California Department of Fish and Wildlife

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Drought Stressor Monitoring: Summary of the California Department of Fish and Wildlife's Statewide Drought Response 2014-2017

August 27, 2019 1:00 p.m. - 3:00 p.m.

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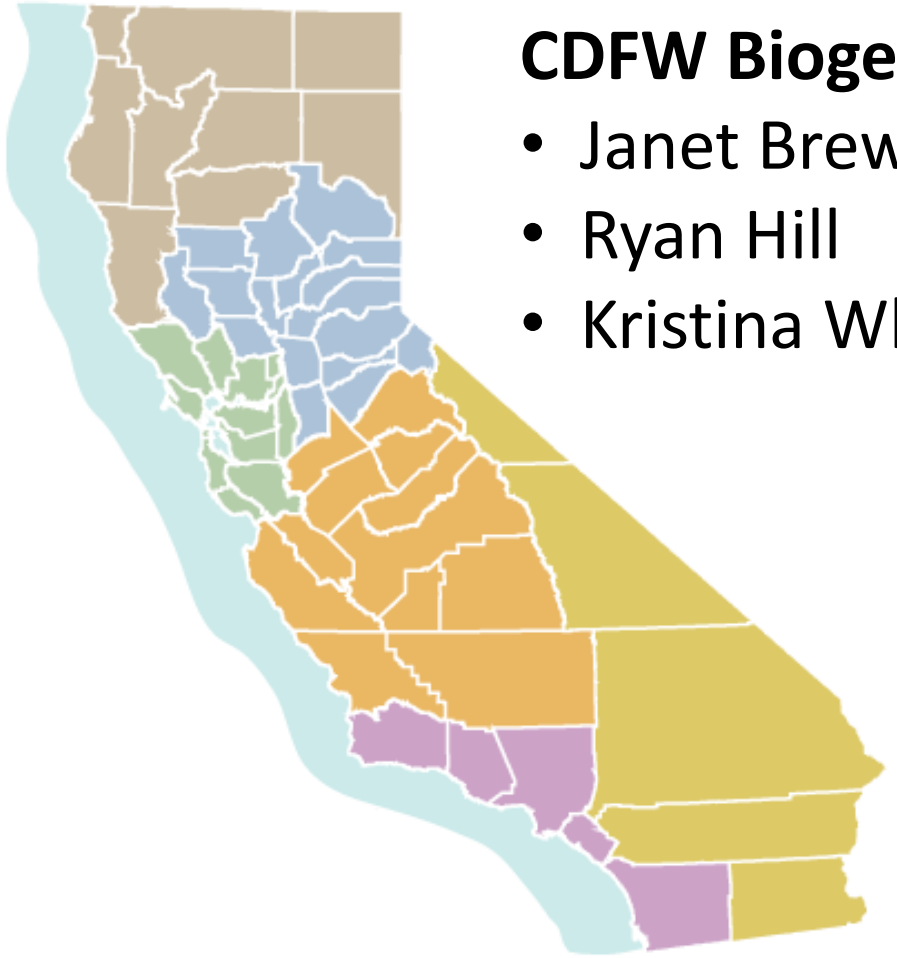

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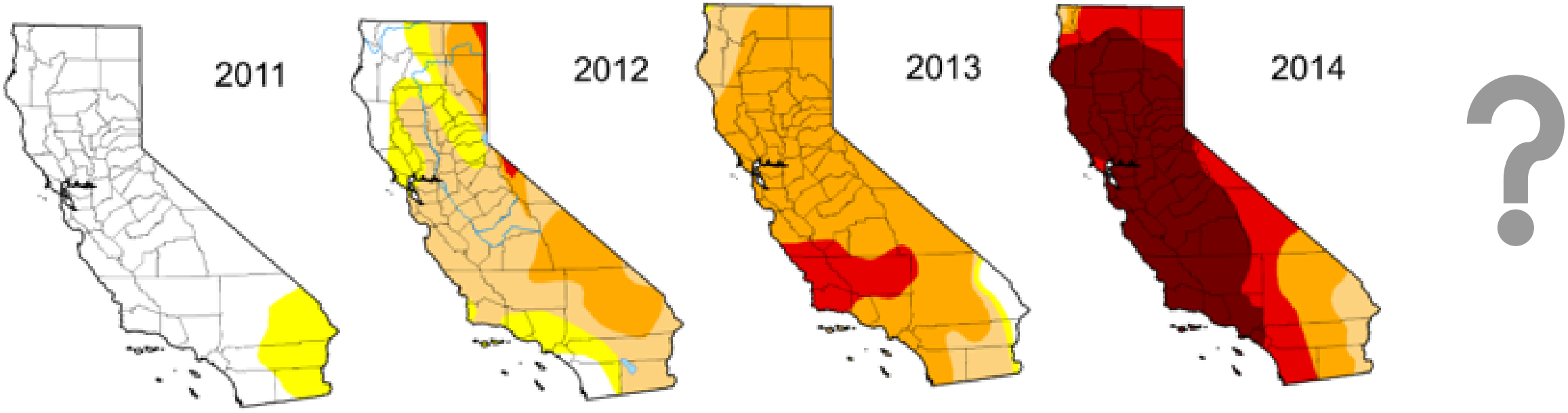


Intensity:

- Abnormally Dry
- Moderate Drought
- Severe Drought
- Extreme Drought
- Exceptional Drought

→ Future Duration???

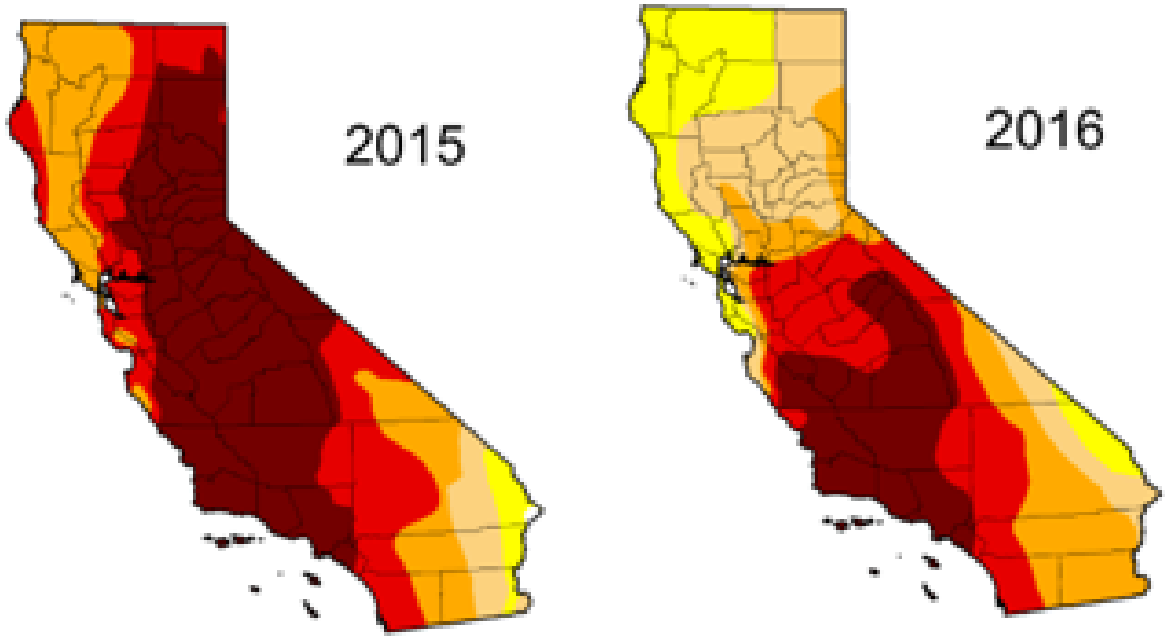
→ Intensity???

Source: U.S. Drought Monitor (http://droughtmonitor.unl.edu/)

- The drought lasted for five years: 2012-2016
- California experienced one of the warmest and driest periods on record.

Intensity:

- **Abnormally Dry**
- **Moderate Drought**
- **Severe Drought**
- **Extreme Drought**
- **Exceptional Drought**



Source: U.S. Drought Monitor (http://droughtmonitor.unl.edu/)

Preparation for CDFW's drought response

- "All necessary actions" required science-based management
  - fish relocation
  - restoration projects
  - water operations
  - conservation hatcheries, etc.

- What did CDFW do in last major drought?

  Unknown statewide efforts

- What were other states doing?
  Unknown

Source: https://realkm.com/2019/03/06/some-misconceptions-of-evidence-based-practice/

Overview

A) **Introduction**

B) **Methods**

C) **Results**

Question 1: Are streams drying?

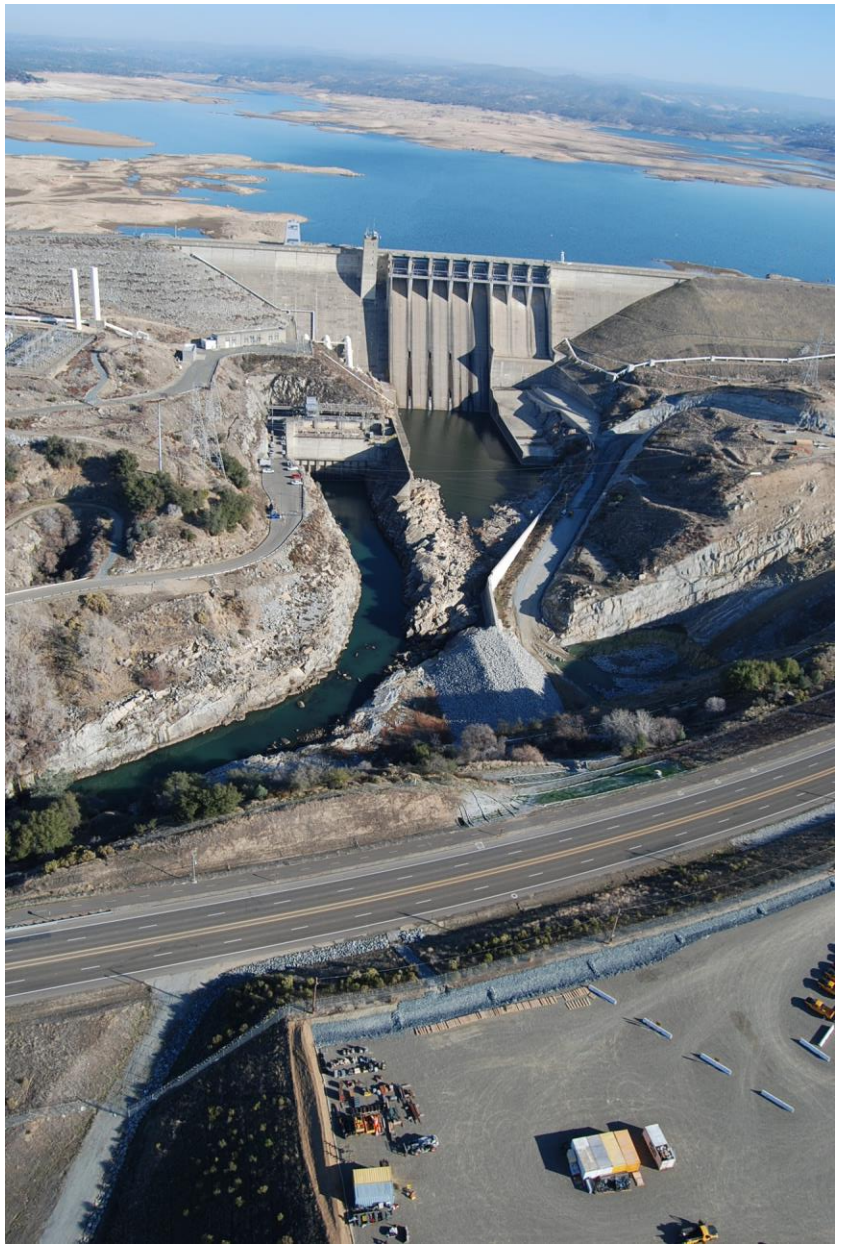
Question 2: Are streams warming?

Question 3: Is the amount dissolved oxygen changing?

Bonus Question: What are effects of drought and mudslides?

D) **Discussion**

E) **Lessons learned / Positioning for the future**



Folsom Lake, January 16, 2014 (Credit: DWR) (Placer, El Dorado, and Sacramento counties)










INTRODUCTION

- **Goals:**
  - To better understand the threats of drought on aquatic species
  - To make science-based management decisions /actions
- **Focus:**
  - 17 species (nearly all CESA / ESA or Species of Special Concern)
  - 141 watersheds and sub-watersheds, spanning 28 counties statewide
- **Questions**
  - Drying? Warming? Changing Dissolved Oxygen? Populations being affected?

METHODS

American River (Sacramento Co.)

Redwood Creek (Humboldt Co.)

Noyo River (Mendocino Co.)

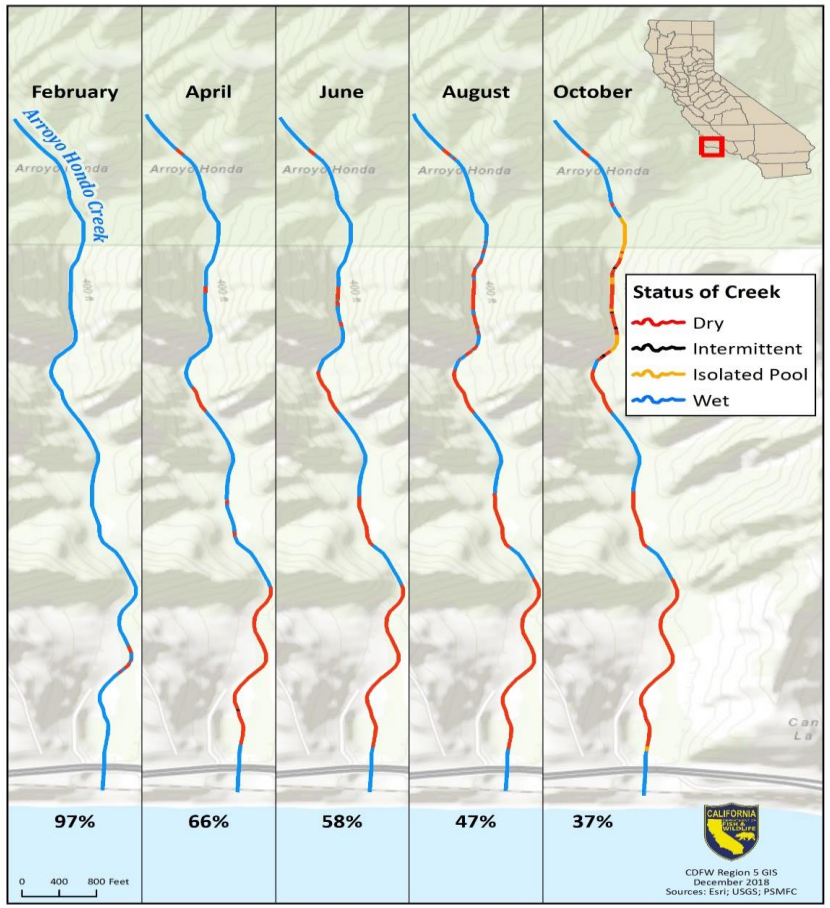
Butte Creek (Butte Co.)

- Implement monitoring in high priority locations for sensitive species (where it didn't exist and augment existing efforts already in place relative to drought.)
- Bi-weekly reporting that reflects CDFW's broad biogeographic ecoregions and regional structure.
- Case Studies on CDFW's website.
- Videos that document the drought's effects on CA's aquatic species.

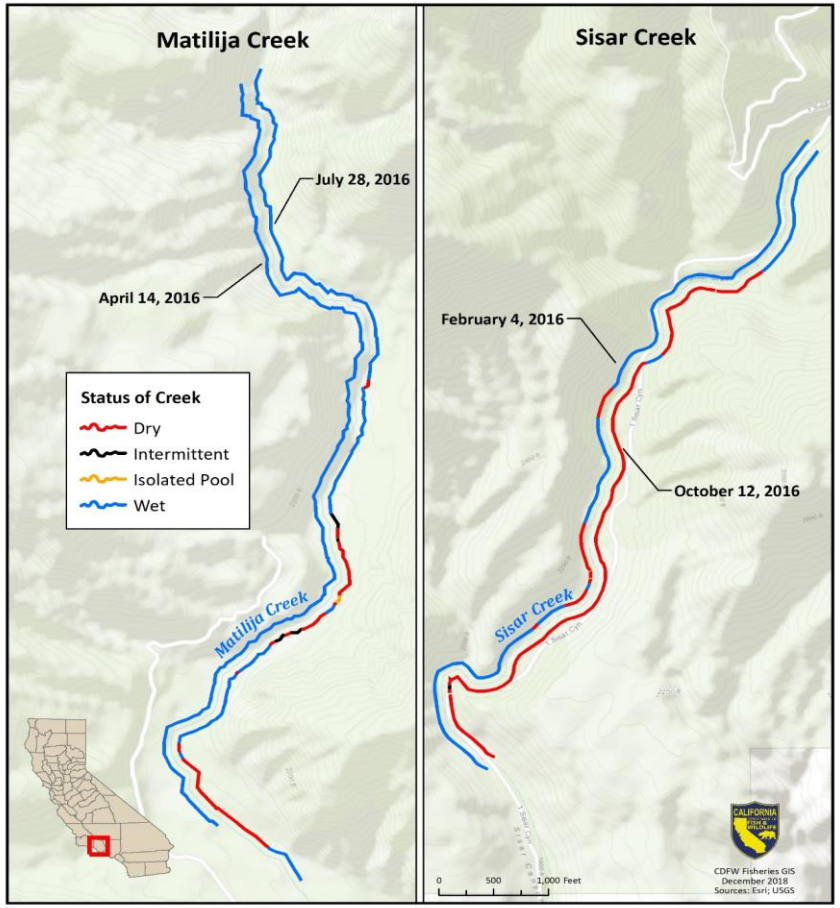
RESULTS:
Question 1: Are streams *drying*? Population effects?

Ventura River
(Ventura County)
March 2016

RESULTS:
Question 1: Are streams *drying*? Population effects?
Example: Steelhead in Ventura County

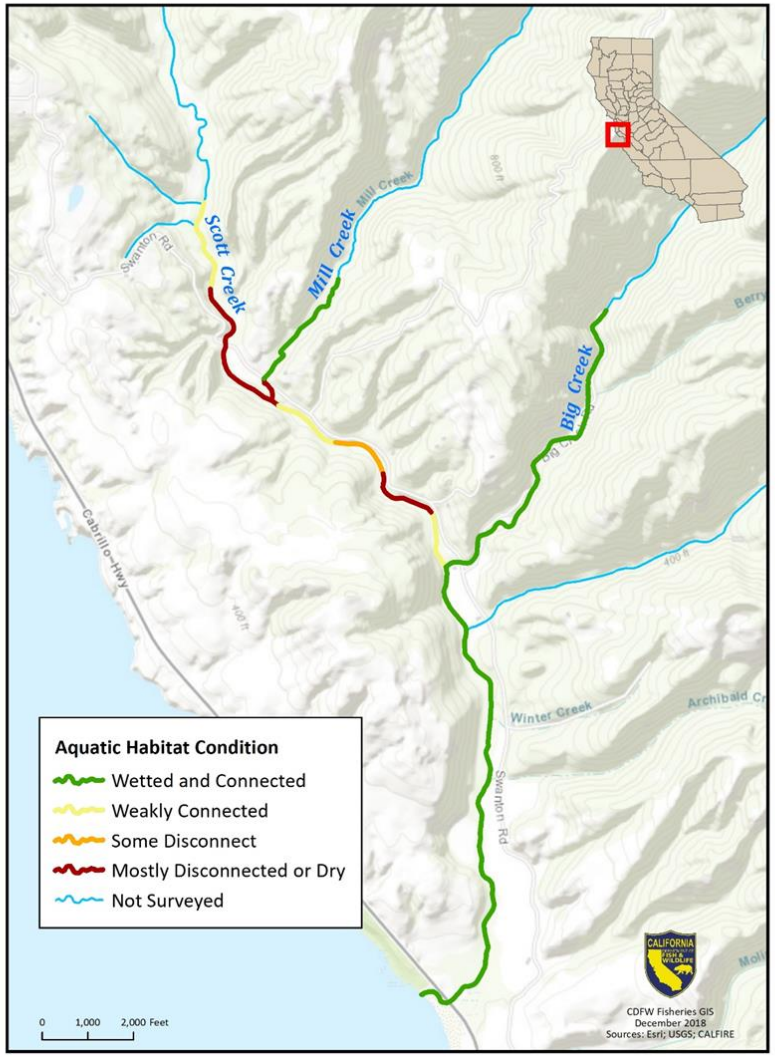


Bimonthly changes in percent of wetted streambed in Arroyo Hondo Creek, Ventura County, in 2015.

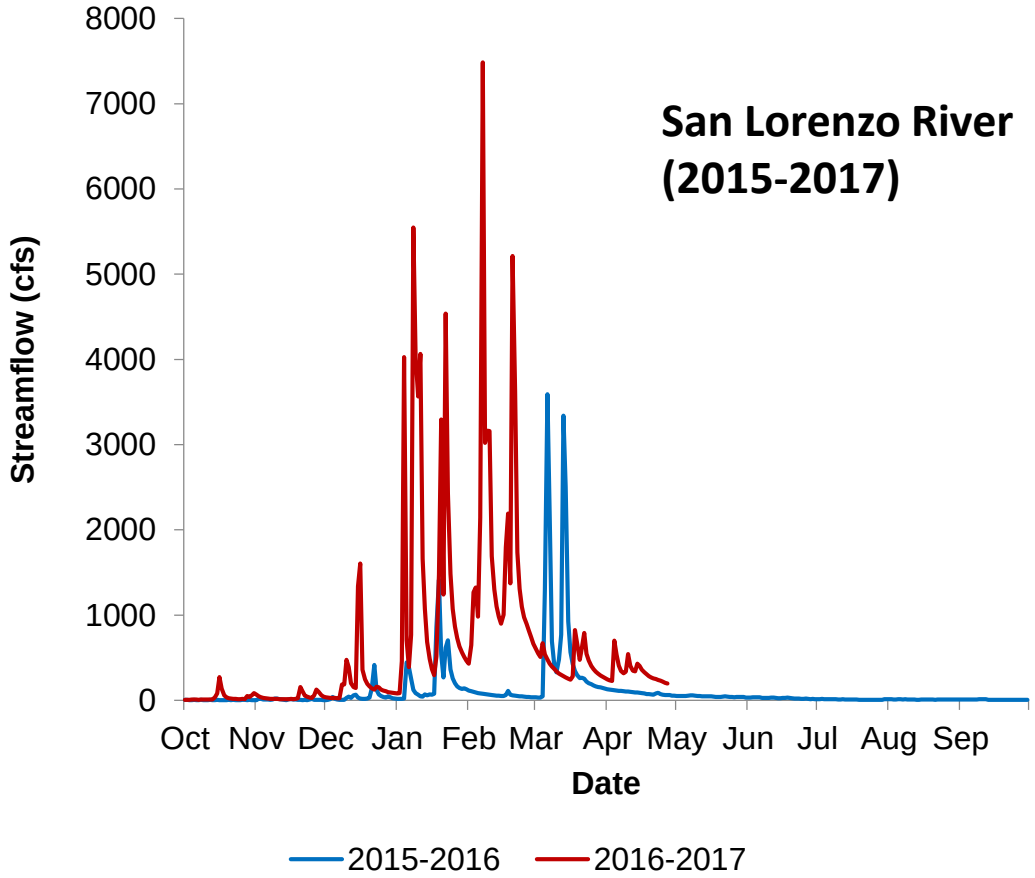


Matilija Creek, tributary of the Ventura River, and Sisar Creek, tributary of the Santa Clara River, in 2016.

RESULTS:
Question 1: Are streams *drying*? Population effects?
Example: Santa Cruz County



Scott Creek (summer 2015)



San Lorenzo River (2015-2017)

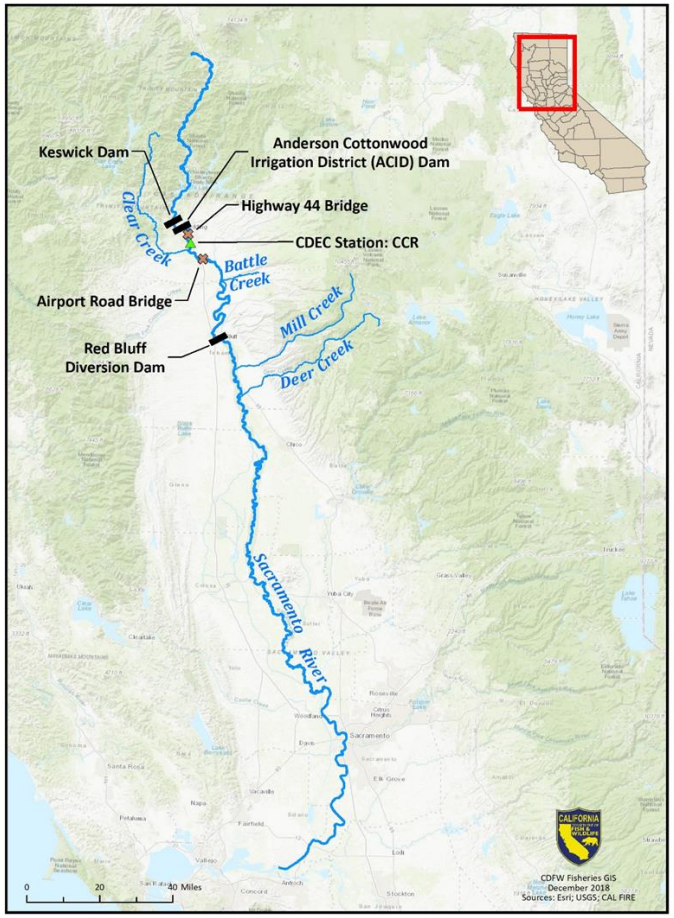
RESULTS:
Question 2: Are streams *warming*? Population effects?

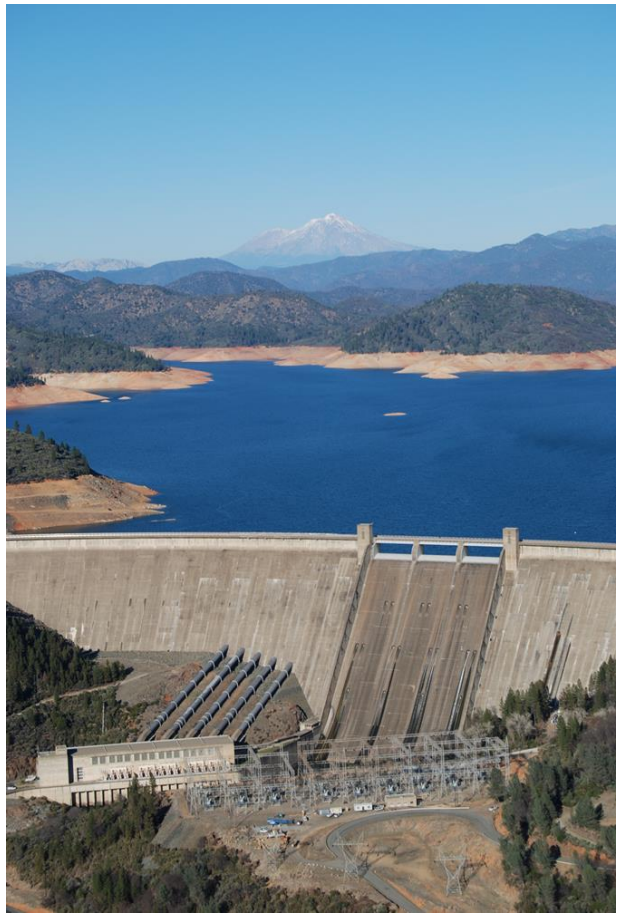
Noyo River (Mendocino County), habitat for Coho Salmon and Steelhead

Salt Creek, tributary of Sacramento River (Shasta County), habitat for fall-run Chinook Salmon and steelhead

RESULTS:
Question 2: Are streams *warming*? Population effects?
Example: winter-run Chinook Salmon (Shasta County)

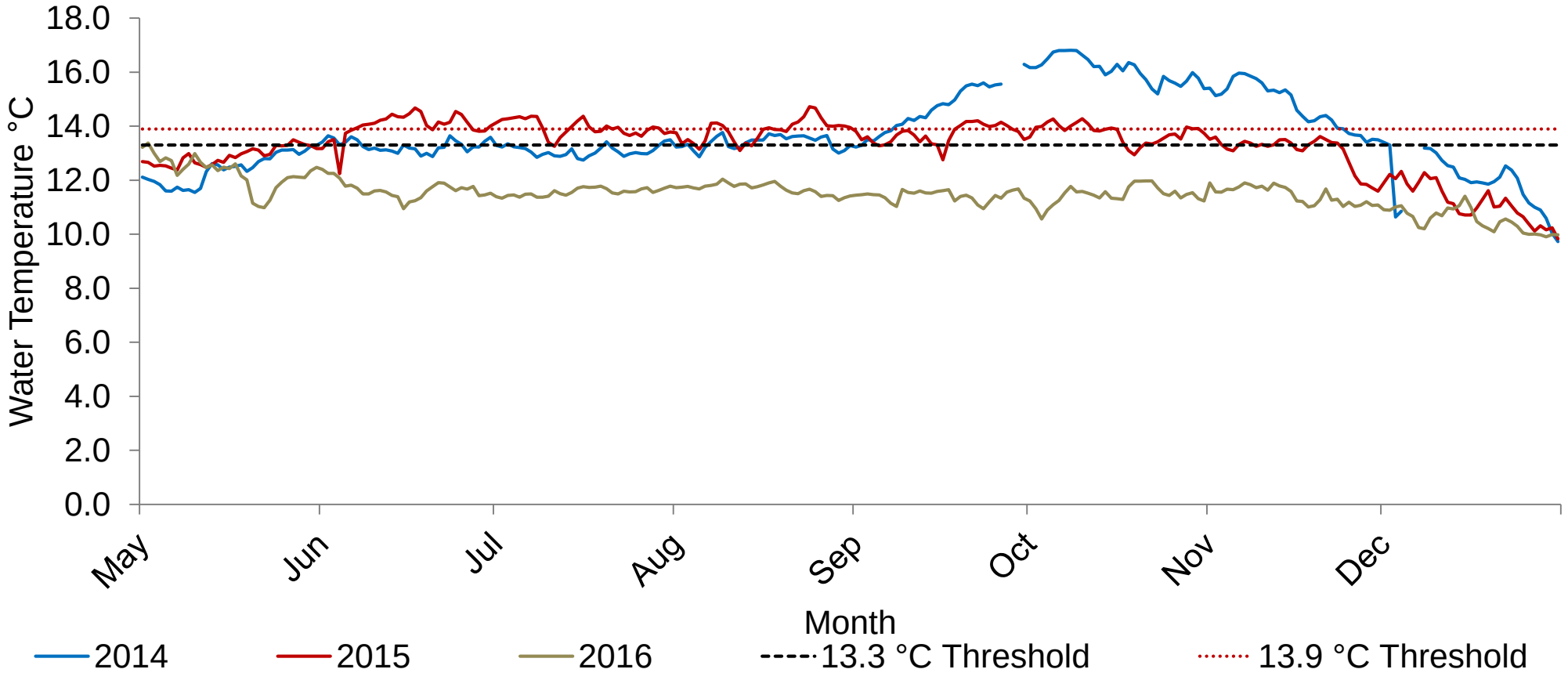
Endangered winter-run Chinook Salmon





Shasta Lake, January 16, 2014 (Shasta Co.) (Credit: DWR)

RESULTS:
Question 2: Are streams *warming*? Population effects?
Continued: winter-run Chinook Salmon (Shasta County)



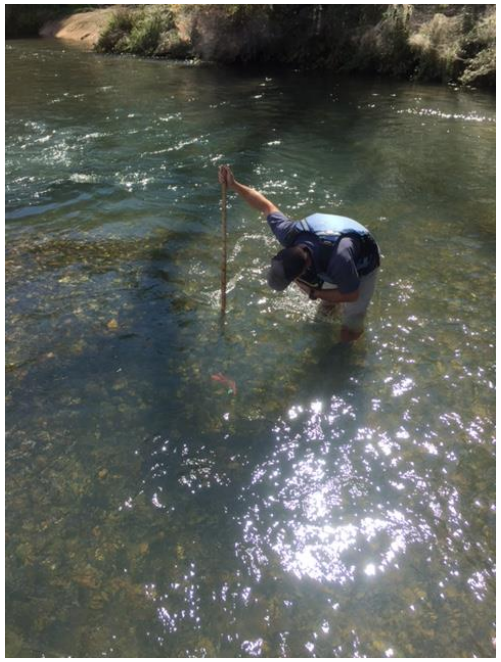
RESULTS:

Question 2: Are streams *warming*? Population effects?

Continued: winter-run Chinook Salmon (Shasta County)

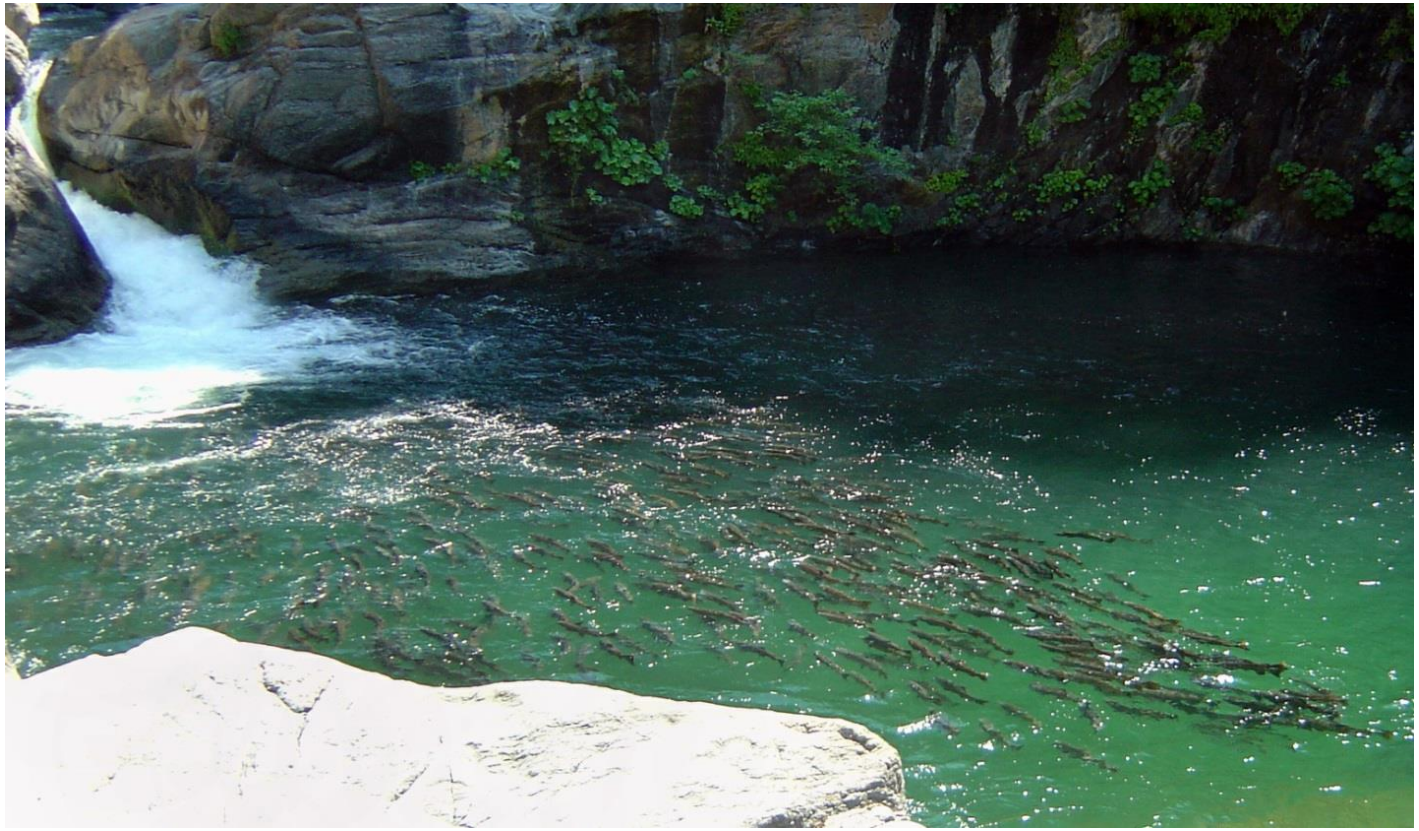
Upstream

Location	2015	2014	2003-2013 Average
Keswick Dam to A.C.I.D. Dam	38%	56%	43%
A.C.I.D. Dam to Highway 44 Bridge	61%	37%	43%
Highway 44 Bridge to Airport Rd. Bridge	1%	7%	14%

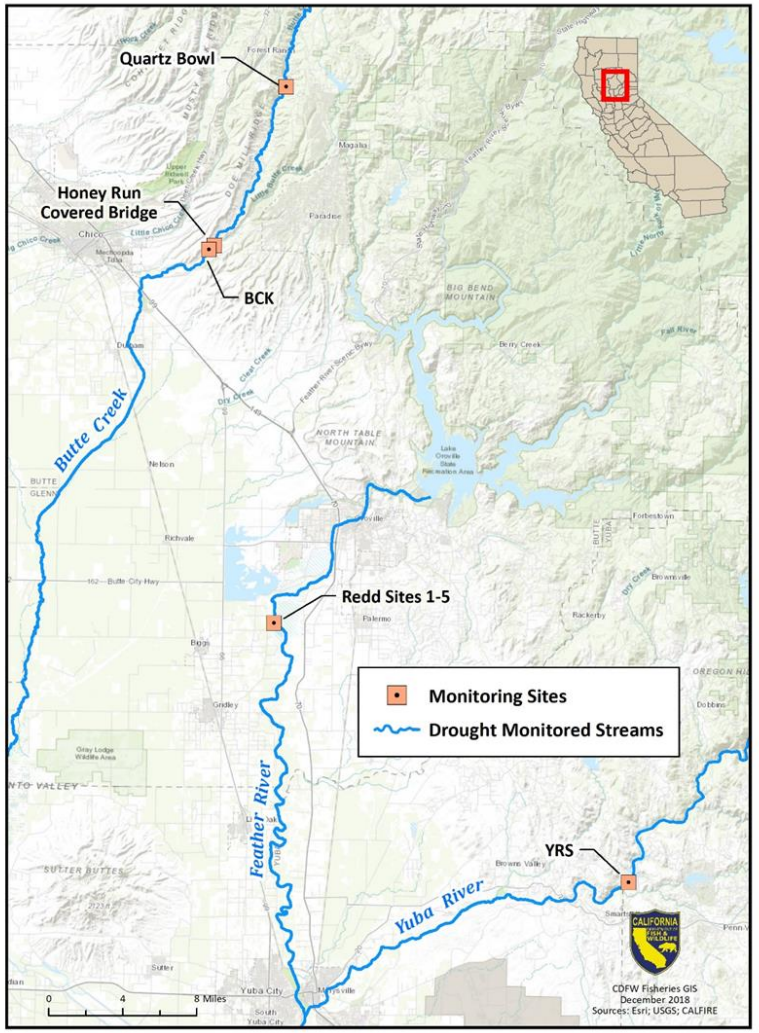


Year	Egg-to-Fry Survival
2003	23.0%
2004	20.9%
2005	18.5%
2006	15.4%
2007	21.1%
2008	17.5%
2009	33.3%
2010	37.5%
2011	48.6%
2012	26.9%
2013	15.1%
2014	5.9%
2015	4.2%
2016	24.0%

RESULTS:
Question 2: Are streams *warming*? Population effects?
Example: spring-run Chinook Salmon (Butte County)

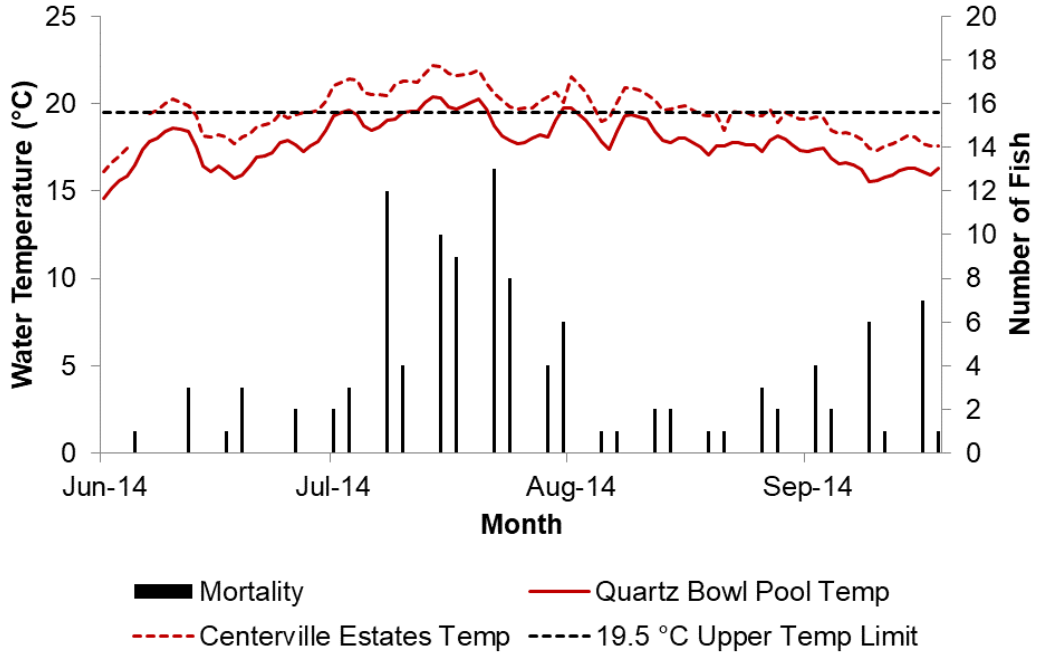


Threatened spring-run Chinook Salmon



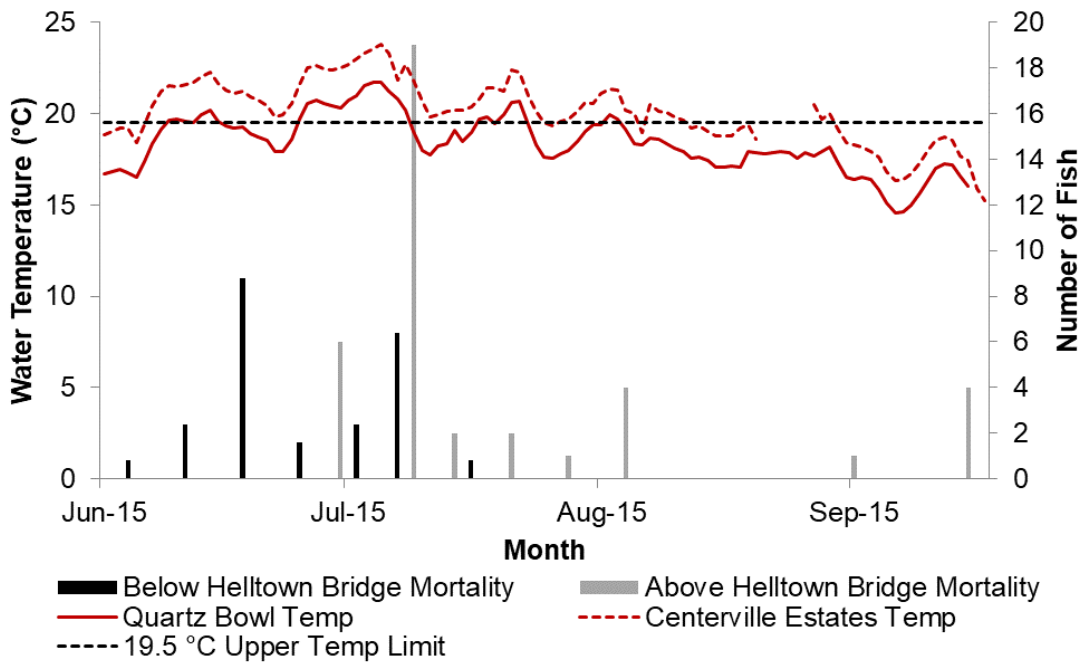
RESULTS:
Question 2: Are streams *warming*? Population effects?
Continued: spring-run Chinook Salmon (Butte County)

Total Number Pre-Spawn Mortalities: 232



2014
Holding / Spawning Season

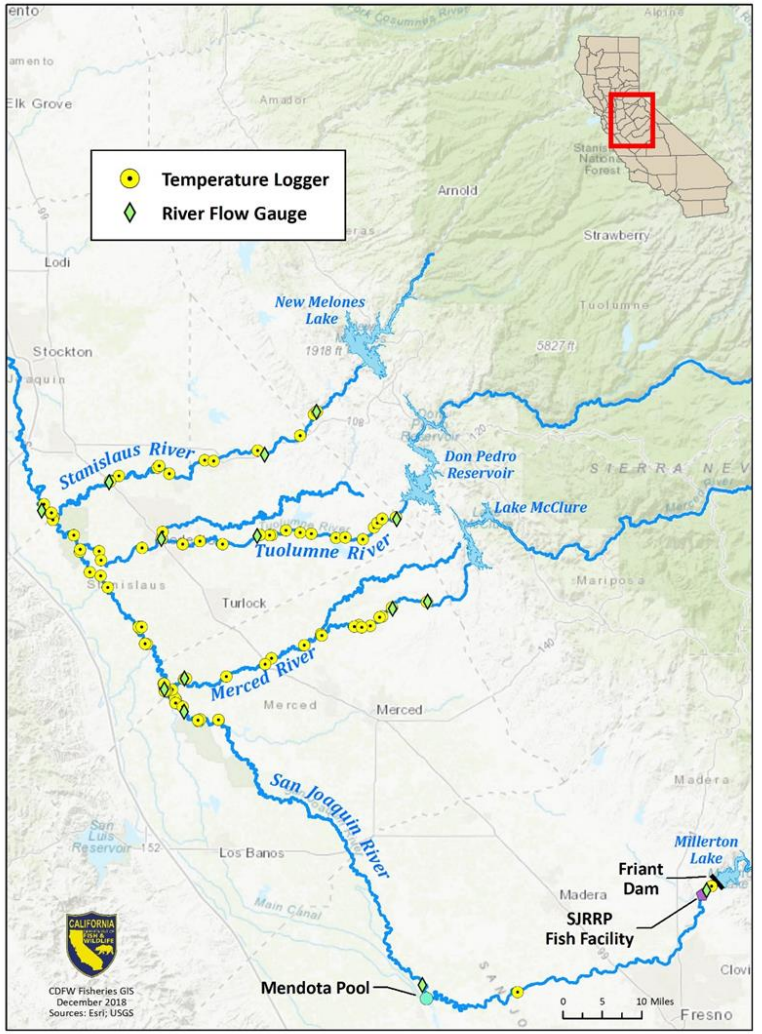
Total Number Pre-Spawn Mortalities: 432



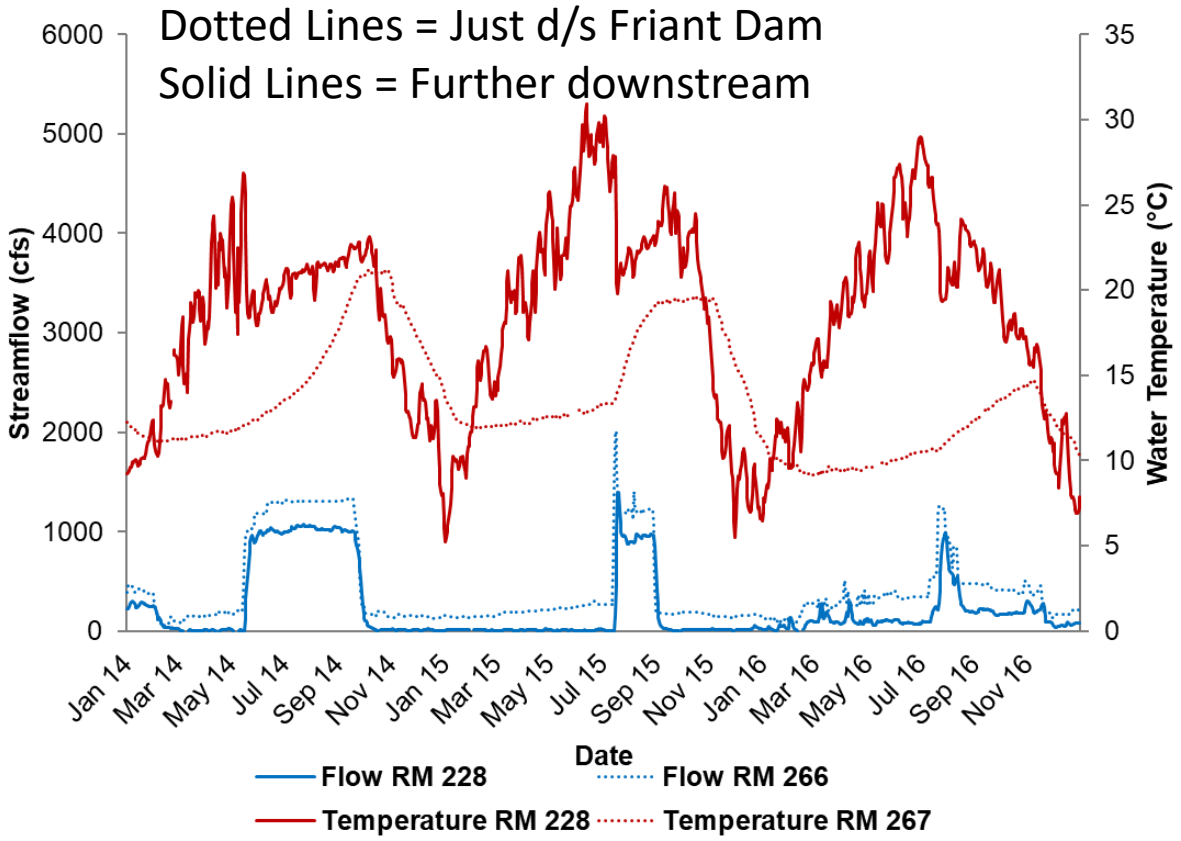
2015
Holding / Spawning Season

RESULTS:
Question 2: Are streams *warming*? Population effects?
Example: San Joaquin River Watershed

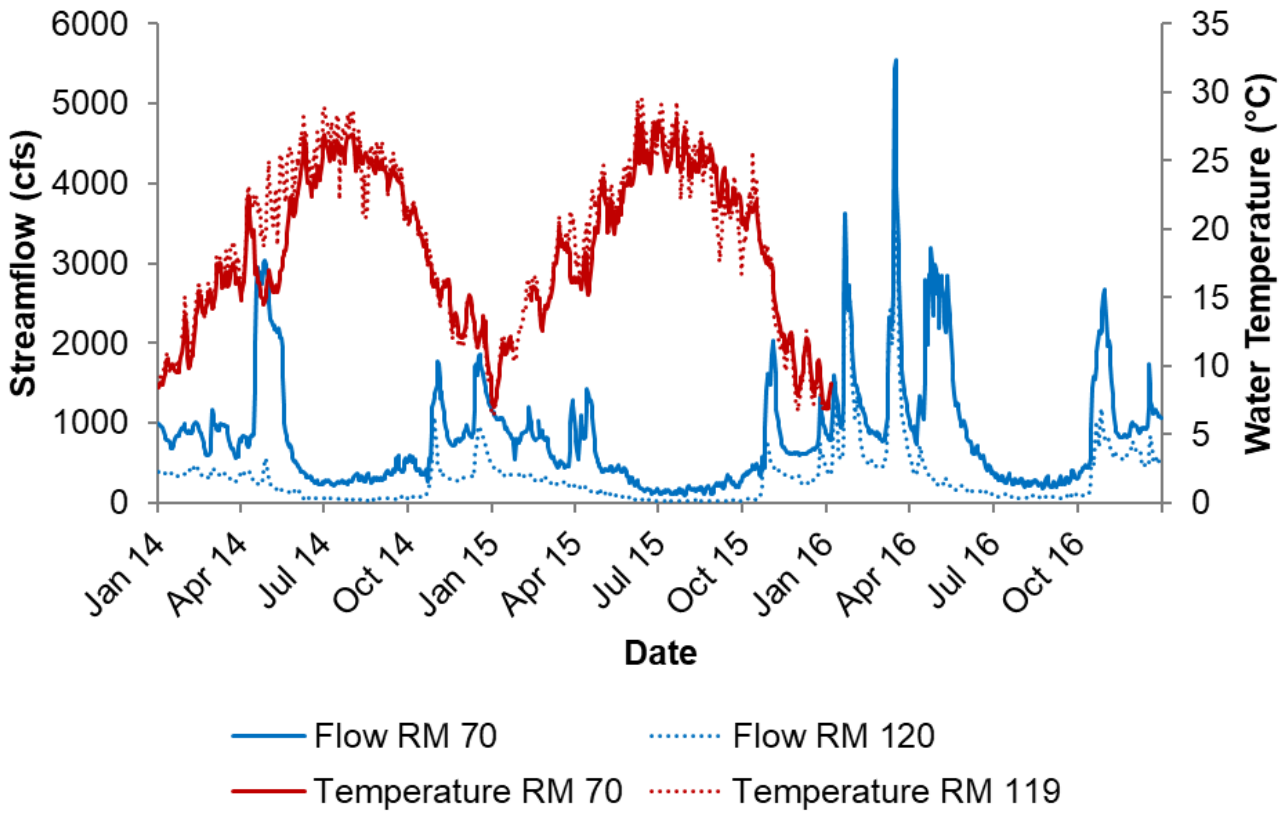
- Fall-run Chinook Salmon,
- Threatened steelhead,
- Threatened spring-run Chinook Salmon (prep work to be re-introduced)



RESULTS:
Question 2: Are streams *warming*? Population effects?
Continued: San Joaquin River Watershed



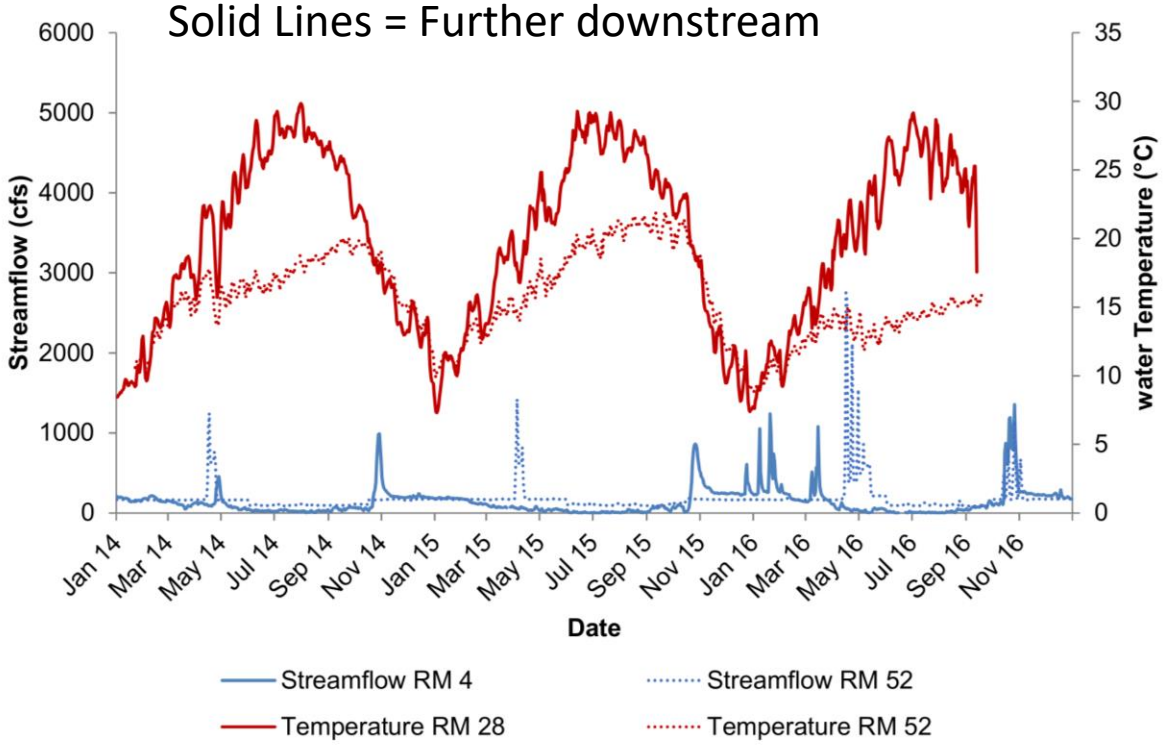
UPPER San Joaquin River (Below Friant Dam) (Fresno County)



LOWER San Joaquin River

RESULTS:
Question 2: Are streams *warming*? Population effects?
Continued: San Joaquin River Watershed

Dotted Lines = Just d/s Crocker-Huffman Dam
Solid Lines = Further downstream



Snorkel Survey Counts in 2014:

- 742 adult and juvenile steelhead
- 14 adult Chinook salmon;
- 9,046 juvenile Chinook salmon.

Snorkel Survey Counts in 2015:

- 59 adult and juvenile steelhead
- one adult Chinook salmon
- 34 juvenile Chinook salmon

Merced River, tributary to San Joaquin River (Merced County)

RESULTS:

Question 2: Are streams *warming*? Population effects?

TOPIC: Freezing an issue in Sierra streams

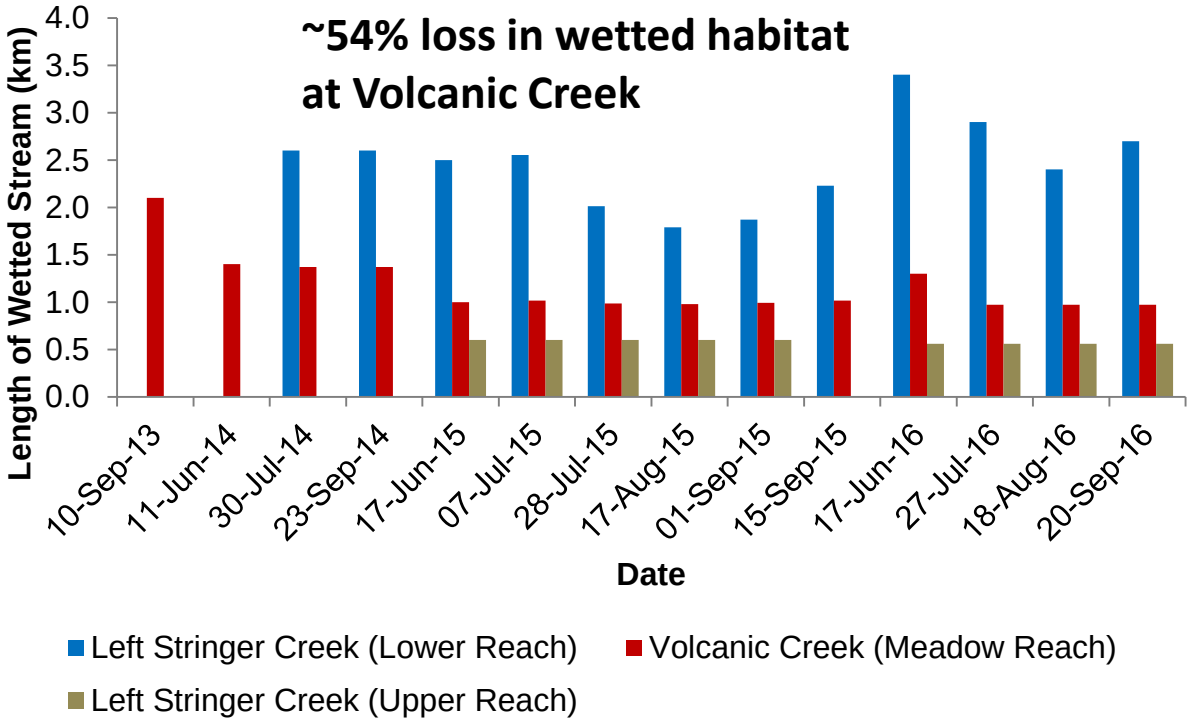
RESULTS:
Question 2: Are streams *warming?* Population effects?
TOPIC: Freezing an issue in Sierra streams
Example: California Golden Trout in Tulare County

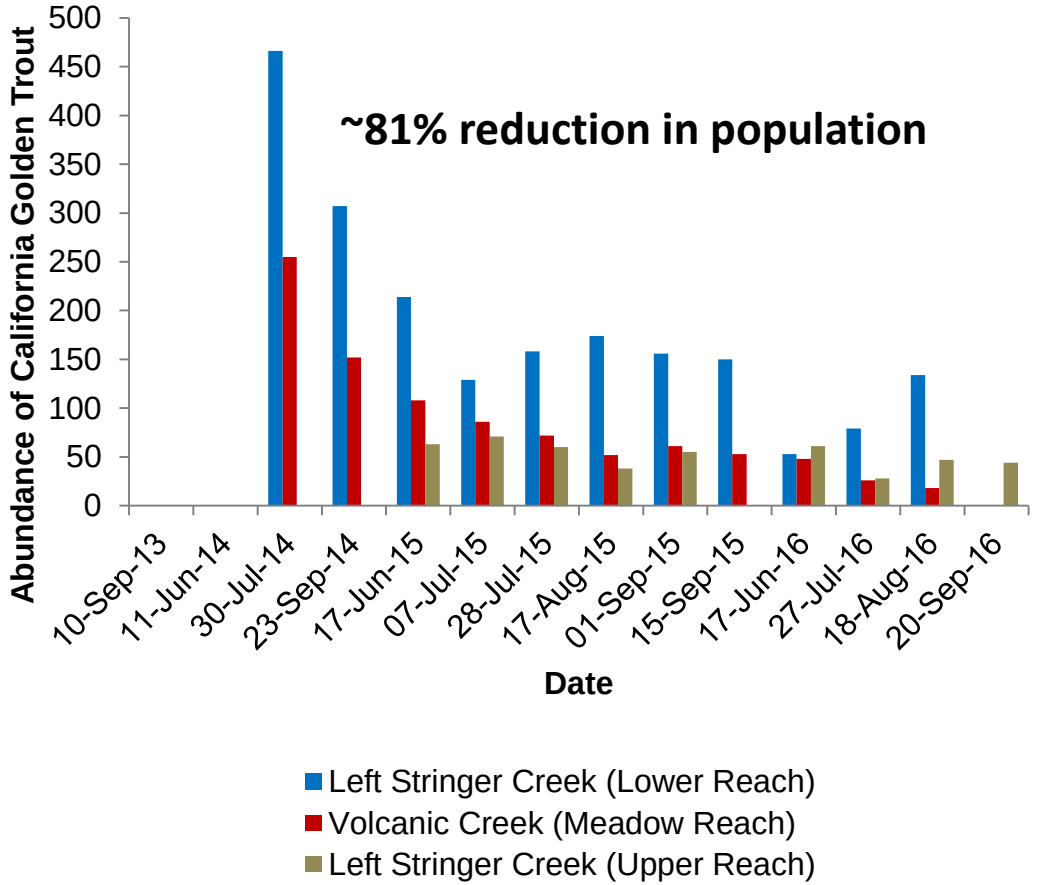
California Golden Trout (unique genetic strain)

https://www.youtube.com/watch?v=tacjH47tS2U

Film credit: CDFW

RESULTS:
Question 2: Are streams *warming?* Population effects? TOPIC: TOPIC: Freezing an issue in Sierra streams
Continued: California Golden Trout in Tulare County



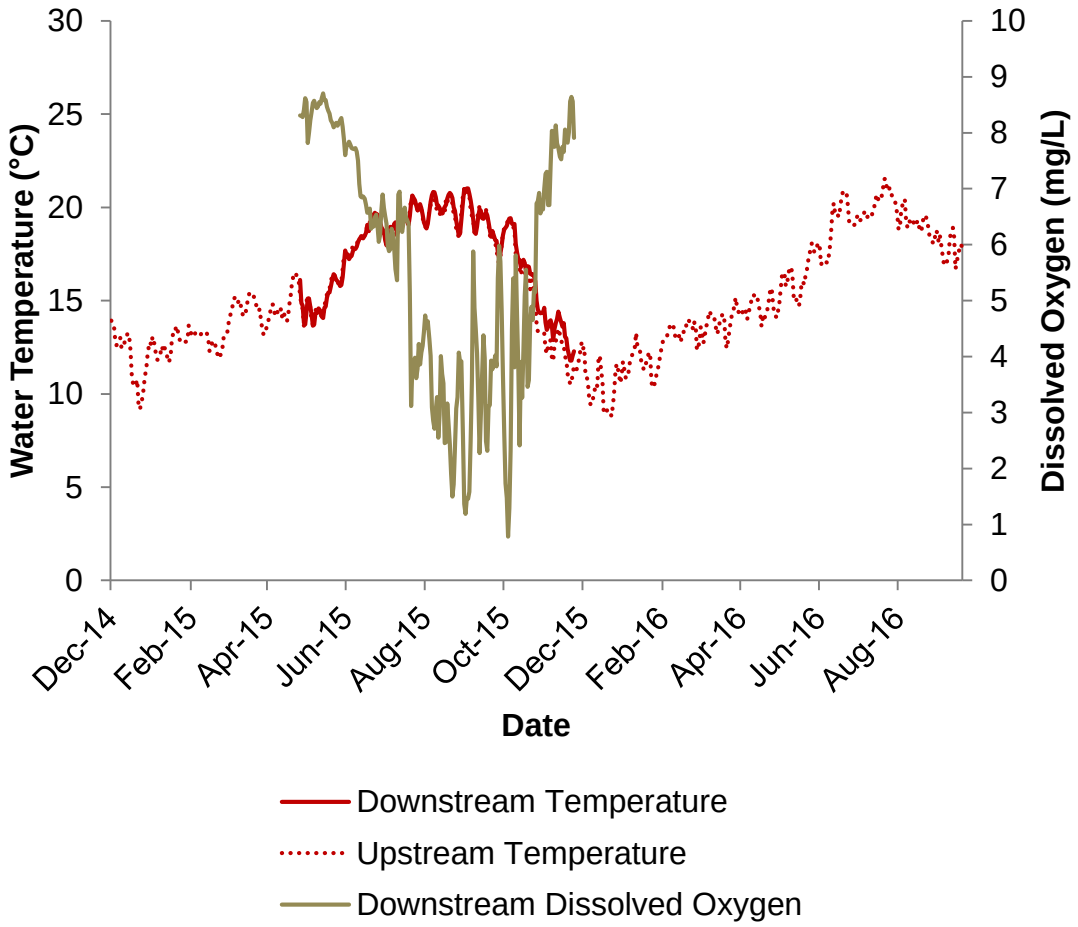


RESULTS:
Question 3: Is the amount of *dissolved oxygen* changing?

Santa Clara Watershed (Ventura County)

Coldwater Canyon Creek (Riverside County)

RESULTS:
Question 3: Is the amount of *dissolved oxygen* changing?
EXAMPLE: Coldwater Canyon Creek (Riverside County)



RESULTS:
Question 3B: Are *both* the dissolved oxygen and temperature changing?

TOPIC: Drought effects on estuaries / bar-built lagoons

Pescadero Creek lagoon (San Mateo County)

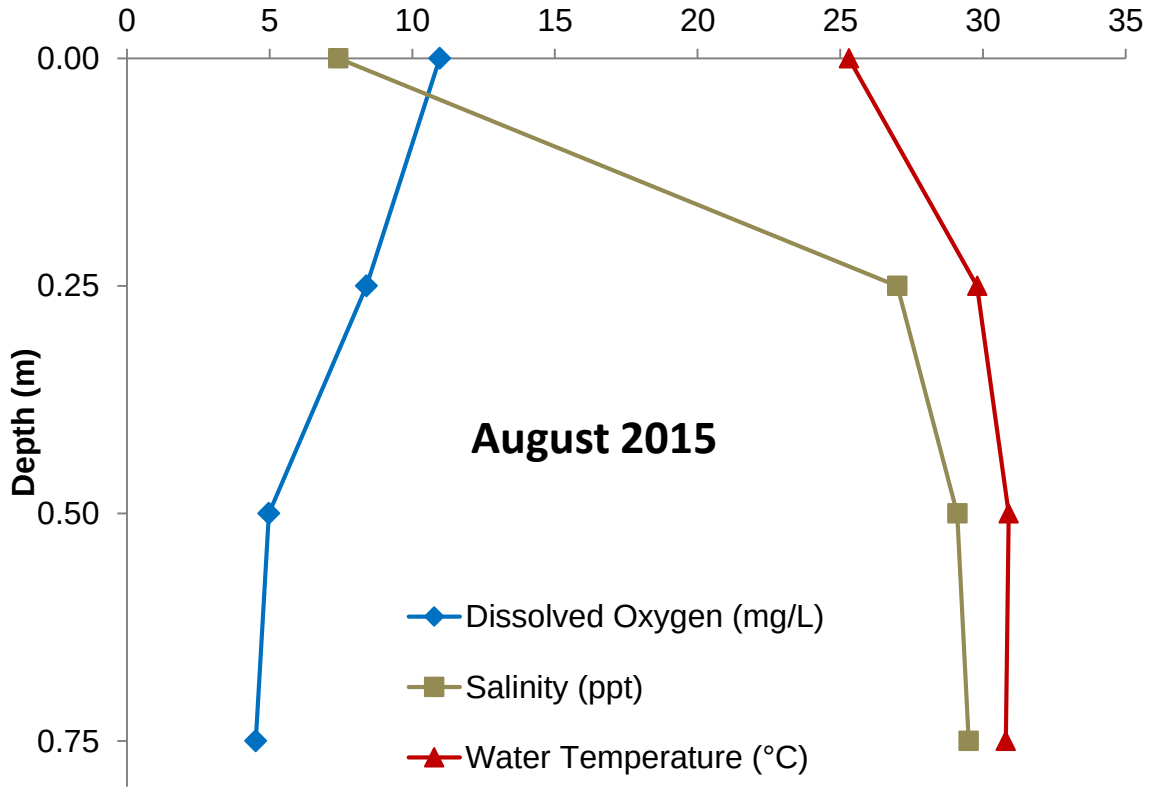
Humboldt Bay Estuary
(Humboldt County)

RESULTS:
Question 3B: Are both the dissolved oxygen and temperature changing?
Examples: Bar-Built Lagoons in Central and South Central California coasts

Pescadero Creek Lagoon (San Mateo County)

ESTIMATES of # Steelhead:

- July 2015: 2,345 (95% CI 1,841 to 3,478).
- October 2015: no steelhead were detected in the lagoon.
- In July 2016: 4,064 (95% CI 3,035 to 5,312)
- October 2016: 1,577 (95% CI 1,162 to 2,325).



RESULTS:

Bonus Question: What are the effects of drought and mudslides?

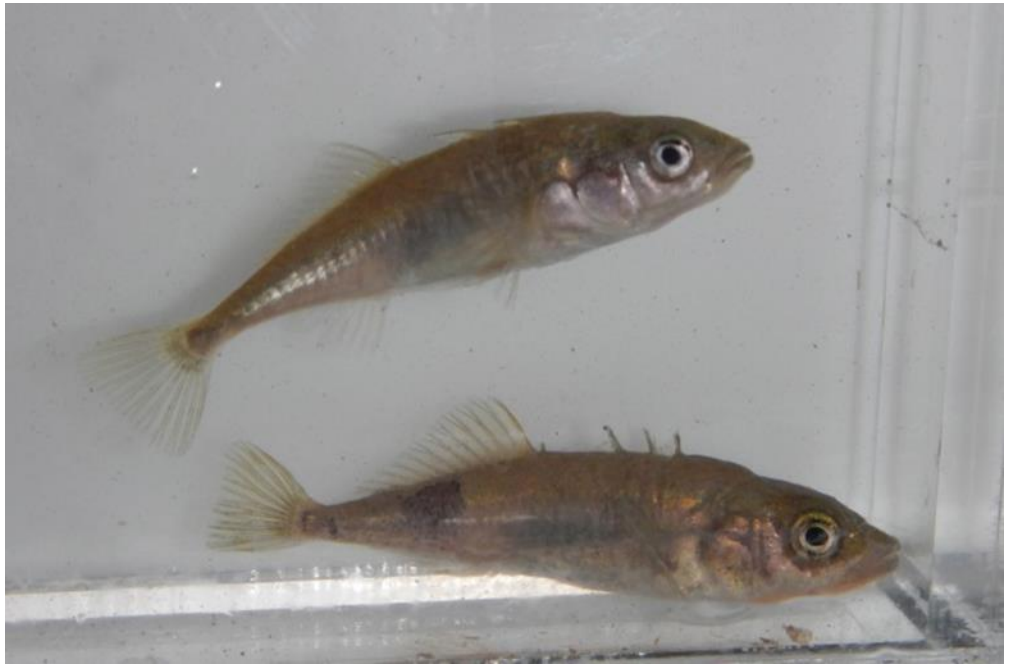
Montecito Creek, Montecito 2018 (Santa Barbara County)

Credit: https://www.dogonews.com/2018/1/17/fire-ravaged-santa-barbara-now-grapples-with-devastating-mudslides

RESULTS:

Bonus Question: What are effects of drought and mudslides?

Example: Unarmored Stickleback in Santa Clara River Watershed (Los Angeles County)



Endangered and Fully-Protected

Unarmored Threespine Stickleback

RESULTS:
Bonus Question: What are effects of drought and mudslides?
Continued: Unarmored Stickleback in Santa Clara River watershed

- July 2016: Sand Fire puts population at risk due to possible sedimentation.
- October 2016: Rescued and temporarily held at Fillmore Hatchery.
- January 2017: Heavy rains buried the collection site under seven feet of ash and sediment.
- Later 2017: Re-Introduced to suitable habitat within the watershed.

DISCUSSION: Summary

- 2012-2016 showed record-breaking drought in California, especially in the southern Central Valley and coastal areas

- Monitoring was integral to understanding the effects of drought on aquatic species and for determining management actions (e.g. fish rescue).

- Patterns recorded that often-affected fish survival:
    1) streams dried earlier and longer;
    2) estuaries and bar-built lagoons exhibited degraded water quality,
    3) water temperatures sometimes rose to critical levels;
    4) wild trout populations in high elevation streams threatened winter anchor ice;
    5) fish were often stranded by low streamflow and adversely affected by poor water quality.

DISCUSSION: Lessons Learned

- Long term monitoring keeps us prepared to deal with drought.
- Long term monitoring shows important context.
- Monitoring helps forecast for future scenarios (e.g. water management)
- Linking monitoring with management improves balance of resources (e.g. fish rescue, fish rescue, etc.)
- Extreme drought provided insight about key habitat that remains wetted. These “sanctuary” habitats and access by aquatic species need to be protected.
- Altered habitat from extreme drought has already begun to show us new threats to fish and habitat we need to be prepared to address:
  - Wildfires
  - Mud slides
  - Flash flooding and debris flows

Positioning for the Future

We now have:

1) monitoring baseline
2) better understanding of refugia
3) a forecast of most at-risk populations

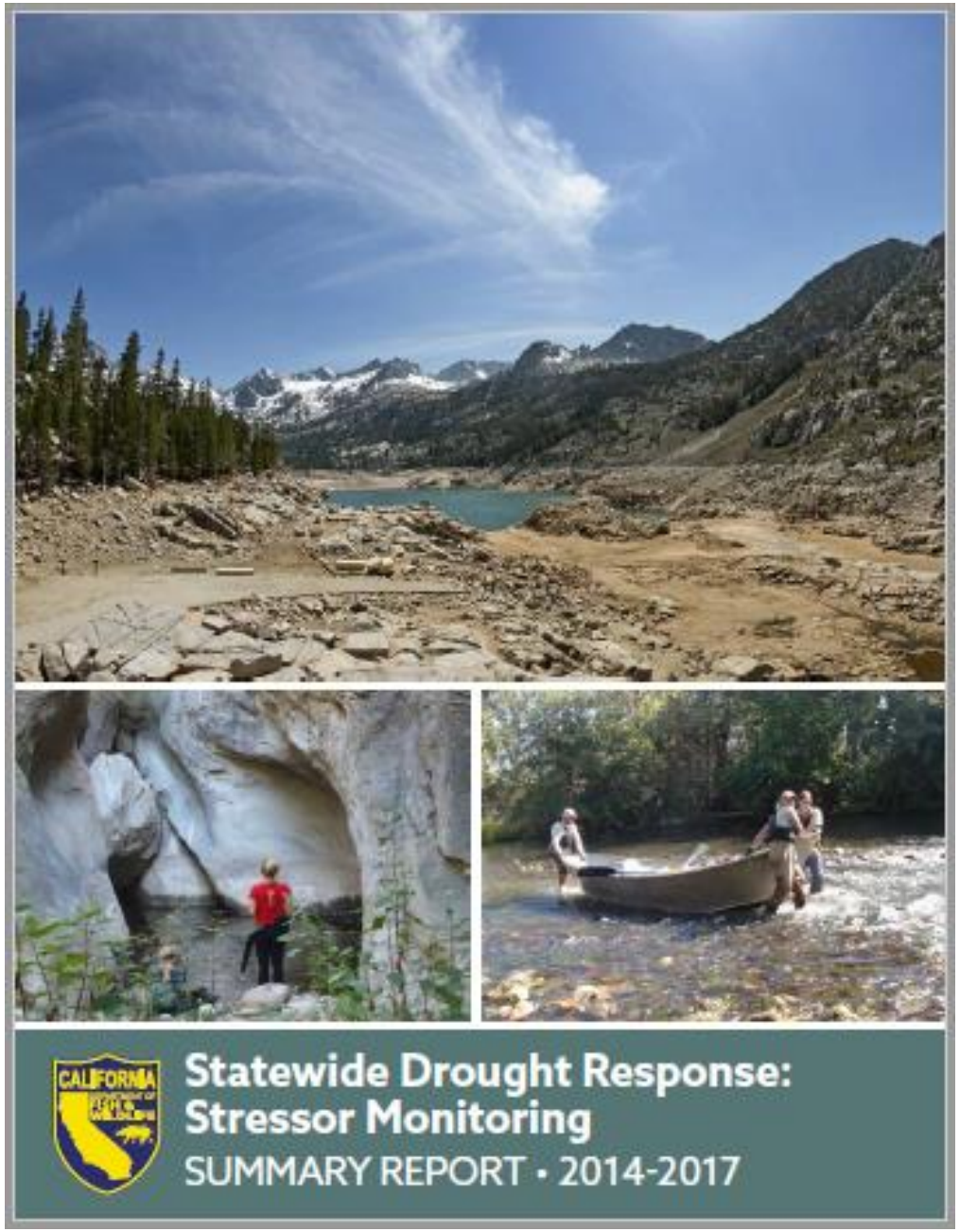
- Need for building resiliency.

Recommendations for the future

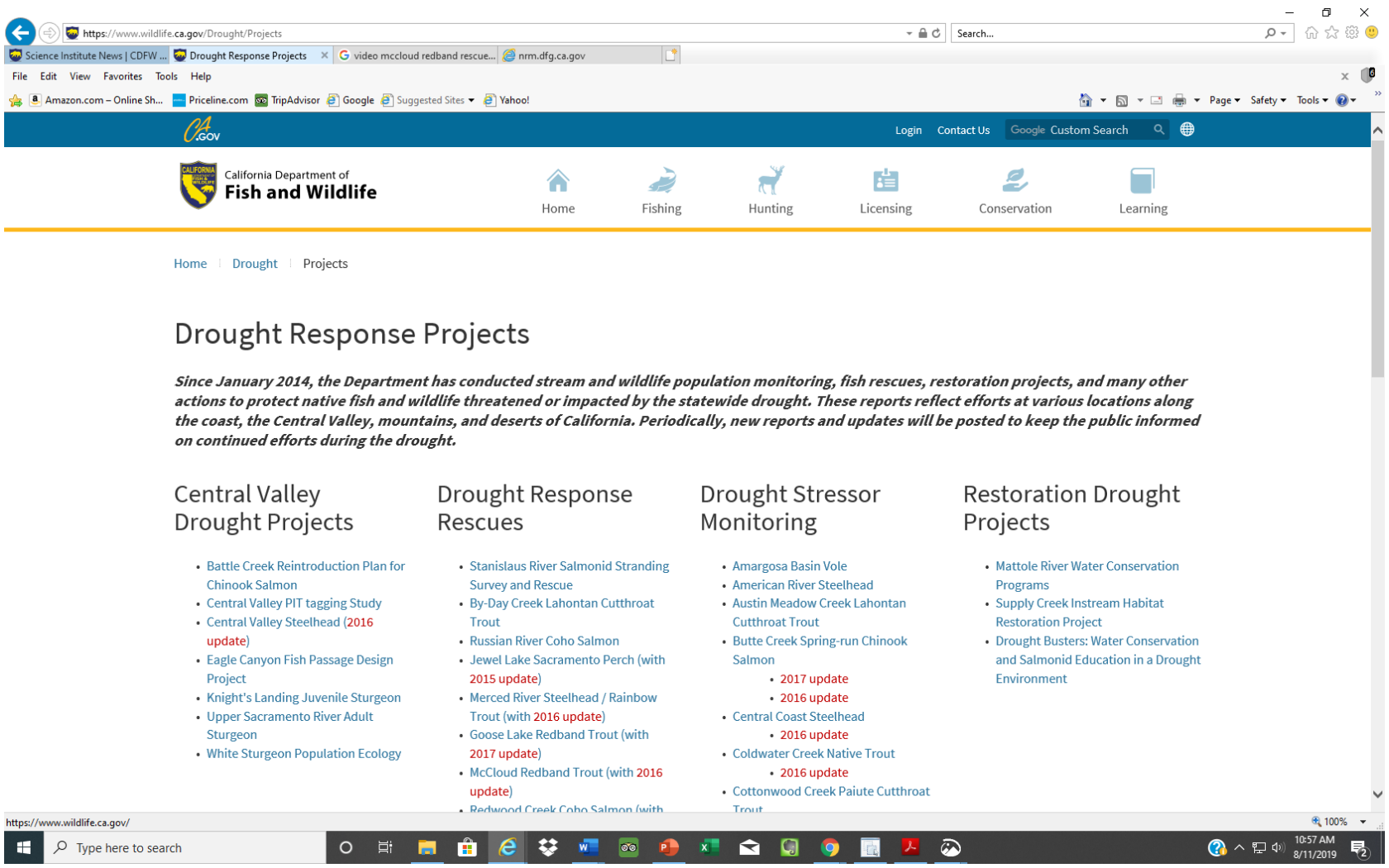
- Monitoring over the long term
- Transparency in results
- Standardizing methods
- Partnerships
- Resiliency
- Innovation

Final Report:

http://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=168170



CDFW Case Studies: https://www.wildlife.ca.gov/Drought/Projects



Videos of CDFW's Drought Efforts

McCloud River Redband Rescue and Recovery

California Trout

Vimeo - Oct 22, 2016

https://vimeo.com/188421508

Film credit: Caltrout

California Golden Trout Rescue Project

CDFW

YouTube - Dec 22, 2016

https://www.youtube.com/watch?v=tvHZzq-h3FE

Film credit: CDFW

California Golden Trout's Long Journey Home

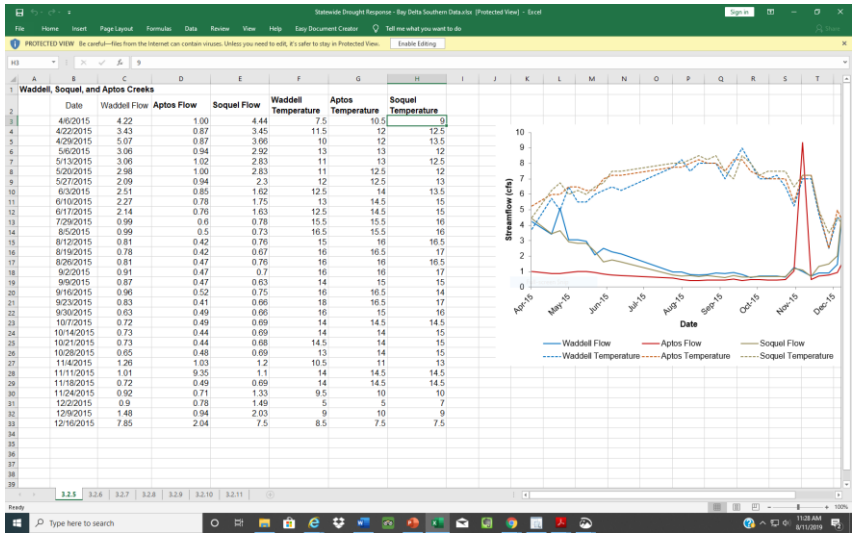
CDFW

YouTube - Aug 23, 2017

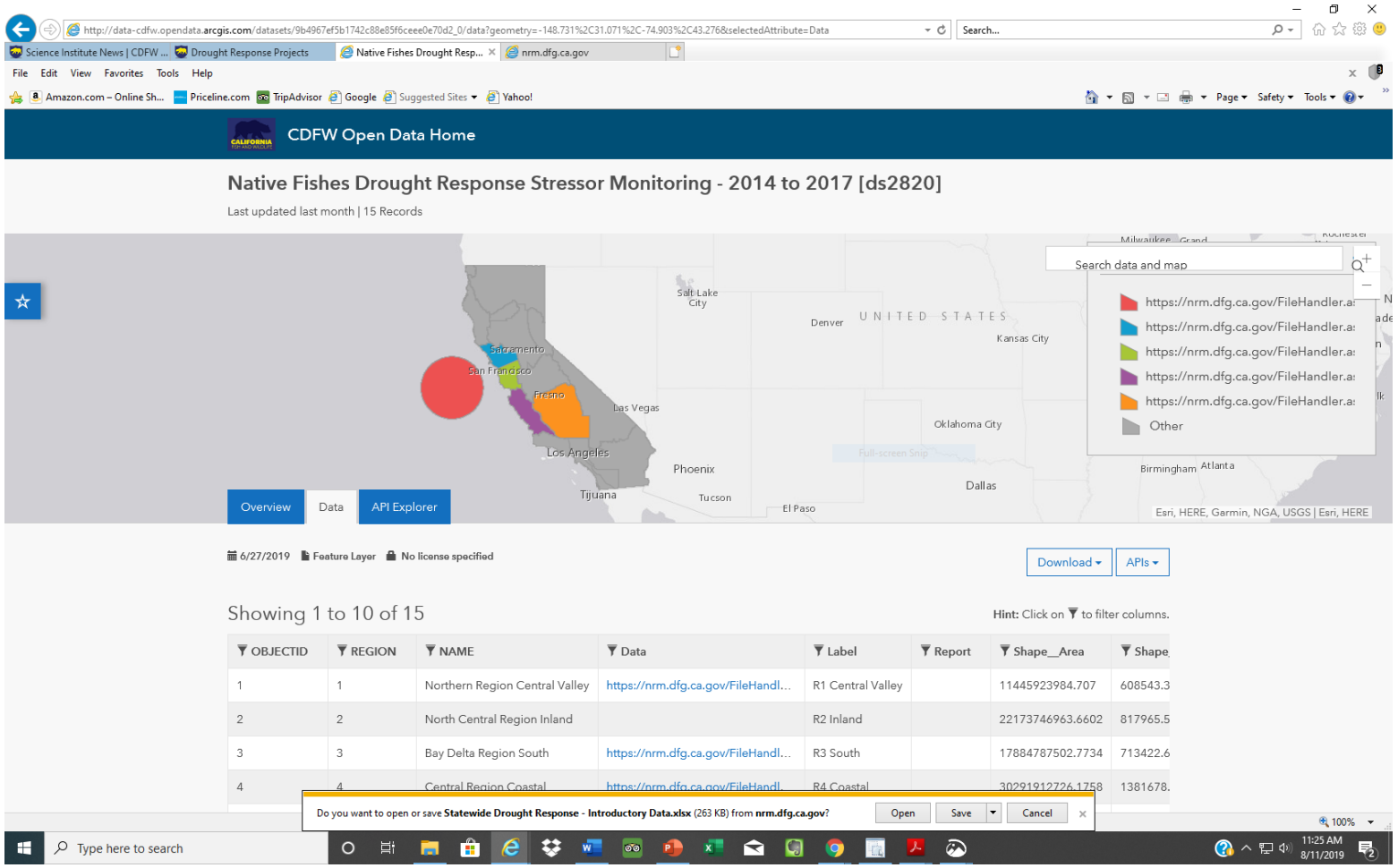
https://www.youtube.com/watch?v=tacjH47tS2U

Film credit: CDFW

Raw data available at CDFW's BIOS website



https://www.wildlife.ca.gov/Data/BIOS



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California Department of Fish and Wildlife

ensuring scientific quality and visibility SCIENCE Institute

CALIFORNIA natural resources AGENCY

CALIFORNIA DEPARTMENT OF WATER RESOURCES


QUESTIONS?