

Give Floods A Chance:

Extending the Duration of Flood Events on Agricultural Landscape in the Central Valley for Fisheries Benefits



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CalTrout

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CA Dept Fish & Wildlife

B. Serup, R. Titus

Acknowledgements

- Largely supported by the Interagency Ecological Program, **DWR has operated a fisheries and invertebrate monitoring program in the Yolo Bypass since 1998.**
- The project would not have been possible without the efforts of many field personnel from the **Aquatic Ecology Section**
- *Wendy Bathan, Gina Benigno, Haley Carlson, Phil Choy, Ling-Ru Chu, Lenny Gimaldo, Bill Harrell, Reve Hevery, Joe Heublein, Chris Hogte, Erika Holland, Naoaki Ikemiyagi, Gardner Jones, Ryon Kurth, Oscar Loya, Kurk Malchow, Josh Martinez, Cindy Messer, Angelica Munguia, Matt Nobriga, Caily Nelson, Mollie Ogaz, Gavin O'Leary, Oliver Patton, Kristine Pierce, Kevin Reece, Shaun Rohrer, LeAnne Rojas, Jasmine Shen, Michelle Winn, Nick Van Ark, Michael Vella and Steve Zeug.*



Bypass management for fish benefit: Outline

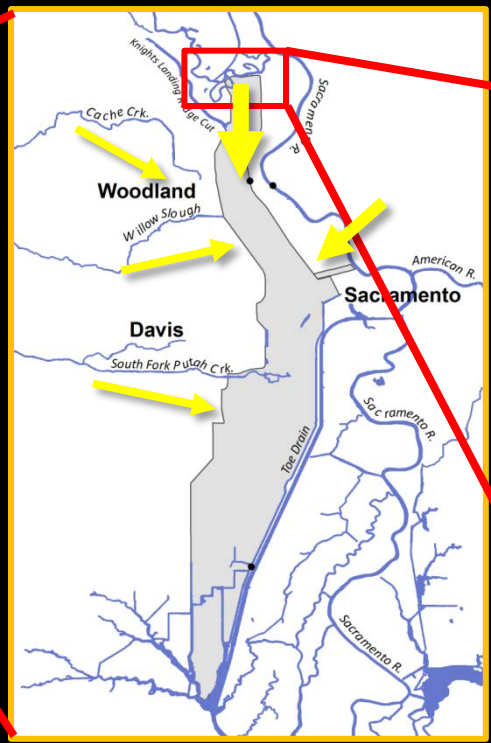
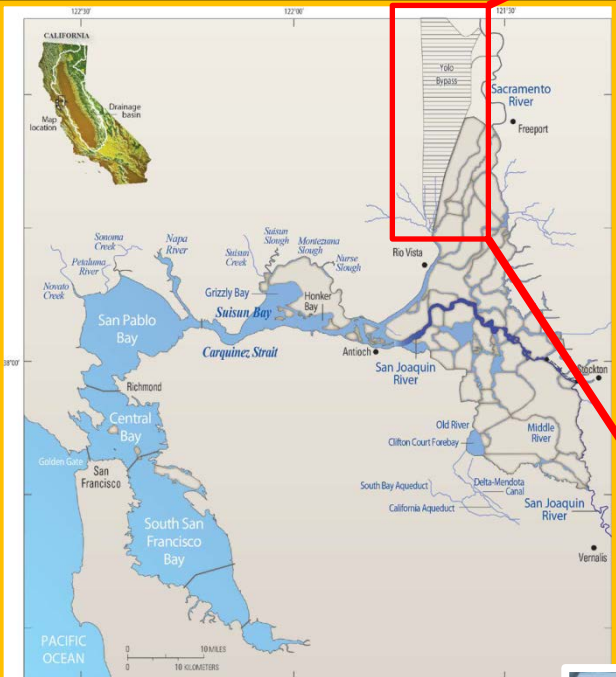
1. How the Yolo Bypass is managed for flood control
2. How the hydrology of the Yolo Bypass affects:
 - Extent and duration of flooding
 - Connectivity and complexity of the bypass
 - Water sources and water quality
 - Salmon prey community and floodplain food web
 - Salmon feeding, behavior and life history diversity

Given what we've learned studying fish benefits within the bypass when managed for flood control...

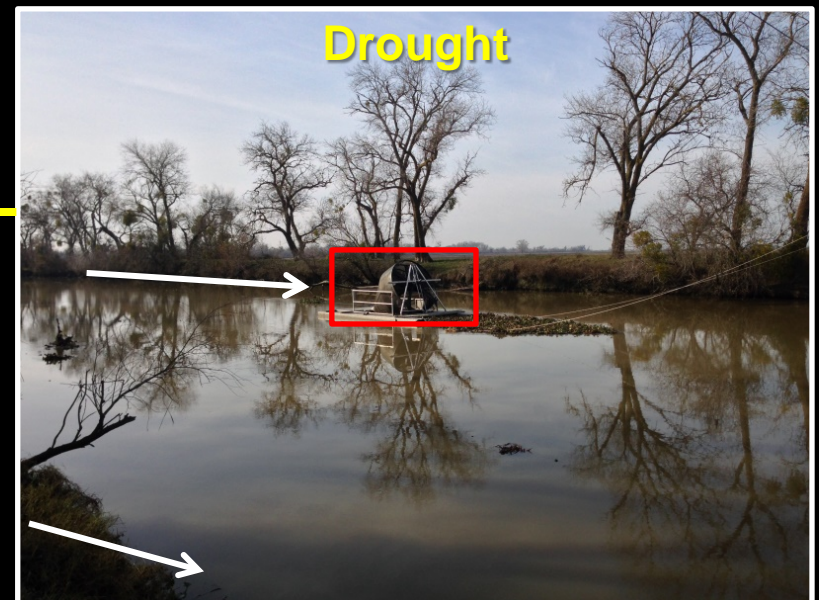
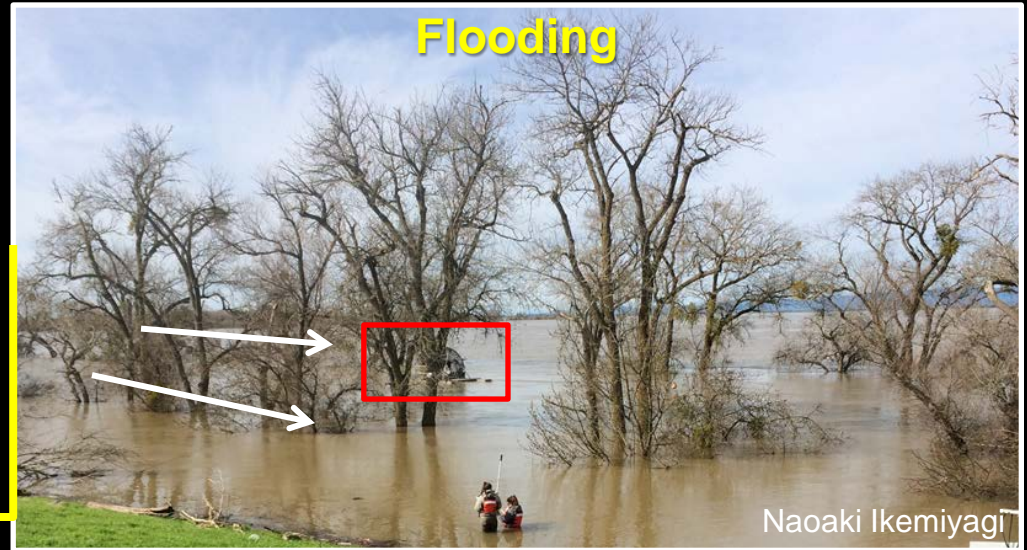
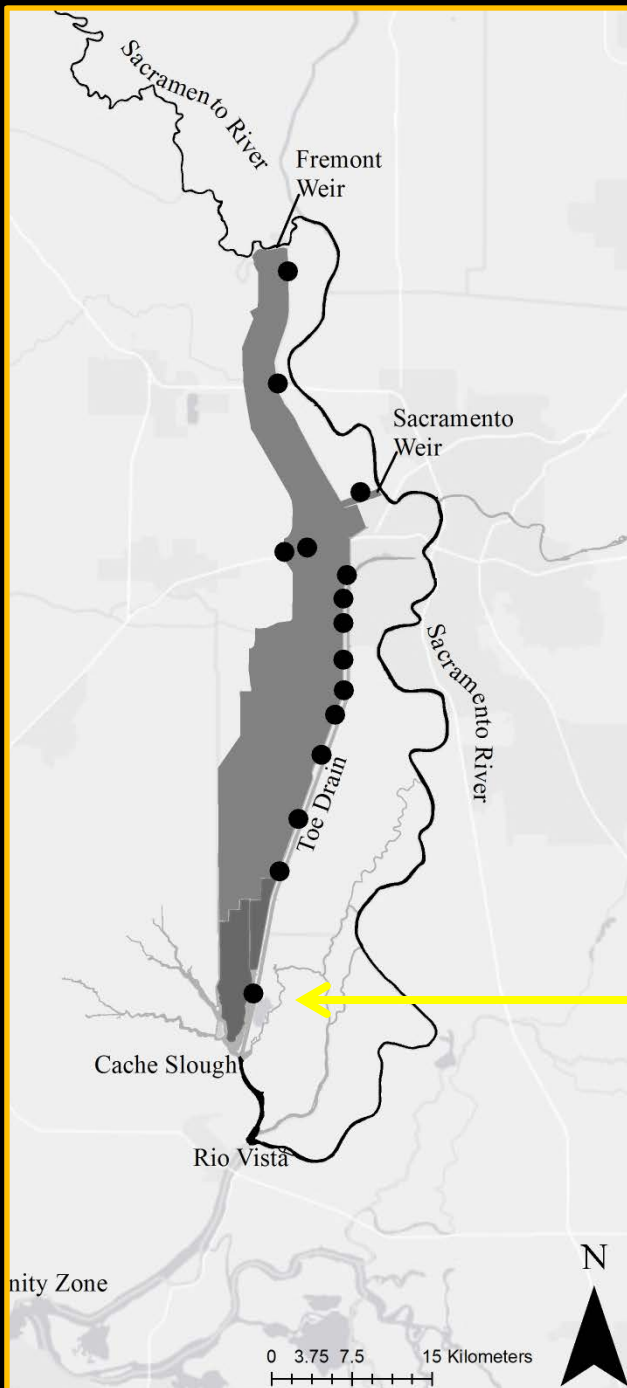
1. Ways to enhance water management for fish benefit
2. Directed studies for bypass management focused on fish benefit



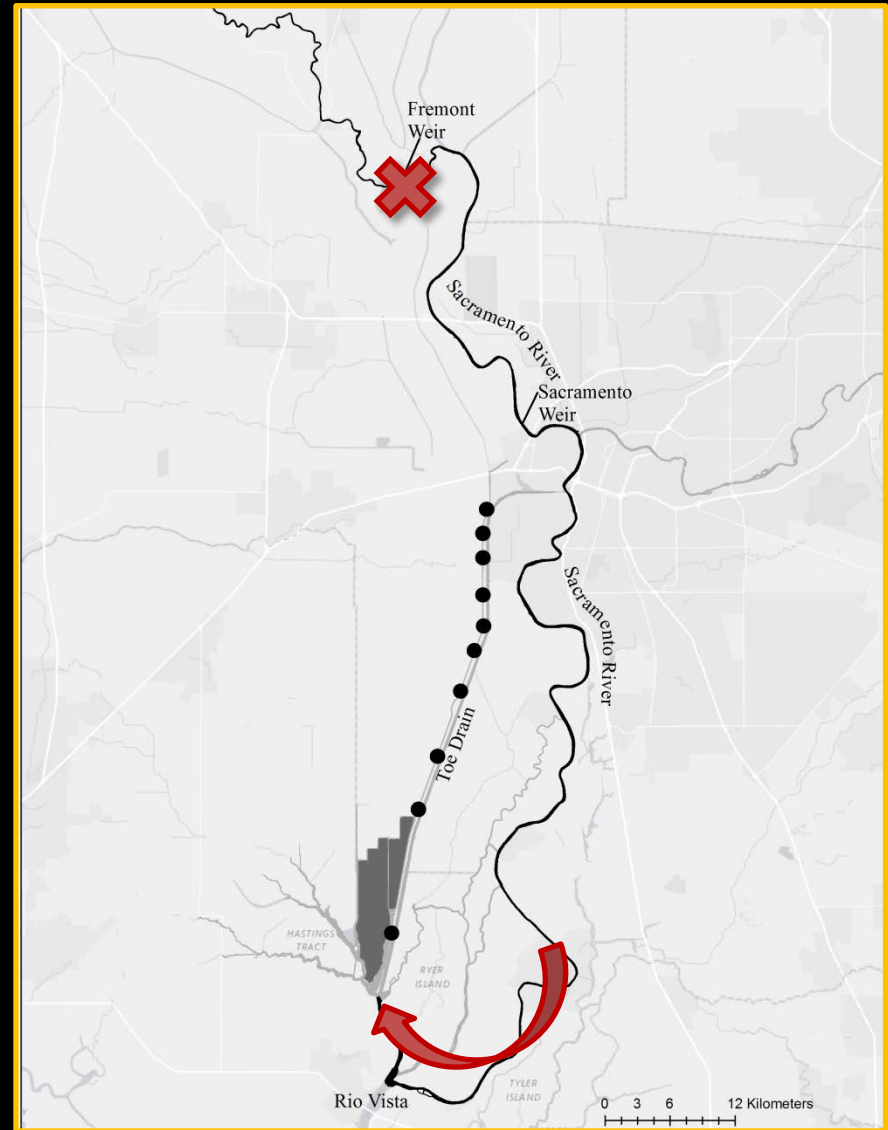
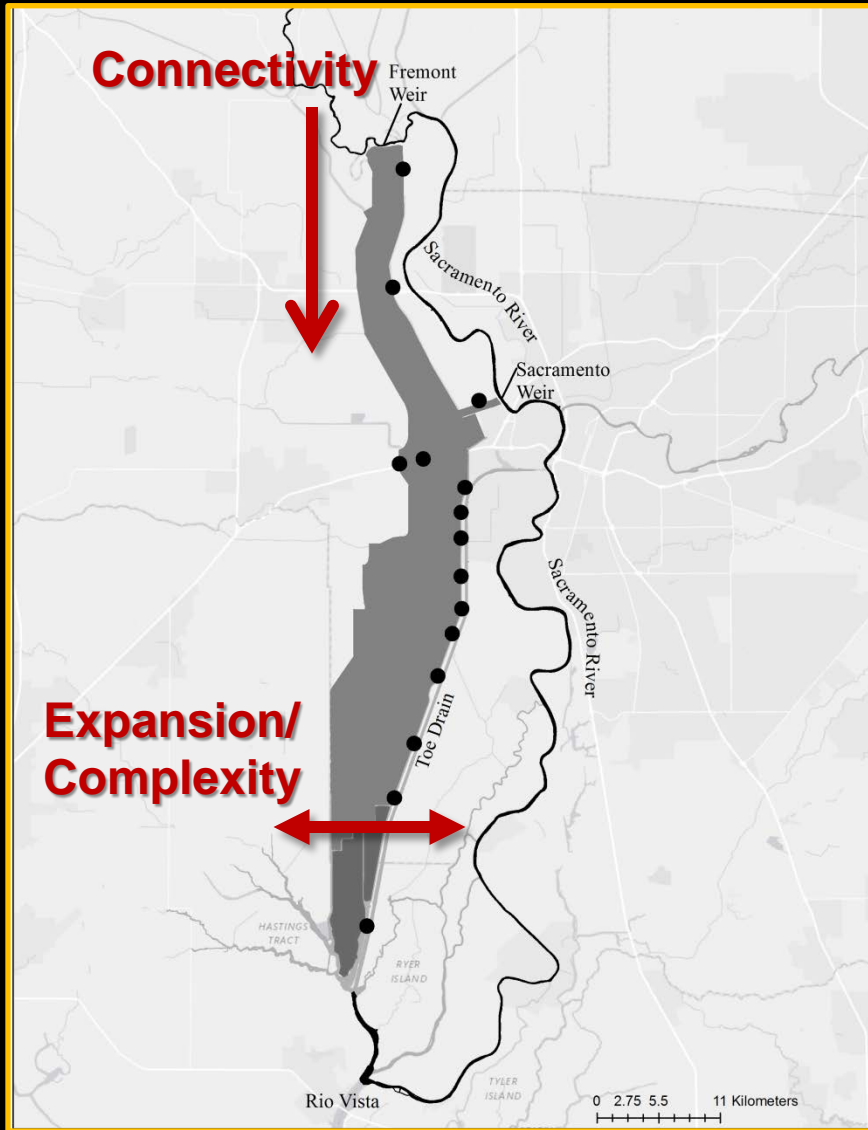
Where is Yolo Bypass?



Yolo Bypass: alternative states



The Duplicity of the Yolo Bypass



Yolo Bypass is hydrologically complex during flooding



© Carson Jeffres

Large flood events offer highly complex habitat- in space and time

Hydrologic banding during
flood of March 1998

Putah Creek
Cache Creek
Knights Landing Ridge Cut
Sacramento River

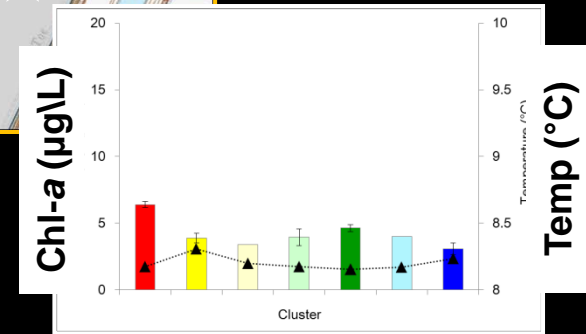
East-west transect
during 2017 flooding

Sommer, T.R., W.C. Harrell, T.J. Swift. 2008. Extreme hydrologic banding in a large-river Floodplain, California U.S.A. *Hydrobiologia*. 598:409-415.

January 17 2017

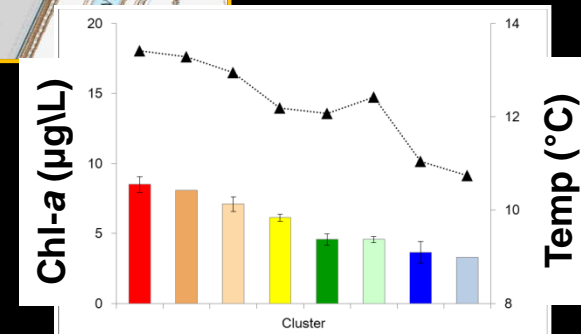
★ Discrete sampling location

*Different colors denote statistically different groups based on turbidity, pH, and conductivity



February 10 2017

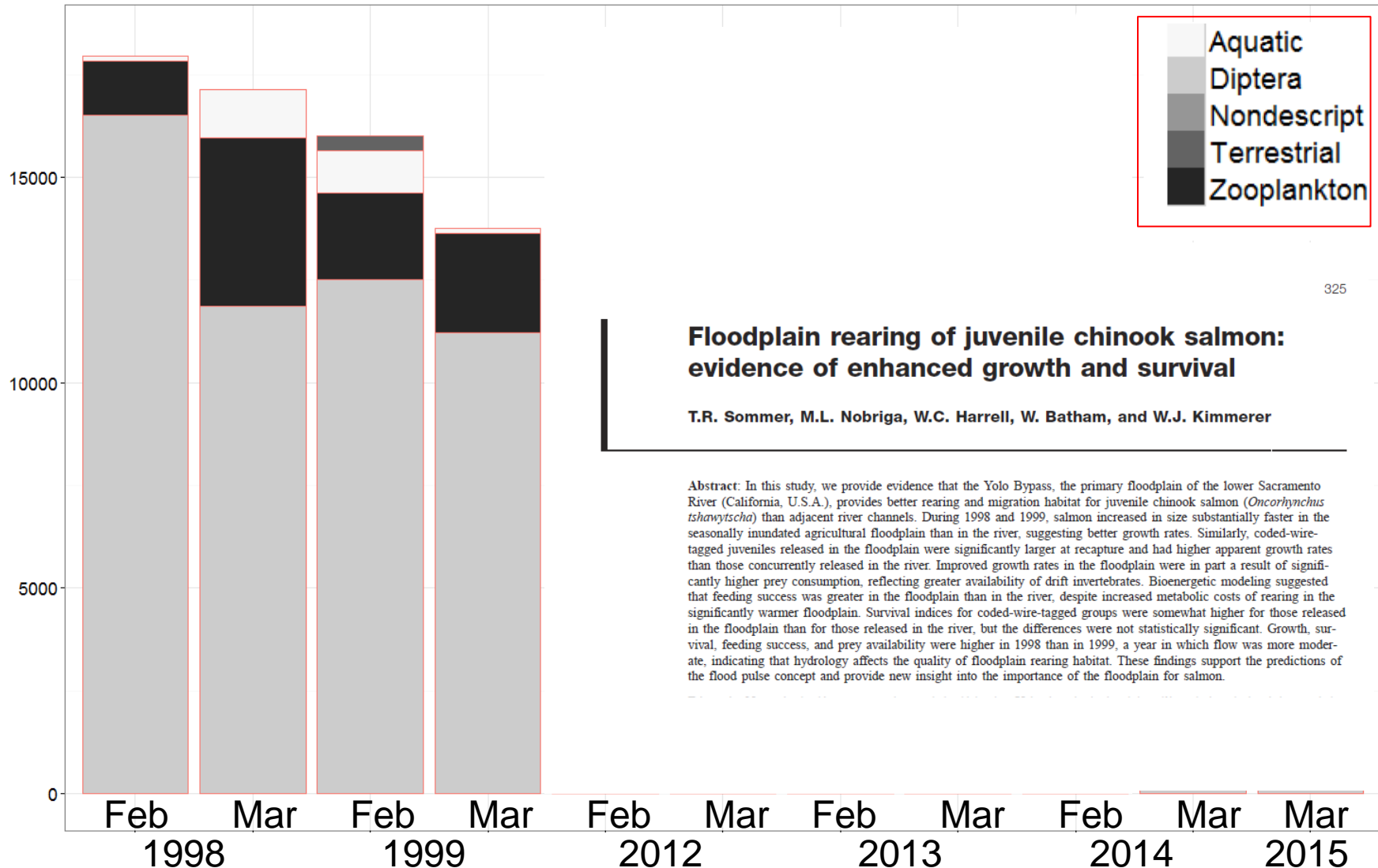
Takata, et al. Extreme hydrologic banding in the Yolo Bypass floodplain revisited: Spatial and temporal water quality and lower trophic patterns during the 2017 flood event. Poster presented at the 2017 Interagency Ecological Program Workshop, Folsom, CA. March 2017.



Dominant prey item in salmon diets varies with varying hydrologic conditions: IRI analysis

Flooding

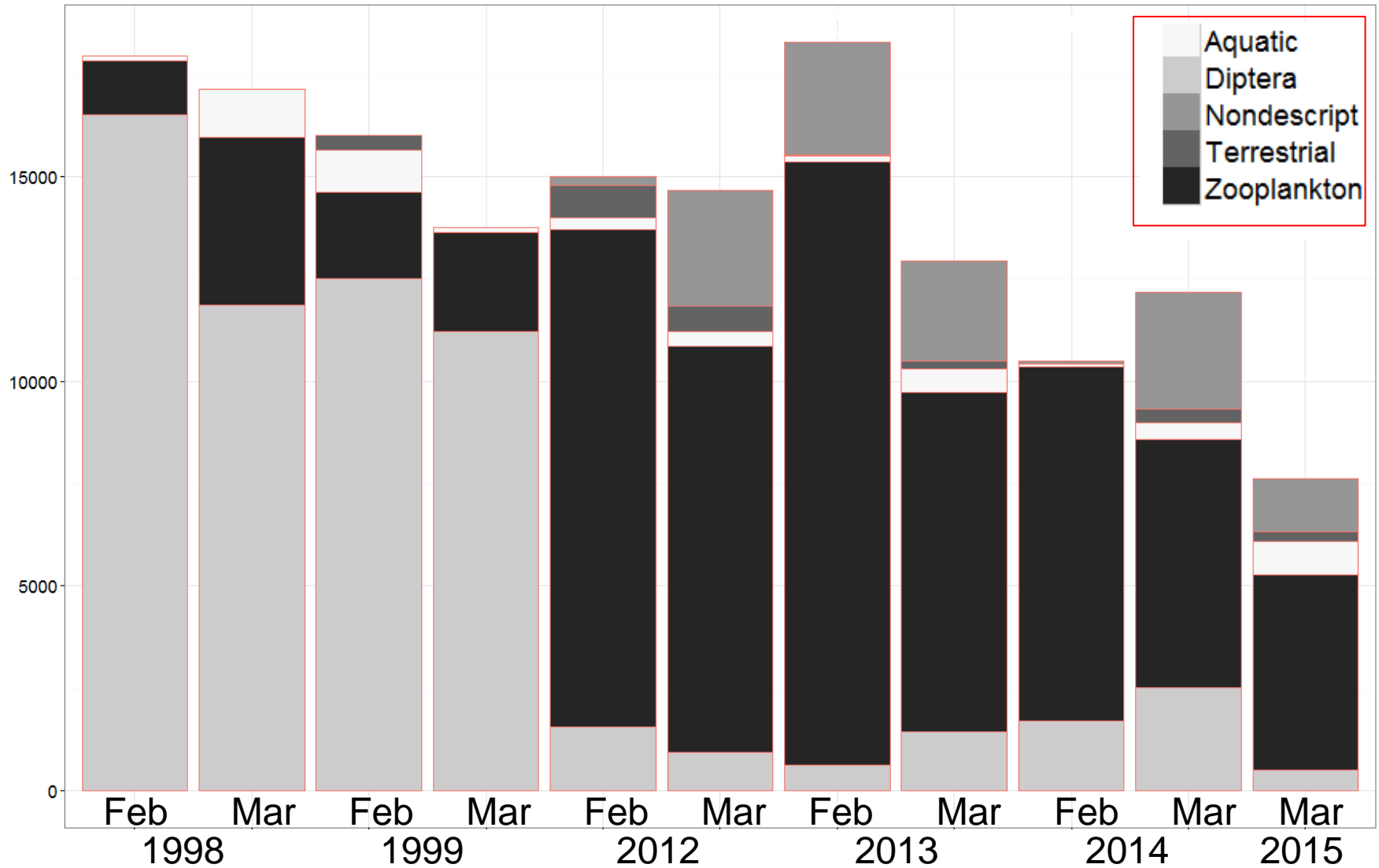
Drought?

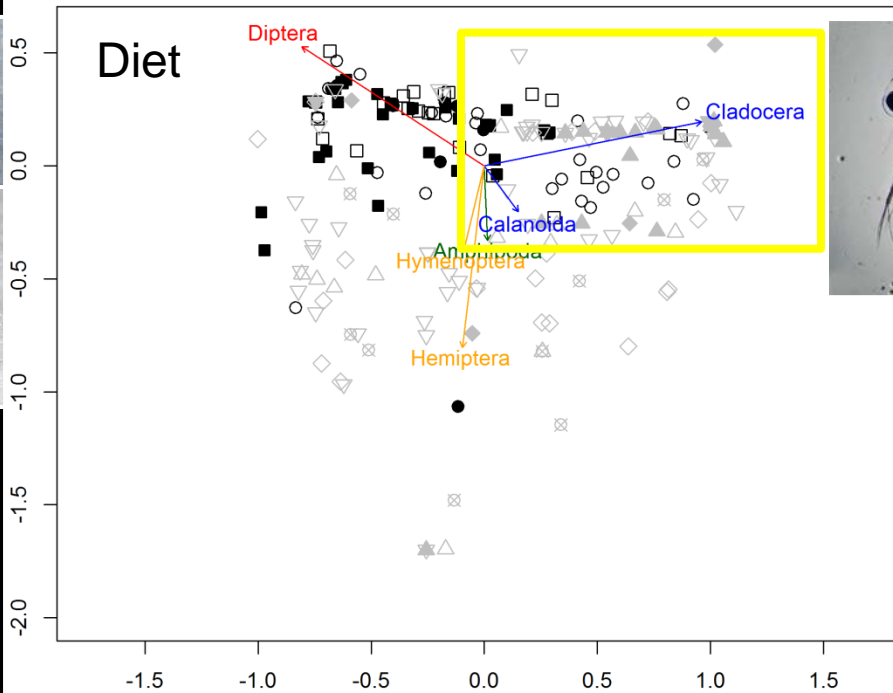
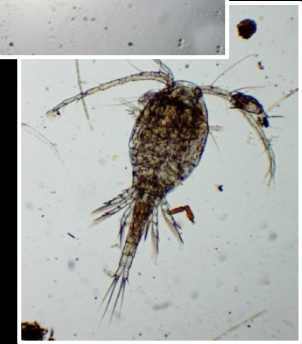
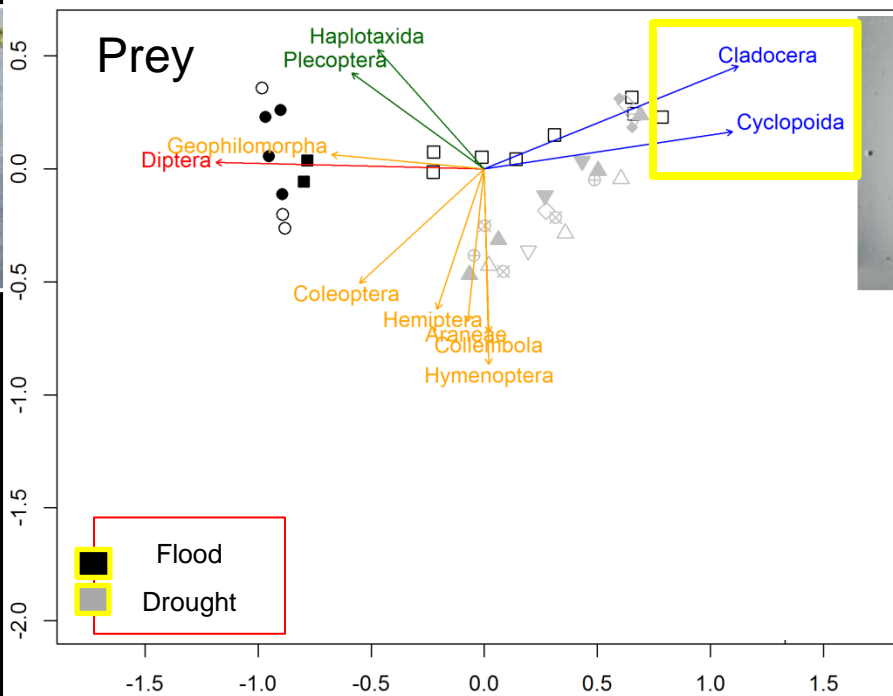


Dominant prey item in salmon diets varies with varying hydrologic conditions: IRI analysis

Flooding

Drought





Goertler, et al. (In Review)
Effects of extreme
environmental regimes on
juvenile Chinook salmon
prey resources and
consumption in a large river
floodplain.

Seasonal Floodplain Could Support Life History Diversity

Variation
in fork
length



=

+ Inundation Duration



+ Variation in Water temperature



+ Season

+ Sampling methods



Seasonal Floodplain Could Support Life History Diversity

Variation
in fork
length



=

+ Inundation Duration

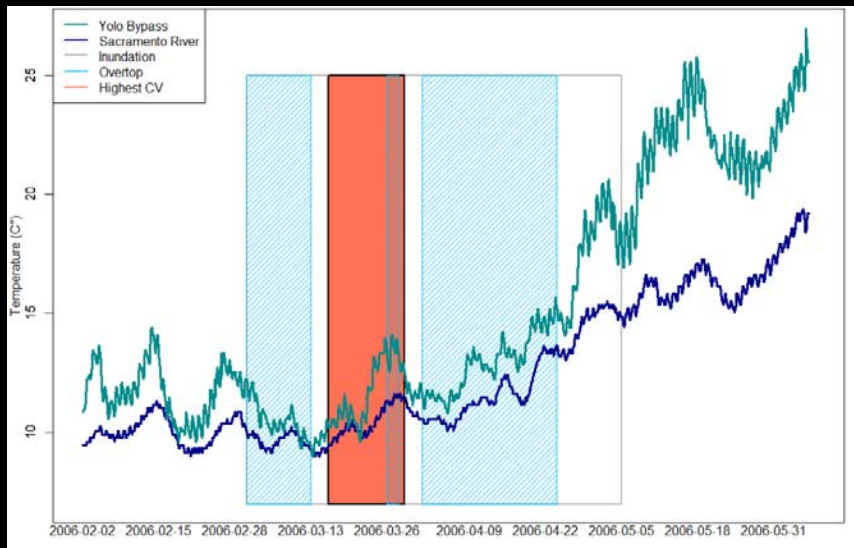


+ Variation in Water temperature



+ Season

+ Sampling methods



*Simplified Sacramento River lacks
thermal heterogeneity when compared
to the flooded Yolo Bypass*

Goertler, et al. (In Review) Evidence that a seasonal floodplain-tidal slough complex supports time-specific size variation for juvenile Chinook salmon (*Oncorhynchus tshawytscha*), with implications for life history diversity.

Seasonal Floodplain Could Support Life History Diversity

Variation
in fork
length



=

+ Inundation Duration

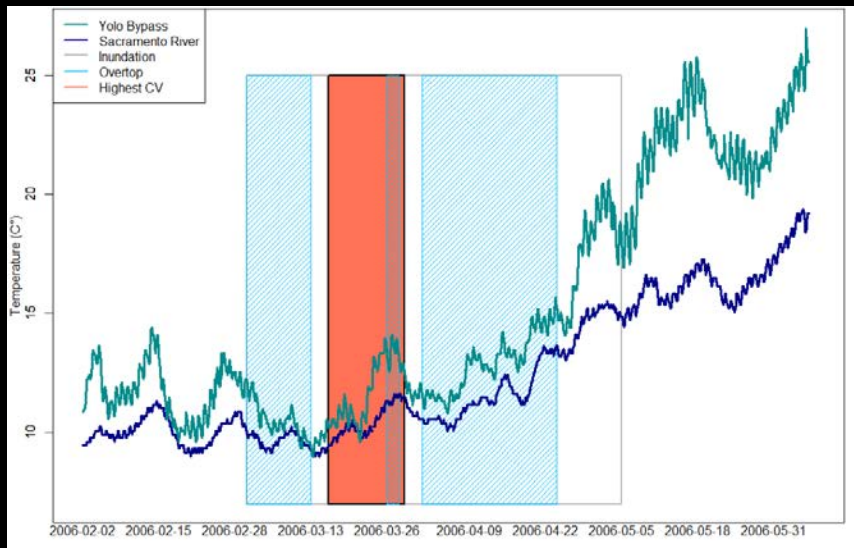


+ Variation in Water temperature

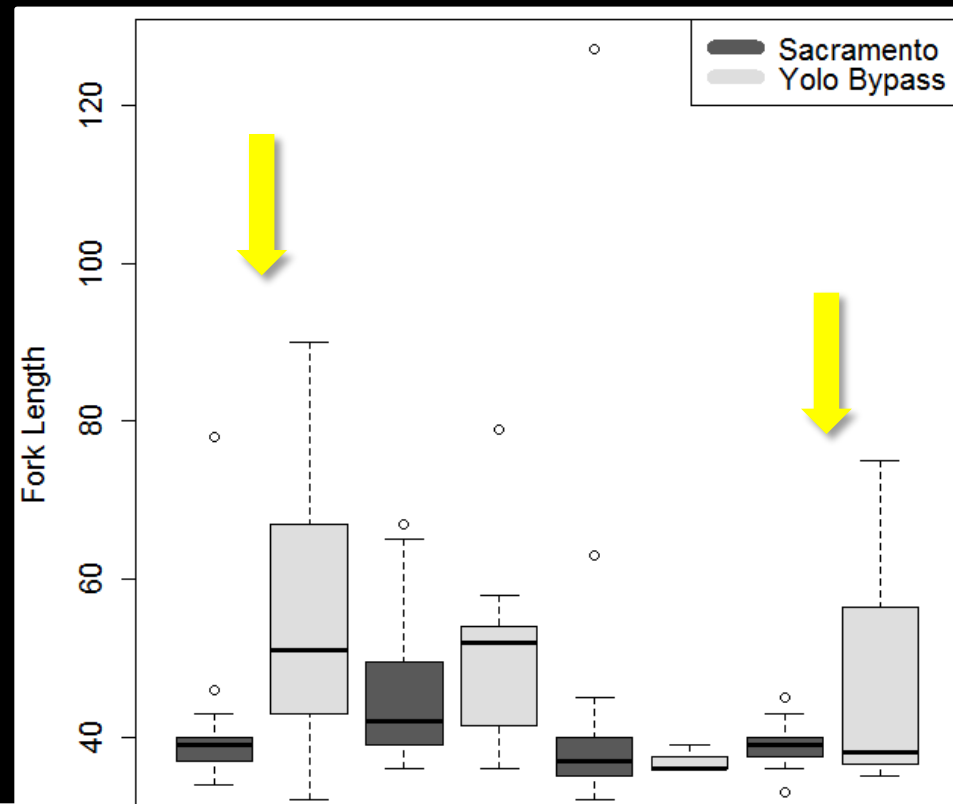


+ Season

+ Sampling methods

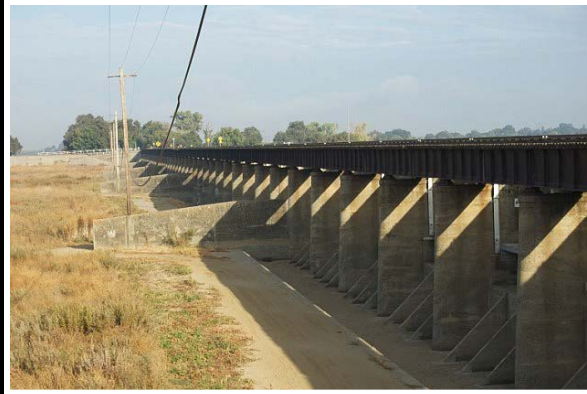


*Simplified Sacramento River lacks
thermal heterogeneity when compared
to the flooded Yolo Bypass*

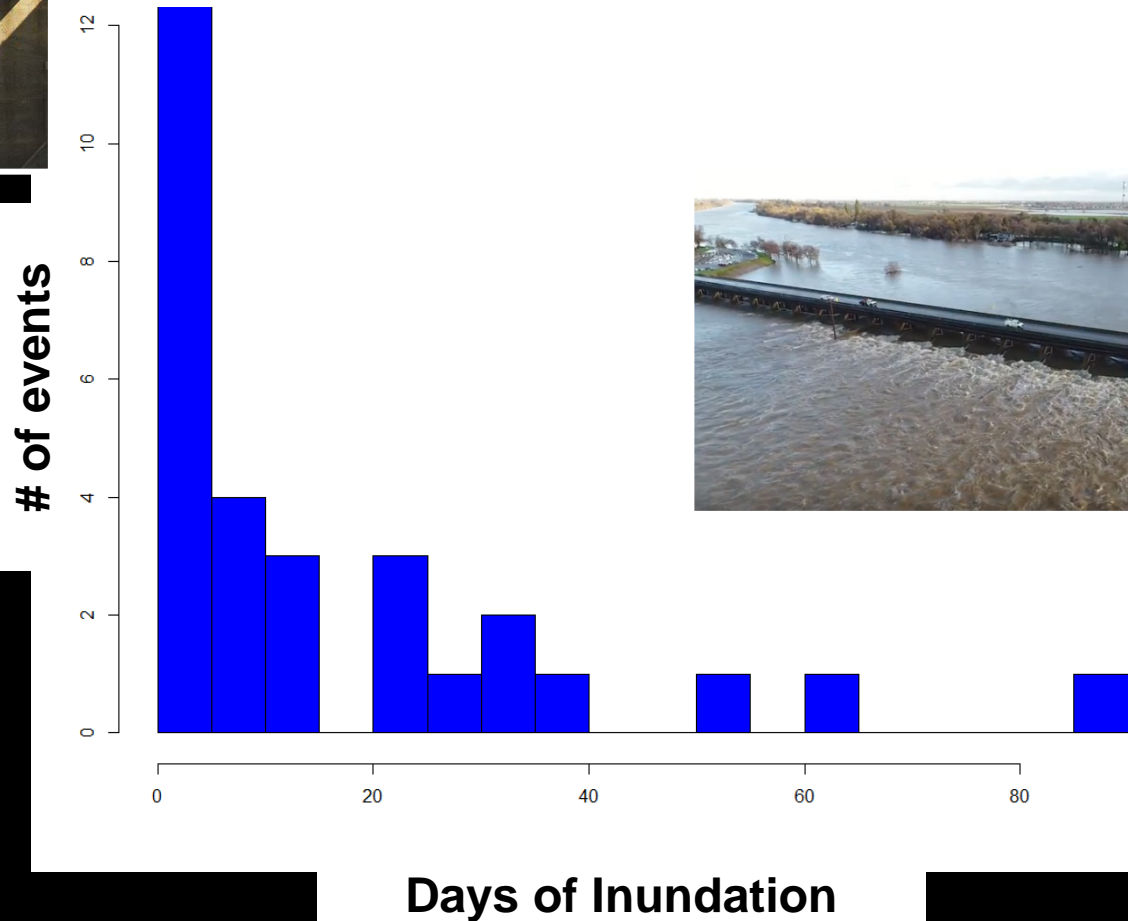


		1998	2000	2002	2003
Inundation	# of Days	90	33	15	29
CV in	Yolo Bypass	0.1704	0.1356	0.1733	0.1345
Temperature	Sacramento R.	0.0960	-	0.1137	0.0806

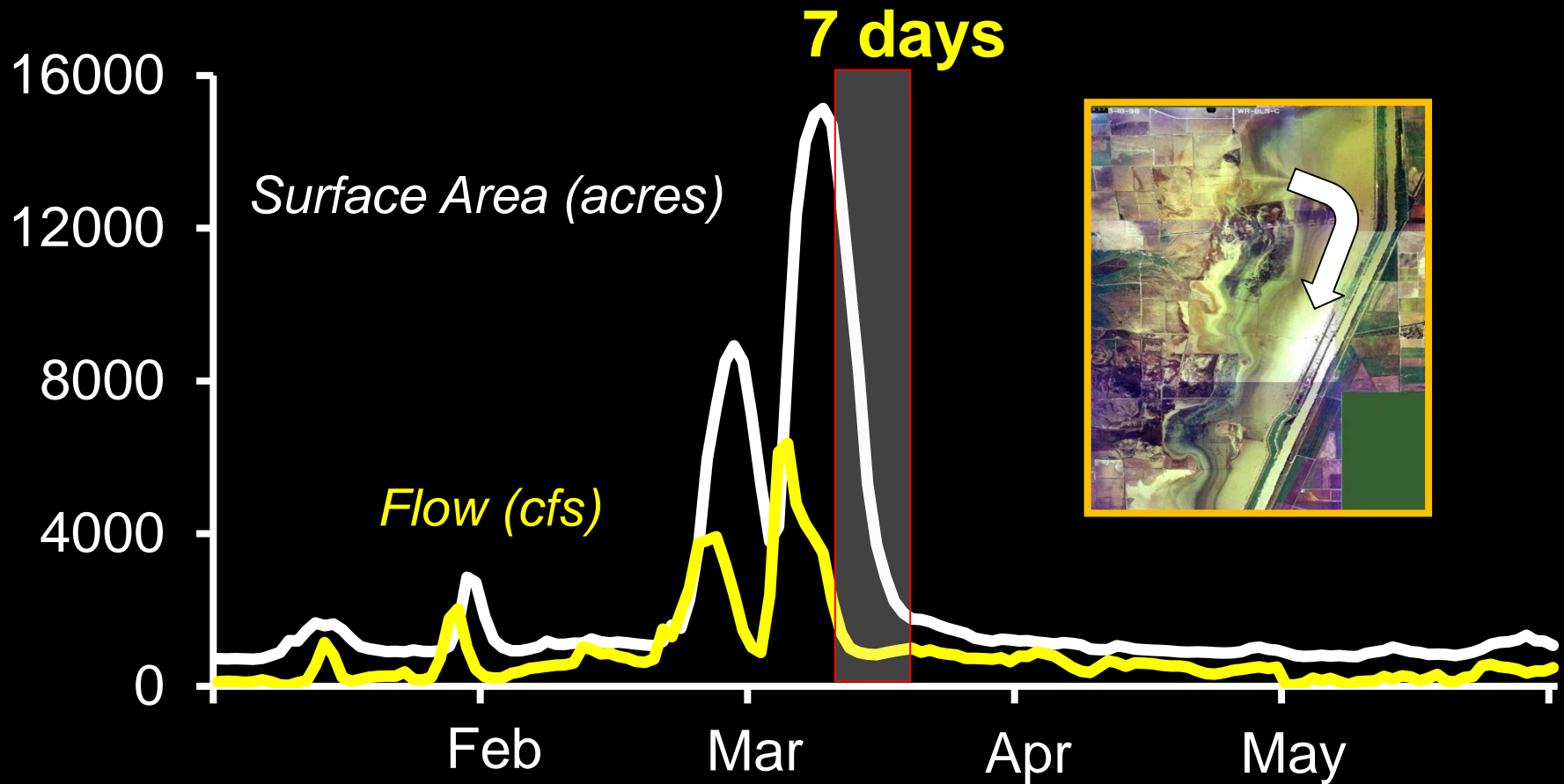
Long flood events (>3 weeks) are not the norm



Number of flood events by their duration over a **20-year** period (1997 – 2017, 23 total events)



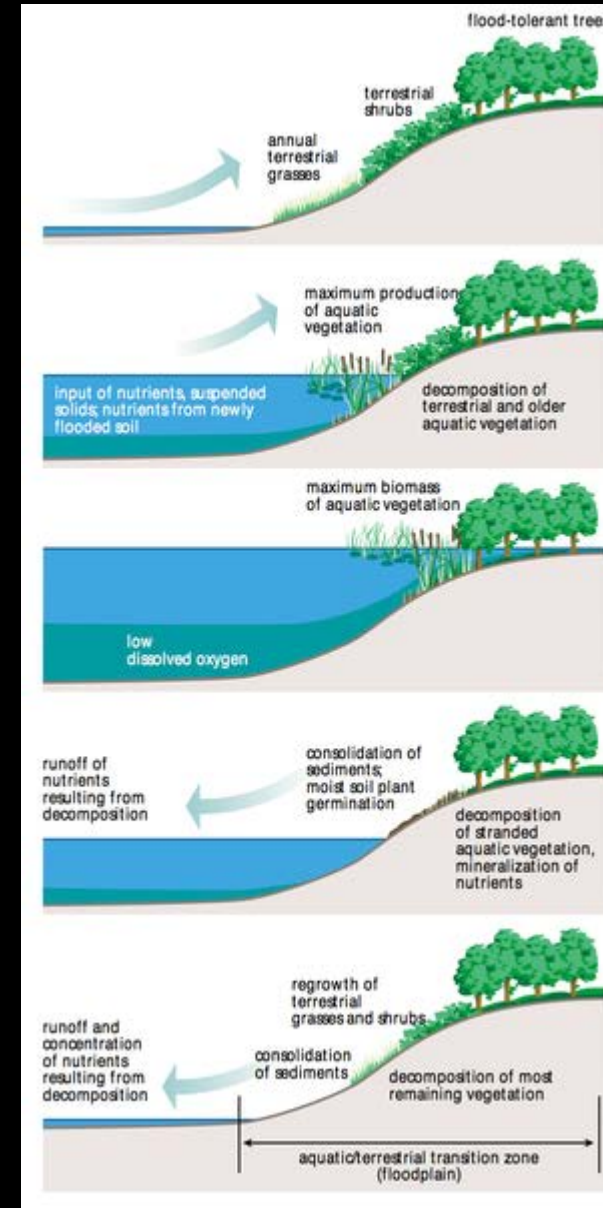
Key Issue: Floodplain Drains VERY Quickly



Preliminary 2014 BiOP TUFLOW Hydraulic Modeling, based on 2001 flows
Source: CBEC & HDR

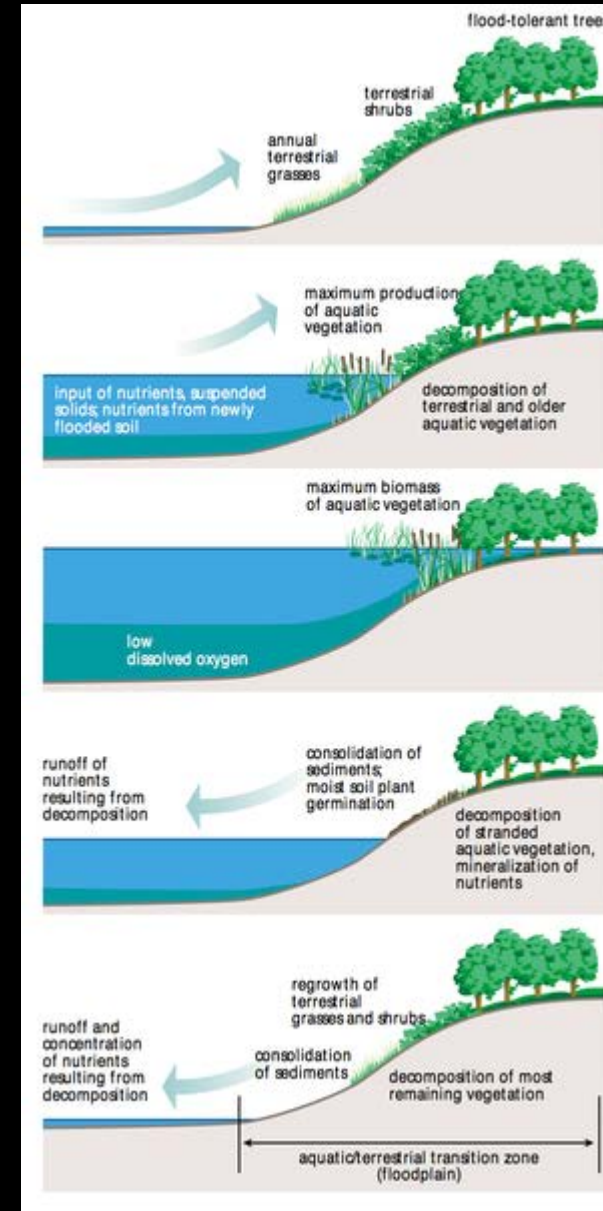
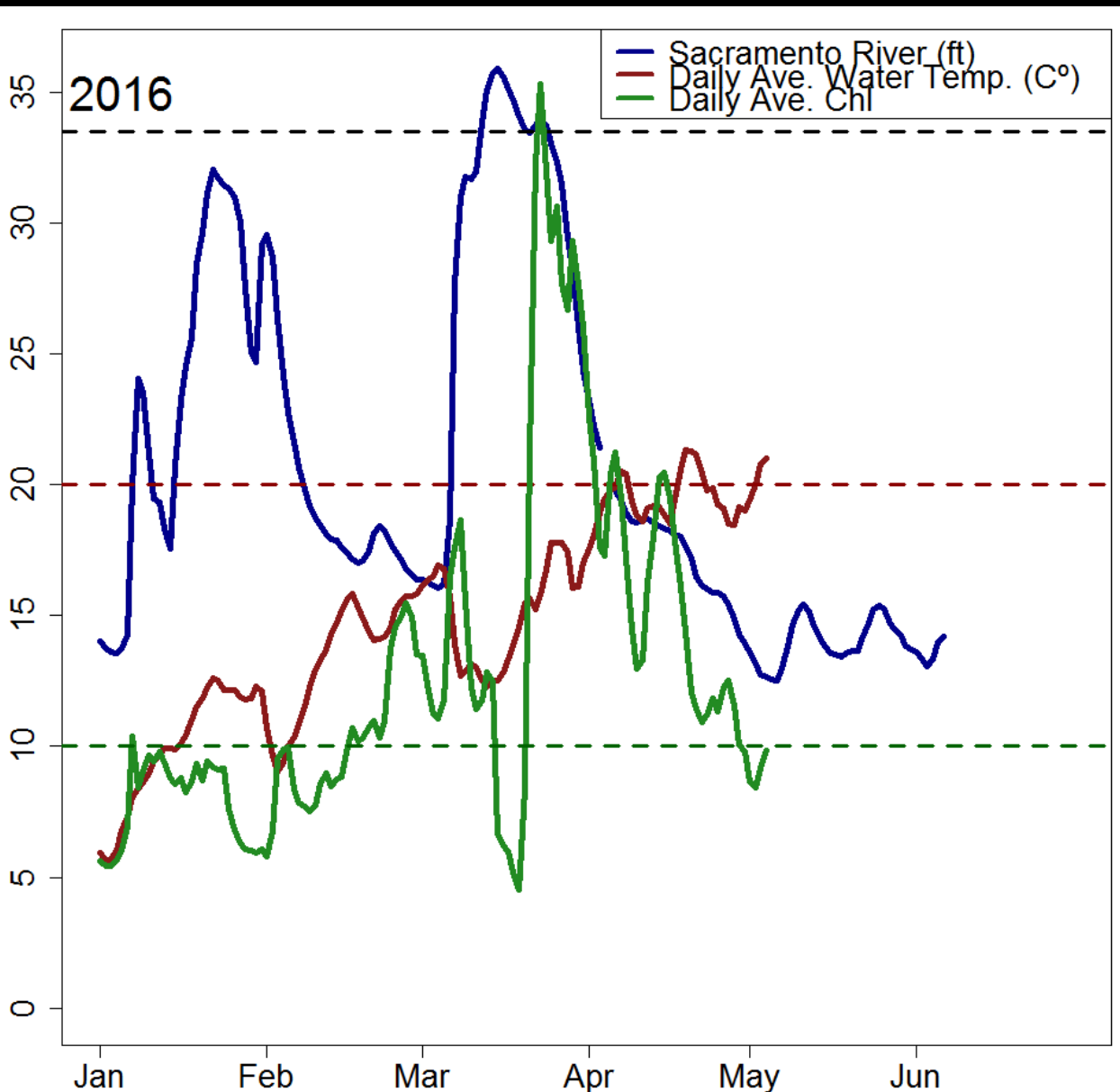
Do shorter flood events have a truncated food web process?

***The Flood Pulse concept in
River-Floodplain Systems
Junk et al. 1989***



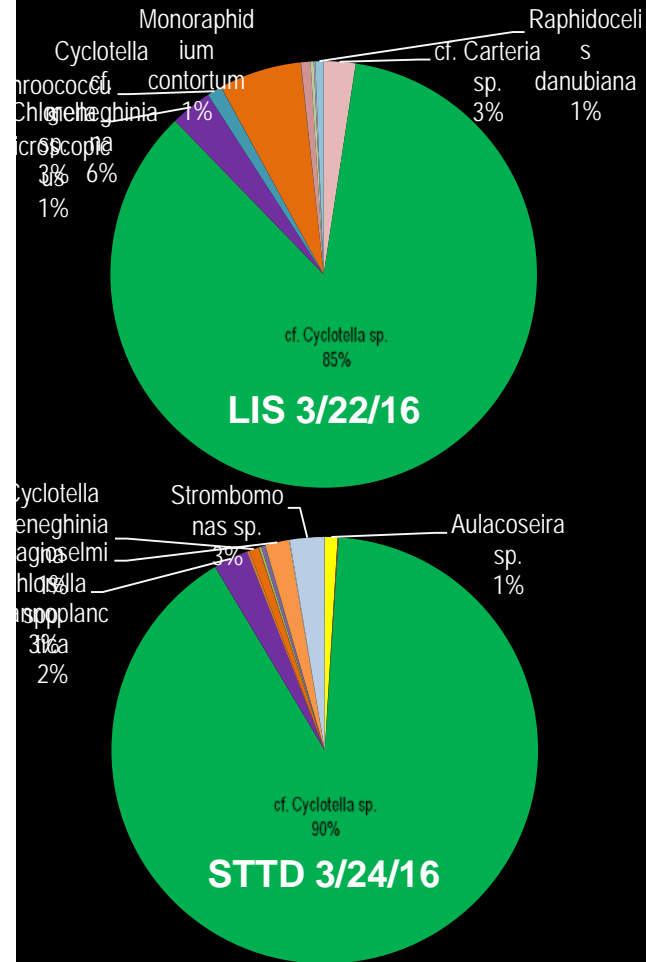
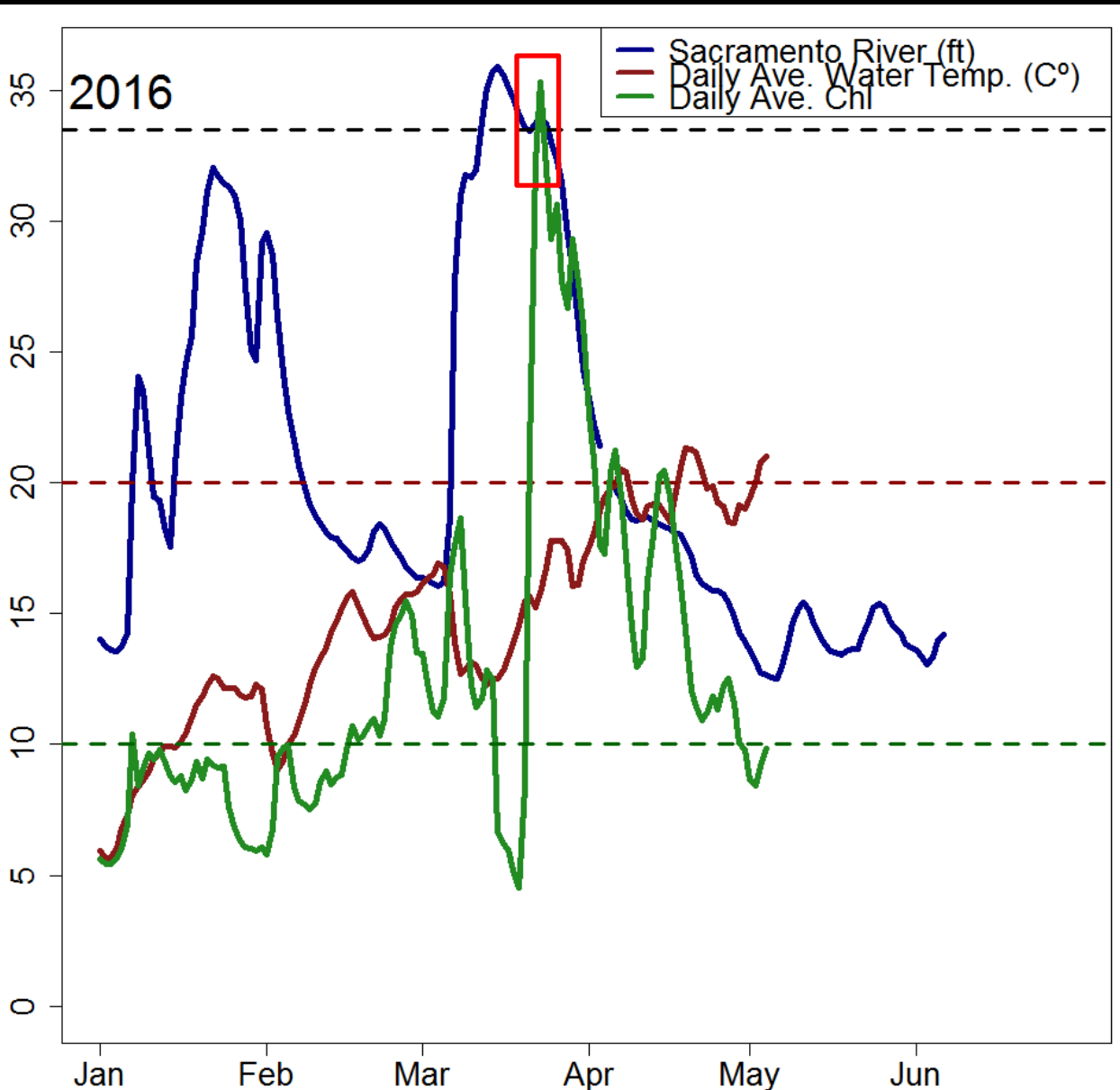
Do shorter flood events have a truncated food web process?

The Flood Pulse concept in River-Floodplain Systems Junk et al. 1989



Evidence that short (<3 weeks) flood events have a truncated food web

Phytoplankton biomass as biovolume during peak chl a at LIS and downstream (STTD) was dominated by the centric diatom *Cyclotella* sp.



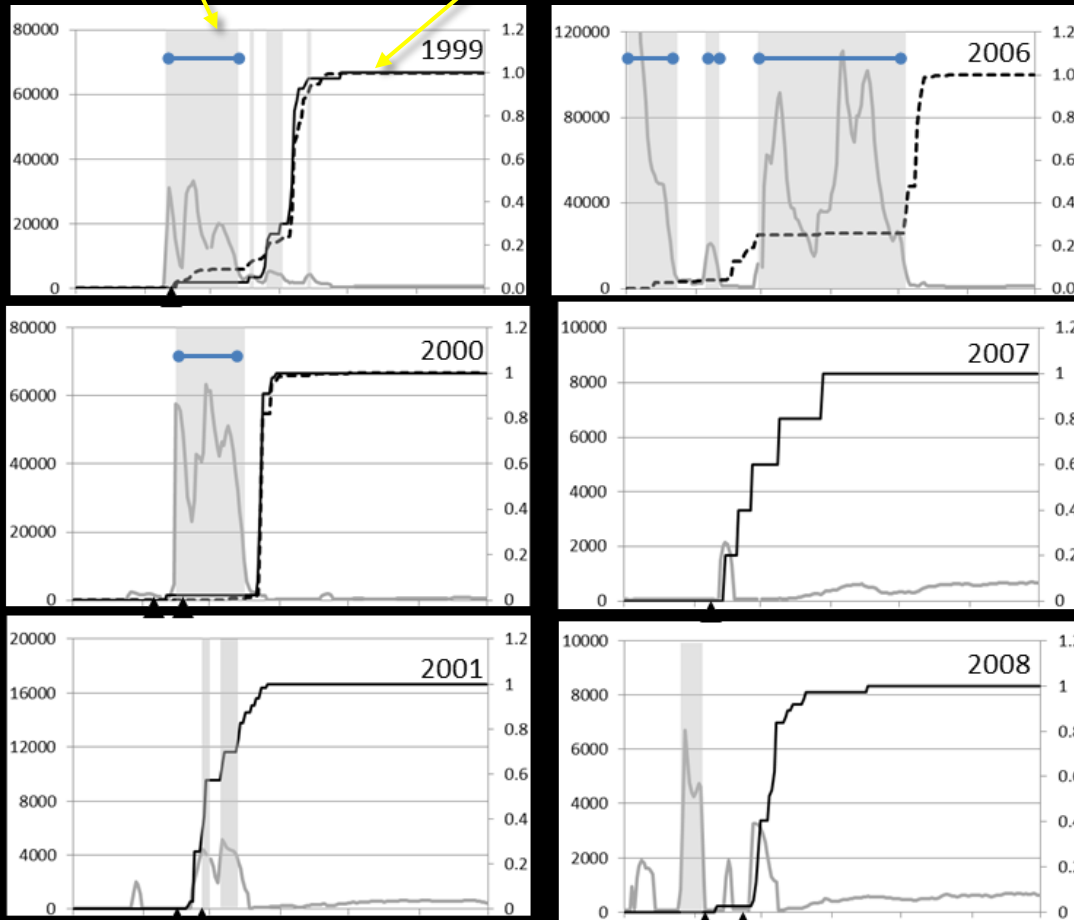
Fichman, R., J. Hamilton & J. Frantzich (November, 2016). Response of Yolo Bypass Floodplain to a Spring Flow Pulse. Poster: Bay-Delta Science Conference, Sacramento, CA.

Juvenile Chinook Salmon Leave Yolo Bypass at Drainage

Yolo Bypass Inundation

Wild and CWT Chinook Catch

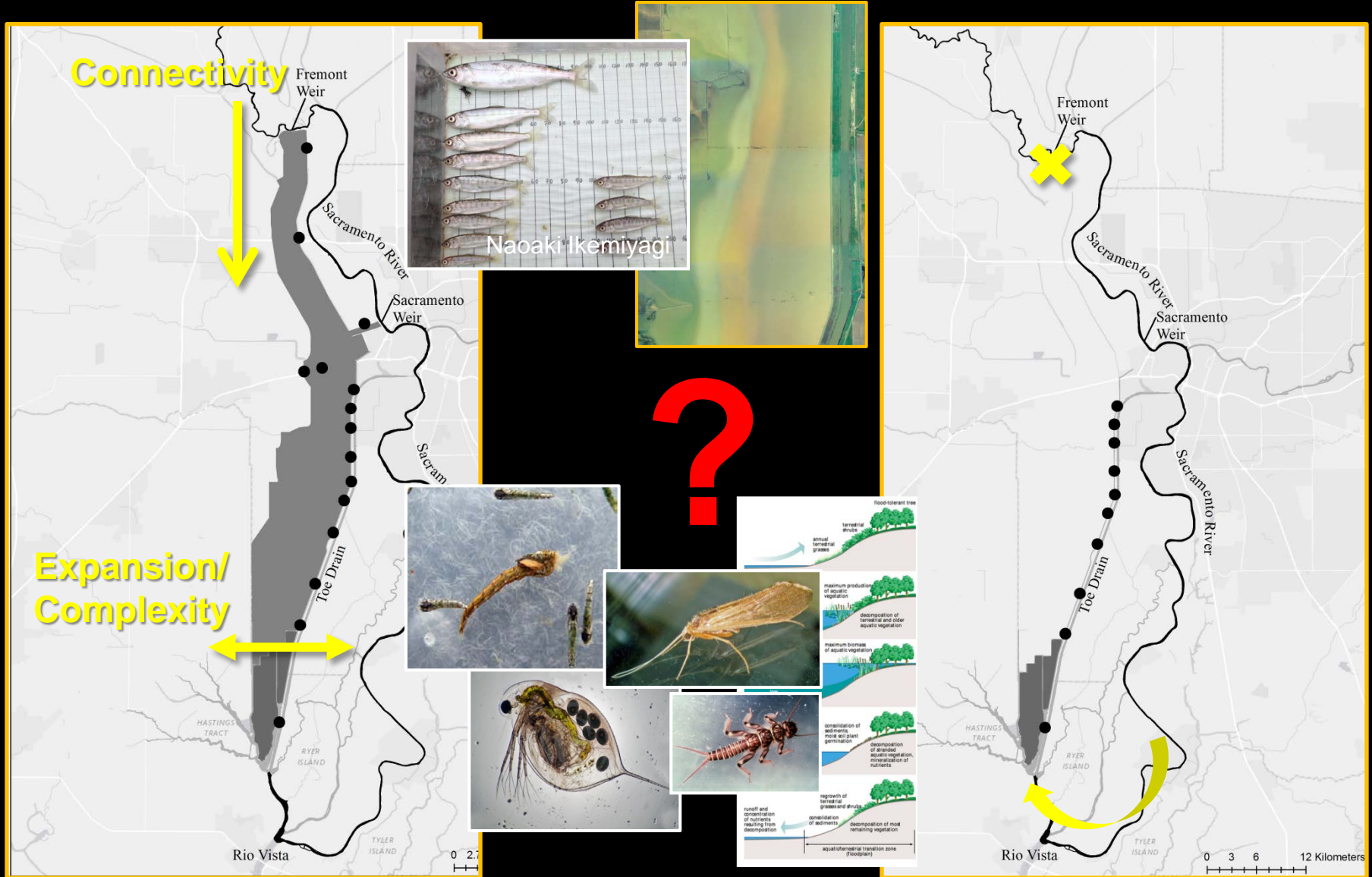
Yolo Bypass Flow (CFS)



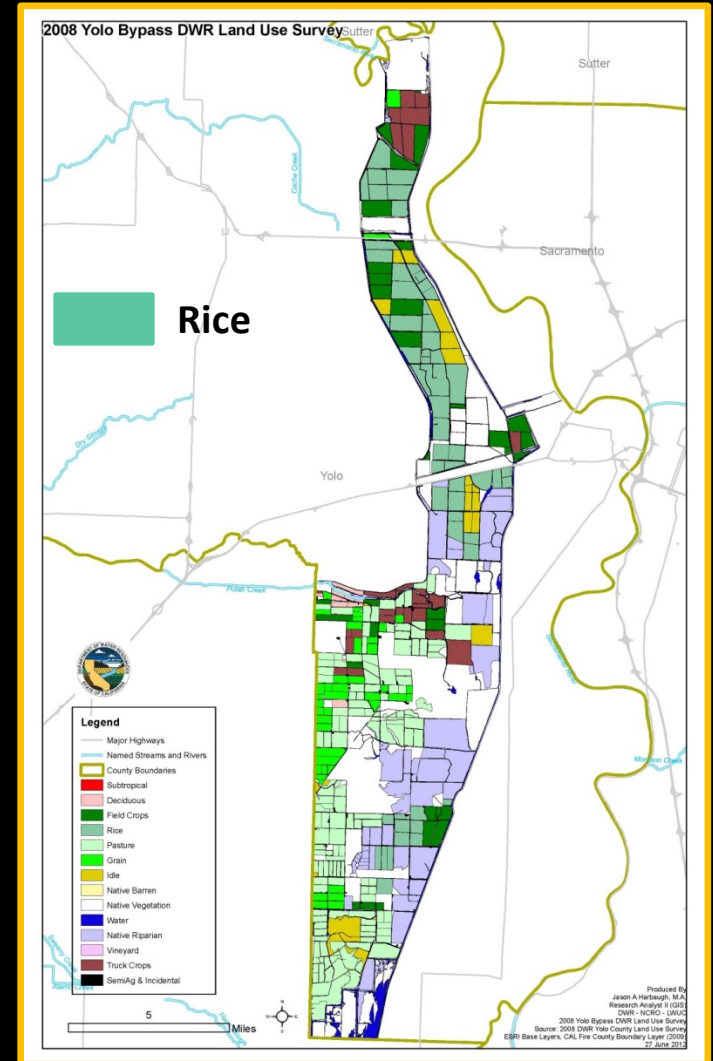
Proportion of Cumulative CHN Catch



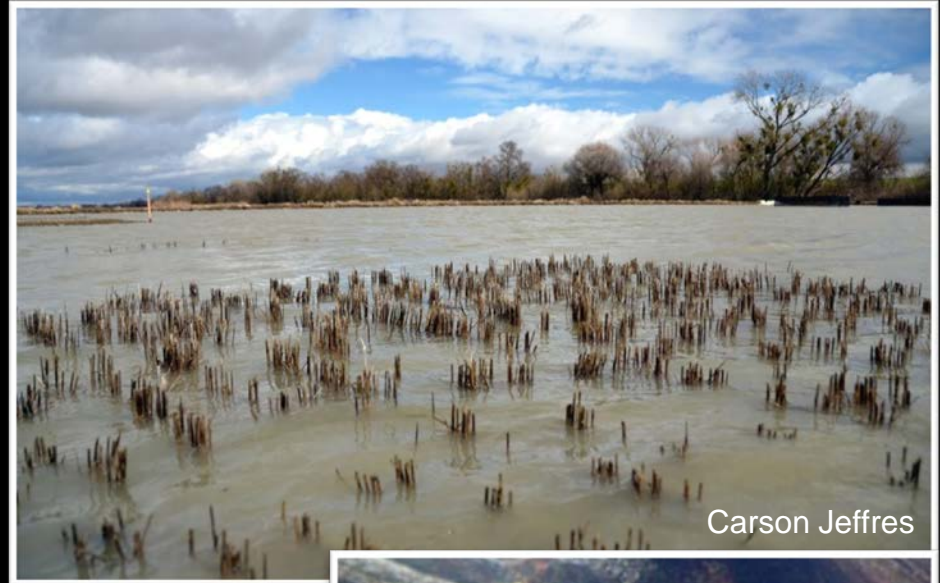
Can we enhance moderate flood events for fish benefit?



Agriculture: A large component of the Yolo Bypass



Can we use rice fields for farming AND fish?



Carson Jeffres



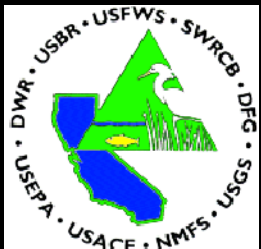
Interagency Partnership to Investigate Managed Agricultural Floodplains since 2012



Carson Jeffres



*Cal Marsh & Farm
Venture, LLC*



Conservation implications of flooding rice fields on winter waterbird communities

Chris S. Elphick^{a,*}, Lewis W. Oring^b

^a Ecology, Evolution and Conservation Biology, University of Nevada, 1000 Valley Road, Reno, NV 89512, USA

^b Department of Environmental and Resource Sciences, University of Nevada, 1000 Valley Road, Reno, NV 89512, USA

Received 2 August 2001; received in revised form 31 January 2002; accepted 11 February 2002



Jacob Katz



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Win-Win Ecology: How the Earth's Species Can Survive in the Midst of Human Enterprise

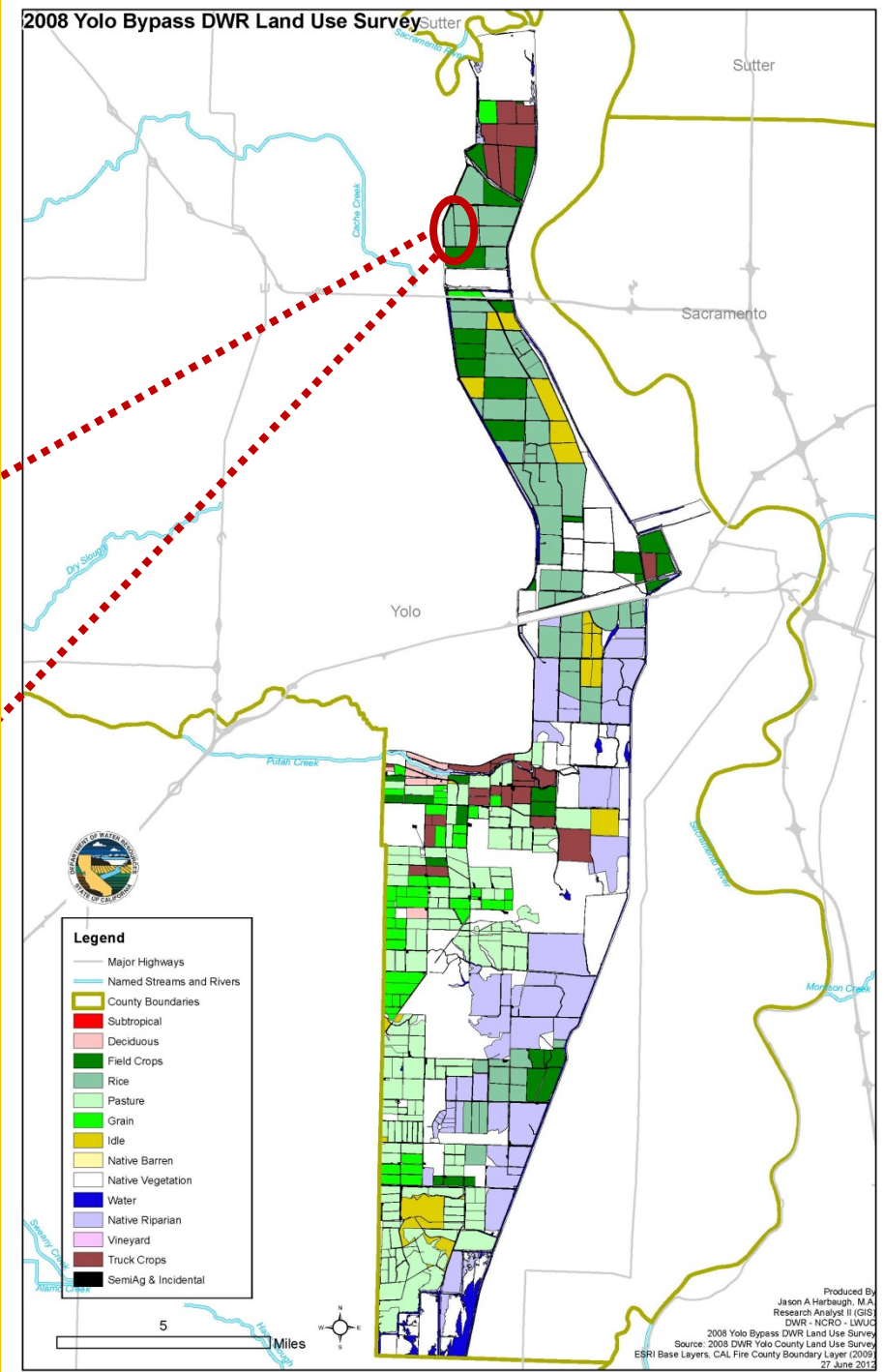
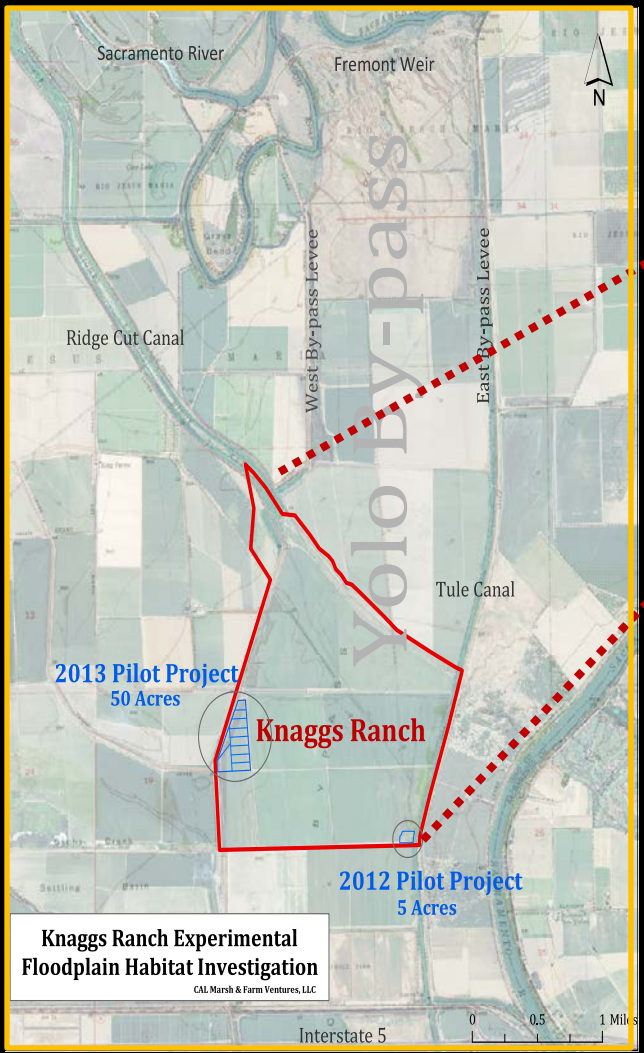
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Ground Zero for Managed Ag Floodplains for Fish:

Knaggs Ranch



Agricultural Floodplain Study: 5+ Years

2012

2013

2014

2015

2016-2017

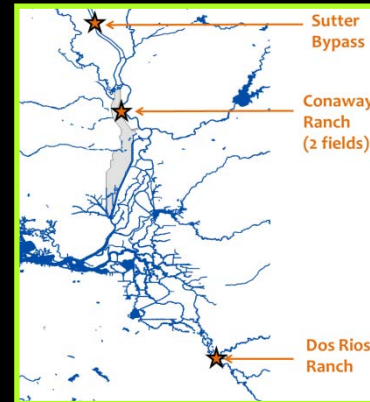
Pilot



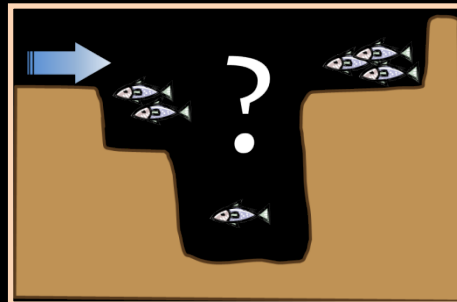
Agricultural Substrate



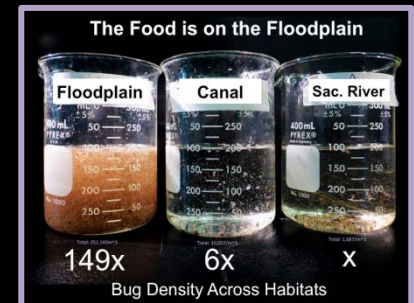
Geography



Depth & Flow

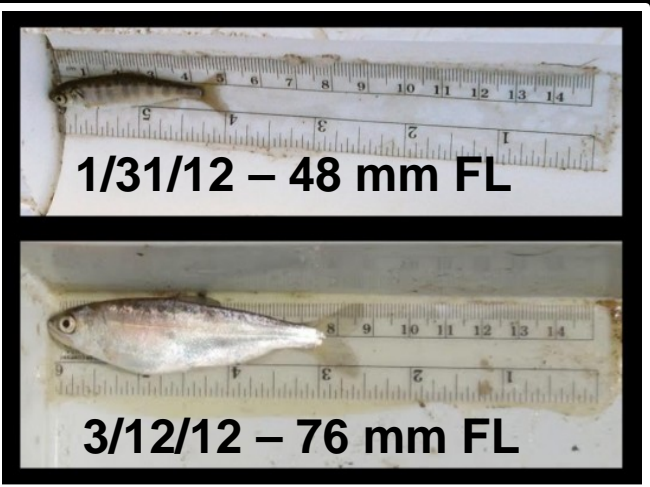
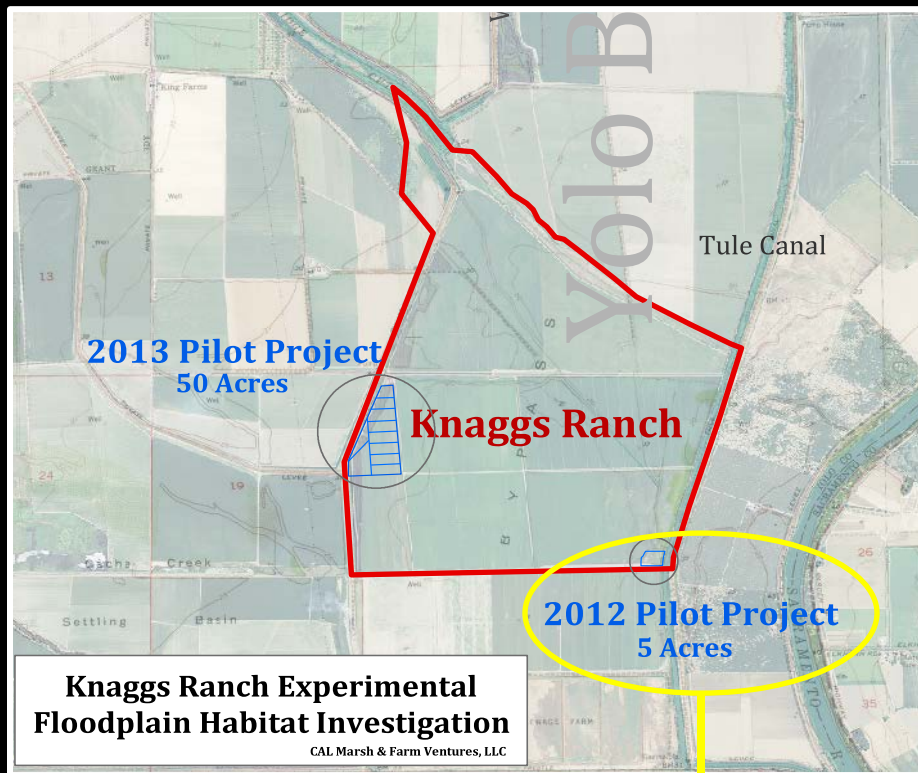


Habitat Comparisons

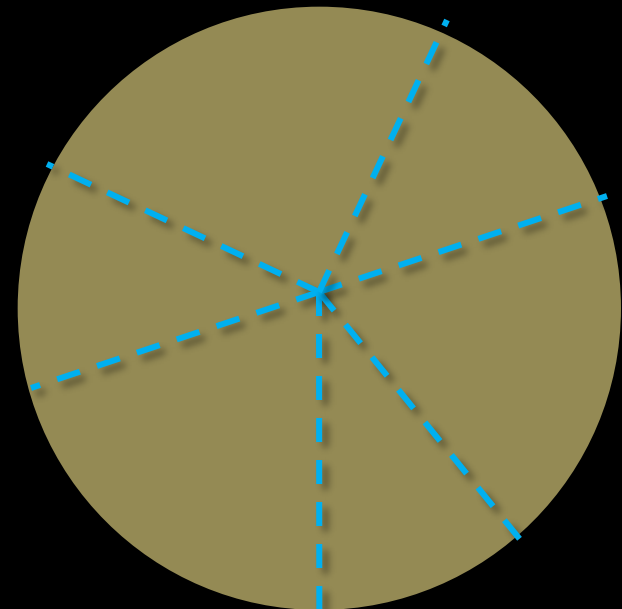
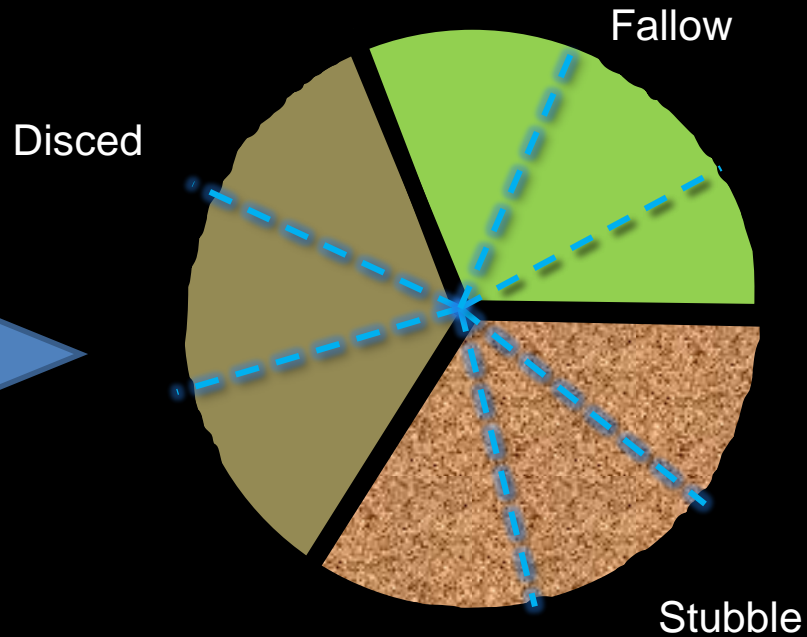


Pilot - 2012: Jan 31 – Mar 12

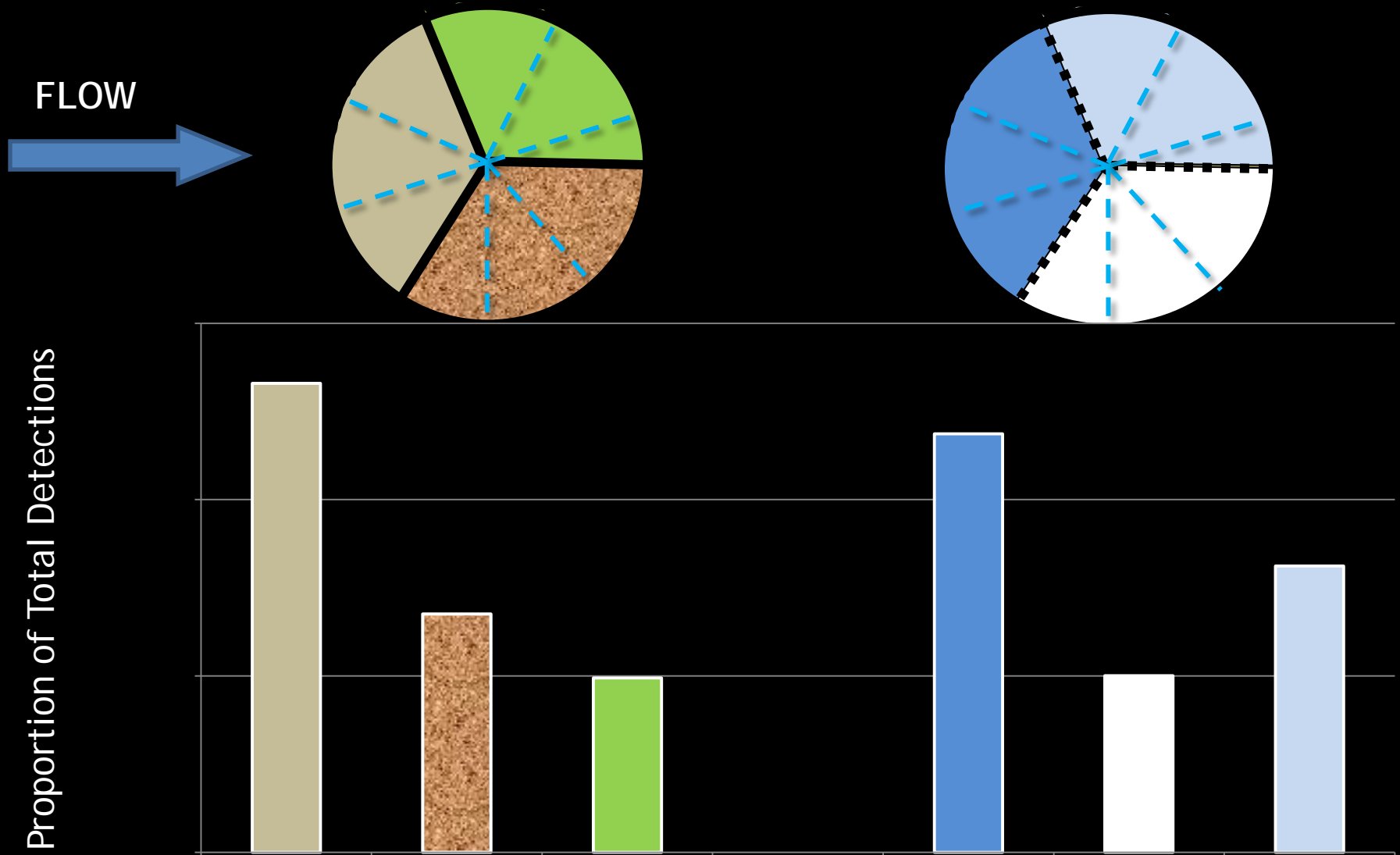
10,000 hatchery fish



Substrate Preference Study 2013

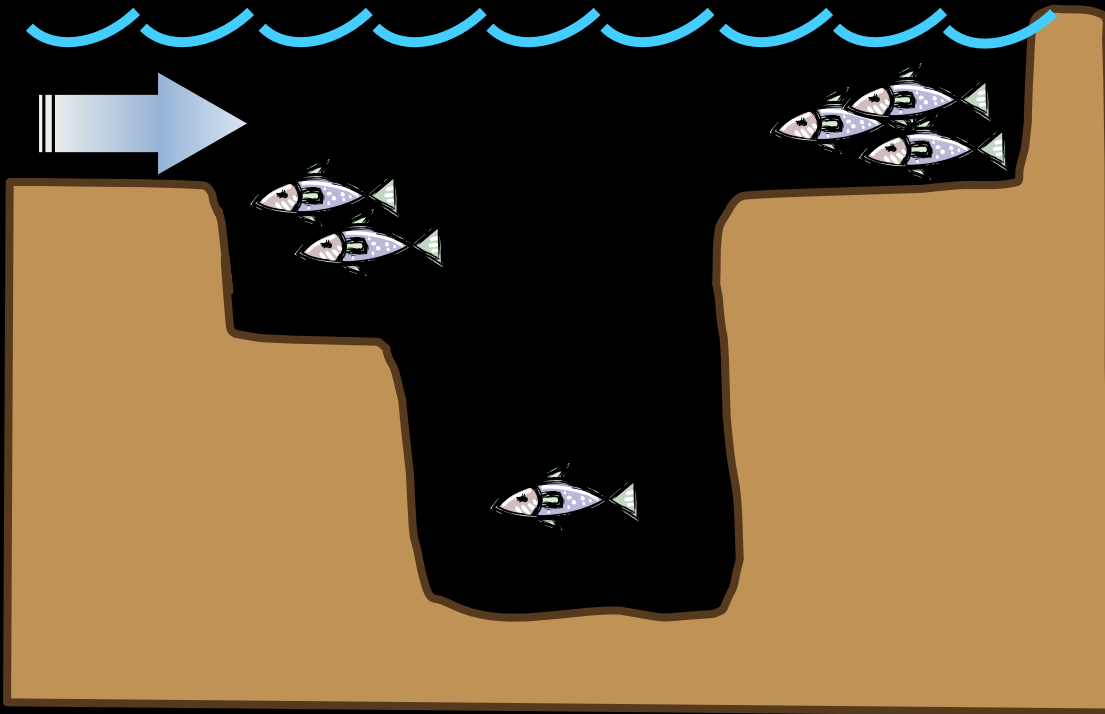


Little Evidence for Substrate Preference



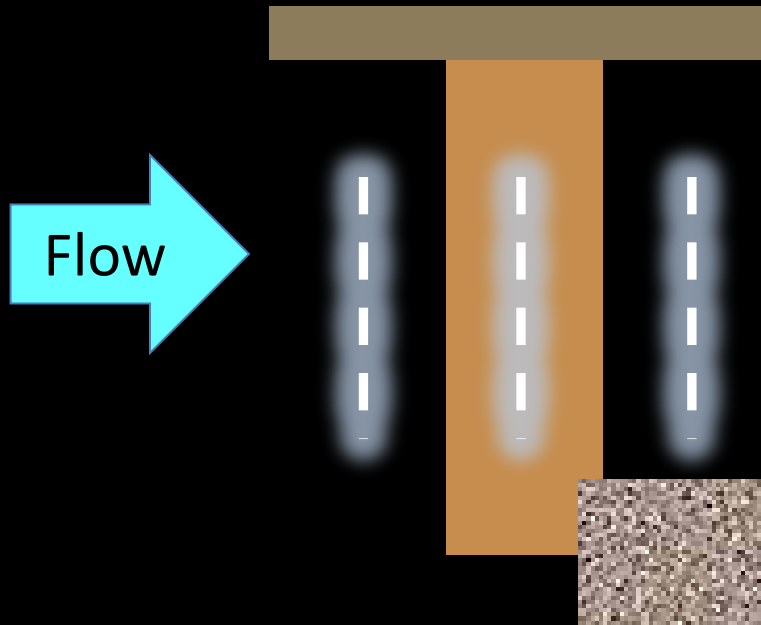
Conrad et al. 2016. Application of passive integrated transponder technology to juvenile salmon habitat use on an experimental agricultural floodplain. *North American Journal of Fisheries Management* 36: 30-39.

Depth and Flow Study 2014



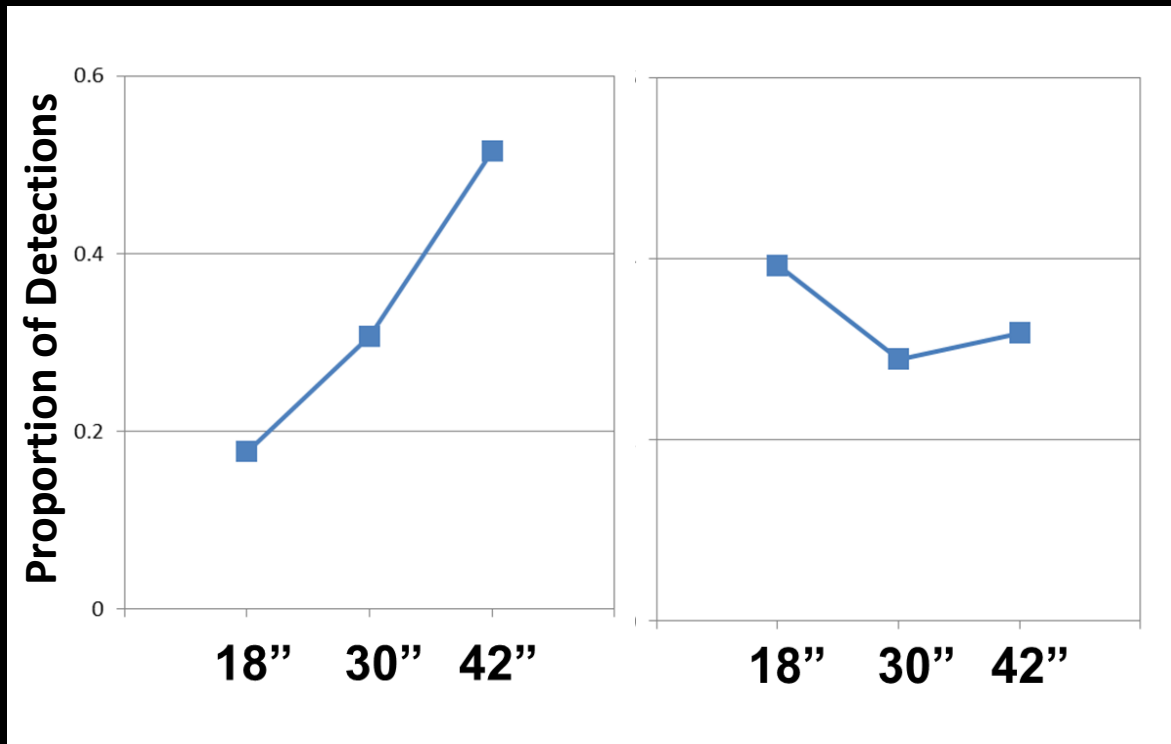
- Survival?
- Preference?

Depth and Flow Study 2014 – Preference



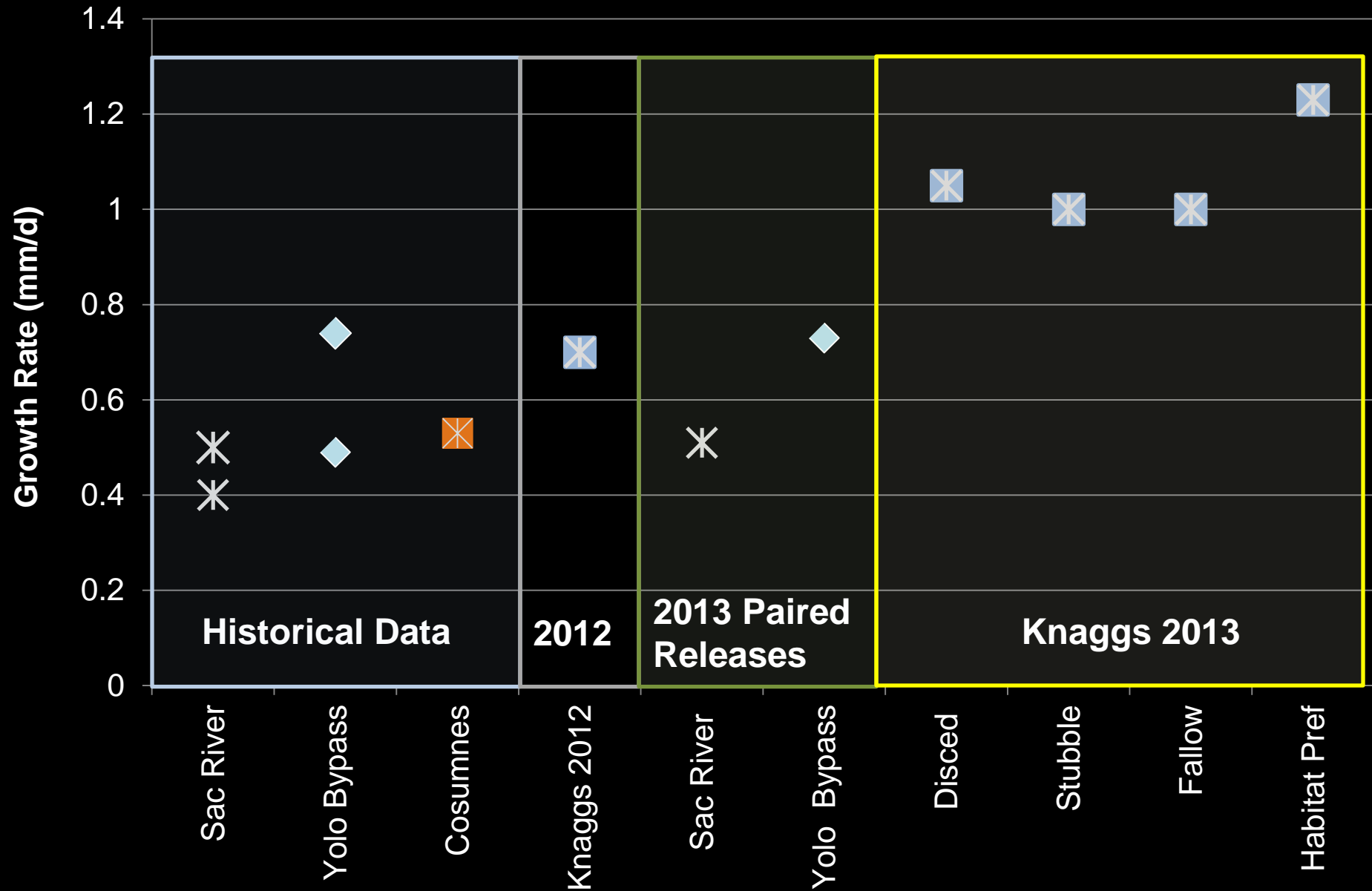
Slide from Lynn Takata

Depth and Flow Study 2014 – Survival

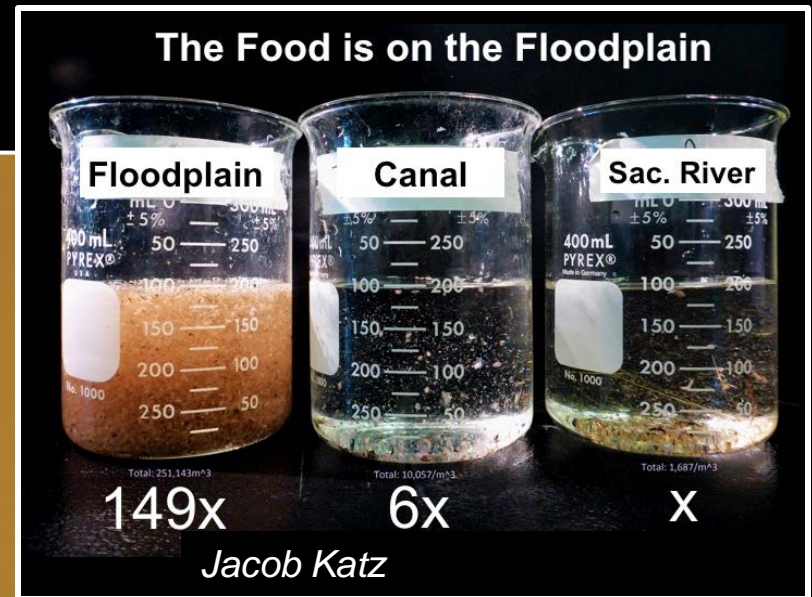


- Survival: 22-64%
- Not related to depth
- Day: deep
- Night: shallow

Unprecedented Juvenile Growth Rates

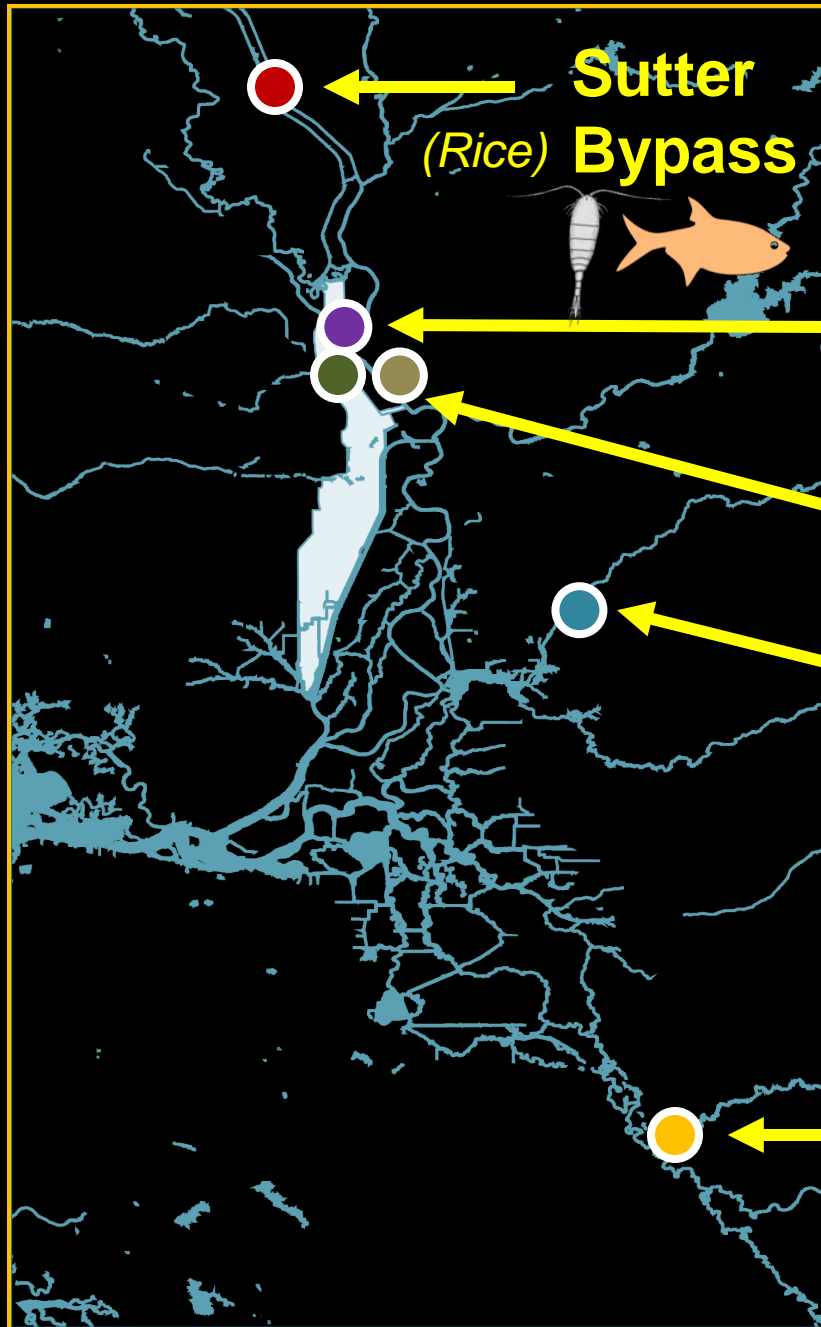


Abundant Food...



Geography – 2015: Feb

Food web & growth study
4 weeks Managed Flooding



Sutter
(Rice) **Bypass**

Knaggs Ranch (Rice)

Conaway Ranch
(2 sites, Rice & Fallow)

Cosumnes River Preserve
(Rice)

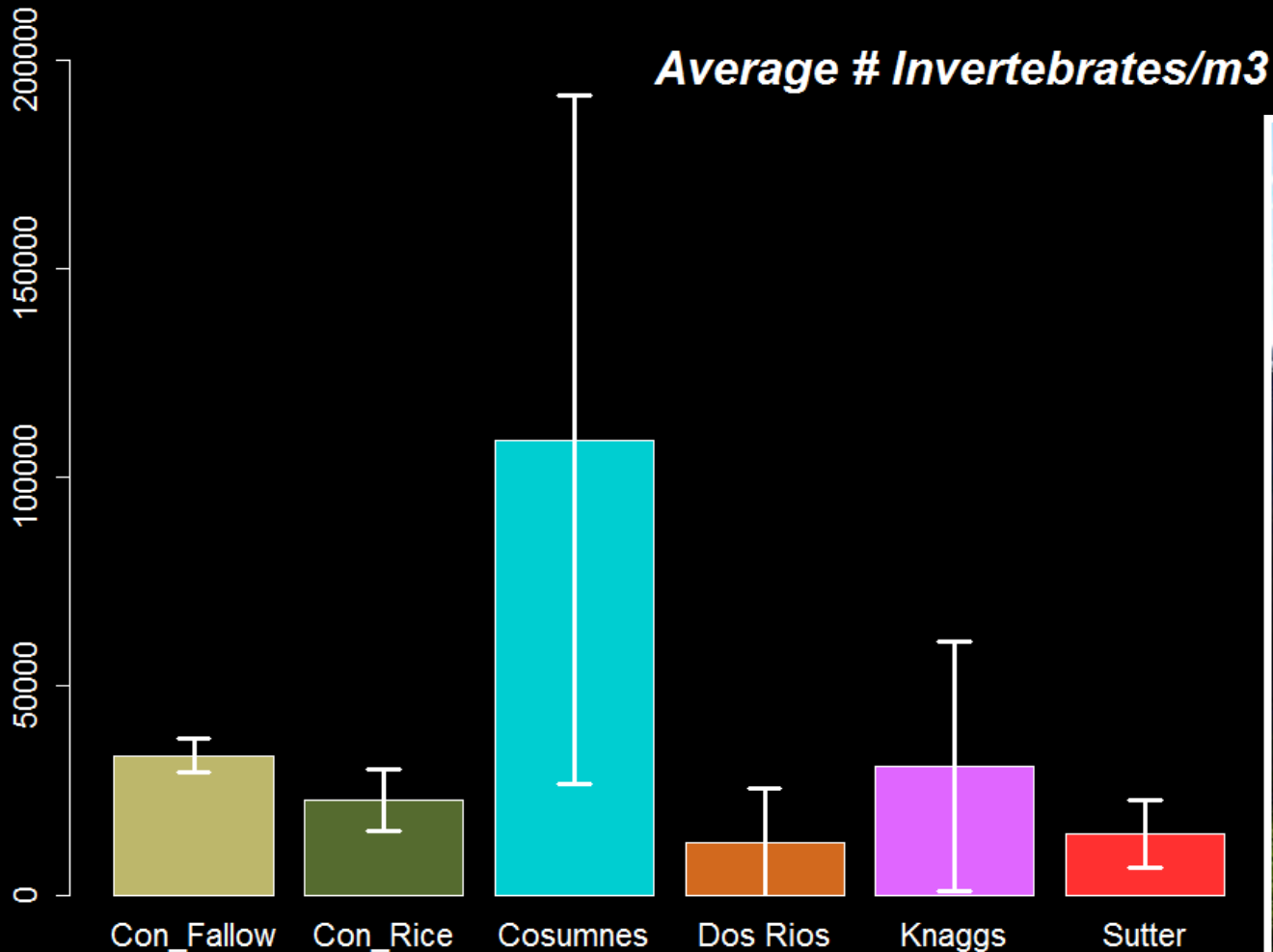
Dos Rios Ranch
(Wheat)





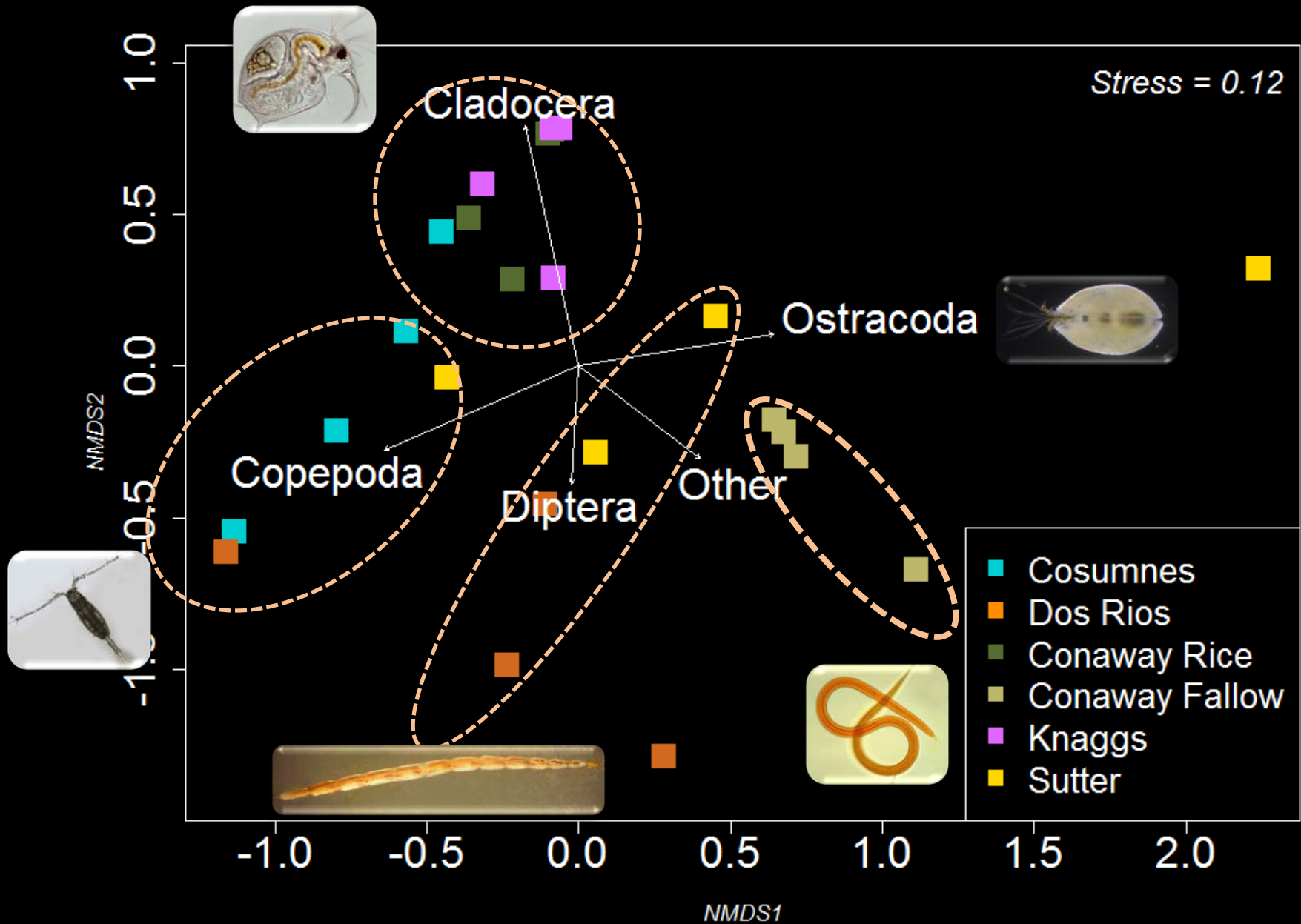
***Chinook Salmon
from Feather River
Hatchery***

Food webs: variable productivity

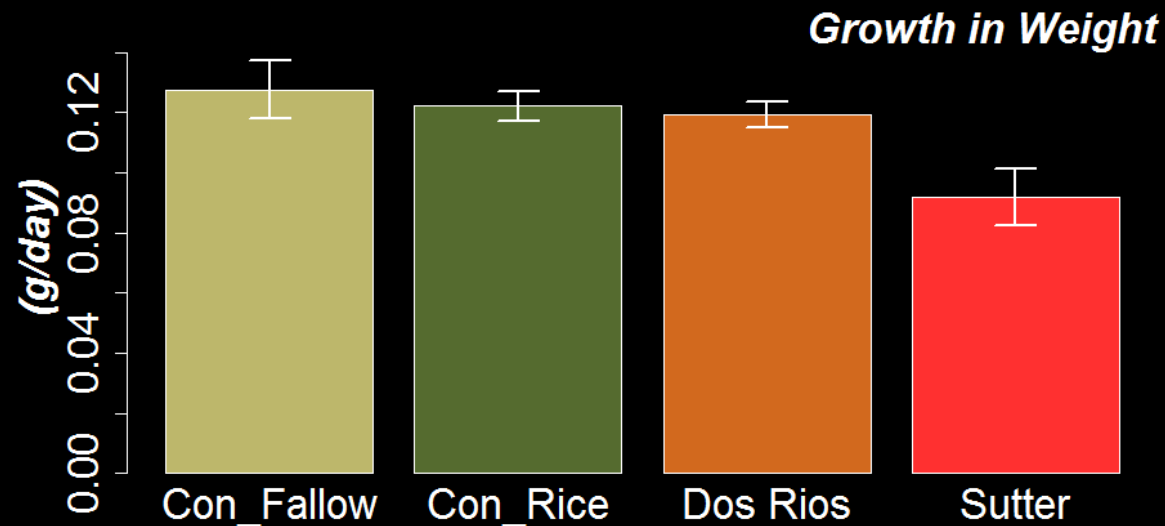
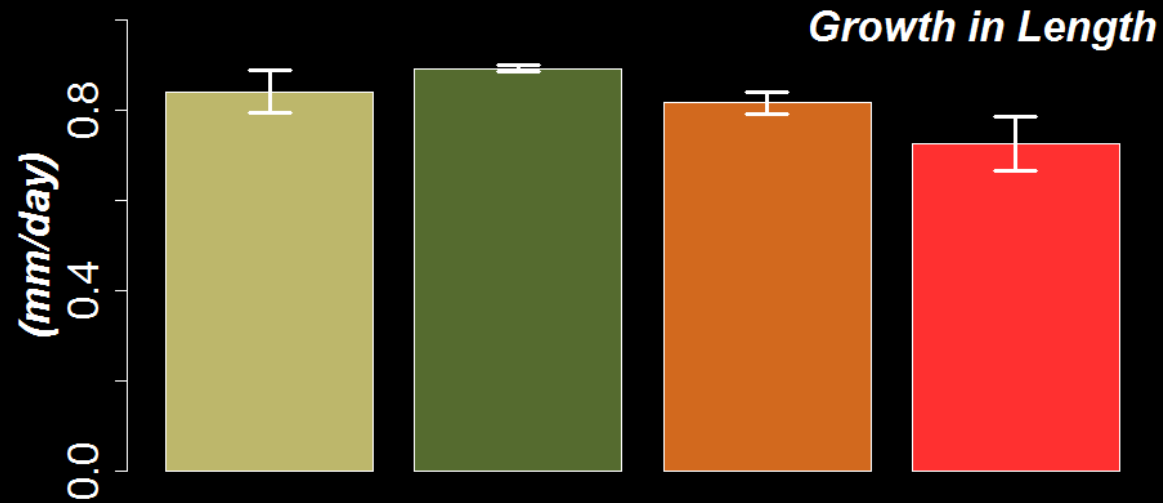


Naoaki Ikemiyagi

Food Webs: the menu varies



Similar Growth Rates Despite Variable Food Webs



Agricultural Floodplain Study: 5+ Years

2012

2013

2014

2015

2016-2017

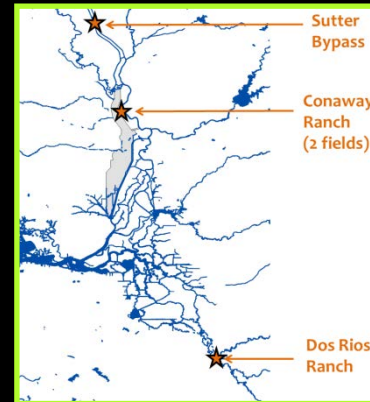
Pilot



Agricultural Substrate



Geography

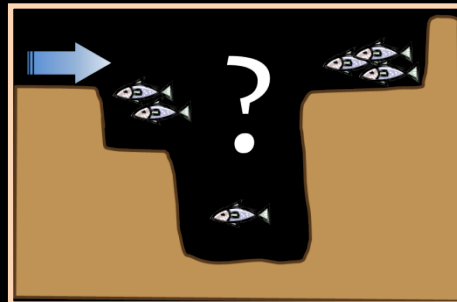


2018?

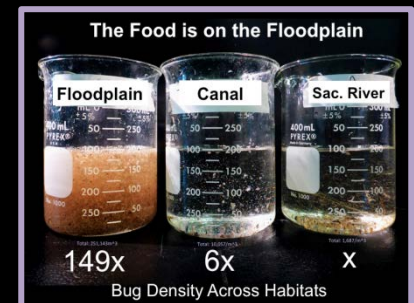
Extend Natural Floods?



Depth & Flow

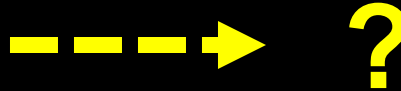


Habitat Comparisons



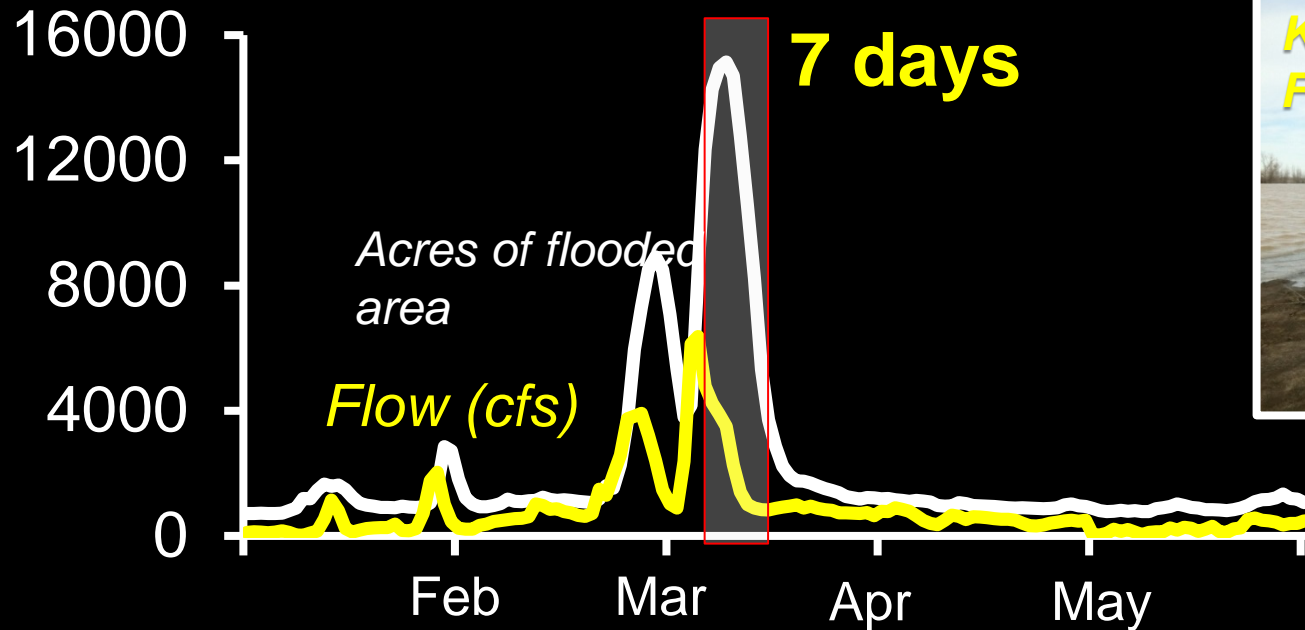
Next steps: creative approaches for more floodplain opportunity

Challenges: Yolo Bypass drains very quickly



Can we extend?

7 days



Preliminary 2014 BiOP TUFLOW
Hydraulic Modeling Source: CBEC & HDR

A diversity floodplains can support growth



Questions?



Lynn Takata