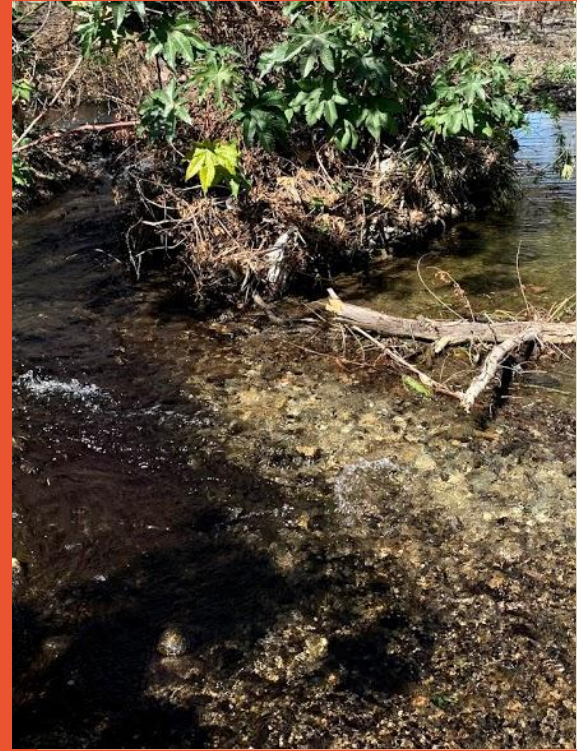


# **Tame Rivers: the effects of urbanization and flood control on Southern California waterways**

By: William Ota  
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Evolution, Ecology, and Organismal Biology







# William Ota

- BA in Biology from Pepperdine
- Worked for two years as a biological science technician for USGS
- Worked for one year as a laboratory manager
- PhD Candidate at UC Riverside





# **01**

## **The Anthropocene & Aquatic Ecosystems**

# **02**

## **Water in California**

# **03**

## **Healthy Rivers**

# **04**

## **Conclusions**



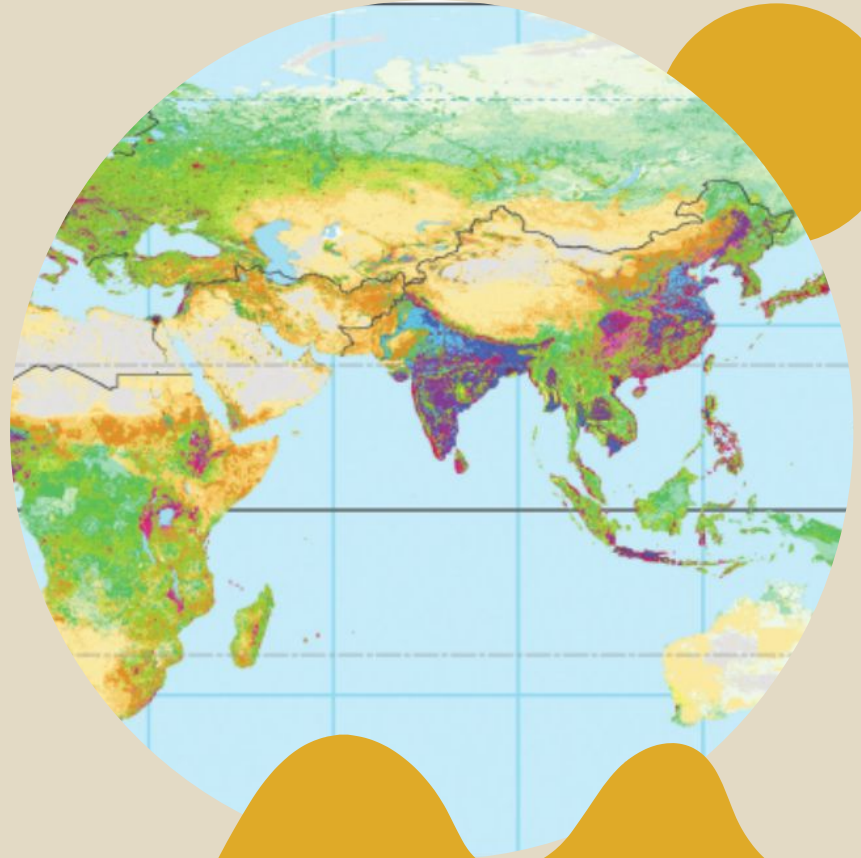
**01**

**The  
Anthropocene &  
Aquatic  
Ecosystems**



# The Anthropocene

Humans are the drivers of global change, in the form of climate change, resource use, and ecosystem transformation



Ellis and Ramunkutty 2008



# Increases in the global population

Global population grew from 1.5 to 6.1 billion people from 1900 to 2000

From 1900 to 2020 California's population increased from ~2 million to almost 40 million





# Major Human Impacts

## Biotic Perspective

Climate Change

Mass extinctions

Mass relocation of species

Mass alteration of ecosystems  
for human needs



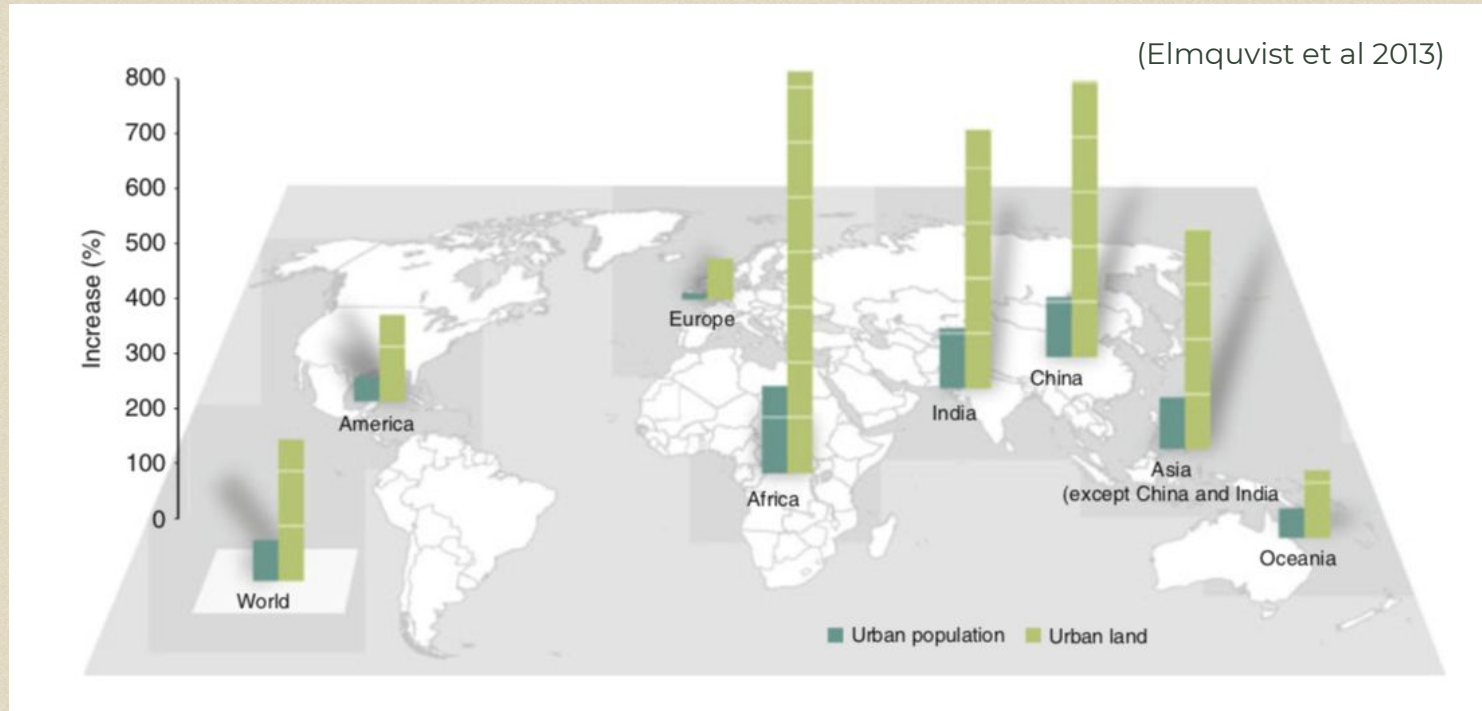


# Population Shifts and Consumption

- 55% of the global population now lives in urban areas
- In 2050 this is expected to increase to 68%
- Globally material consumption has also increased from 8.8 metric tons per year in 2000 to **12.2 metric tons** per year in 2017
- In the US that number is



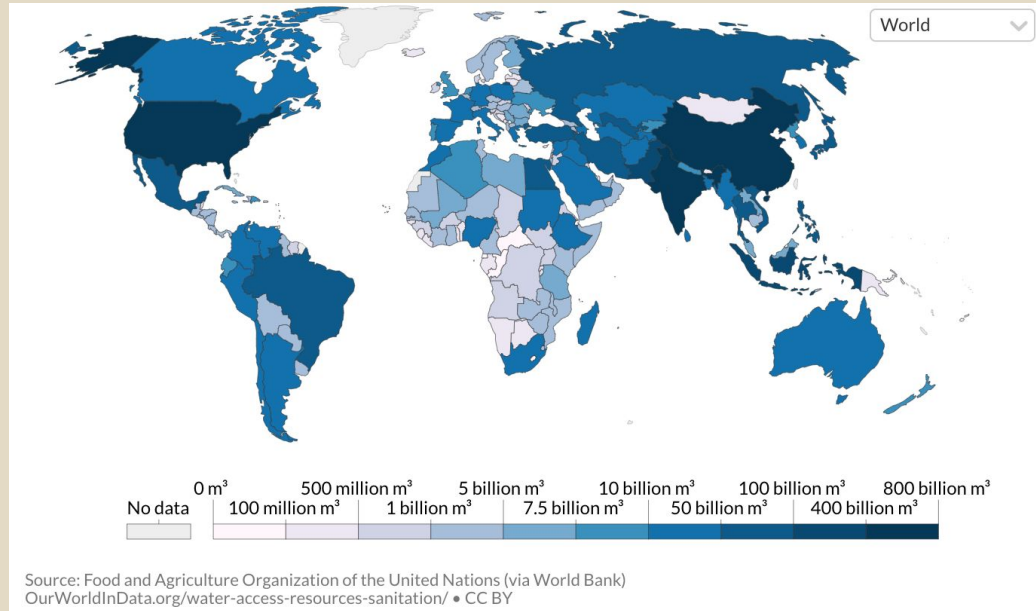
# Growth of Urban Ecosystems



As the human population continues to grow so does the migration to urban centers



# Freshwater Consumption

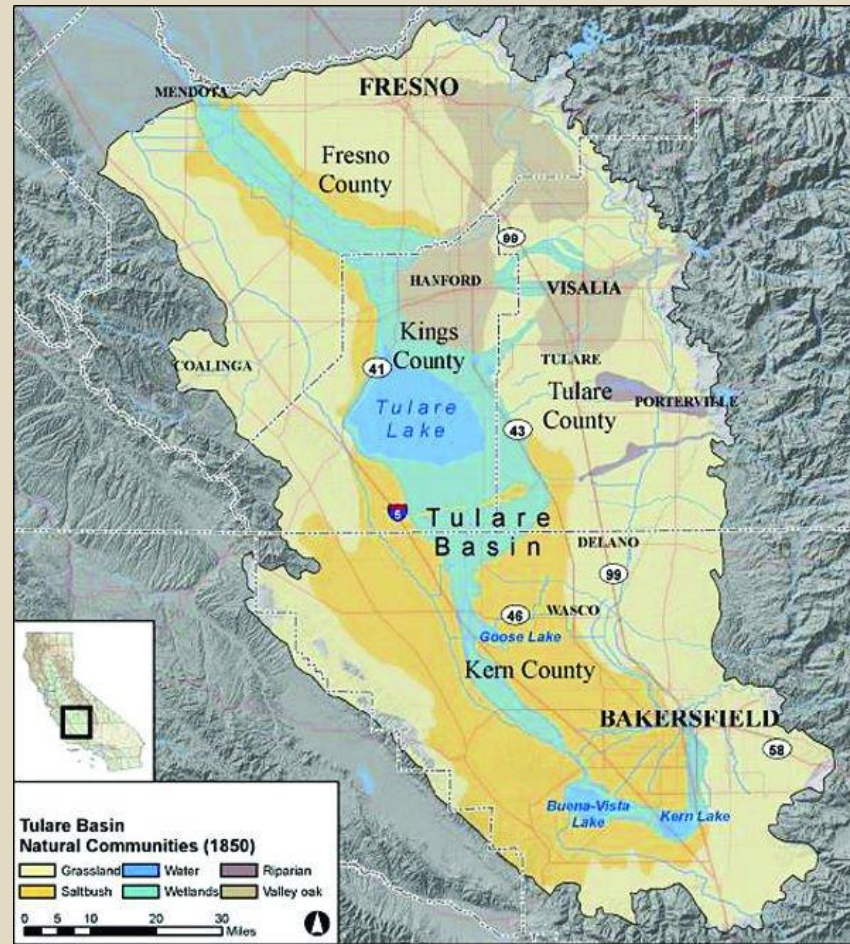


- Freshwater use has increased six-fold since 1900
- ~70% of freshwater use goes to agriculture
- In the US 40 out of 50 state water managers expect water shortages under average conditions in some portion of their states over the next decade

<https://ourworldindata.org/water-use-stress>

<https://www.epa.gov/watersense/statistics-and-facts>

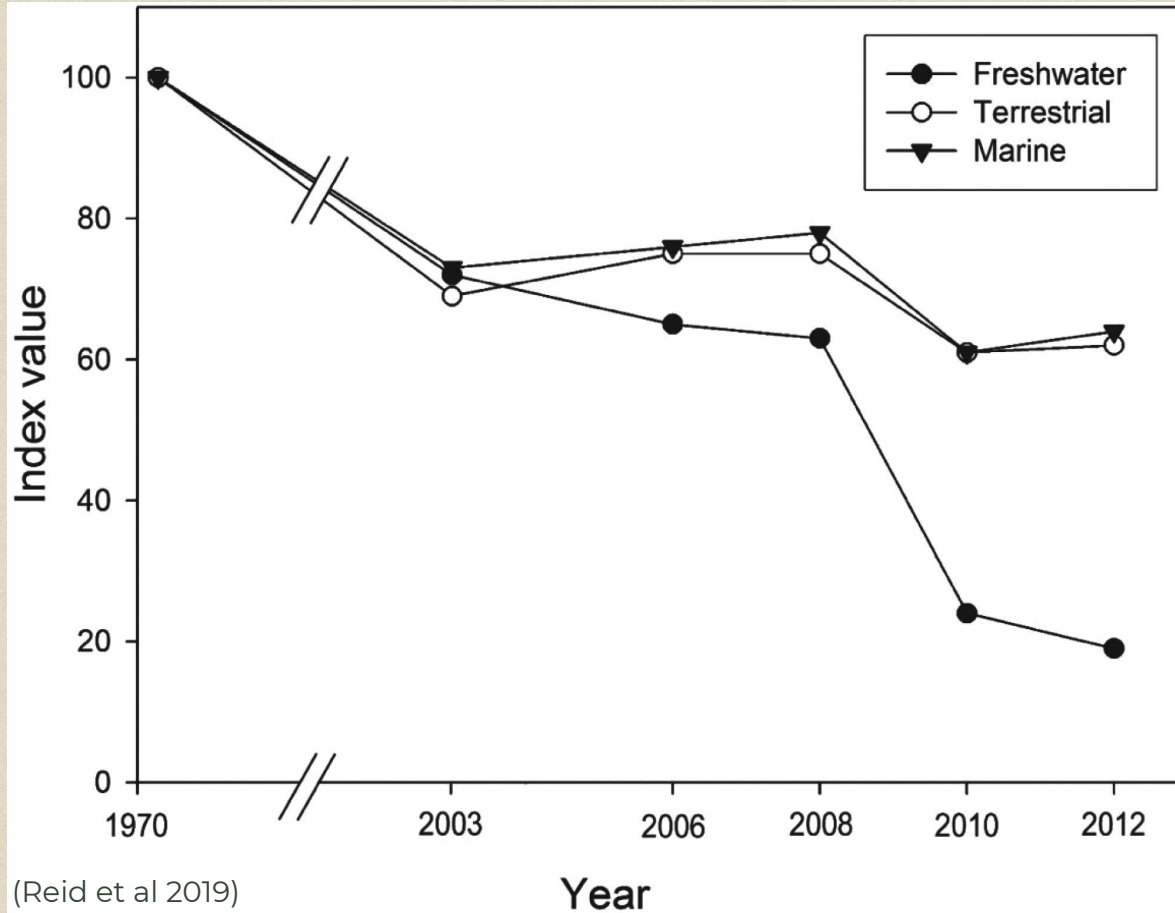
# The loss of freshwater ecosystems



<https://unfccc.int/news/wetlands-disappearing-three-times-faster-than-forests>



# Freshwater Biodiversity Crisis



Freshwater ecosystems cover only about 0.8% of the Earth's surface (Gleick, 1996)

Contain 6% of all described species (Hawksworth & Kalin-Arroyo, 1995)

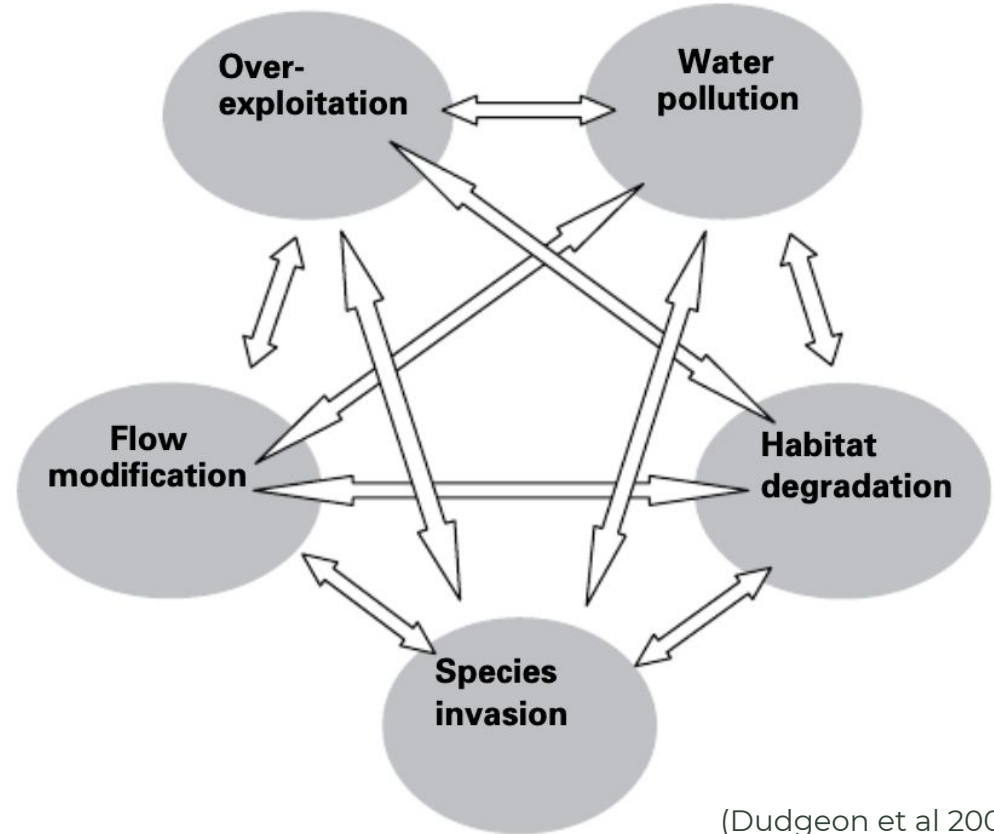
Freshwater vertebrates are in crisis (Reid et al 2019)

# Drivers of Freshwater Biodiversity Loss

5 major threats to maintaining freshwater biodiversity (Dudgeon et al 2006)

These threats are more extreme within urban ecosystems

On top of these specific threats are the omnipresent challenges presented by climate change





# Urban Stream Syndrome

A collection of common effects of increasing urbanization on freshwater ecosystems (Walsh et al 2005)

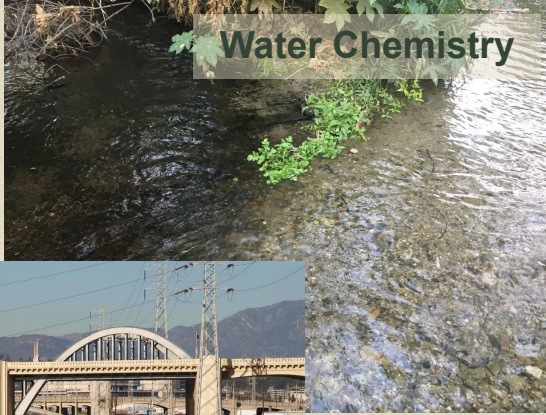


# Urban Stream Syndrome

Hydrologic Change



Water Chemistry



Urban streams are consistently altered in specific ways (Walsh *et al.* 2016)

Channel Morphology



Ecosystem Processes



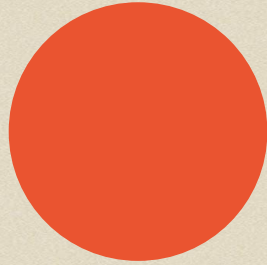
Invasive Species



Many of these alterations are due to:

- Urban Runoff
- Impervious surface percentage
- Legacy pollutants (Paul & Meyer 2001)





# 02

## Water in California

“Had humans never settled in Los Angeles, evolution, left to its own devices, might have created in a million more years the ideal creature for the habitat: a camel with gills.”  
- **Marc Reisner**



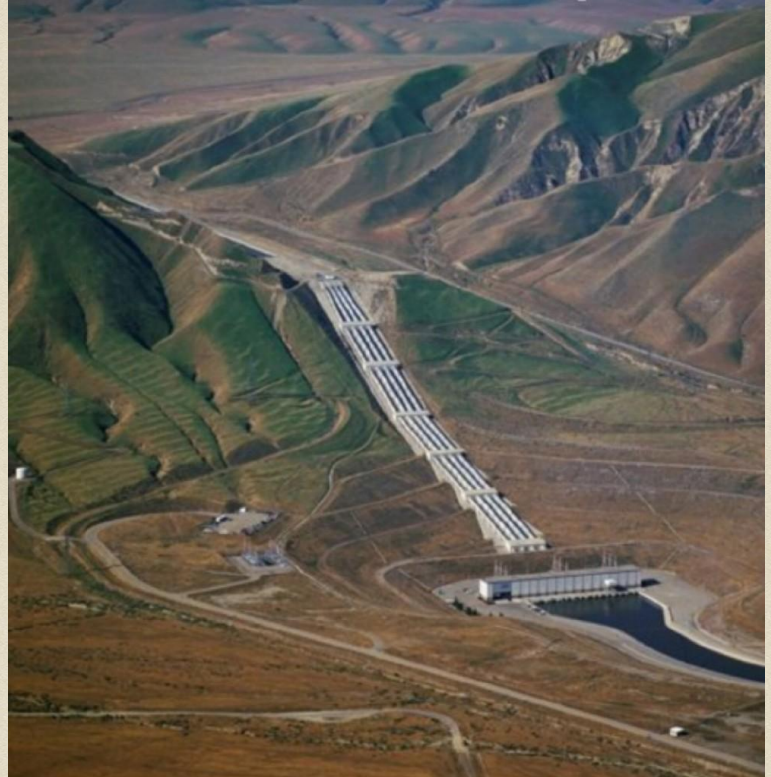
# California Water

1

One of the most hydrologically altered locations on the planet

2

The states population and economy are propped up by the use of 64 million acre feet of water per year





# How do we get the water we use?

Dams, reservoirs, and canals

Challenges:  
Evaporative loss

Salinity

Water Rights

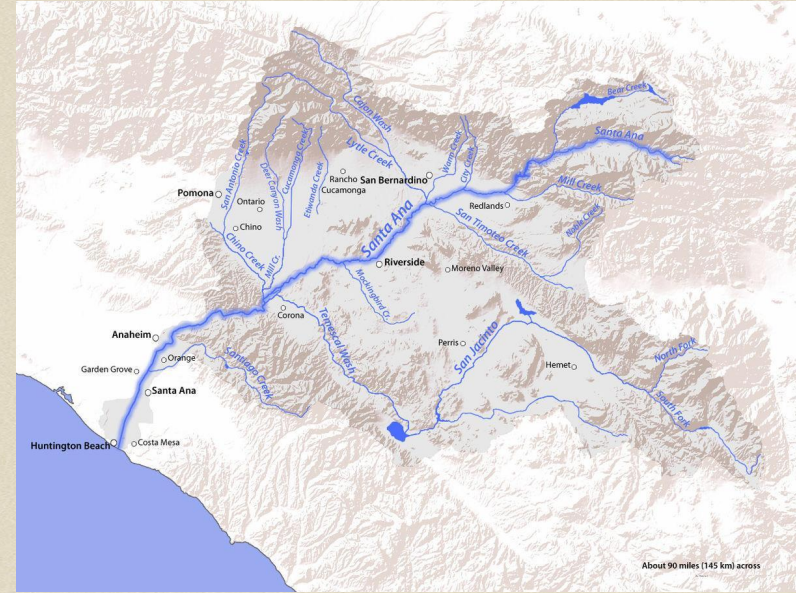
Projections





# The Santa Ana River

The heart of the largest watershed in Southern California the Santa Ana River has undergone massive anthropogenic changes in the last century following floods in 19<sup>th</sup> and 20<sup>th</sup> centuries



Wikipedia

# The city of Anaheim in 1938



Anaheim Public  
Library



# Development and Floods

Major floods in 1862 and 1938

Resulted in increasing property damage and loss of life

Two dams were built to protect Riverside and Orange Counties from 100 year flood events



<https://www.scientificamerican.com/article/atmospheric-rivers-california-mega-flood-lessons-from-forgotten-catastrophe/>



# Santa Ana River Dams

- Army Corp of Engineers proclaimed the area safe from a 100 year flood event
- The dams have had a major impact on the hydrology of the Santa Ana River
- Prado was completed in 1941
- Seven Oaks was completed in 2000





# Historic Santa Ana River



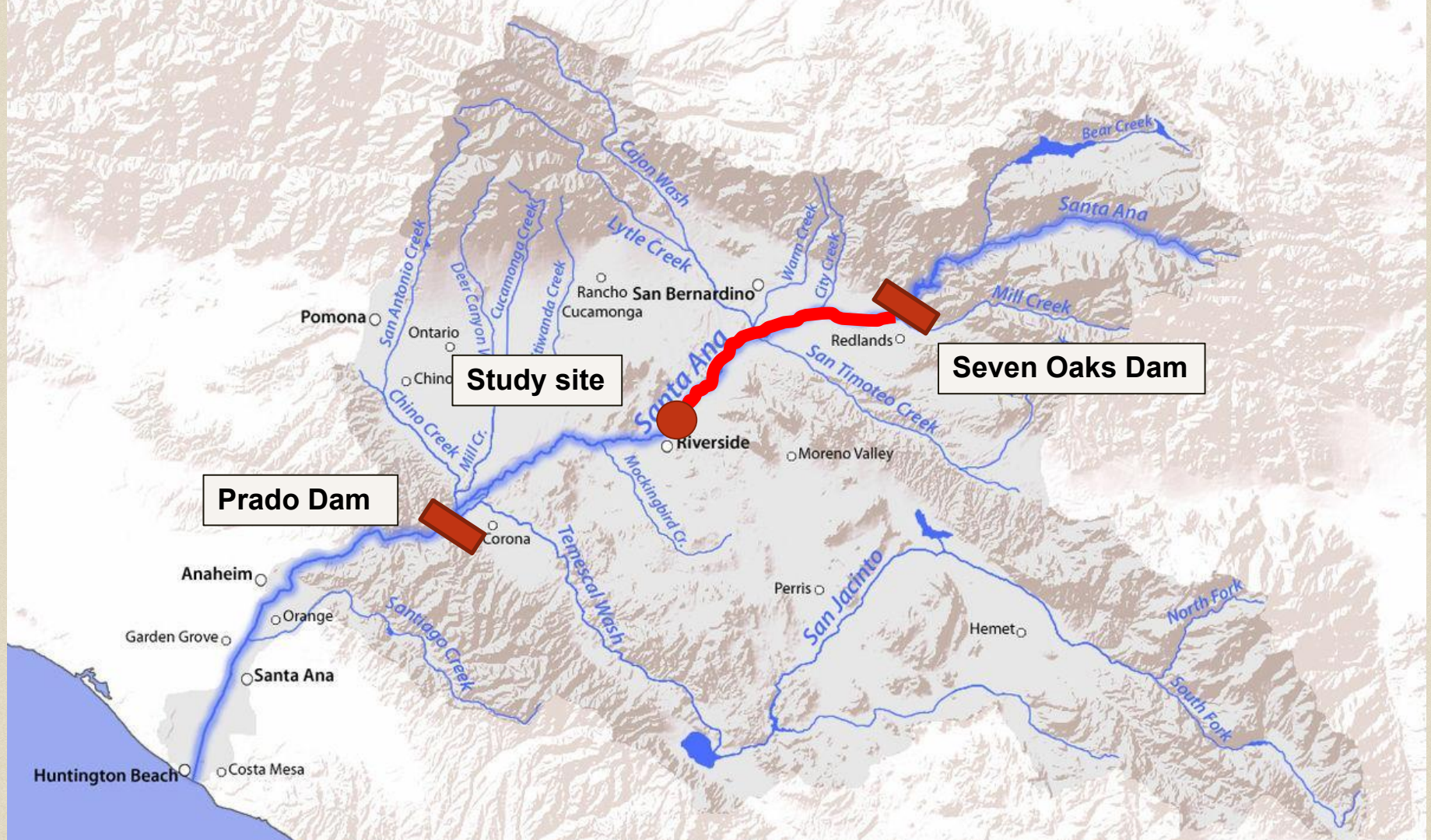
Pierce Photography  
Collection, USC Libraries.

# Urban Santa Ana River



wikipedia





**Study site**

**Seven Oaks Dam**

**Prado Dam**



# Wastewater

The Santa Ana is now maintained by various wastewater plants

These wastewater facilities contribute to key symptoms of Urban Stream Syndrome

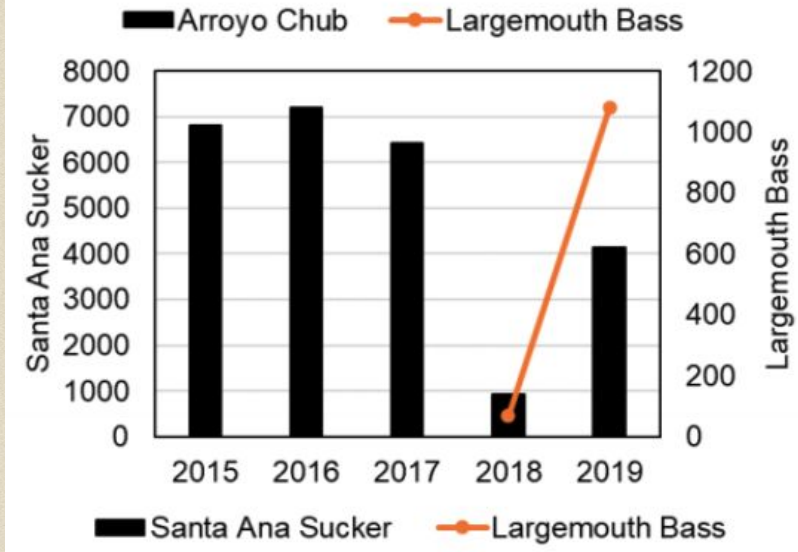
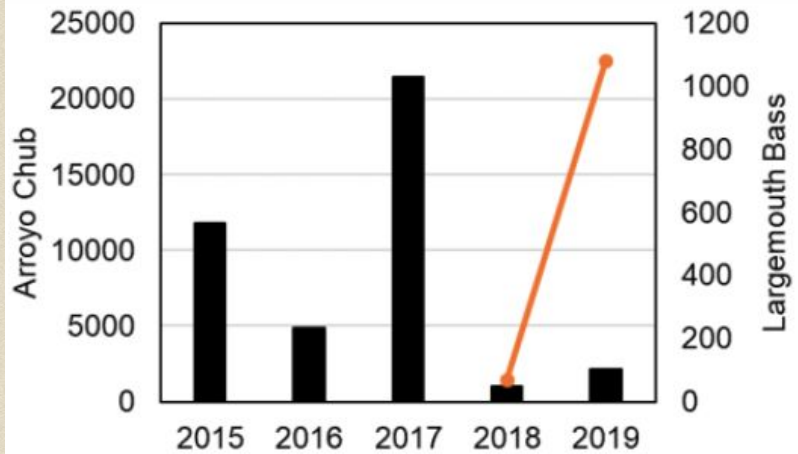
- Water Chemistry
- Channel Morphology
- Hydrology





# The Santa Ana Sucker and Arroyo Chub





# Native Species Declines

In 2018 groundwater wells went online in the urban Santa Ana River to prevent river dry downs

Native species populations declined and largemouth bass populations boomed

Populations shifted downstream away from wastewater channels





**03**

**What is a healthy  
river?**



# **The confluence of the RIX and Rialto wastewater treatment channel**





# Questions

1. How do we define a healthy river?
2. What is the correct balance between human needs and ecosystem needs?



# Dominguez Channel

Sometimes these questions  
have an obvious answer





# LA River

Other times they do not





# What value do rivers and species have?

Ecosystem Services

Intrinsic Value

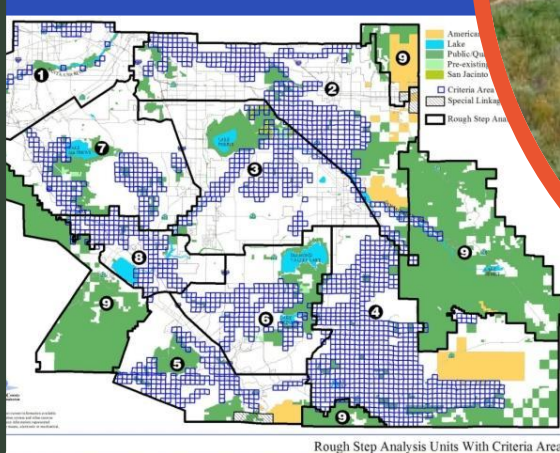
Biological Value

Beauty





# Answering these questions will determine the future of rivers in California





04

# Conclusions

Sample Collection and Isotopic  
Niche Models



# CONCLUSIONS

1

**Historically we have shaped  
freshwater ecosystems to serve us**

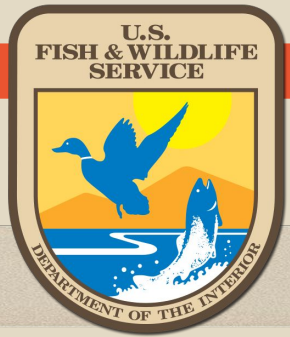
Do we want to and can we  
continue to treat water the same  
as we have?

**How and why will we  
change our use of water**

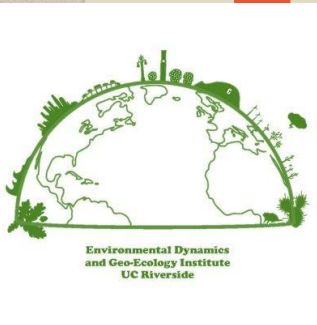
2

What changes make sense in the  
Anthropocene?

Can we restore rivers to something  
close to their historic state?



CNAS



# THANKS

Does anyone have  
any questions?

[wota001@ucr.edu](mailto:wota001@ucr.edu)



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