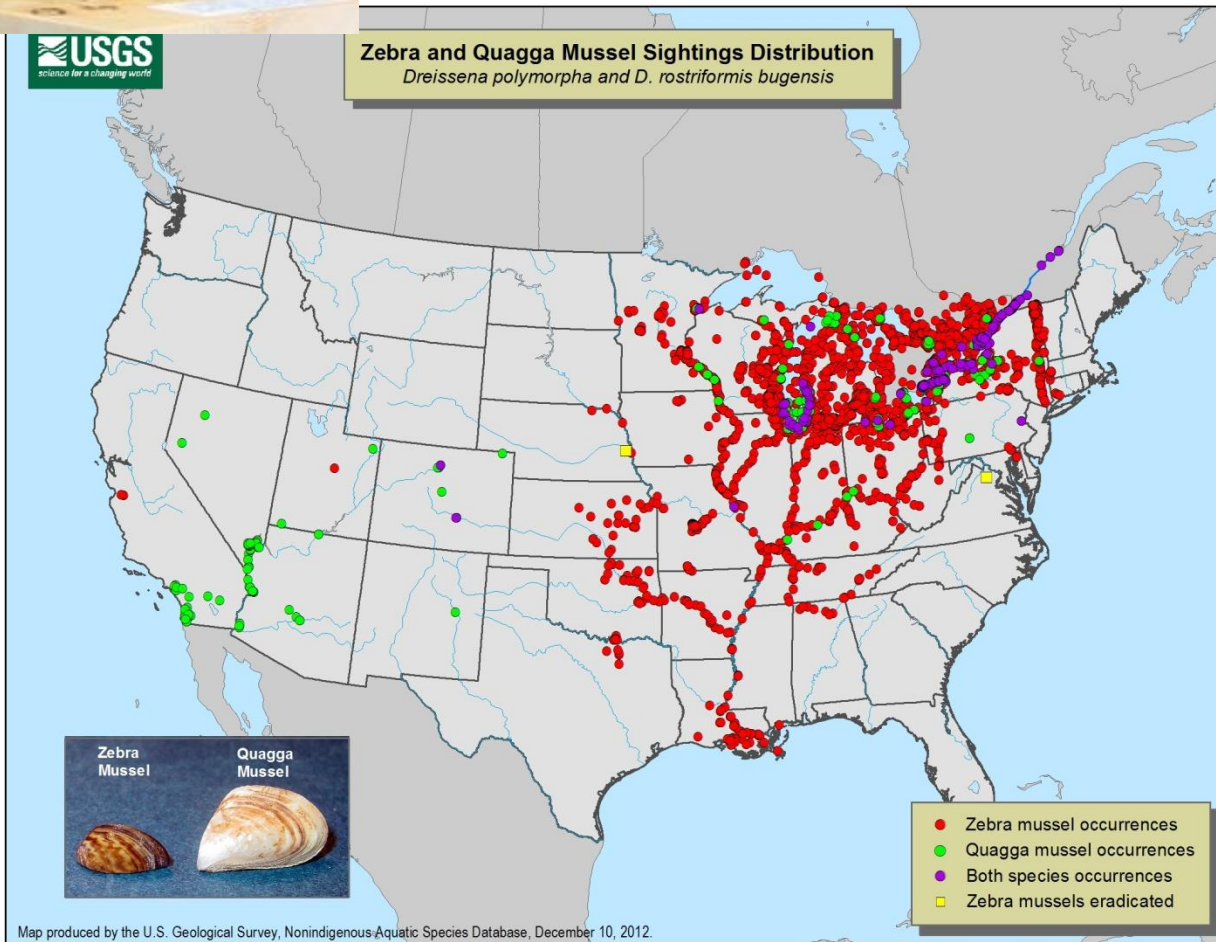
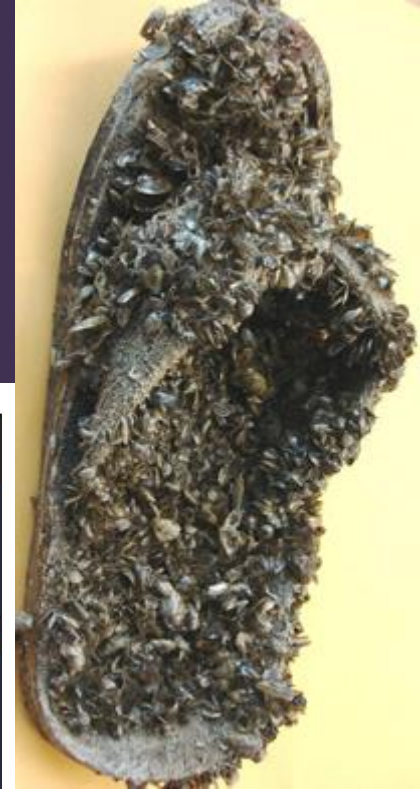


**Loach: San Joaquin River near
Fresno, Fall 2014.**



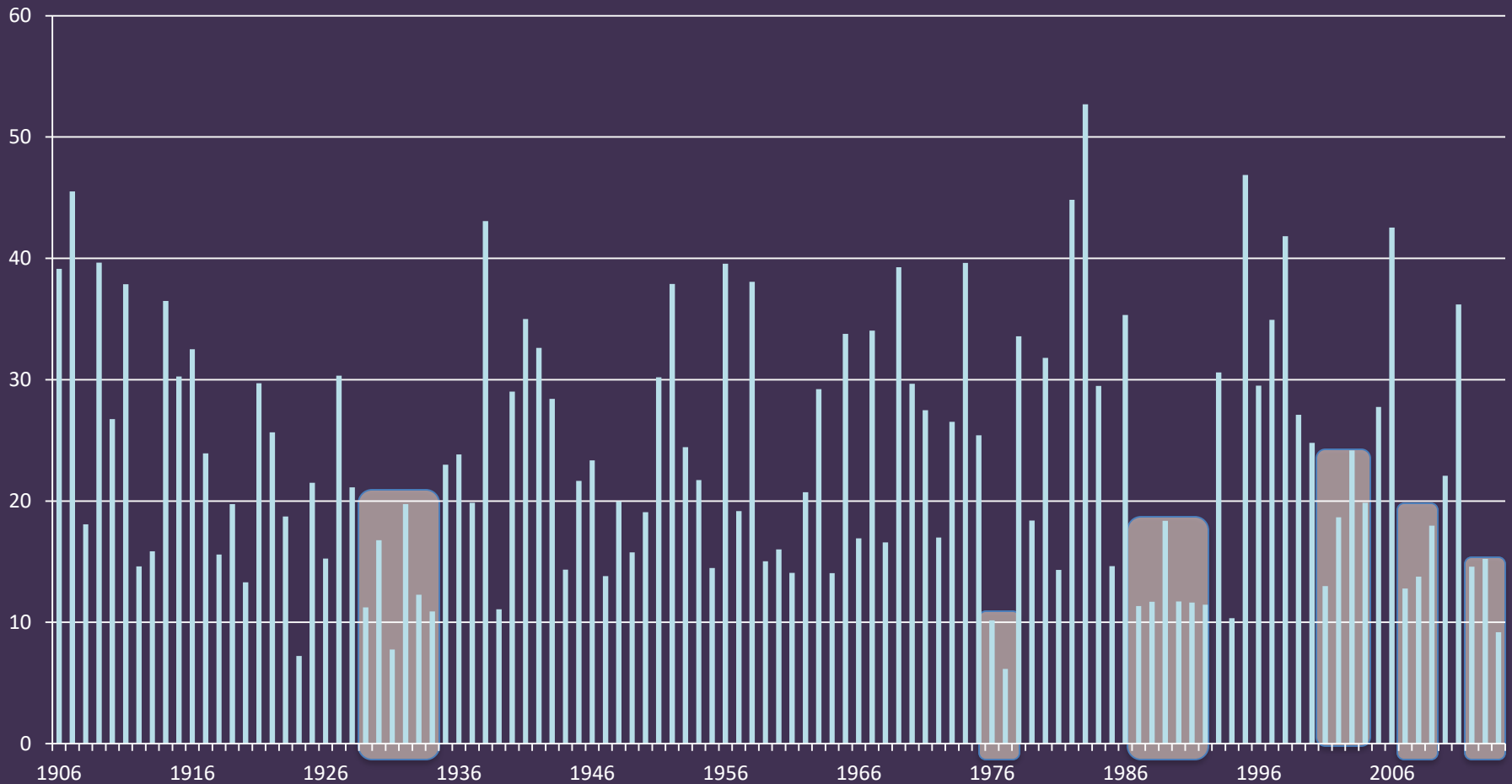


Today?





Central Valley Runoff MAF



Exports in acre-feet

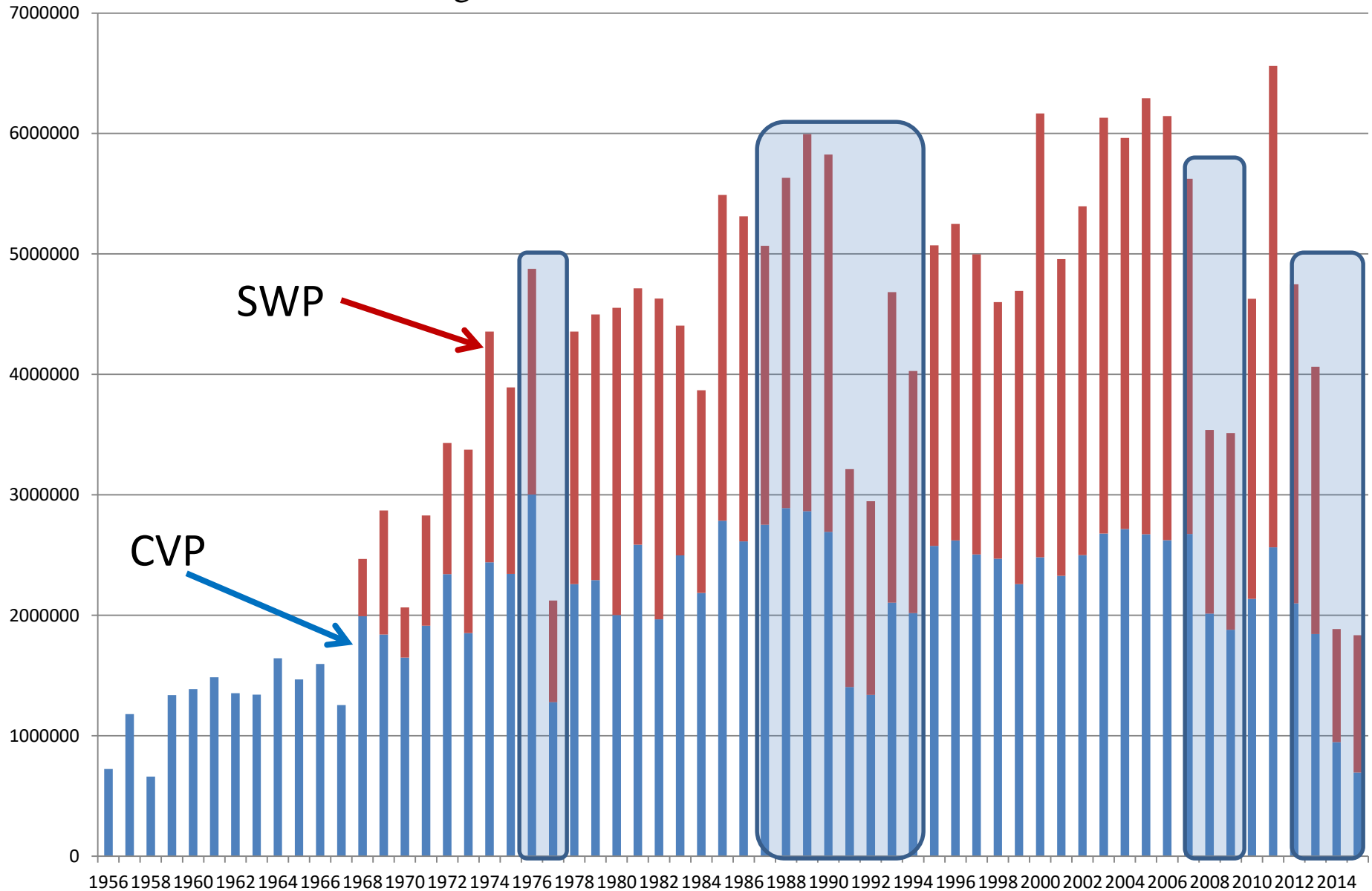
1 acre-foot = 325,851 gallons

OR

1233 kiloliters

OR

1 cfs for 12 hours



Problems:

Snow is increasingly unreliable

Storage options are limited

Export facilities are at risk

Fish adapted to CA climate are at risk

Scope, Limits, Uncertainties:

Systemic, Mountains to Bay

No single action can address much

Many users at table

Engineering of landscape restricted/done

Set Goals:

Water supply?

Maximum each year vs stable each year

Water demand?

Conservation, Contracts and Costs

Reliability?

Maintain old vs build new

Good government? Integrate with whom?

Costs:

Money: Purchase price vs Maintenance

Legislation: Beneficial Uses change with water supply? Conservation mandates?

Reliability?

Maintain old vs build new

What Next?

