Aquatic ecology and bioassessment in the CAWSC: from urban streams to climate change in the San Francisco Estuary

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USGS
science for a changing world

Objective

- From Jim H: “…updates on your work so newer attendees know what USGS does associated with aquatic assessments and general ecology. ”

Topics

- Some capabilities you may not be aware of
  - Pesticide lab
  - High speed/frequency water quality
- Aquatic ecology projects: past and present
  - Stream/River ecology
  - Bay-Delta ecology

- NOTE: This talk is data free!

Caveats

- There are other USGS folks in CA doing Ecology
  - National Research Program (Menlo Park: Terry Short)
  - Western Ecological Research Center (aquatic, terrestrial, avian, plants, contaminants etc.)
- Not all CAWSC groups covered
  - Hydrology (Rivers, Bay-Delta ecology)
  - Sediment

Pesticide Fate Research Group (PFRG)
California Water Science Center

Megan McWayne
Chemist

Jim Orlando
Hydrologist

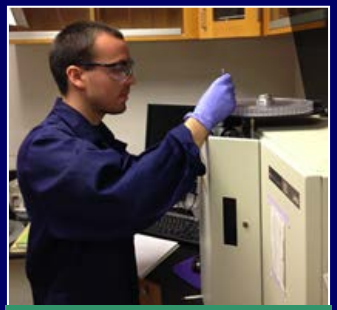
Michelle Hladik
Research Chemist

Mike Gross
Post Doc- Chemist

Emily Woodward
Post Doc- Soil Scientist

http://ca.water.usgs.gov/projects/PFRG/index.html

Corey Sanders
Chemist

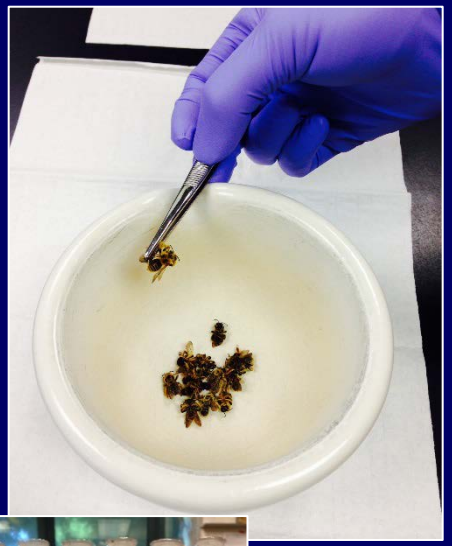


Matt De Parsia
Hydro Tech/
GIS Trainee

Sean Stout
Hydrologist

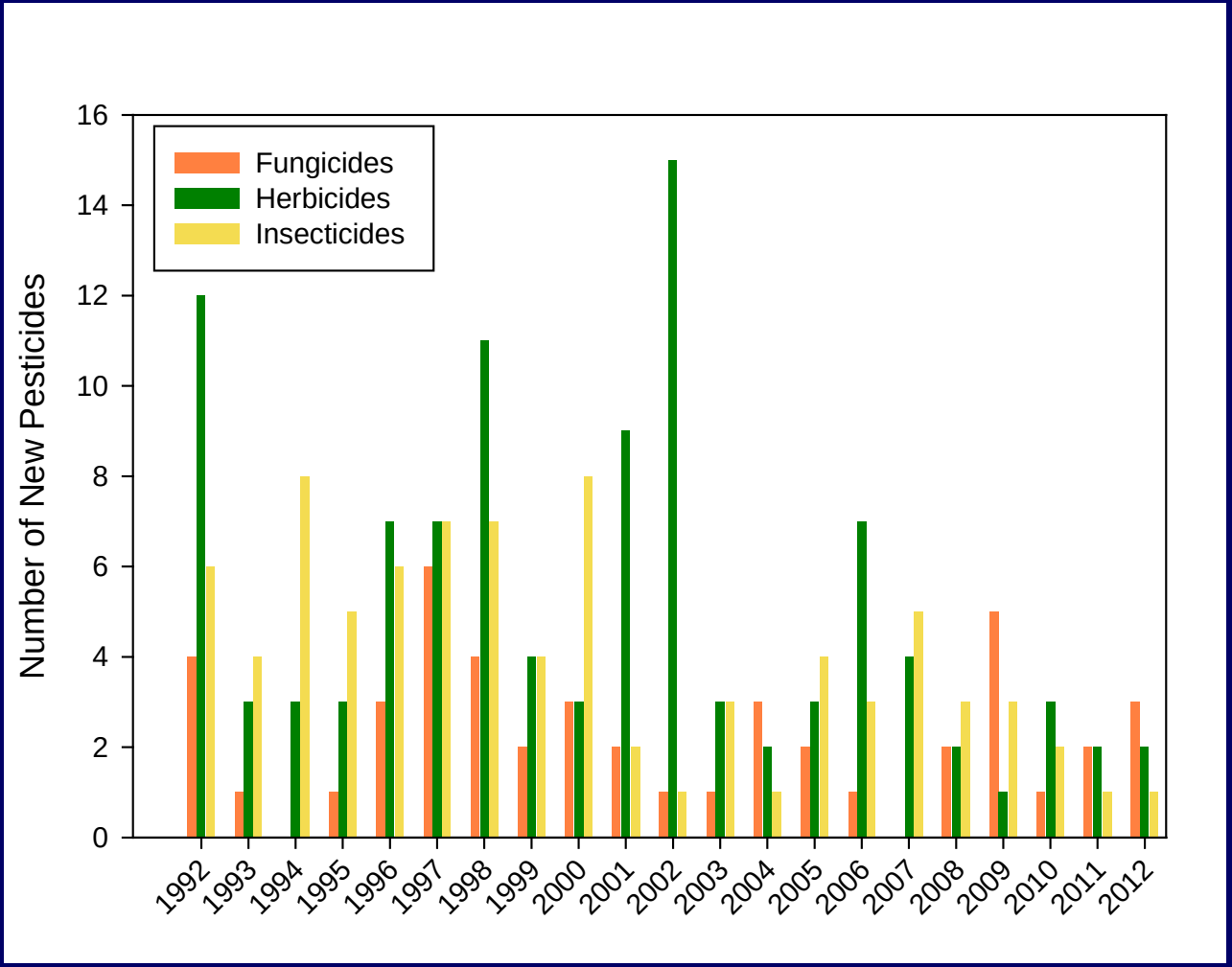
Pesticide Fate Research Group

- Major focus: fate of current-use pesticides (and other organics) in aquatic environments
  - Chemical analysis of pesticides in a variety of matrices (water, sediments, tissue)
  - Methods developed and optimized for specific needs
    - Very low MDL
    - Small sample volumes



- **Collaborate with toxicologists and ecologists to understand effects**

Method Driver → Changing Pesticide Use



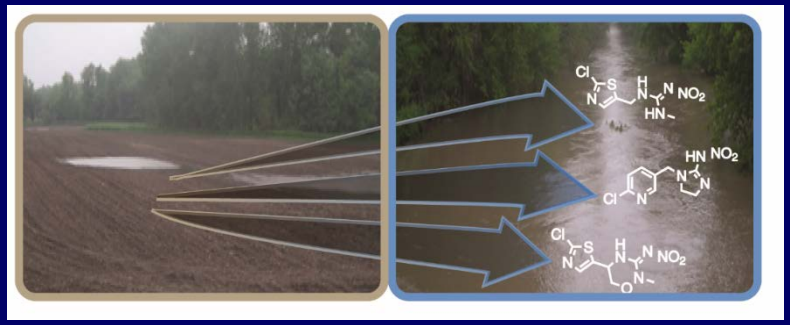
Since 2000 there have been an average of 11 new pesticide active ingredients introduced in the SF Bay/Delta watershed each year.

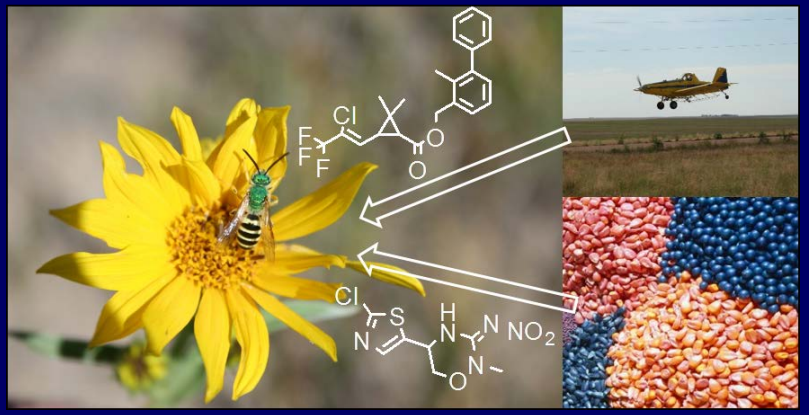
PFRG - Methods To Date

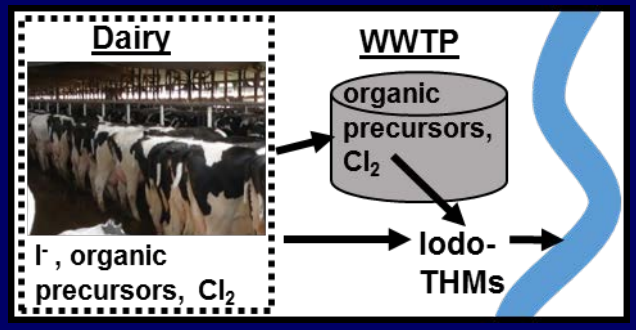
- Water
  - GC-MS 128 pesticides, 62 in 2008 journal article plus additions
  - LC-MS/MS 35 pesticides, 10 in 2012 SIR plus additions
- Sediment
  - Current-use pesticides (119) in bed sediment via GC-MS (USGS report: TM5-C3)
  - Pyrethroid insecticides (14) in sediment and water via GC-MS and GC-MS/MS (USGS report: TM5-C2)
- Tissue
  - Frogs - 100 CUPs GC/MS (2013 journal article)
  - Cleanup methods have changed, expanded to fish, aquatic insects, bees (~150 compounds; 2016 journal article)
  - GC-MS/MS and LC-MS/MS

Recent Highlights

- Neonicotinoid insecticides in surface water
- Native bee tissue- pesticide residues
- Pyrethroid insecticides in sediment
- Disinfection byproducts in wastewater

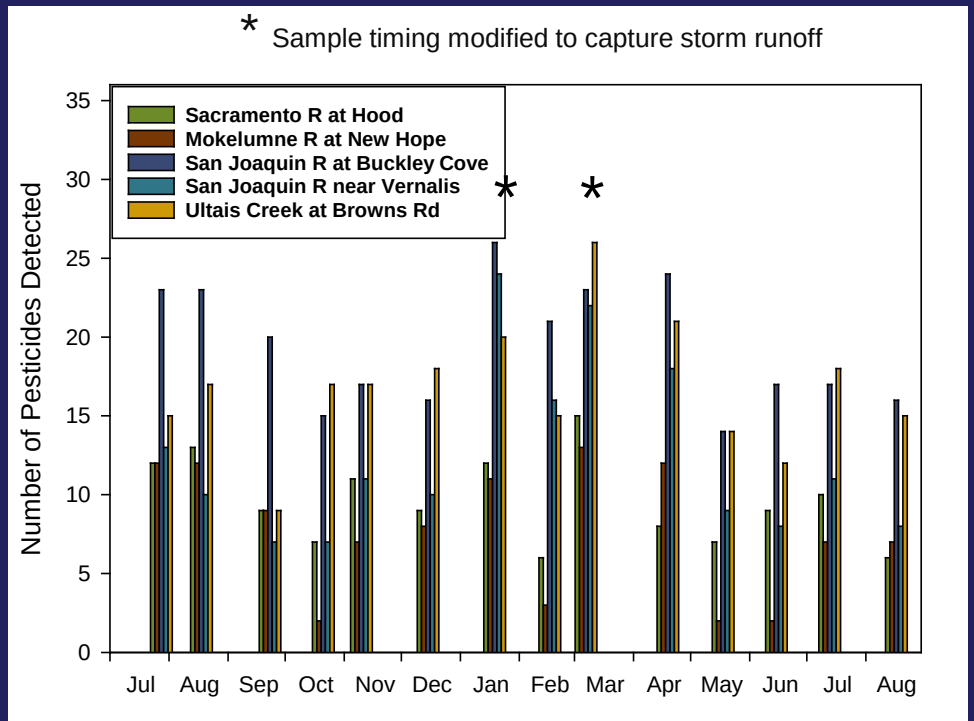






Delta Regional Monitoring Program Results

- All samples contained mixtures of multiple pesticides
- To date have detected 60 current-use pesticides in water and 11 on suspended sediments
- Significant acute toxicity has not been detected, however reduced growth and/or reproduction has been measured in multiple samples

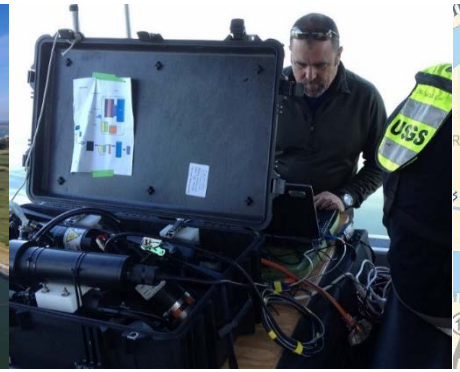


	Average # Pesticides
Hood	10
Mokelumne	8
Buckley Cove	19
Vernalis	12
Ulatis Creek	17

San Joaquin River near Vernalis

High speed mapping of water quality and water isotopes measurements "Water quality at 20 mph!"

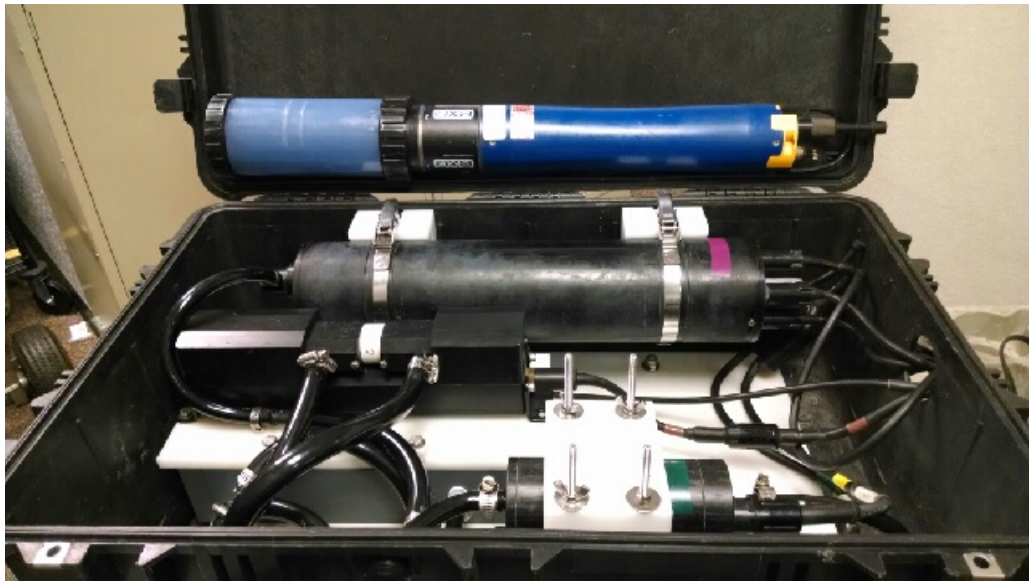
Bryan Downing, Brian Bergamaschi, Tamara Kraus, Katy O'Donnell, Scott Nagel, Elizabeth Stumpner and Travis von Dessonneck

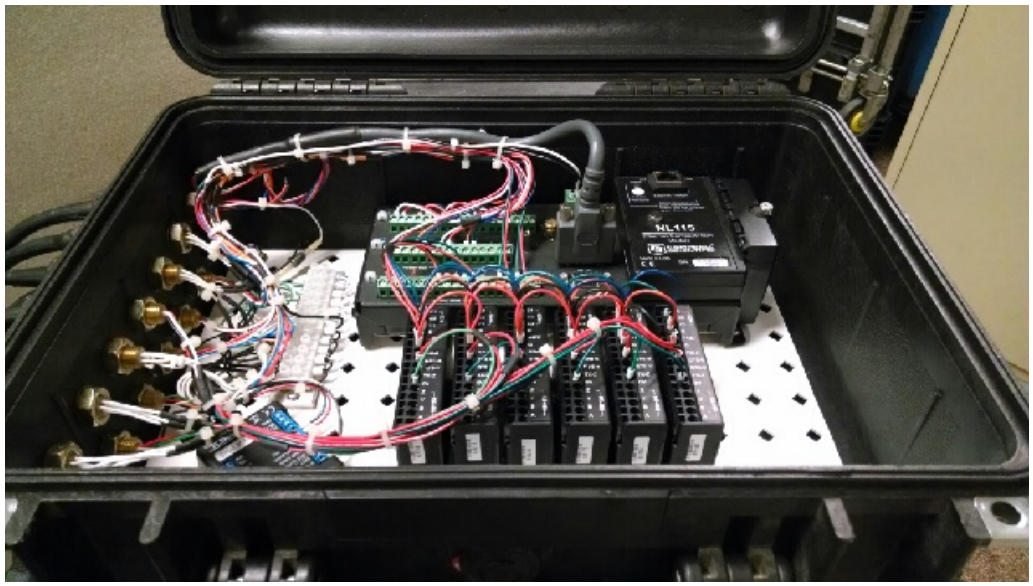


High Speed Mapping

1. Necessity evolved from research needs for multiple projects
2. Advances in opto-electronic sensors make it possible to measure important biogeochemical parameters directly

High Speed Mapping

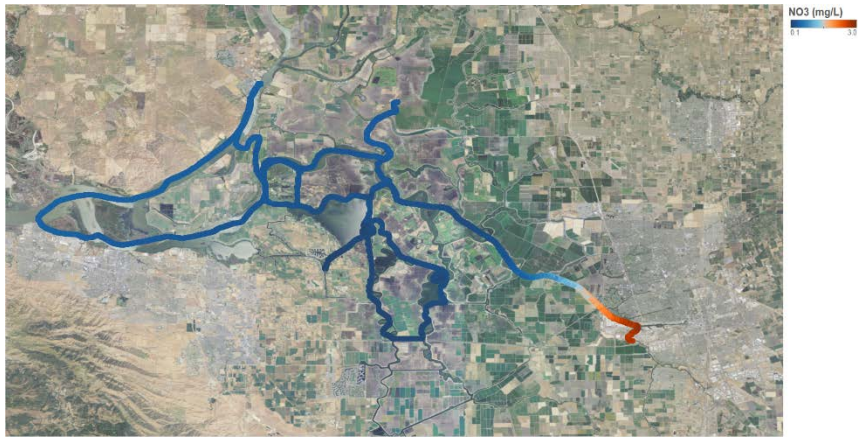




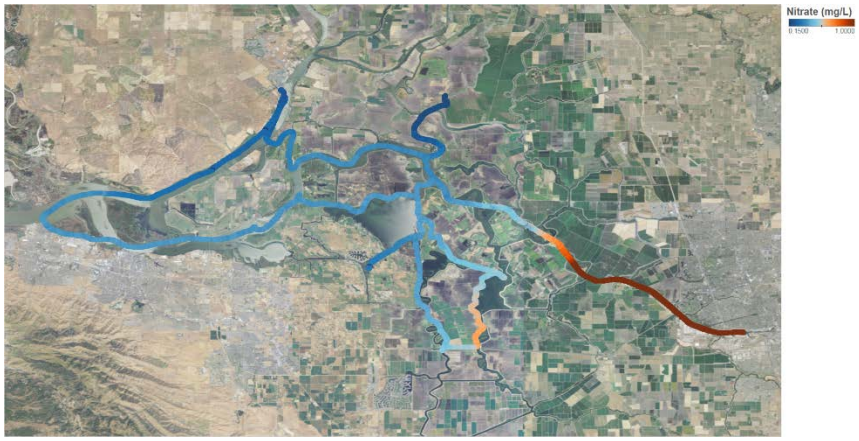
- Seabird 45 Thermosalignograph
- Satlantic ISUS Nitrate Analyzer
- WETLabs CHL-A Fluorometer
- WETLabs FDOM Fluorometer
- WETLabs Transmissometer (676 nm)
- WETLabs ac-s spectrophotometer
- EXO2 (flow through adaptor)
  - Temperature
  - conductivity, salinity
  - pH, dissolved oxygen,
  - Turbidity, FDOM
  - chlorophyll-a
  - phycocyanin
- GPS system
- Custom datalogging system.

Nitrate (mg/L)

Sept 14, 2015

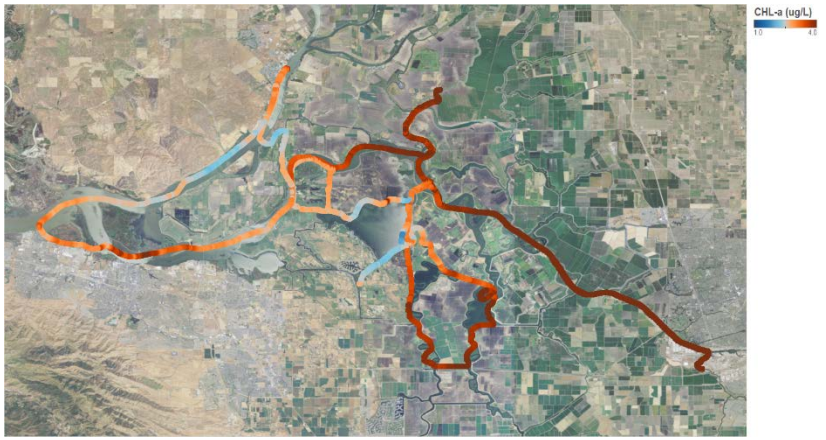


April 18, 2016



Chlorophyll-a (ug/L)

Sept 14, 2015



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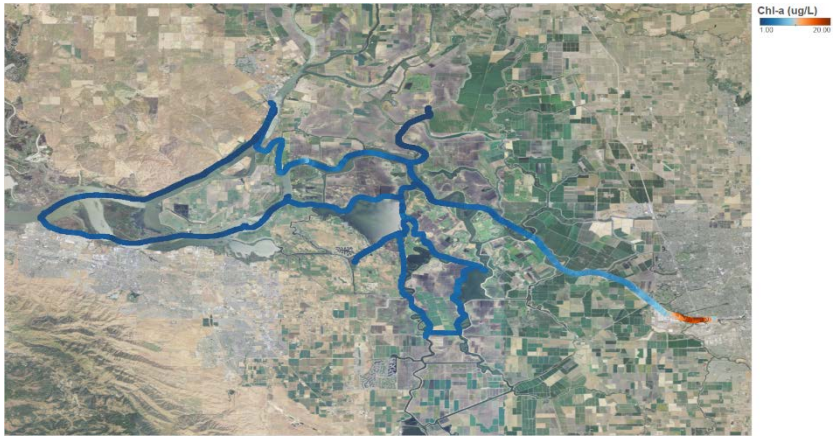

Nitrate (mg/L)

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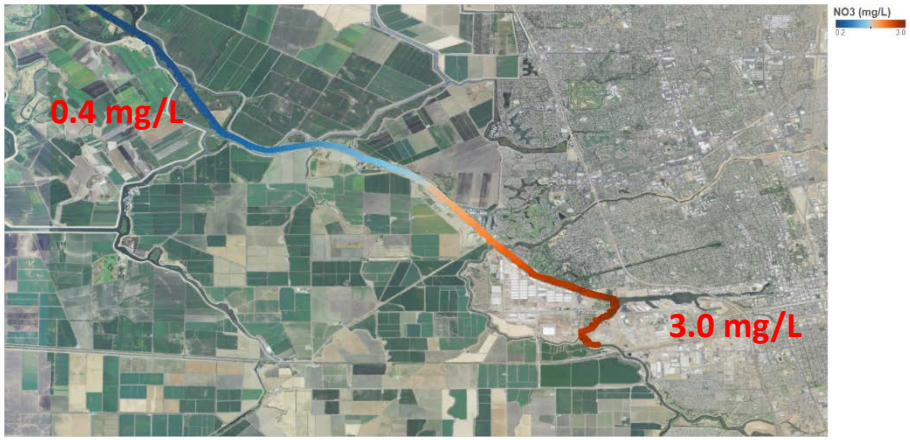
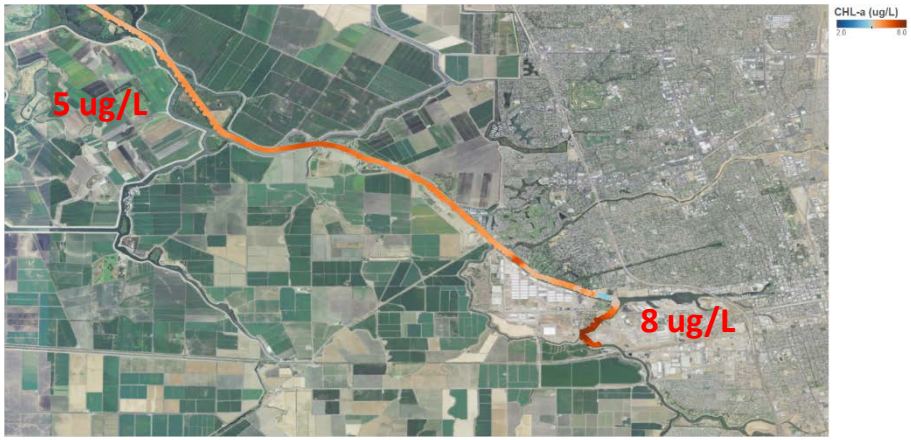


April 18, 2016

Chlorophyll-a (ug/L)

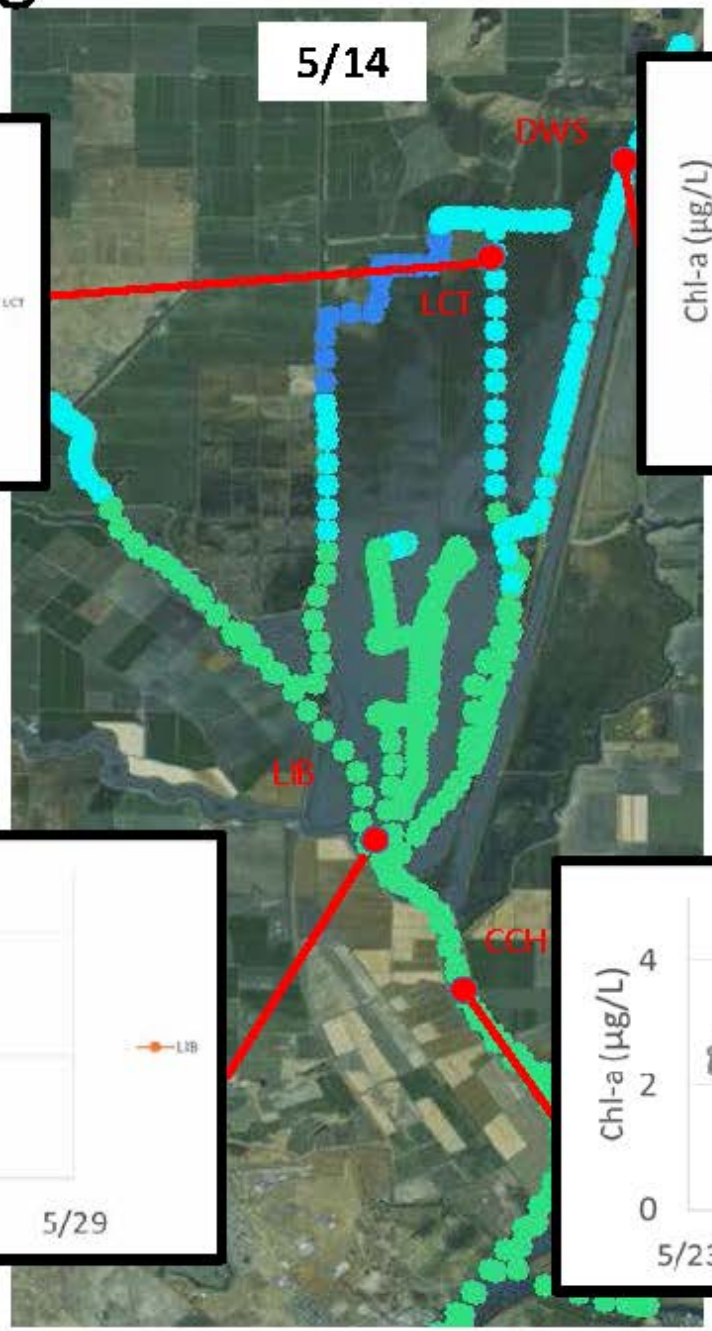
Sept 14, 2015

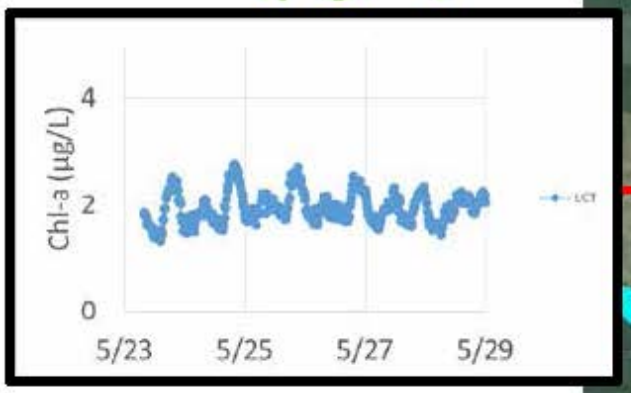


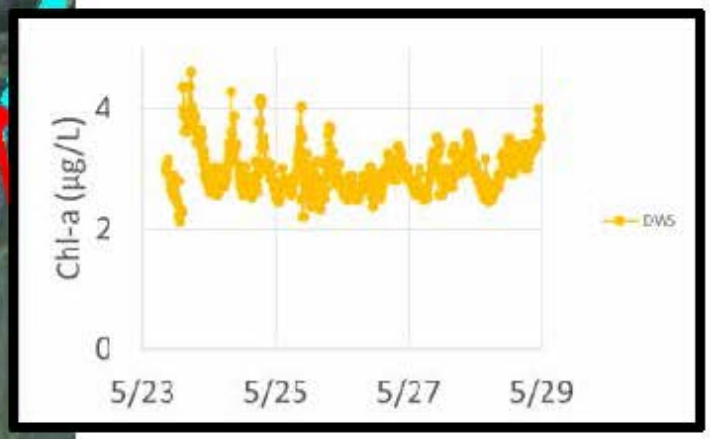
April 18, 2016

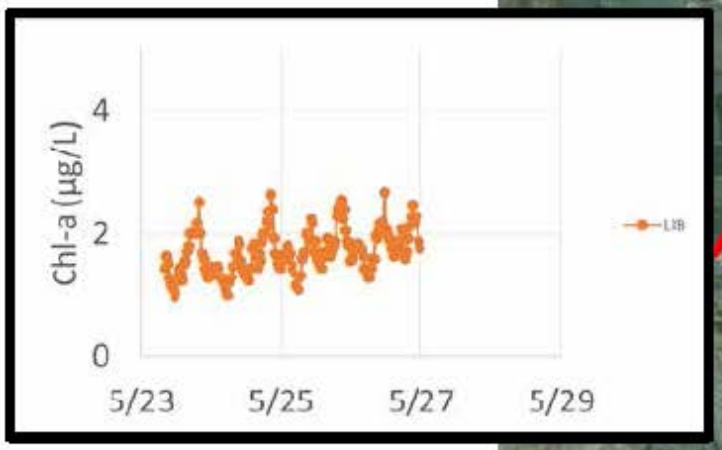
Spatial Mapping & Fixed Stations = spatial and temporal variability

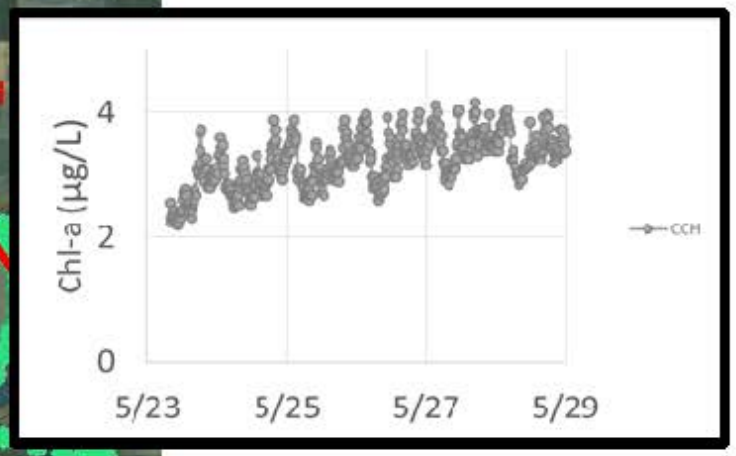
Chl-a (µg/L)











Watershed - Integrated Hydrologic Modeling: Aquatic Biology Group Staff

Larry Brown
Research Biologist
Aquatic ecology

Jason May
Biologist
Aquatic ecology

Marissa Wulff
Biologist
Aquatic ecology

Fred Feyrer (Newest)
Research Fish Biologist
Bay-Delta (6+ staff)

Plus many other USGS folks, temps, students, etc.

Past and Present Stream Projects: Field assessments of fish, invertebrates, algae, habitat

- National Water Quality Assessment Program
  - San Joaquin River drainage (1991-1995)
  - Sacramento River drainage (1994-1998)
  - Santa Ana River drainage (1997-2001)
  - Ongoing reference site monitoring
- Whiskeytown National Recreation Area
  - Metals availability and bioaccumulation
  - Bioassessments
  - Fire effects
- Kings River Experimental Watersheds
  - Algae as a monitoring tool
- NAWQA Sierra Nevada Flow-Ecology
- Santa Ana River Native Fishes
- NAWQA Stream Quality Assessment (previous talk)

Experience in a wide range of habitats: Headwaters of the lower San Joaquin River

Mud Slough

Salt Slough

Upper Santa Ana River

Highly altered but still very productive

Lower Santa Ana River

Beautiful streams!

Kings River Experimental Watersheds

But tiny!

Whiskeytown NRA

All sizes!

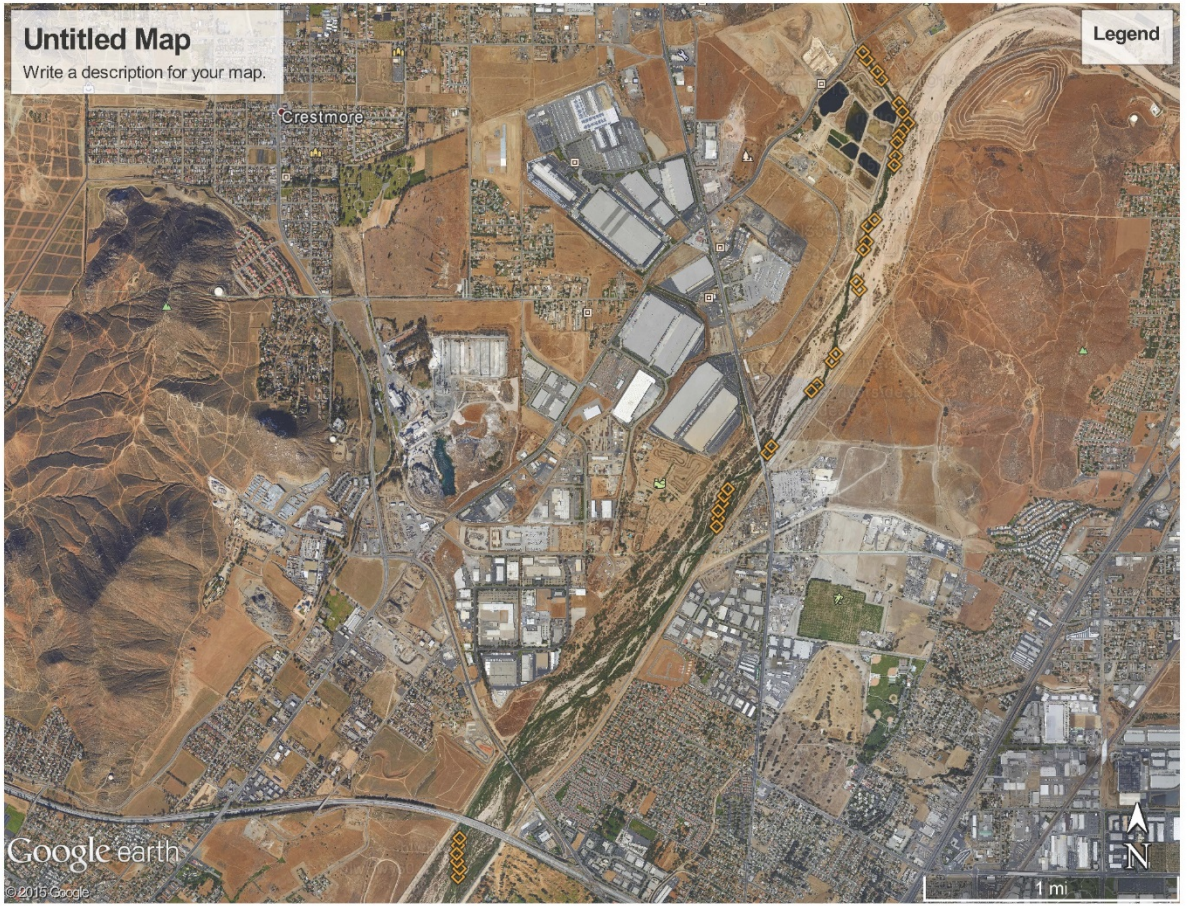
Cool native species!

Aquatic communities
resilient in response
to intense but patchy fire

Biology of native fishes in the Santa Ana River, an effluent dominated urban river

Arroyo chub

Santa Ana sucker



Motivation

- Santa Ana sucker is a Federal threatened species and Arroyo chub is a State species of special concern
- A Habitat Conservation Plan is currently being developed for the upper Santa Ana River Basin and more data are needed
- Questions:
  - How many fish are there?
  - What kind of habitats are they using?

Lots of office projects: modeling, analysis of existing data, collaboration, meetings

Past and Present Stream Projects: modeling, synthesis

- National Water Quality Assessment Program
  - Modeling biology-habitat relations western US
  - Modeling biology-habitat relations southern California
  - Modeling biology-habitat relations northeastern U.S.
  - Effects of urbanization on stream ecosystems across the U.S.
- SCCWRP and CA DFW
  - 2 projects on habitat/flow-biology (R. Mazor, after lunch)
- The Nature Conservancy (and NAWQA)
  - Modeling natural flow characteristics of California streams (Jeanette Howard, Julie Zimmerman, Jason's talk)

Bay-Delta Fish Studies

1. Nutrients and fish kills in Rodeo Lagoon (FF)
2. Se toxicity in Sacramento Splittail (FF)
3. Delta Smelt studies (FF)
4. Longfin Smelt studies (FF)
5. Tidal wetland functions for fishes (FF and LRB)
6. Climate change (CASCaDE project, LRB)

Nutrients and fish kills in Rodeo Lagoon

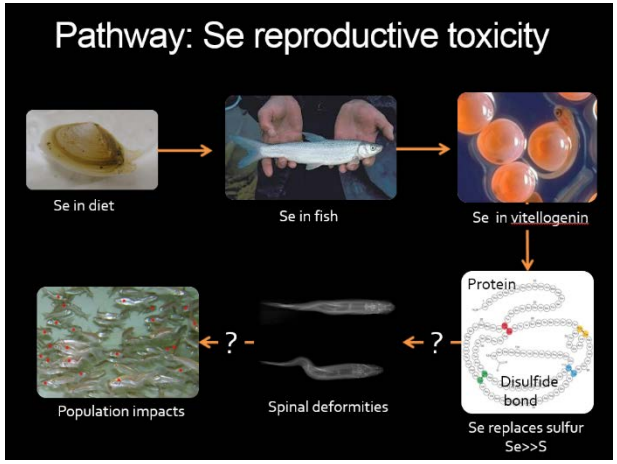
Questions

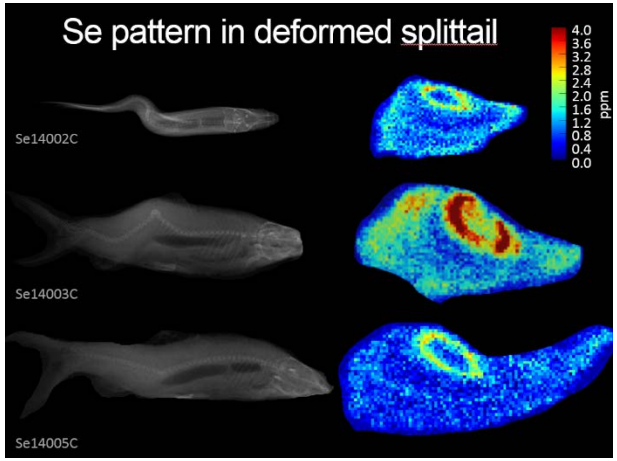
- Identify nutrients contributing to eutrophication
- Foodweb dynamics
- Fish habitat reconstruction

Collaborators:
Darren Fong (NPS)
Megan Young (NRP Menlo Park)
Tamara Kraus (CAWSC)
Rachel Johnson (NMFS)

Funding:
USGS-NPS Partnership

Se Toxicity in Sacramento Splittail





Questions

- Se concentrations in adult Sacramento Splittail
- Environmental or maternal source

Collaborators:
Robin Stewart (NRP Menlo Park)
Rachel Johnson (NMFS)
Karin Limburg (SUNY)

Funding:
US EPA

Delta Smelt Studies

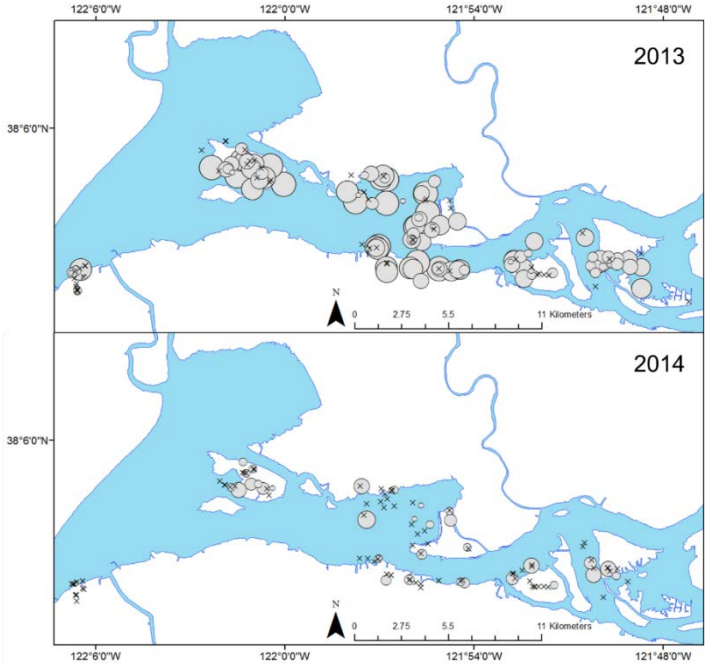
Questions

- Physical processes driving Delta Smelt distribution and movements
- SmeltCam R&D

Collaborators:
Larry Brown(CAWSC)
Jon Burau (CAWSC)
Noah Adams (WFRC Columbia River Lab)
Matt Sholtis (WFRC Columbia River Lab)

Funding:
CA Dept. Water Resources

Longfin Smelt Studies



Questions

- Longfin Smelt distribution and habitat

Collaborators:
Jon Burau (CAWSC)
Lenny Grimadlo (ICF International)

Funding:
Metropolitan Water District

Tidal Wetland Functions for Fishes

Questions

- Spatio-temporal variability in biological processes
- Tidal time-scale processes
- Physical and biological processes in the Sacramento Deepwater Shipping Channel

Task		Title	PI
1	a	Flow and turbidity network	Burau and Ruhl
	b	Suspended sediment transport	Morgan-King and Wright
	c	Turbidity and suspended sediment transport at Benicia	Schoelhammer
	d	Nutrients	Downing and Bergamaschi
2	a	Transport and water quality at Little Holland Tract	Stumpner and Burau
	b	Physical attributes and water quality of the Sacramento Deepwater Shipping Channel	Stumpner and Burau
	c	Sediment dynamics at Little Holland Tract	Lacy
	d	North Delta benthos	Thompson and Parchaso
	e	Tidal wetland functions for fishes	Feyrer and Brown
3		Coordination and reporting	Brown

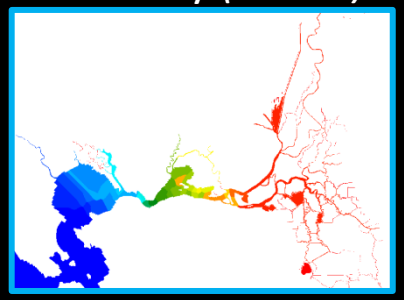
Collaborators:
USGS CAWSC, NRP
IEP agencies and others

Funding:
Bureau of Reclamation

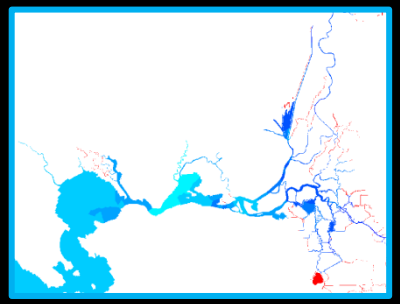
CASCaDE II

- Translate climate change data into effects on habitat of fishes of concern

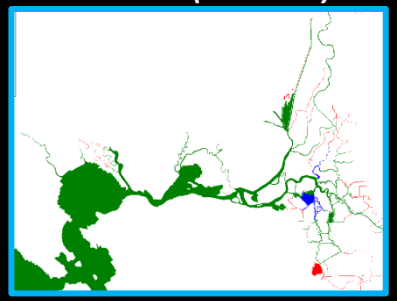
Salinity *(meas.)*



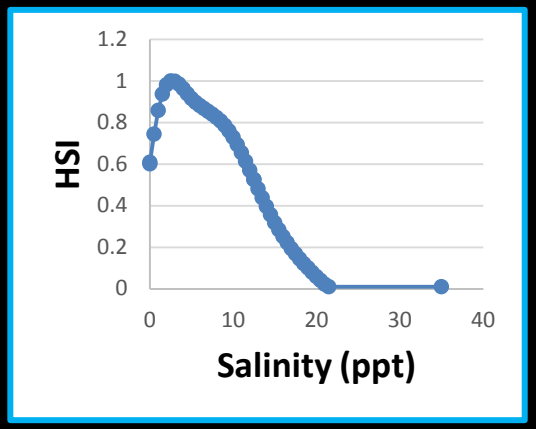
Temperature *(meas.)*

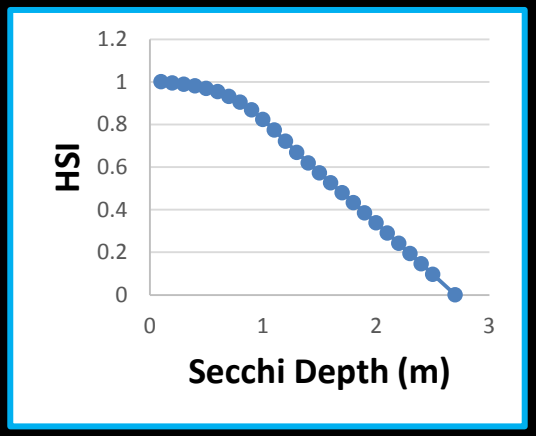


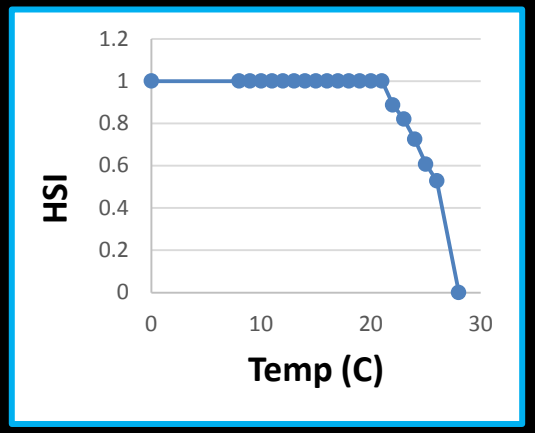
Secchi *(meas.)*



Delta smelt





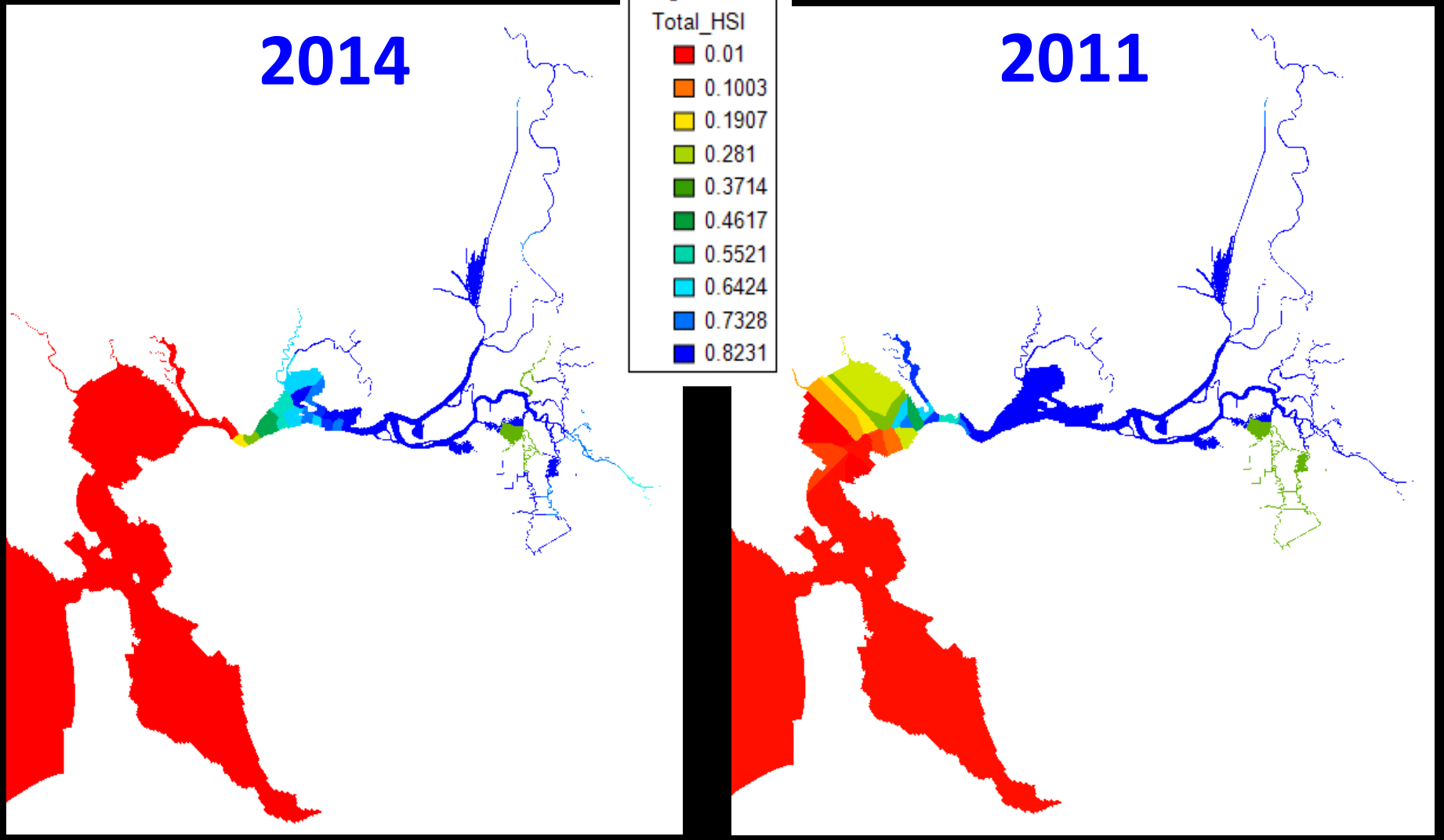


HSI curves: IEP-CDFG FMWT data, 1967-present

Input maps: 2014 FMWT

Preliminary analysis: L. Brown, M. Wulff

Delta smelt habitat suitability as f(S,T,secchi)



Preliminary analysis: L. Brown, M. Wulff

Questions?

(These activities after hours of course!)