

# A Brief Introduction to Central Valley Fish Assemblages

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# Objectives of this Presentation

- Provide background for Bob's talk
- Introduce pre-European settlement Central Valley habitats and fish communities, emphasizing the San Joaquin River Drainage
- Summarize changes in habitats and fish communities and recent research on community structure and habitat relations of the existing mixture of native and introduced species

# Why Monitor Fish?

(Karr 1991)

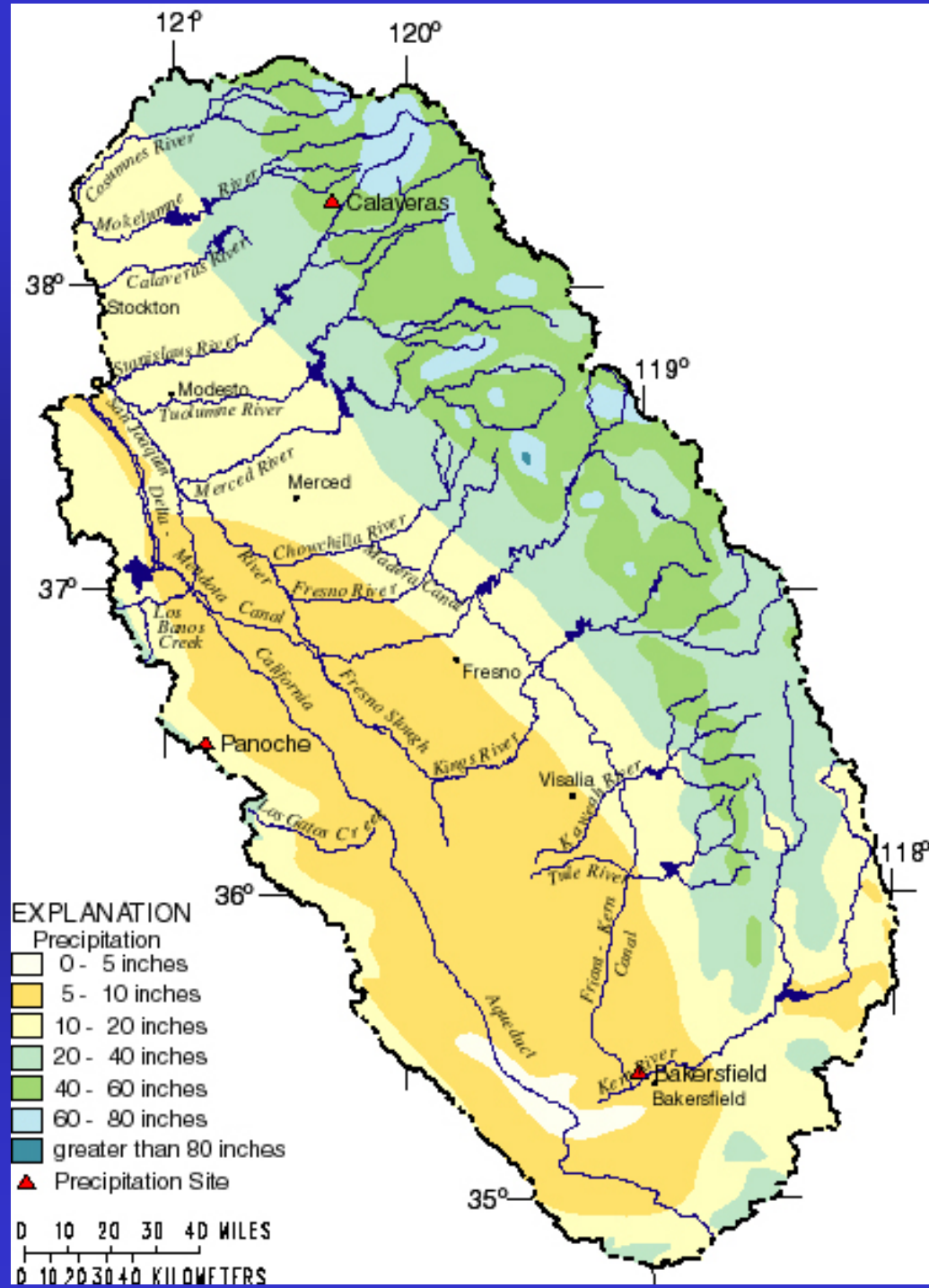
- Extensive life history information
- Species representing a variety of trophic levels
- Relatively easy to identify (on site)
- General public can relate to statements about fish (ESA and game species)
- Both acute and stress effects can be evaluated
- Direct connection to a beneficial use (recreational fishing)

# San Joaquin River Drainage

Mediterranean  
climate with hot  
dry summers and  
cool wet winters

This is a snowmelt  
driven system

Water use depends  
on storage



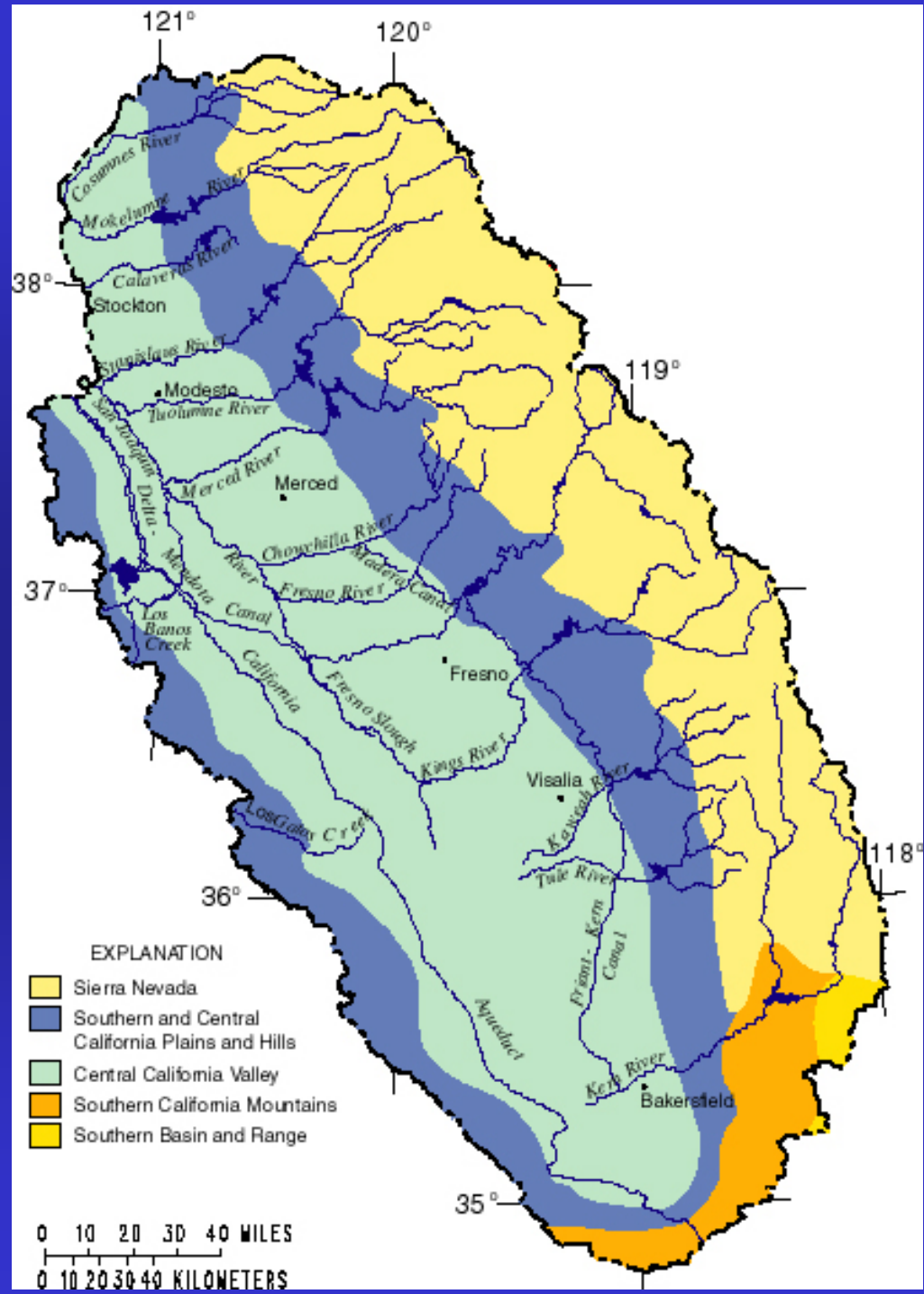
# Ecoregions

The drainage includes three basic ecological regions:

Sierra Nevada

Foothills

Valley





# Historic Sierra Nevada



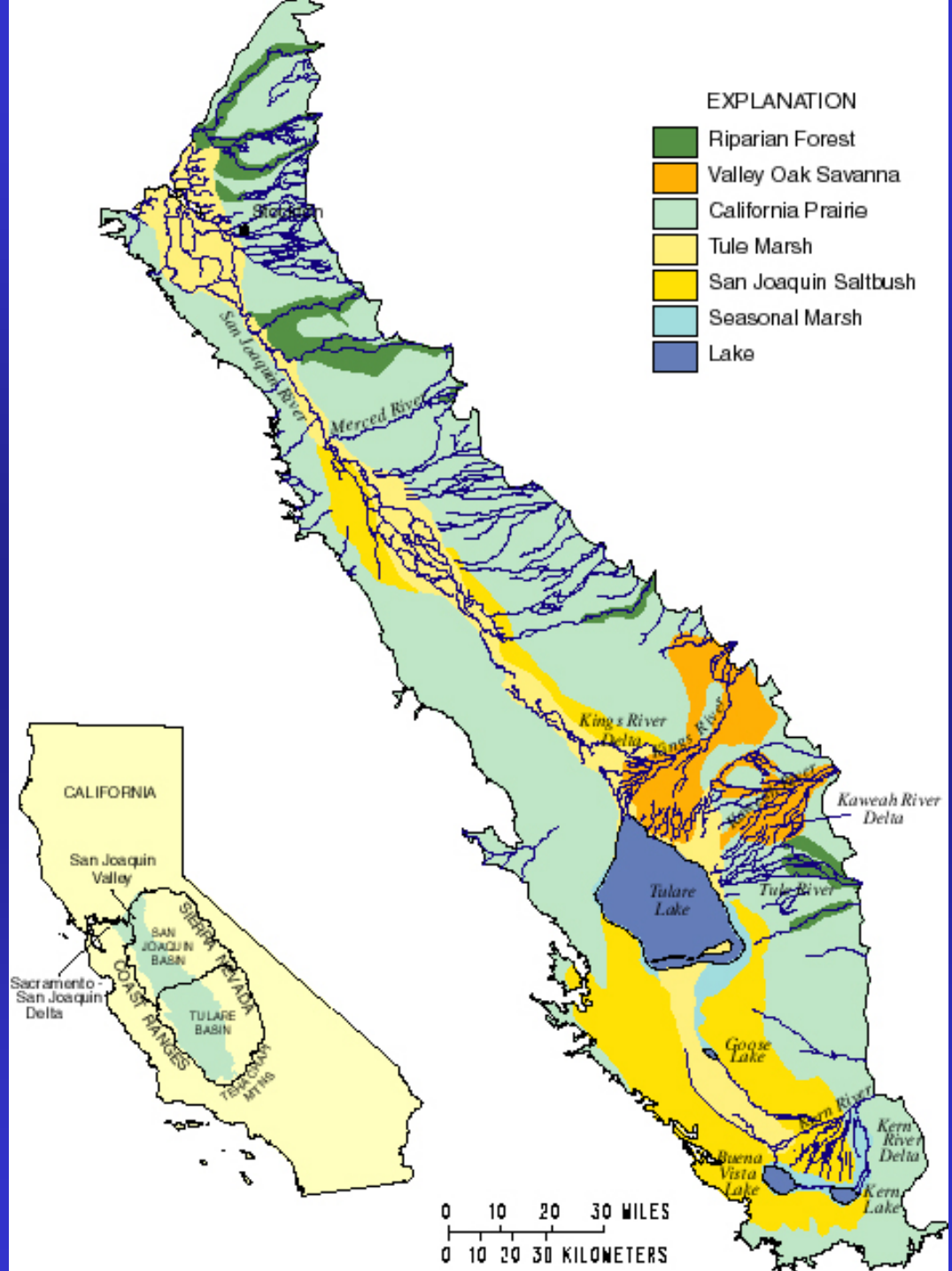
# Historic Foothills





# Historic Central Valley Habitat Types

- Valley oak savannah
- Grasslands/prairie
- Riparian forest
- Seasonal marsh
- Tule marsh
- Tulare Lake or Delta





Similar to the changing terrestrial habitats, there are natural environmental gradients in stream ecosystems.

Human activities can alter the natural gradients or co-occur with them.

Biota respond to both natural and disturbed gradients.

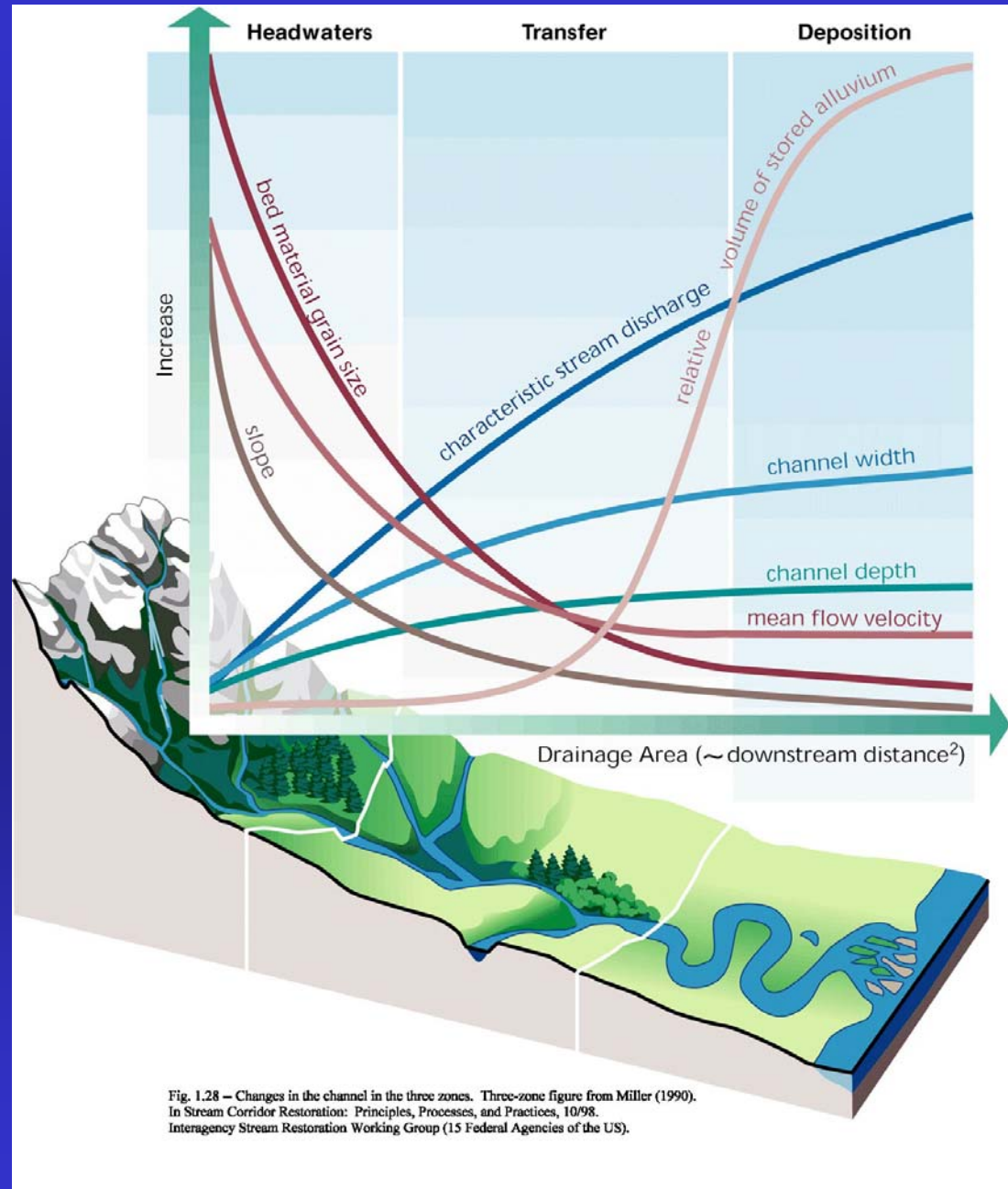


Fig. 1.28 – Changes in the channel in the three zones. Three-zone figure from Miller (1990). In Stream Corridor Restoration: Principles, Processes, and Practices, 10/98. Interagency Stream Restoration Working Group (15 Federal Agencies of the US).

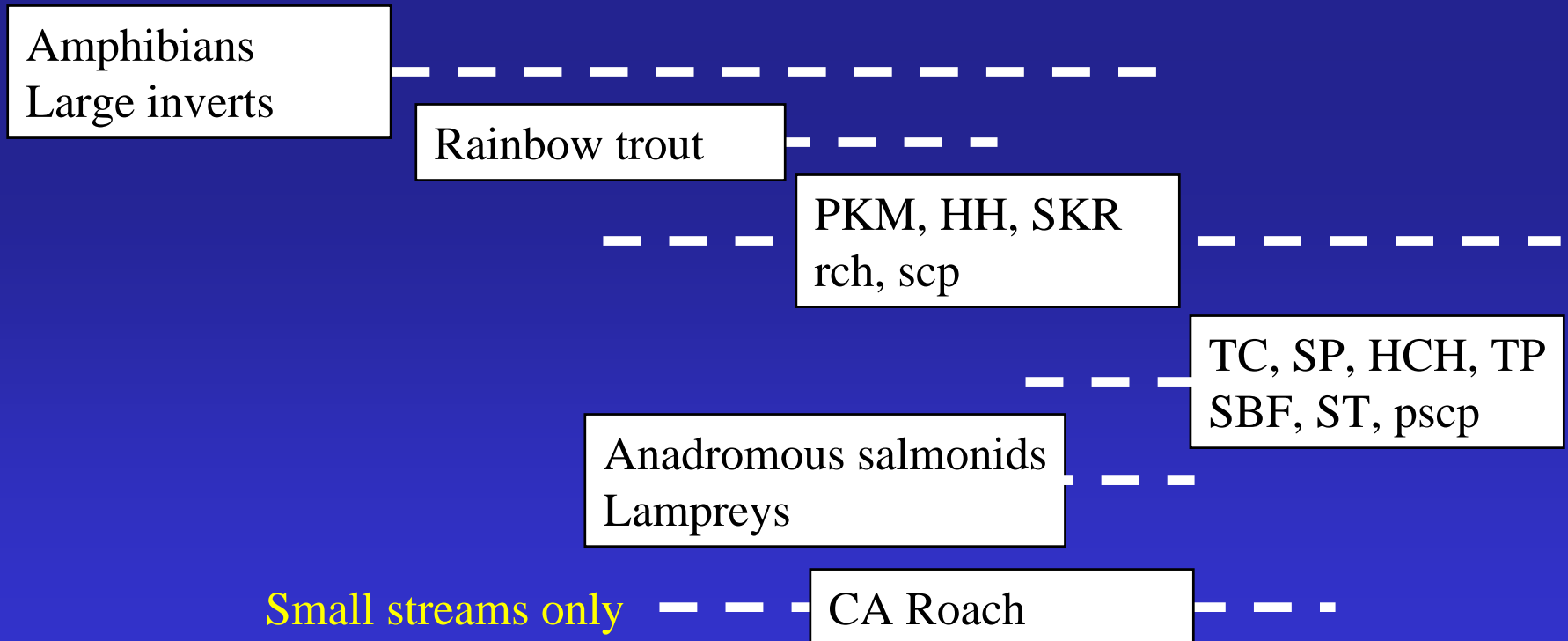
# Subregions of the Sacramento-San Joaquin Aquatic Zoogeographic Region (Moyle 2002)

- 10-15 million year isolation resulted in highly endemic fish fauna
- 28 native species
- 8 species at risk of extinction
- 3 species already extinct



# Natural Fish Distributions

Mountains	Mountains	Foothills	Valley
Fishless zone	Trout zone	Pikeminnow- hardhead-sucker zone	Deep-bodied fishes zone
> 1,000 m	450 - 1,000 m	30 - 450 m	< 30 m



# Sierra Nevada





# Fishless Zone



# Mountain community (Trout Zone)





# Foothills





# Anadromous Species

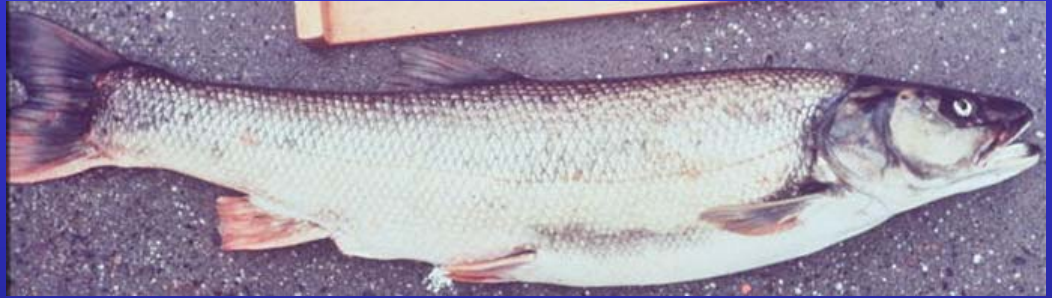


Spring-run and fall-run)





Foothill  
Community  
(Pikeminnow-  
hardhead-  
sucker Zone)



# Oak savannah/woodland





# California Roach Zone

(small foothill streams)



# Grassland





# Riparian Forest

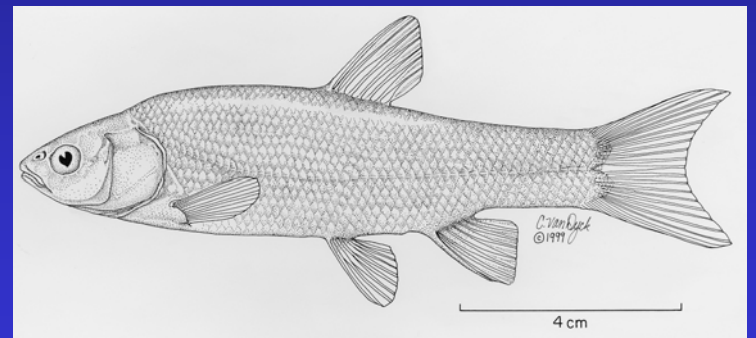


# Tule Marsh





# Valley Community (Deep-bodied Fishes Zone)





# Summary observations

- Few species
- Highly endemic

What  
Happened?

Gold brought  
people!

People brought  
fish and changes  
in land and  
water use



# Valley Changes

- Gold mining (dams and sediment)
- Flood control and land reclamation for agriculture and urbanization (dams)
- Water for agriculture and water supply (dams, distribution systems)
- Accompanying changes in water quality and hydrology
- Introduced species





Dredger mining disturbed substrates and required water for sluices. Mercury used to capture gold.

Hydraulic mining required dams to provide hydraulic head and caused sediment problems. Mercury used to capture gold.



# Dams

- Some water supply (lower flows)
- Mostly hydropower (fluctuating flows)
- Lower elevation dams block migration



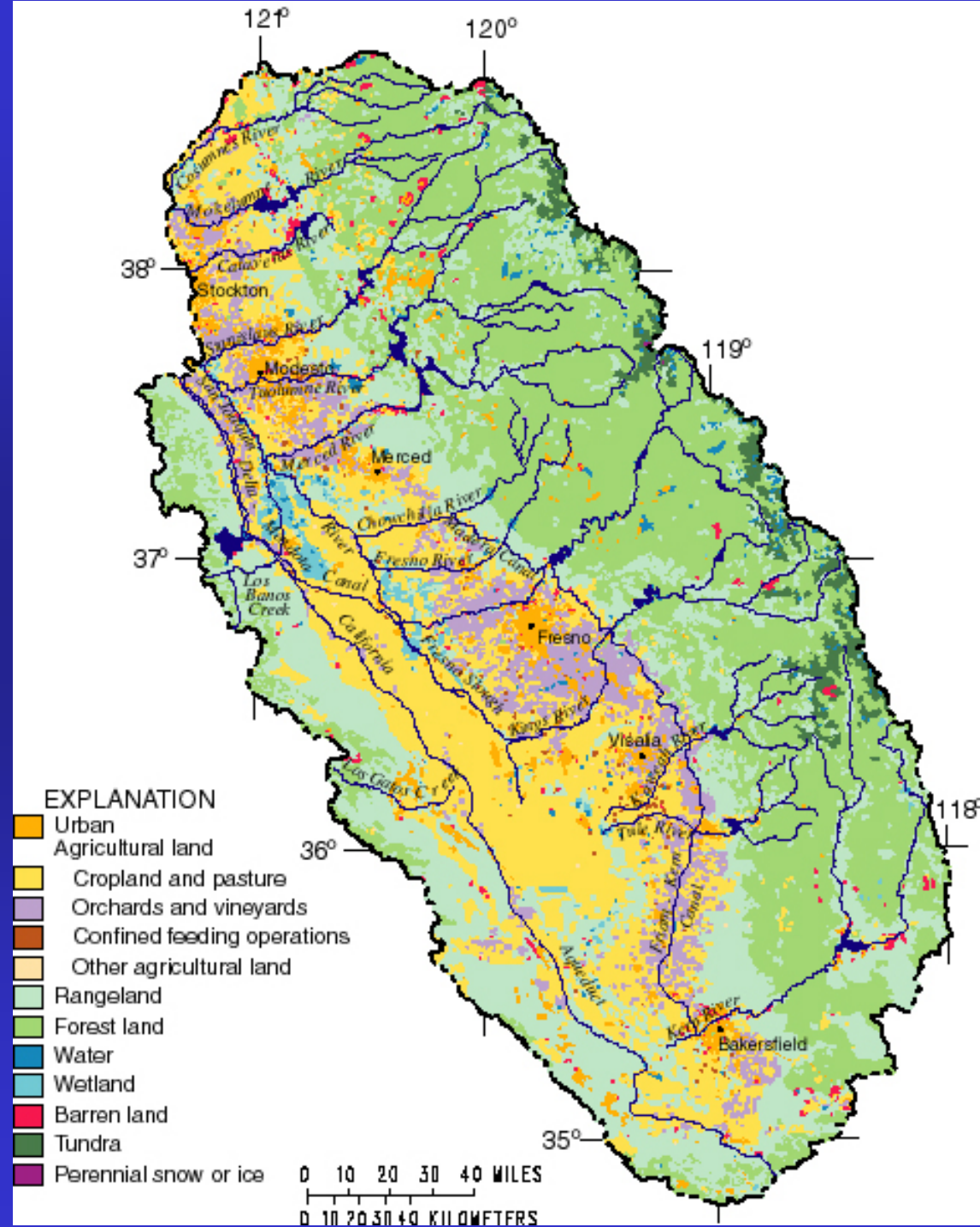


# Flood Control and Water Distribution Allow Extensive Agriculture





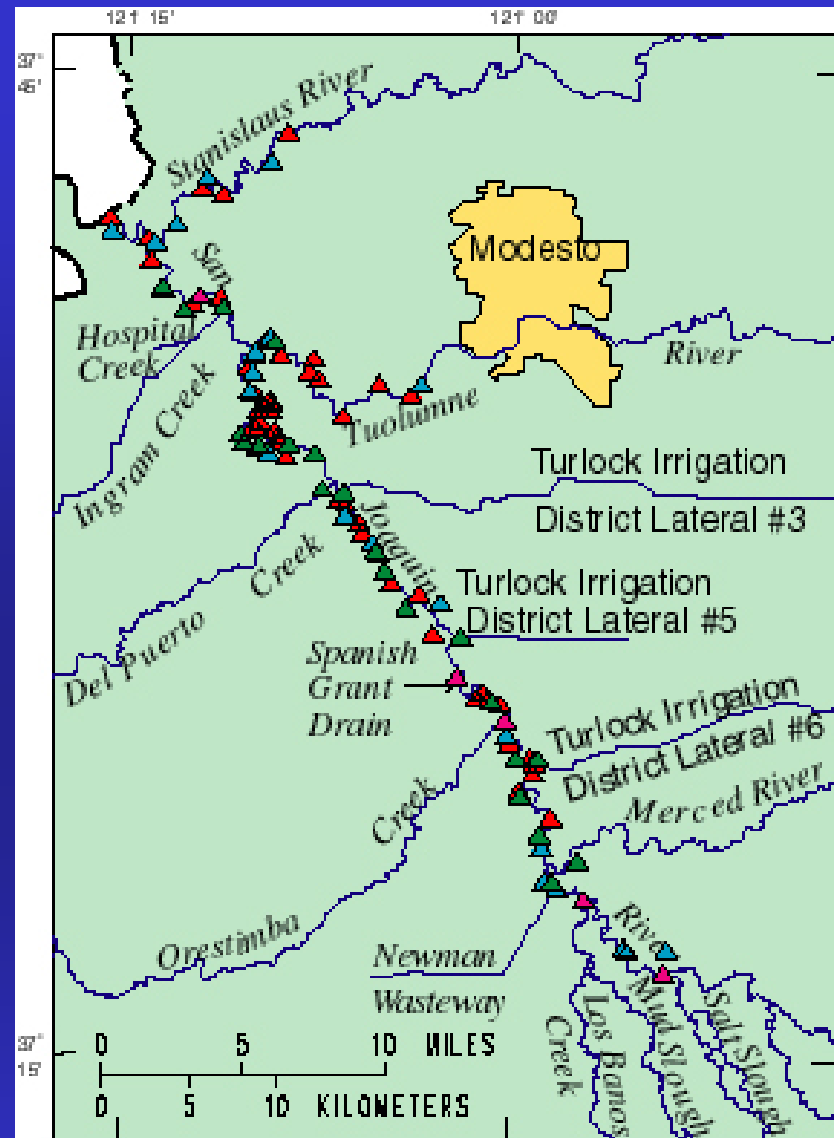
Valley floor almost completely converted to agricultural land uses





# Agricultural drains are sources of:

- Pesticides
- Nutrients
- Salts
- Trace metals  
(Kesterson-Se)
- Suspended  
Sediments



## EXPLANATION

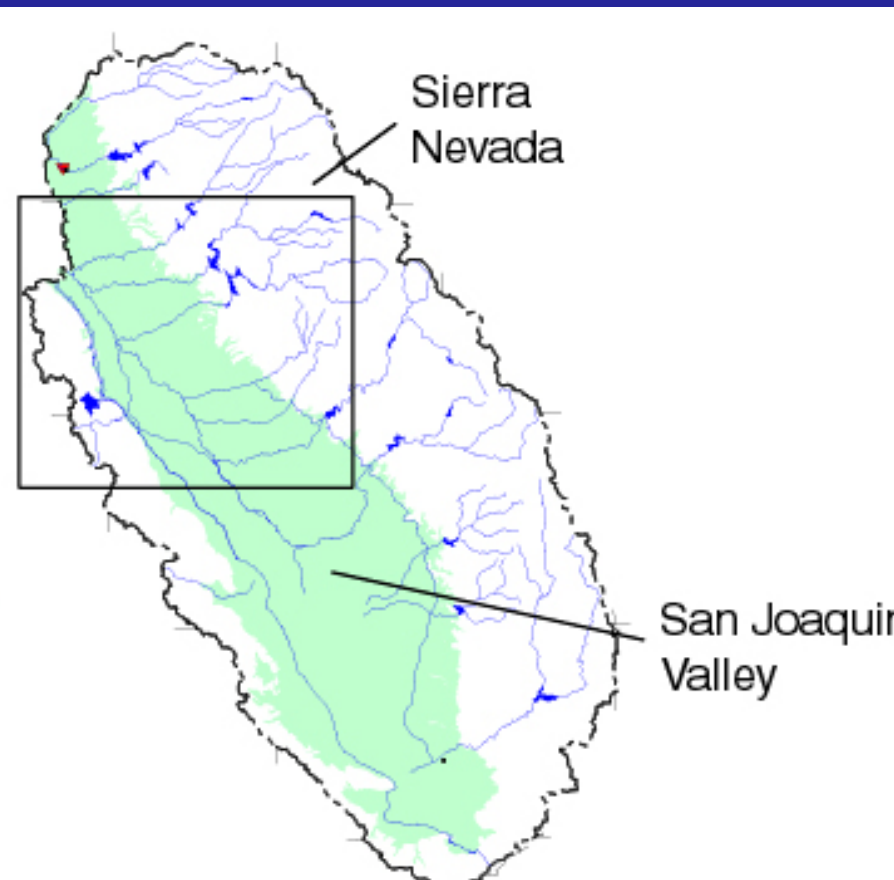
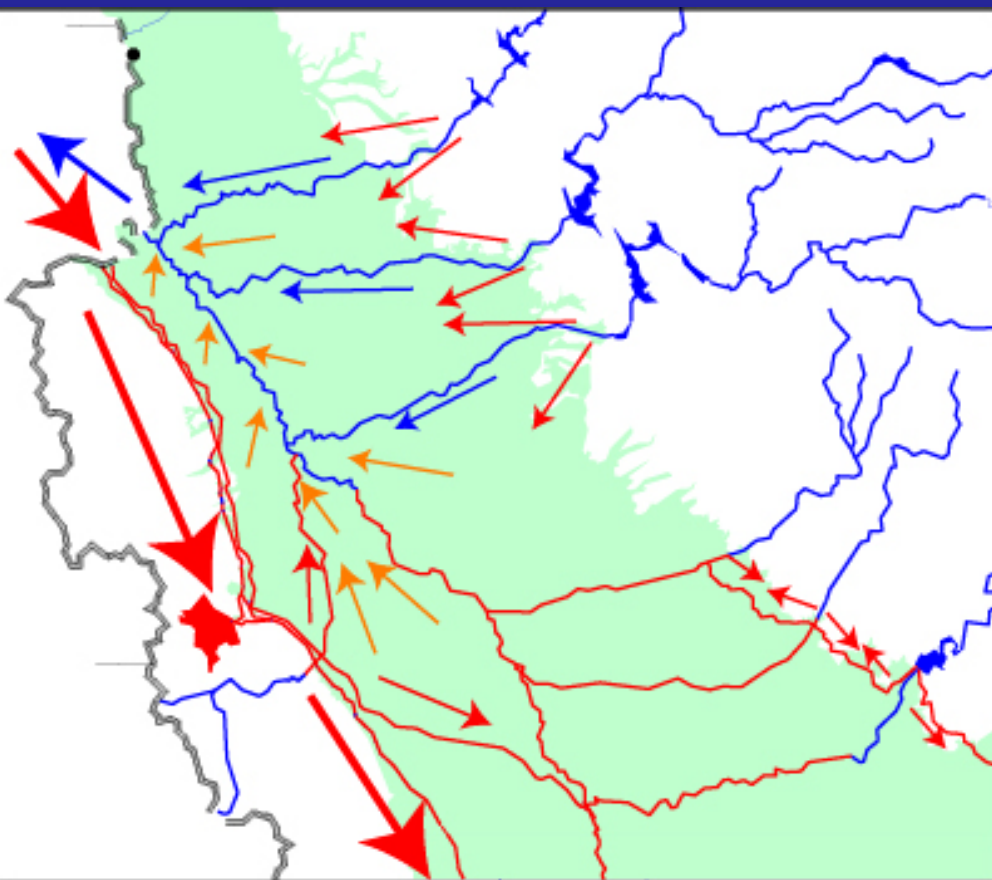
Discharge, in cubic feet per second

- ▲ less than or equal to 1
- ▲ greater than 1 and less than or equal to 5
- ▲ greater than 5 and less than or equal to 25
- ▲ greater than 25



# Water Flows in the San Joaquin River Drainage

- Instream flows
- Diversions, canals, and dry streambeds
- Agricultural and other return flows

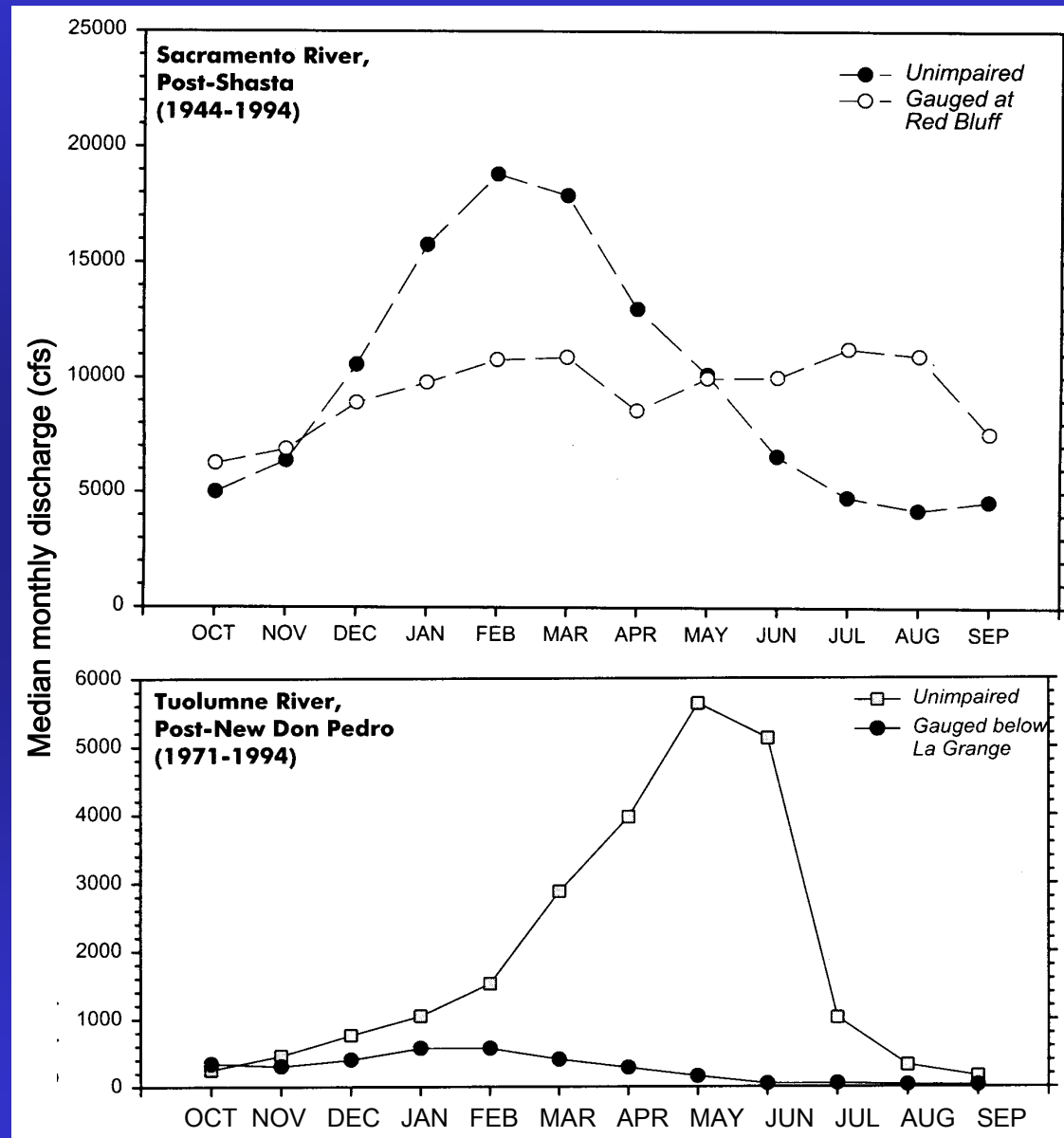


# Natural hydrographs have been altered

The Sacramento River below Shasta Dam is used to convey water to the Delta for export south.

Water project operations have redistributed flow and dampened seasonal variations.

In the San Joaquin basin, reservoir operations, combined with massive water diversions at the dams, have dramatically reduced flows and suppressed seasonal variability.



# High flow events are now rare or absent on many rivers and streams

From: Mount, J. F. California Rivers and Streams. 1995.

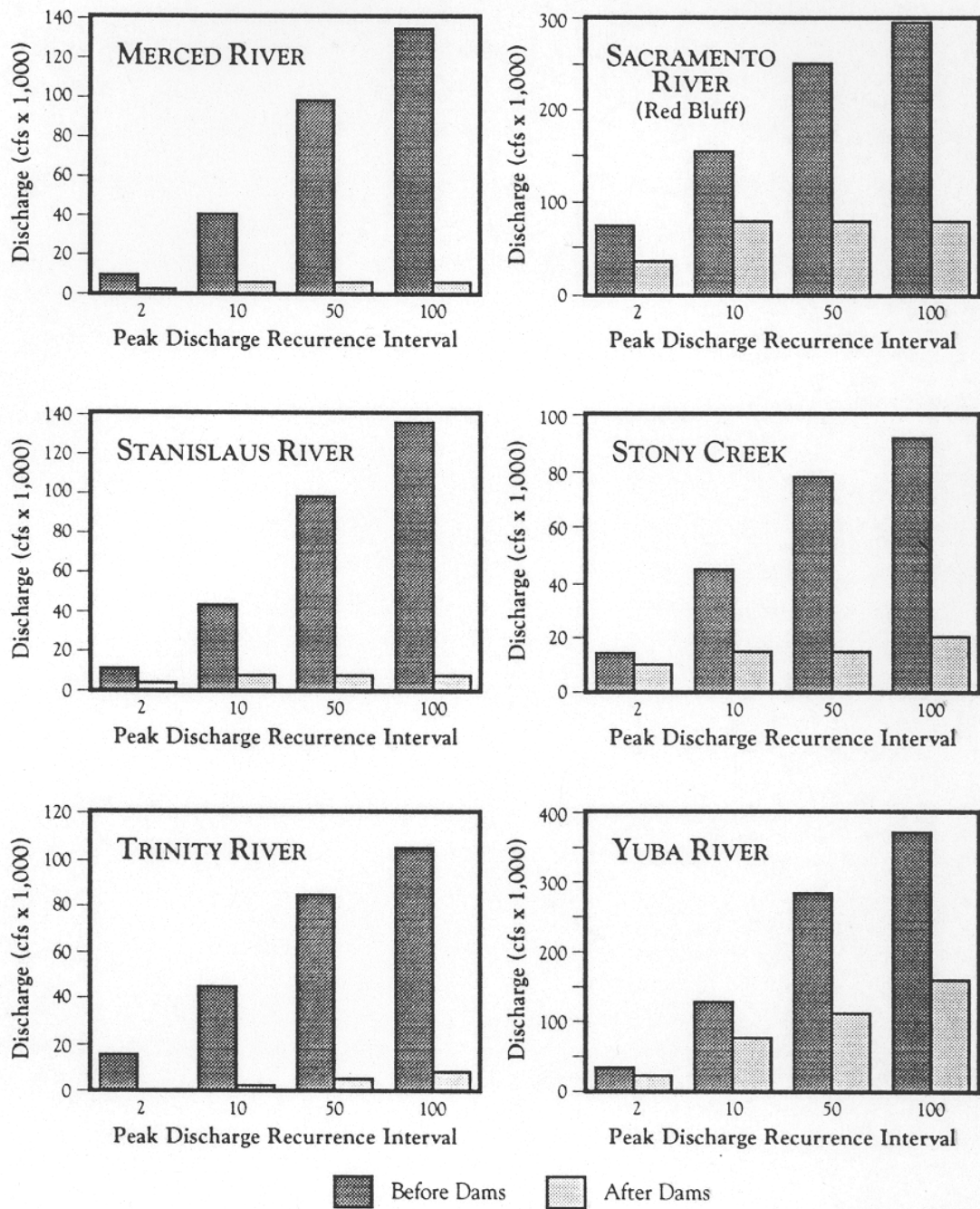
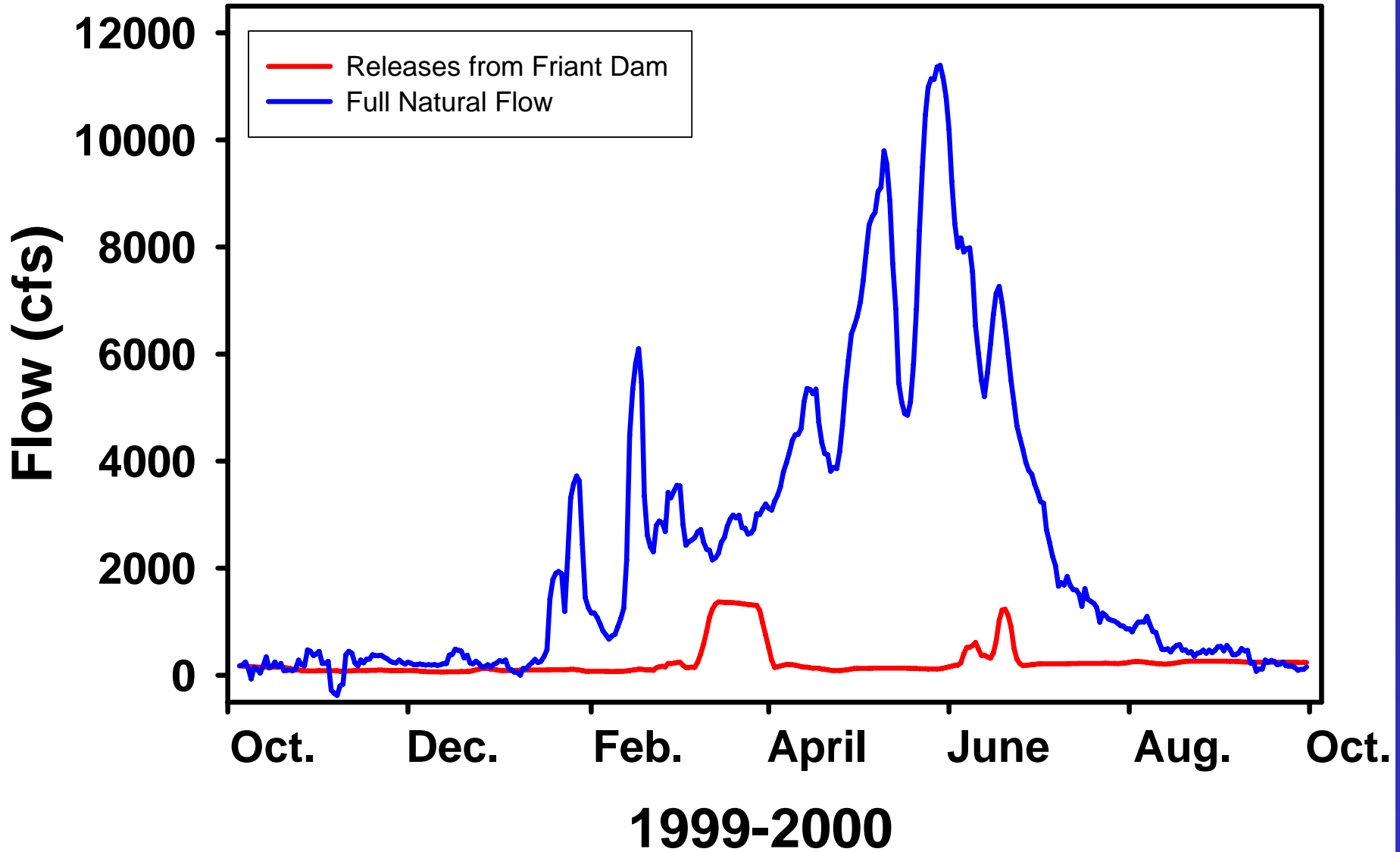


Fig. 16.4. Comparison of peak discharge/recurrence interval relationships prior to and after dam closure on selected rivers in California. (Based on data summarized in Kondolf and Matthews 1993)

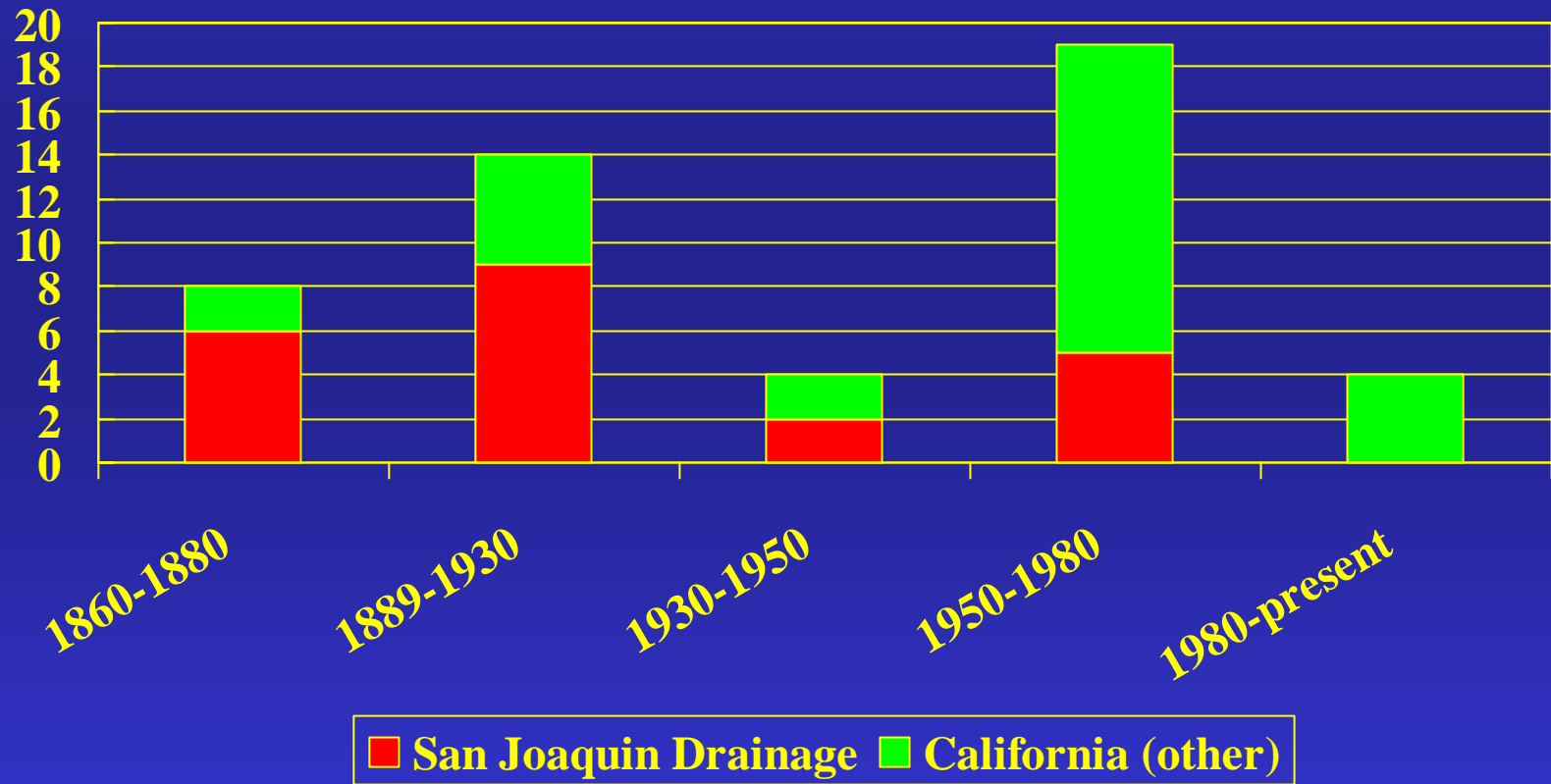


# San Joaquin River

## Releases vs Full Natural Flow



# Fish Introductions to California

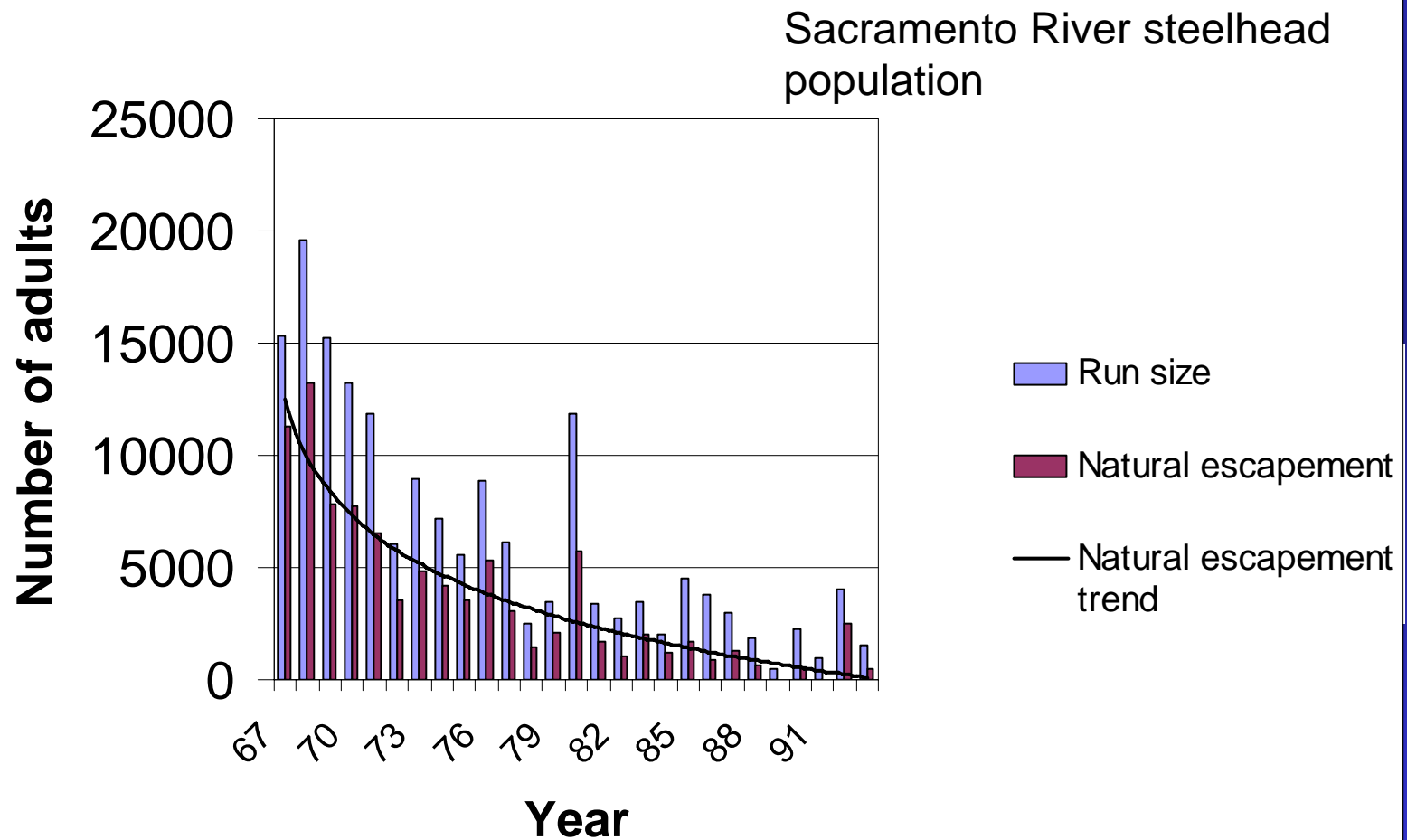


# Overall Species Status (Moyle 2002)

	Sacramento-San Joaquin						
	Goose Lake	Pit River	McCloud River	Central Valley	Clear Lake	Monterey area	Kern River
Native species	8	13	7	28	14	19	4
Introduced species	11	15	5	40	18	20	12
Total species	19	28	12	68	32	39	16
Species at risk	3	2	0	8	3	4	1
Extinct species	0	1	3	3	3	3	0



# Extirpation of Spring-run Chinook Salmon and Steelhead Rainbow Trout



That is what was, what do we  
have now?

Results of my work in the San Joaquin River  
drainage most recently the National Water  
Quality Assessment Program

# Lower San Joaquin River is disconnected from its tributaries





# Real Headwaters



Mud Slough

Salt Slough



# The Mainstem Begins



# East-side Tributaries



Stanislaus River near confluence

Merced River near confluence





# Agricultural Drain Tributaries



# Water Quality in Mainstem Improves at Downstream Sites



San Joaquin River at  
Vernalis

San Joaquin River at  
Fremont Ford

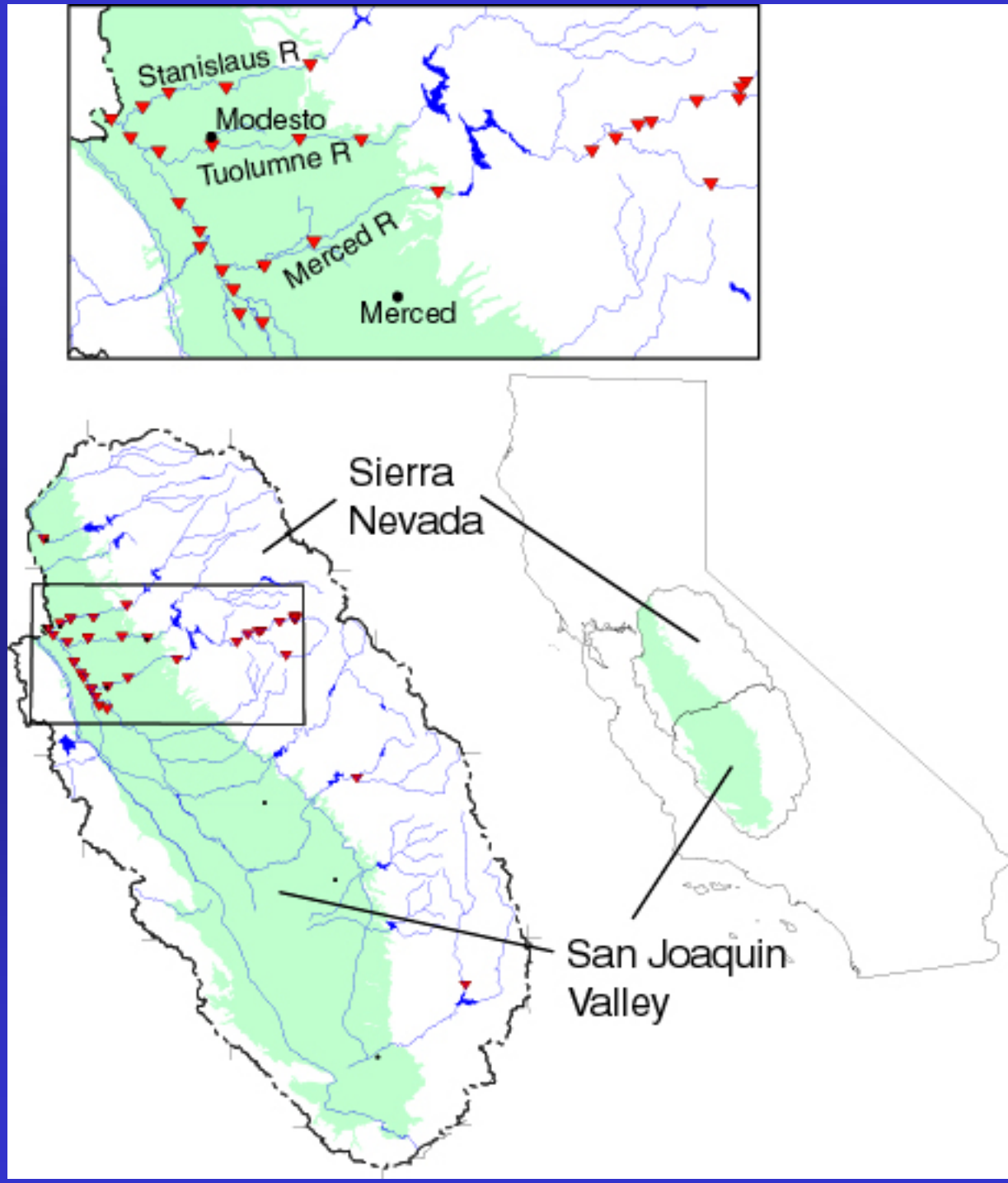




Location of  
NAWQA  
study area  
and study  
sites

31,000 sq. mi.

But not much  
surface water  
in the valley!





# NAWQA sampling (1993-1995)

## Total of 30 Taxa Captured

### Native Taxa:

#### *Petromyzontidae:*

Lampreys

#### *Salmonidae:*

Rainbow trout

#### *Cyprinidae:*

Hardhead

Sacramento pikeminnow

Sacramento hitch

Sacramento splittail

Sacramento blackfish

#### *Catostomidae:*

Sacramento sucker

#### *Embiotocidae:*

Tule perch

#### *Cottidae:*

Prickly sculpin

### Introduced Taxa:

#### *Clupeidae:*

Threadfin shad

#### *Cyprinidae:*

Common carp

Goldfish

Fathead minnow

Red shiner

#### *Ictaluridae:*

Black bullhead

Brown bullhead

White catfish

Channel catfish

#### *Poeciliidae:*

Western mosquitofish

#### *Atherinidae:*

Inland silverside

### Introduced Taxa:

#### *Percichthyidae:*

Striped bass

#### *Centrarchidae:*

Largemouth bass

Smallmouth bass

Green sunfish

Bluegill

Redear sunfish

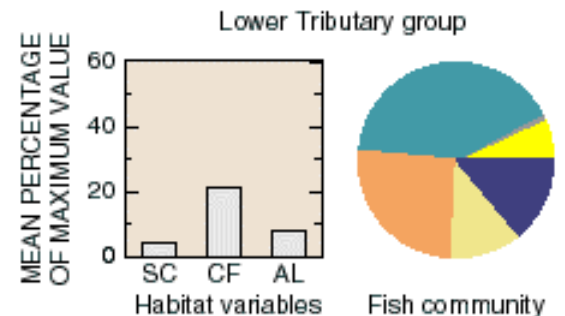
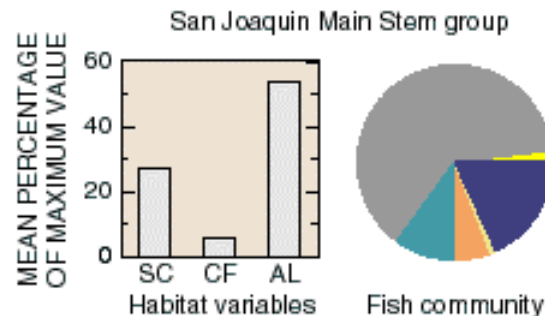
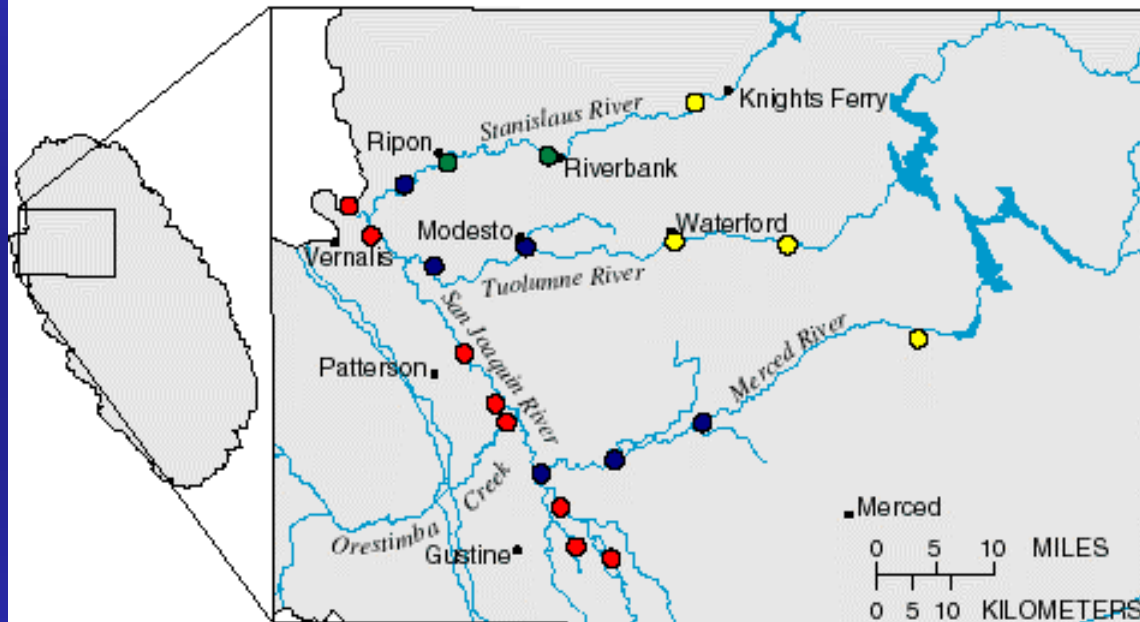
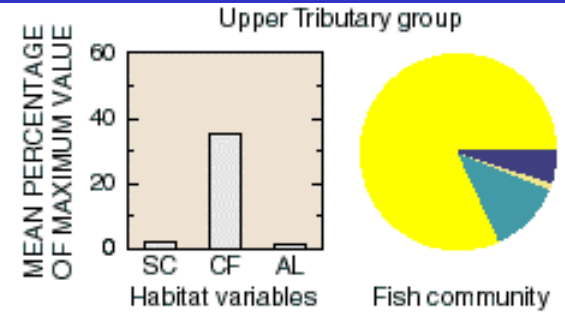
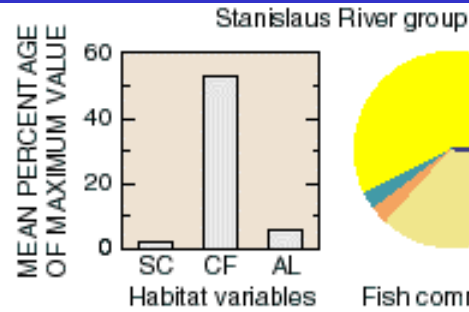
Black crappie

White crappie

#### *Percidae:*

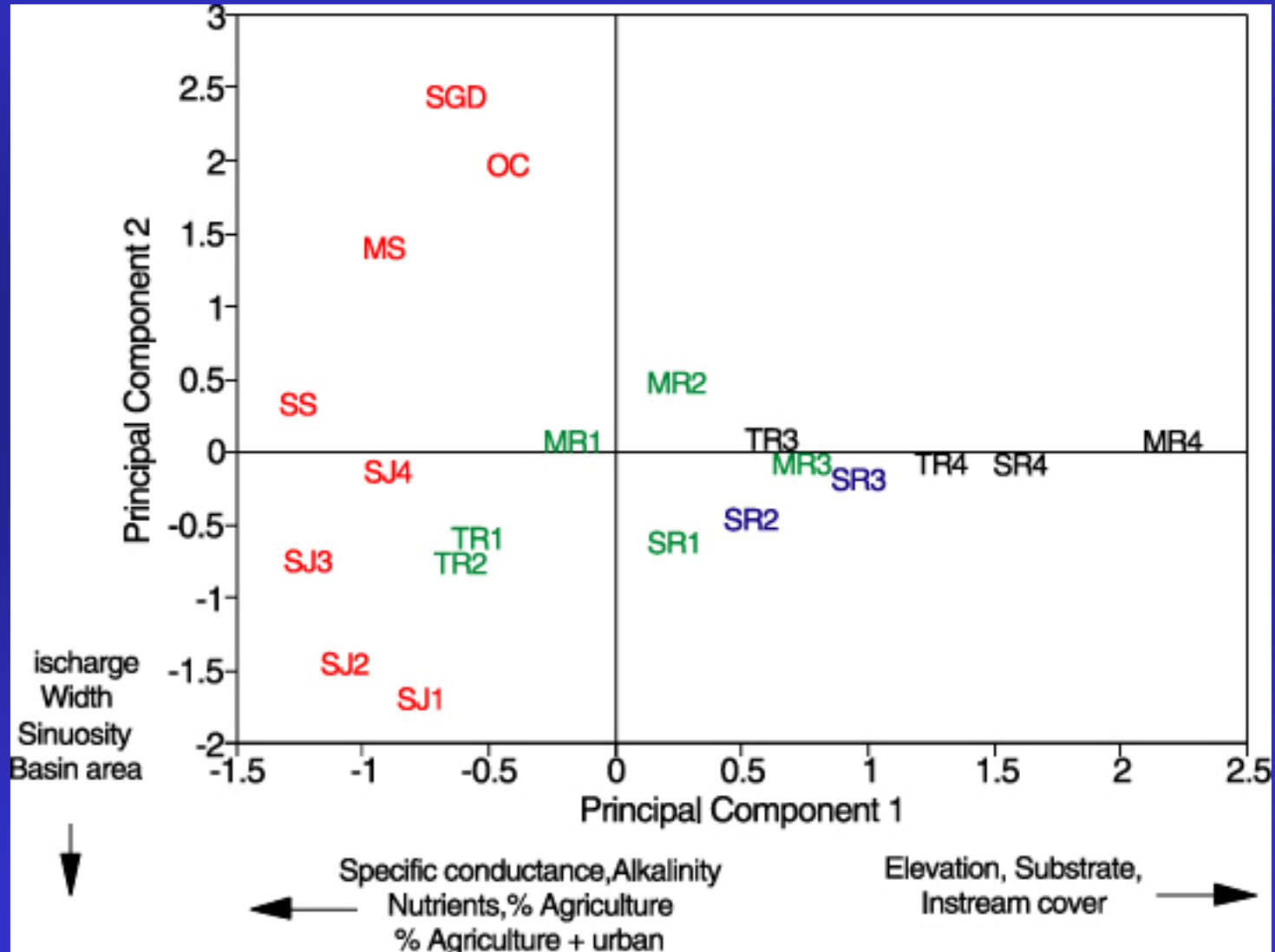
Bigscale logperch

# Fish communities of the San Joaquin River System



# Environmental Gradients in the San Joaquin River Drainage

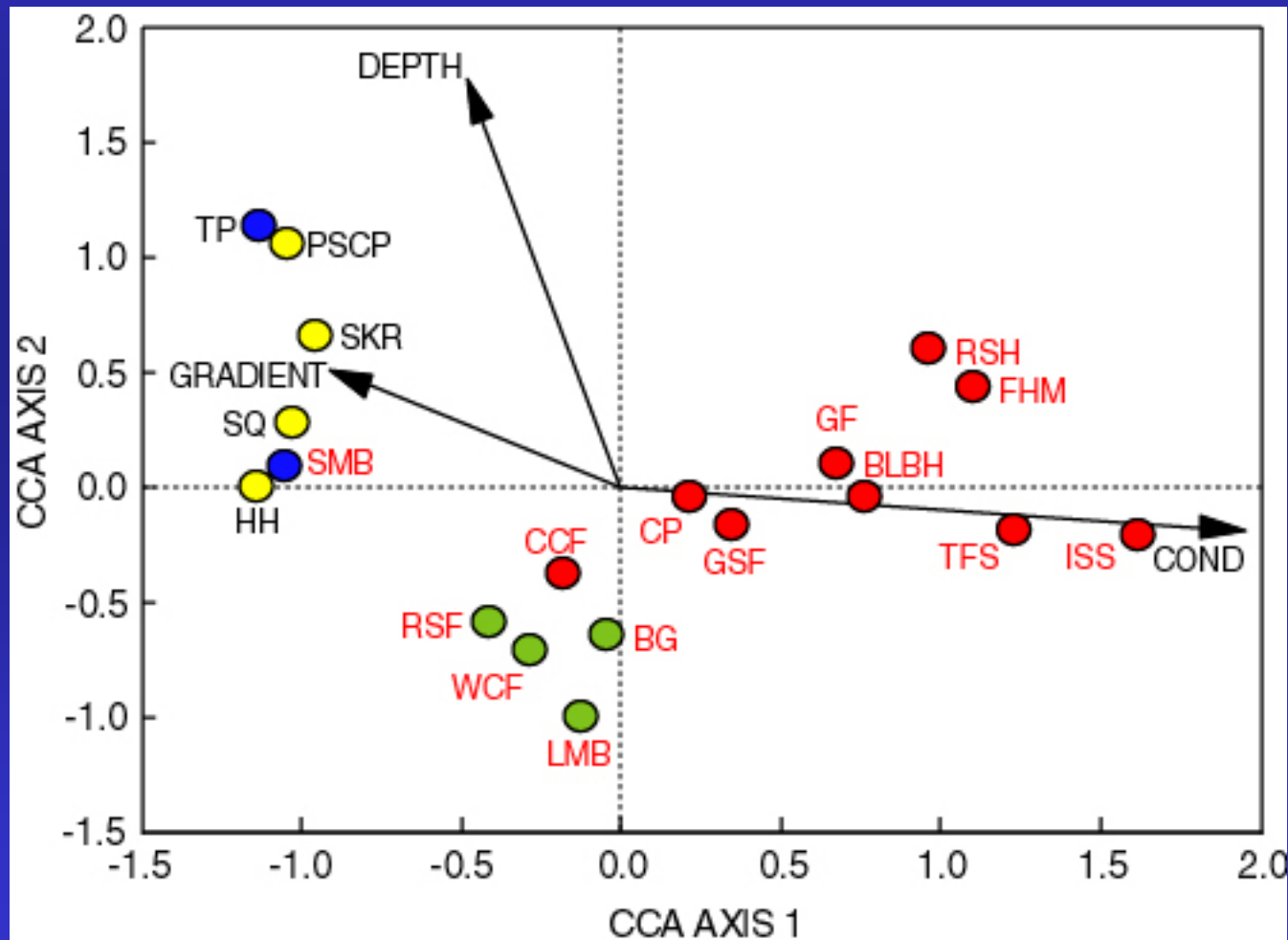
(Is the pattern consistent with environmental differences?)



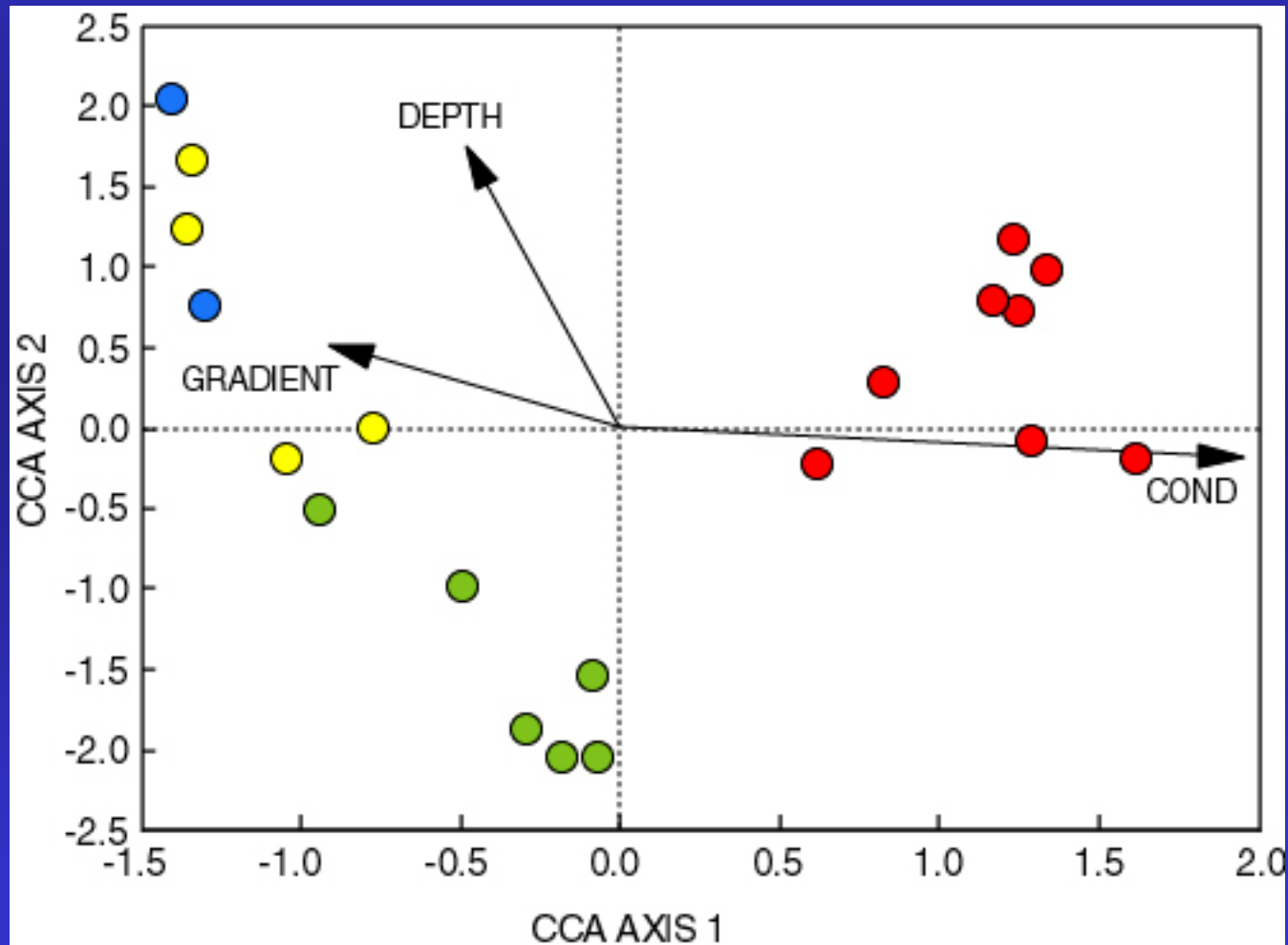


# CCA Ordination of Species

(How are species distributed with respect to environmental variables?)



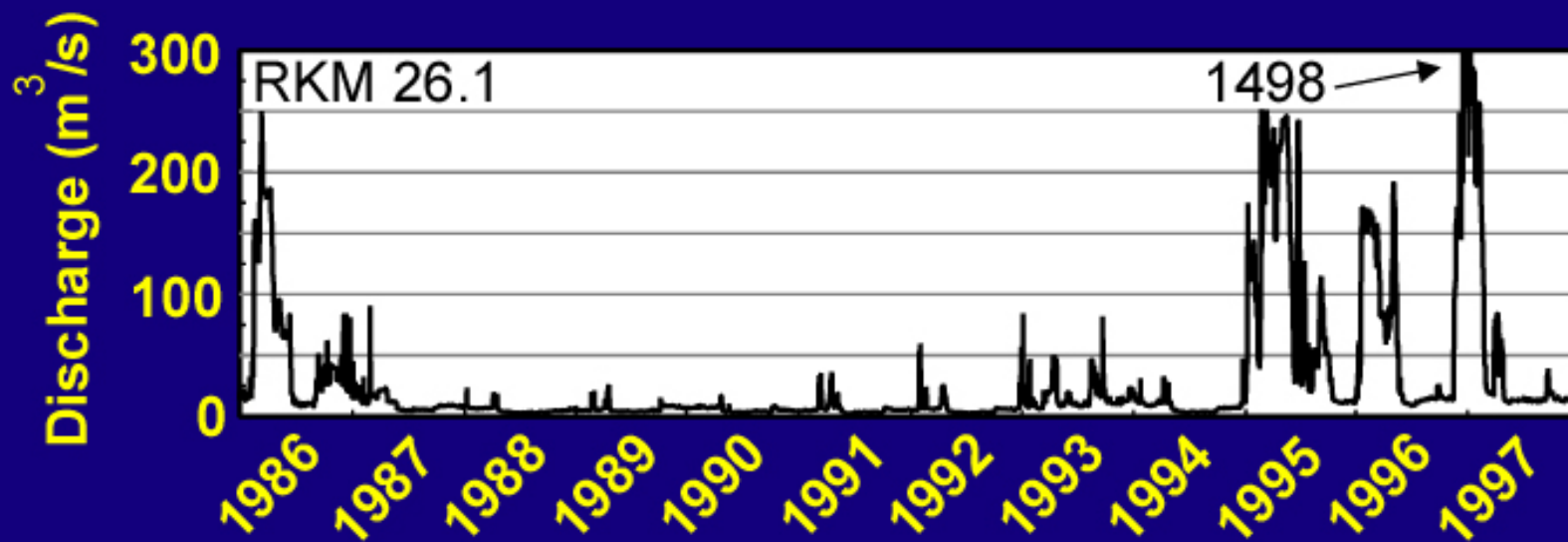
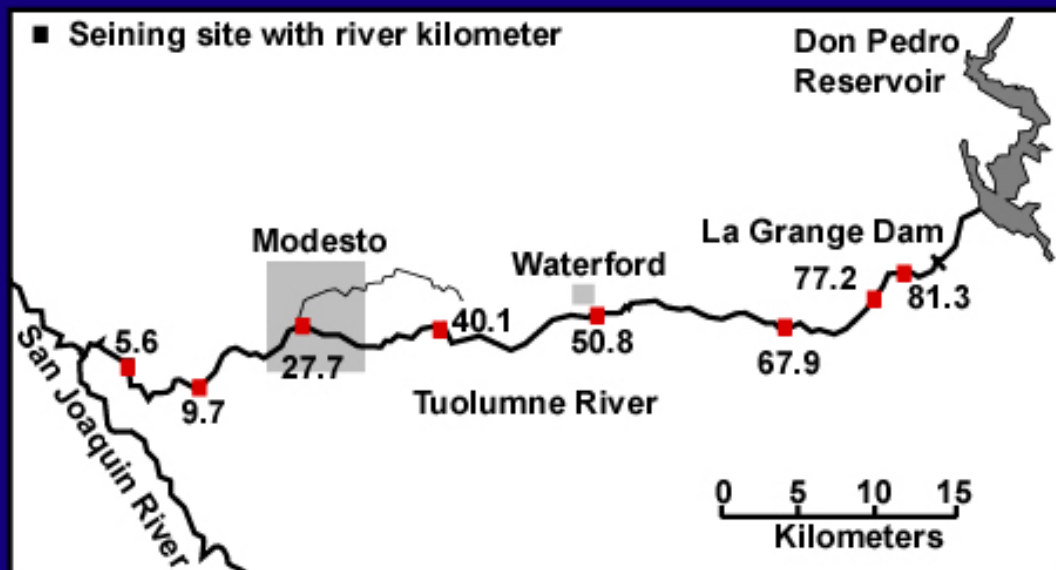
# CCA Ordination of Sites

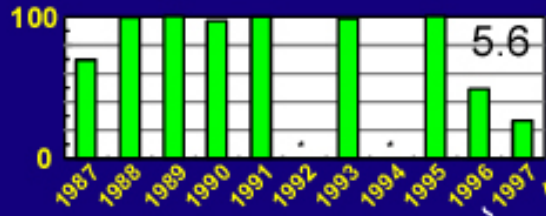
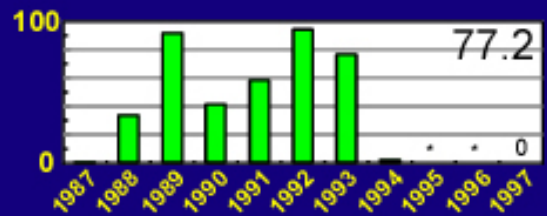
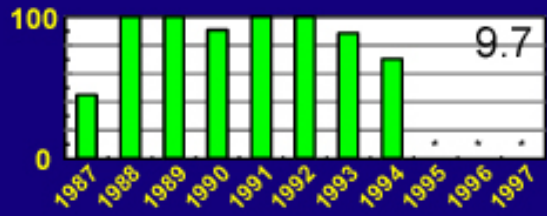
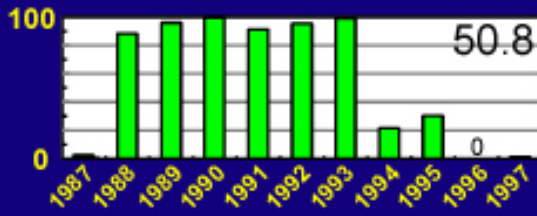
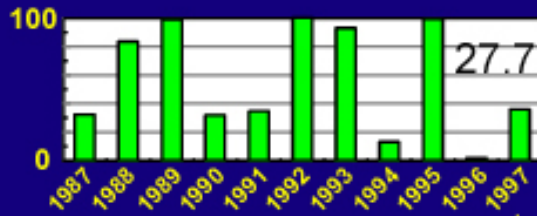


These results represent a snapshot. How does the system change over time?

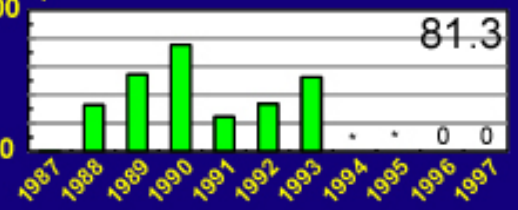
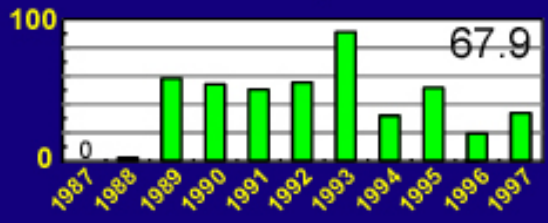
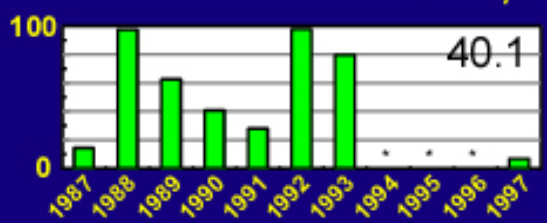
- This requires a long-term dataset
- Such a data set was available for the Tuolumne River from a salmon monitoring program that also recorded other species captured







**Percentage of exotic species at sites on the Tuolumne River 1987-1997**

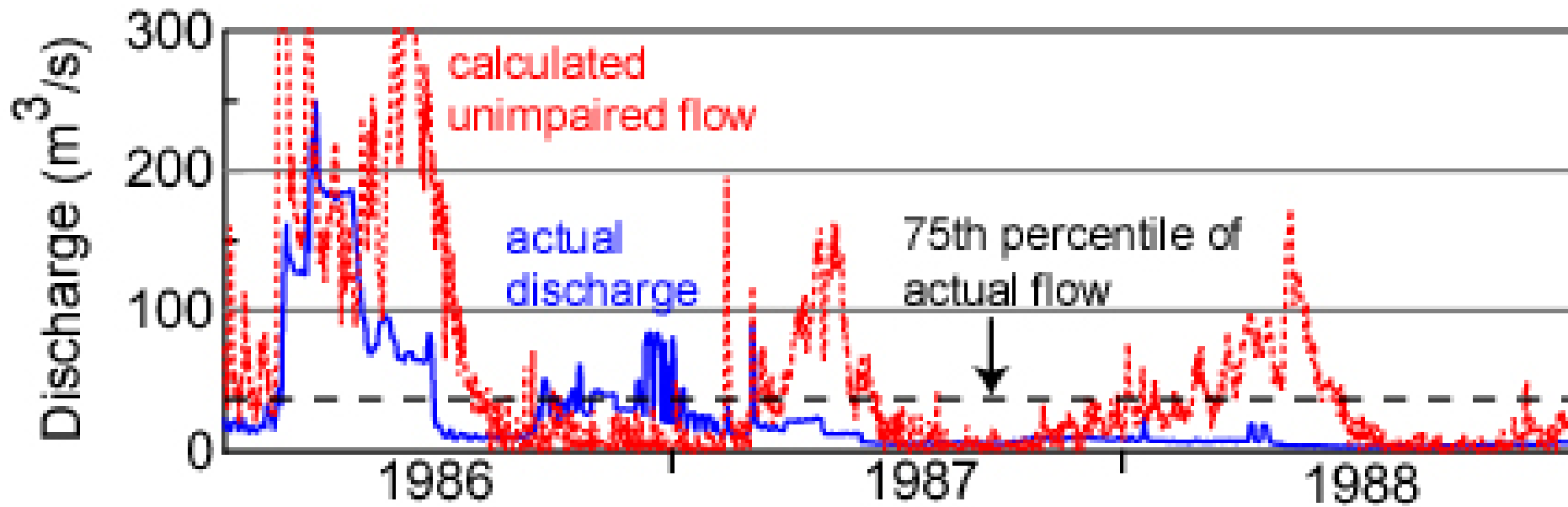


# Flow and Location are Important

Model	AIC <sub>c</sub>	Difference in AIC <sub>c</sub>	Akaike weights	Adjusted R <sup>2</sup>
RKM + Q <sub>year-1</sub>	-182	--	1.00	0.66
Q <sub>year-1</sub>	-145	37	<0.01	0.44
RKM + Q <sub>year</sub>	-130	52	<0.01	0.32
RKM	-122	60	<0.01	0.23
Q <sub>year</sub>	-108	74	<0.01	0.08



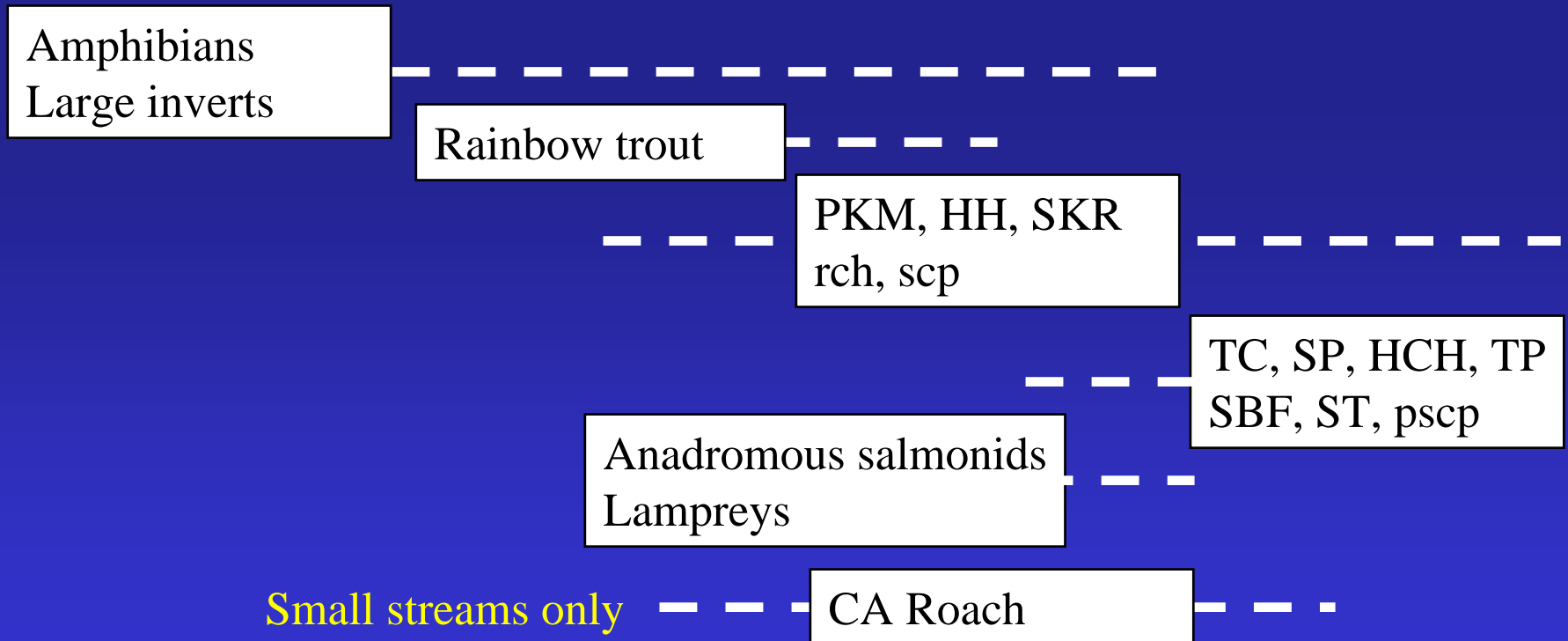
# Tuolumne River Discharge



- Winter/spring flow pulse favors reproduction of natives
- Flat hydrograph favors introduced centrarchids and catfish
- Seining captures fish as 1 year olds rather than YOY

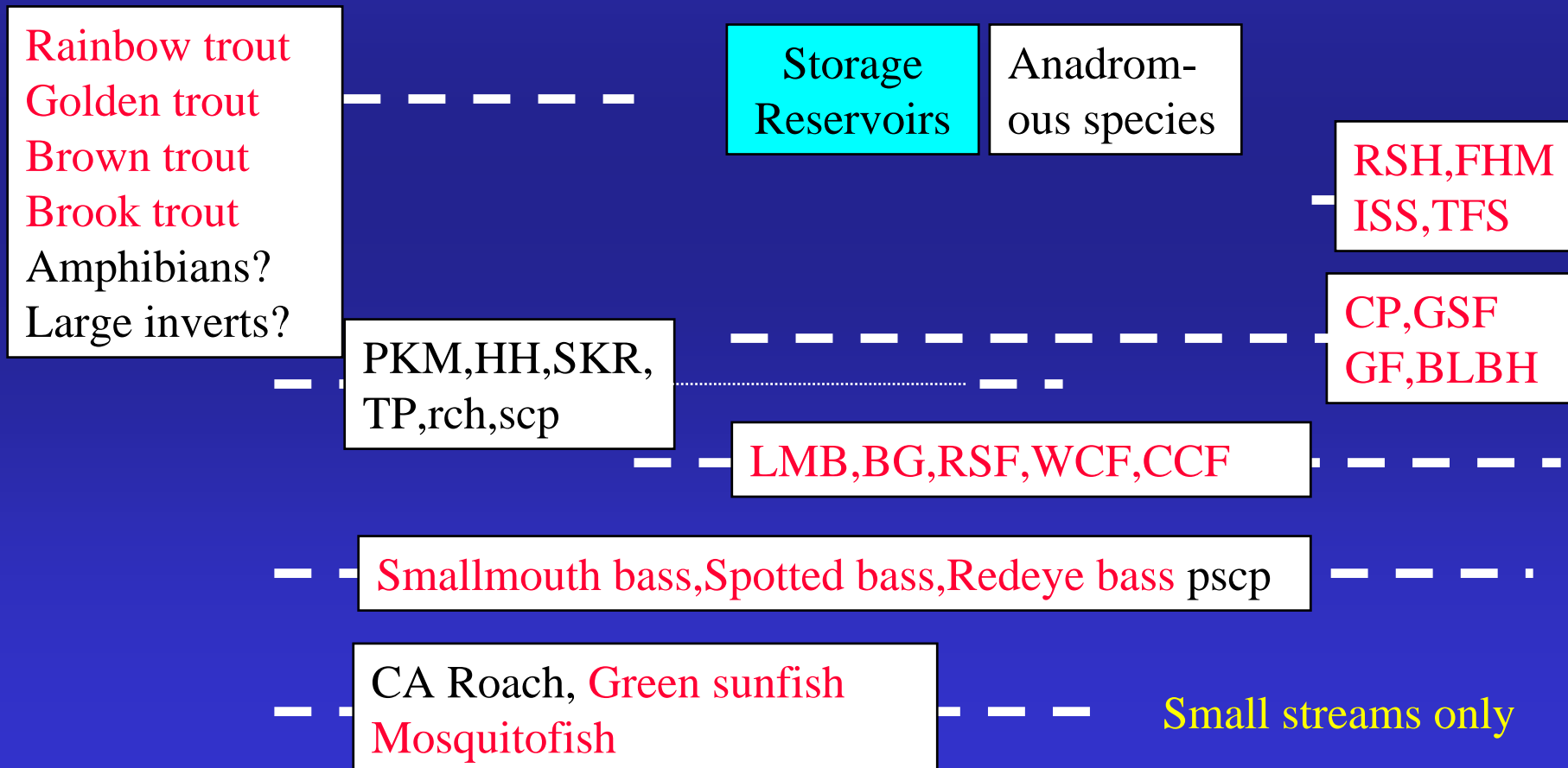
# Natural Fish Distributions

Mountains	Mountains	Foothills	Valley
Fishless zone	Trout zone	Pikeminnow- hardhead-sucker zone	Deep-bodied fishes zone
> 1,000 m	450 - 1,000 m	30 - 450 m	< 30 m



# Altered Fish Distributions

Mountains	Foothills	Valley
Trout zone	Pikeminnow-hardhead-sucker zone	Deep-bodied fishes zone
> 450 m	30 - 450 m	< 30 m



# Future of the Central Valley Fishes?

- Flow modifications and habitat restoration being pursued mainly with regard to salmon issues. These may help other resident native species.
- Sacramento River drainage fishes in better shape than San Joaquin drainage. This has limited extinctions and extirpations.
- Alien species continue to arrive in California and could enter the basin...



# Recent Arrivals in CA



Northern pike  
(angler introduction)

Shokihaze goby  
(ballast water)



# Fish IBI Challenges

(modified from Hughes talk)

- Generally depauperate native fauna
- Low species richness in streams
- Population abundance very important (because richness is low)
- High % alien species & individuals
- Major natural gradients co-occur with human disturbance gradients
- Reference sites for valley floor?
- Definition of “good” in the context of extinct and extirpated species