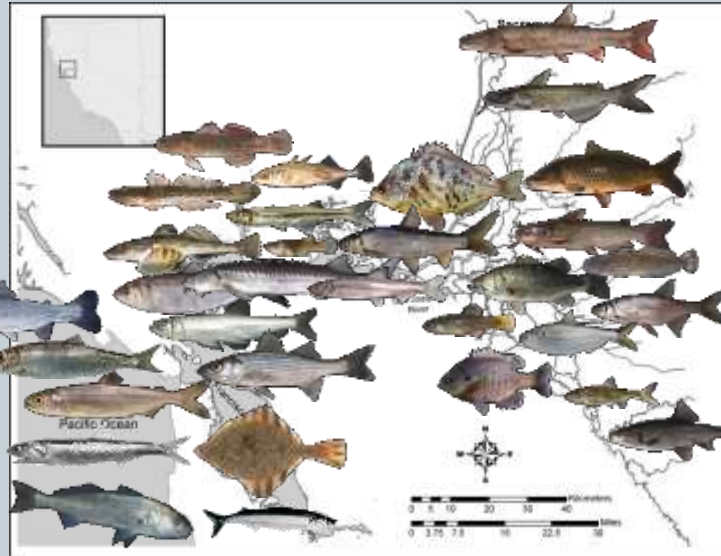


The utilization of tidal marshes (etc.) by fishes of the upper San Francisco Estuary



MATT NOBRIGA
U.S. FISH AND WILDLIFE SERVICE, BDFWO



Most photo credits go to Rene Reyes

<http://www.usbr.gov/mp/TFFIP/photos/fish/ReyesFishGallery.html>

Fish habitat in Bay-Delta tidal marshes etc.



Variation in Spring Nearshore Resident Fish Species Composition and Life Histories in the Lower Sacramento-San Joaquin Watershed and Delta

Larry R. Brown¹
James T. Hays

Littoral Fish Assemblages of the Alien-dominated Sacramento-San Joaquin Delta, California, 1980-1983 and 2001-2003

LARRY R. BROWN^{1*} and DENNIS MICHNIUK²

Living in a Dynamic Environment: Variability in Life History Traits of Age-0 Splittail in Tributaries of San Francisco Bay

FREDERICK FEYRER³ AND TED SOMMER⁴
Aquatic Ecology Section, California Department of Water Resources, 3251 S Street,
Sacramento, California 95816, USA

JAMES HOBBS

Assessing nursery habitat quality for native smelts (*Osmeridae*) in the low-salinity zone of the San Francisco estuary

J. A. HOBBS^{5*}, W. A. BENNETT⁶ AND J. E. BURTON⁷

Spatial and Temporal Distribution of Native and Alien Ichthyoplankton in Three Habitat Types of the Sacramento-San Joaquin Delta

LENNY F. GRIMALDO⁸, ROBERT E. MILLER⁹,
CHRISTOPHER M. PIRIGGIN⁹, AND ZACHARY P. HYMANSON⁹

Fish Assemblages in Reference and Restored Tidal Freshwater Marshes of the San Francisco Estuary

Lenny F. Grimaldo^{8,10}, Robert E. Miller⁹, Chris M. Piriggin⁹, and Zachary Hymanson⁹

Dietary shifts in a stressed fish assemblage: Consequences of a bivalve invasion in the San Francisco Estuary

Frederick Feyrer³, Bruce Herbold³, Scott A. Matern⁶ & Peter B. Moyle⁶

Importance of Flood Dynamics versus Intrinsic Physical Habitat in Structuring Fish Communities: Evidence from Two Adjacent Engineered Floodplains on the Sacramento River, California

FREDERICK FEYRER³, TED SOMMER⁴, AND WILLIAM HARRELL

San Francisco Estuary and Watershed Science

Volume 1, Issue 1 October 2003 Article 2
Issues in San Francisco Estuary Tidal Wetlands Restoration

Will Tidal Wetland Restoration Enhance Populations of Native Fishes?

Larry R. Brown¹

Macroinvertebrate Prey Availability and Fish Diet Selectivity in Relation to Environmental Variables in Natural and Restoring North San Francisco Bay Tidal Marsh Channels

Eric S. Brown¹¹, Charles A. Simenstad¹², Jason D. Wolf¹³, Jeffrey S. Corbett¹⁴, and Stephen W. Boyer¹⁵

Variation in condition factor and growth in young-of-year fishes in floodplain and riverine habitats of the Cosumnes River, California

F. Ribeiro¹⁶, P. E. Crain¹⁷ & P. B. Moyle¹⁸

Diet and growth of non-native Mississippi silversides and yellowfin gobies in restored and natural wetlands in the San Francisco Estuary

Sahrye E. Cohen¹⁹, Stephen M. Bollens²

Dietary Segregation of Pelagic and Littoral Fish Assemblages in a Highly Modified Tidal Freshwater Estuary

LENNY F. GRIMALDO⁸

Community composition and diet of fishes as a function of tidal channel geomorphology

Tammie A. Vistalain^{14,20}, Stephen M. Bollens², Charles Simenstad³

Fish Community Ecology in an Altered River Delta: Spatial Patterns in Species Composition, Life History Strategies, and Biomass

MATTHEW L. NORRIS²¹, FREDERICK FEYRER³, RANDALL D. BAKER²², AND MICHAEL GROTZKOWSKI²³

Native and Alien Fishes in a California Estuarine Marsh: Twenty-One Years of Changing Assemblages

SCOTT A. MATERN⁶ AND PETER B. MOYLE

Fish community structure and environmental correlates in the highly altered southern Sacramento-San Joaquin Delta

Frederick Feyrer³ & Michael P. Healey⁹

Key science certainties for tidal wetland/marsh restoration



- 1. TIDAL MARSHES AND WETLANDS WILL PRODUCE FISH AND WILDLIFE BENEFITS**
- 2. BIVALVE GRAZING – KNOWN PROBLEM – WHAT’S THE SOLUTION?**
- 3. WE CANNOT GUESS WHAT EMERGENT OUTCOMES MAY STEM FROM A LOT OF RESTORATION**

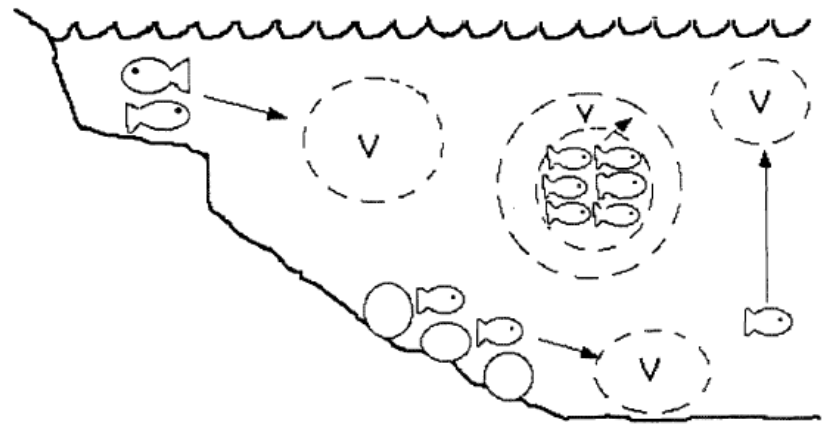
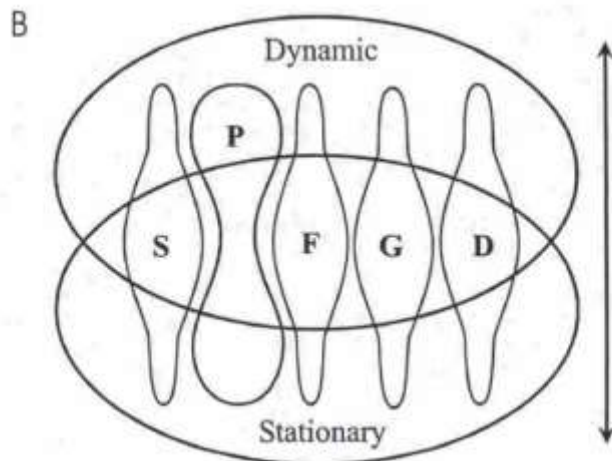
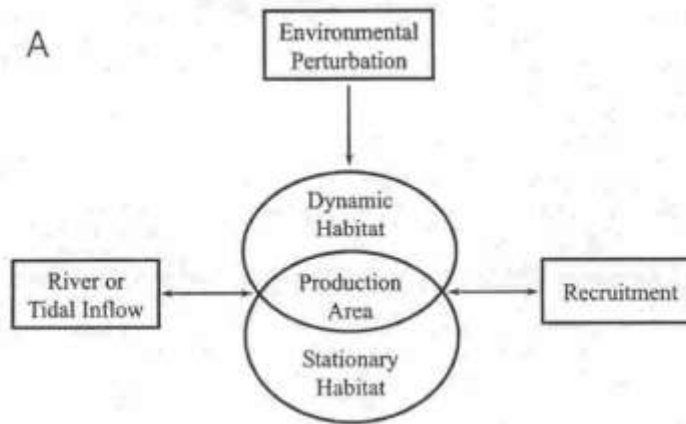
Key Points



**FUNDAMENTALS OF FISH HABITAT
(KNOWN – NEEDS SYNTHESIS)**

**FRESHWATER FLOW REGIME
(POTENTIALLY PROFOUND PROBLEM –
NEEDS RESEARCH)**

Fish habitat emerges from an interaction of water quality and submerged landscape features



Dynamic habitat: salinity

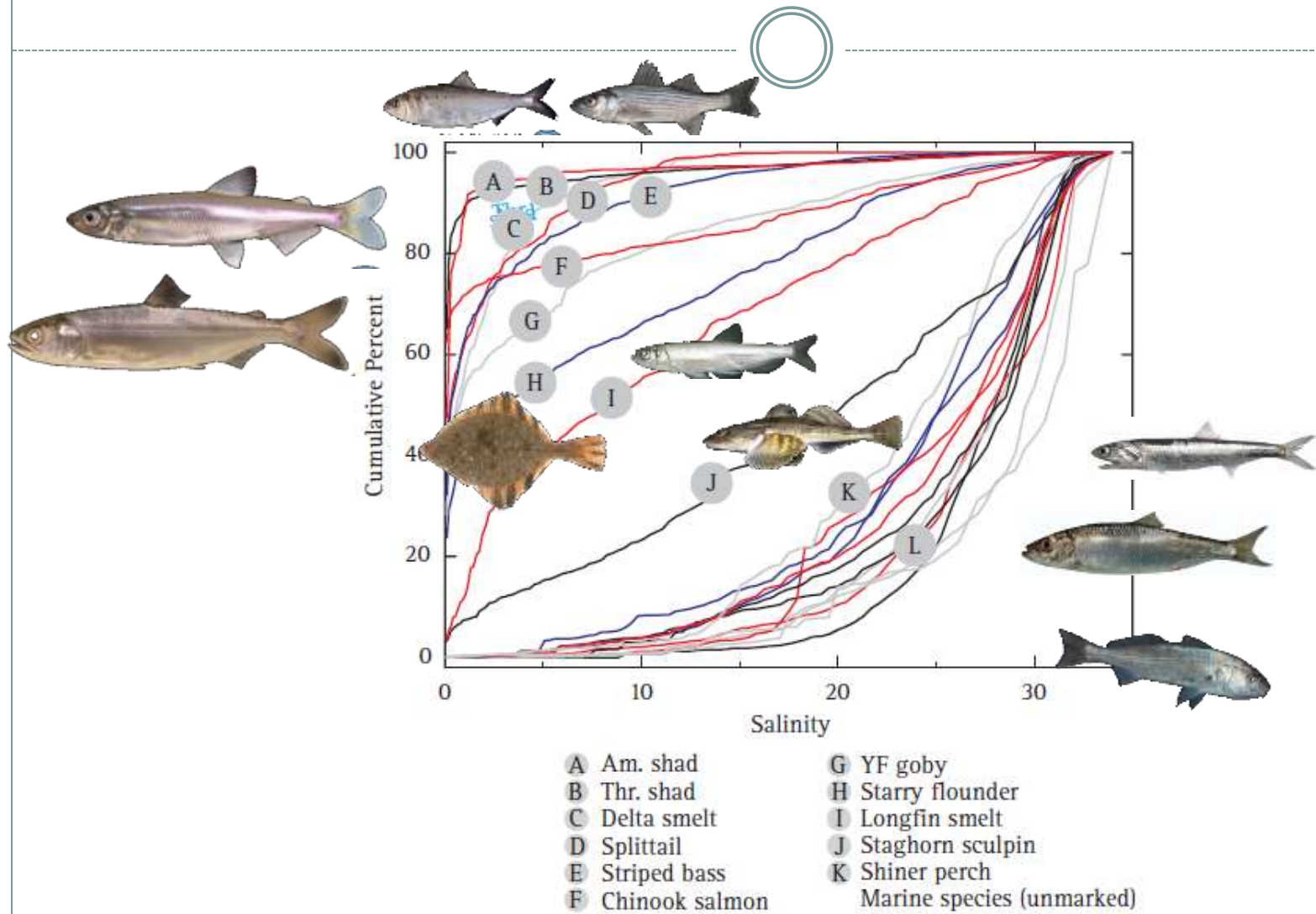
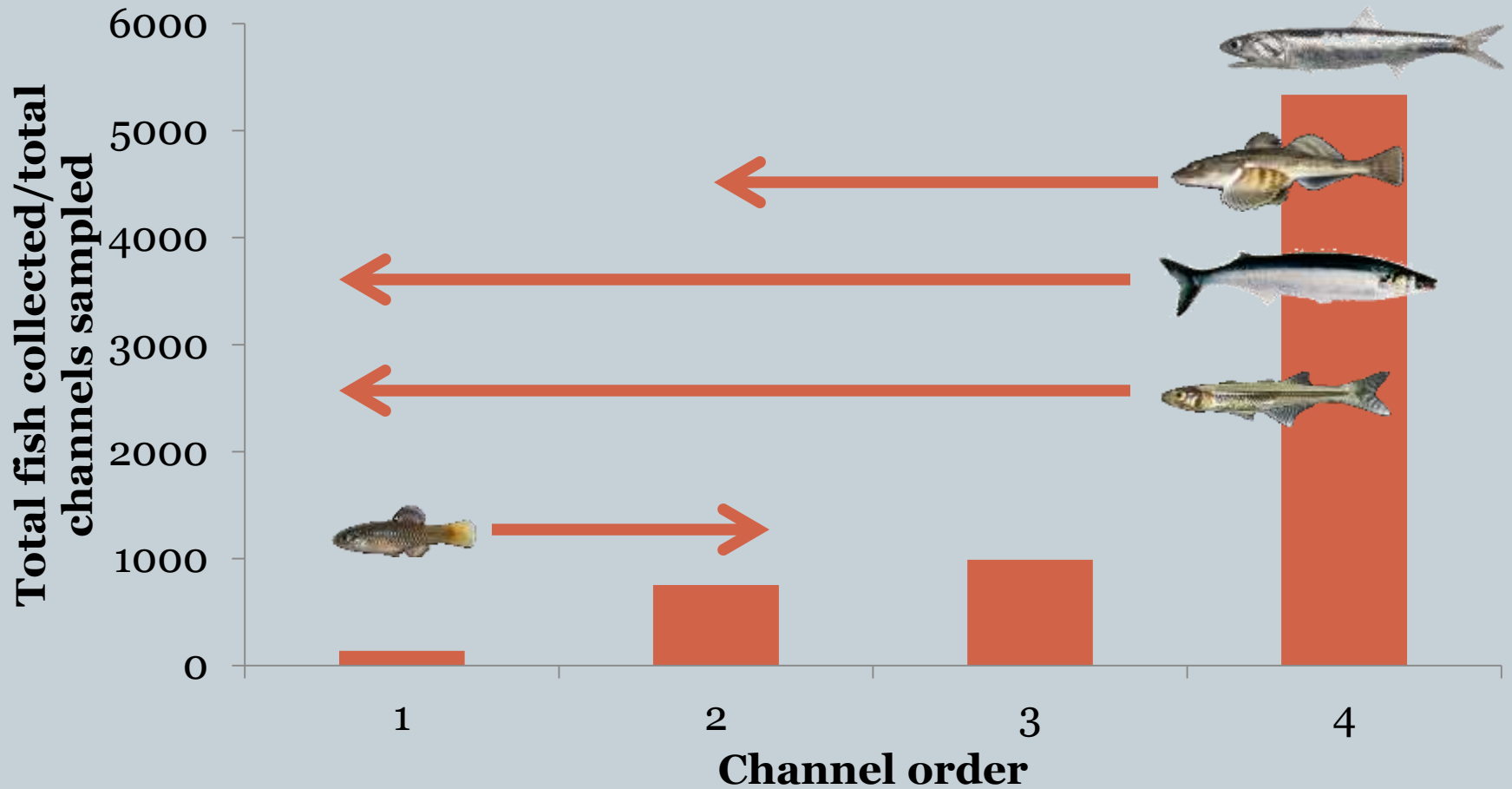


Figure from Kimmerer (2004; SFEWS)

Stationary marsh habitat: channel order



Data from Visintainer, Bollens & Simenstad (2006; MEPS)

Freshwater flow regime



HUMOR ME WITH A THOUGHT EXPERIMENT



Summary of long-term trends in the estuary flow regime

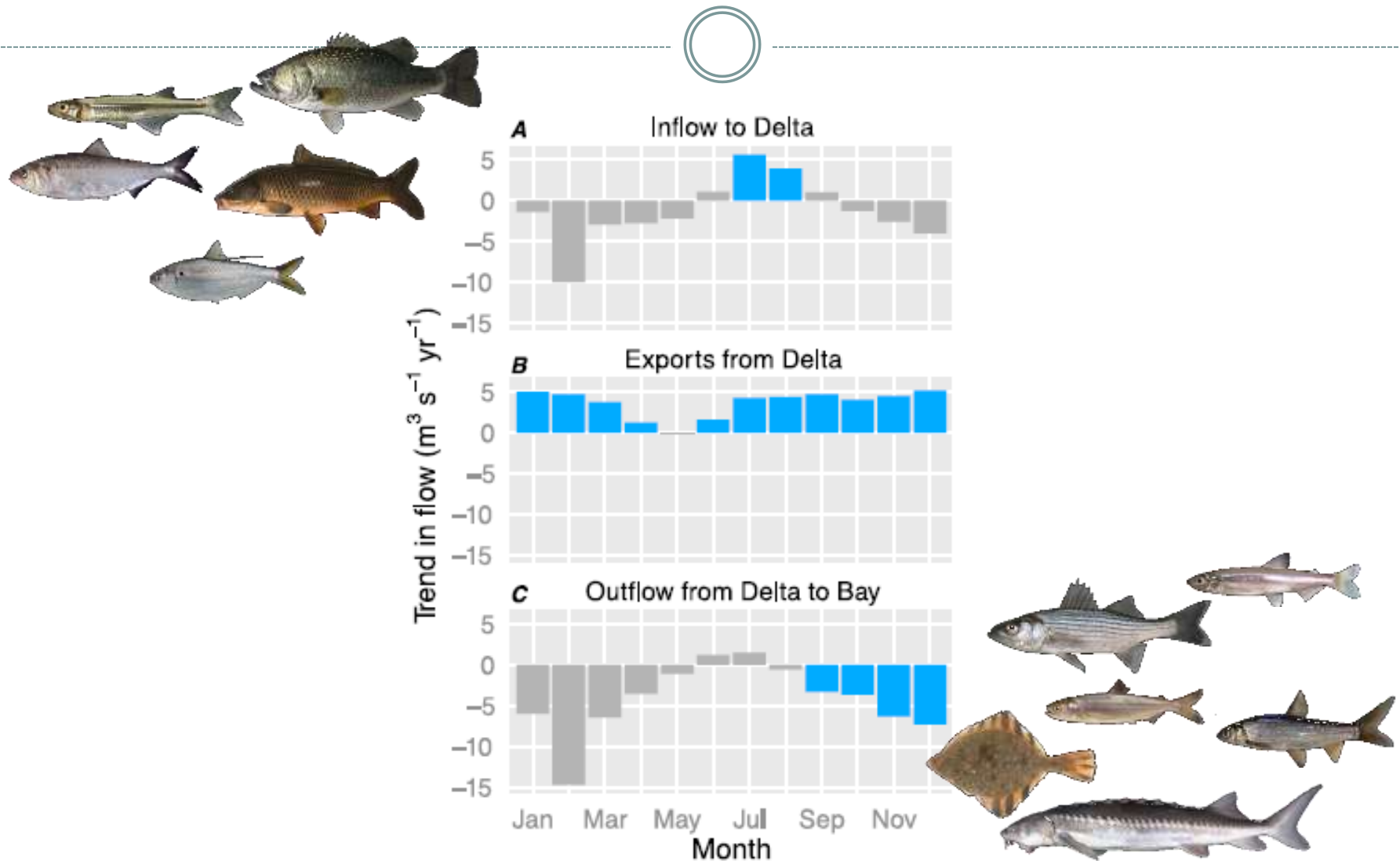
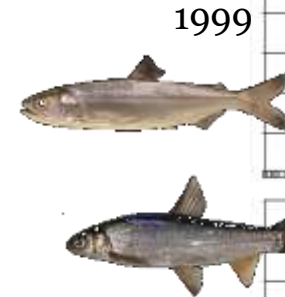
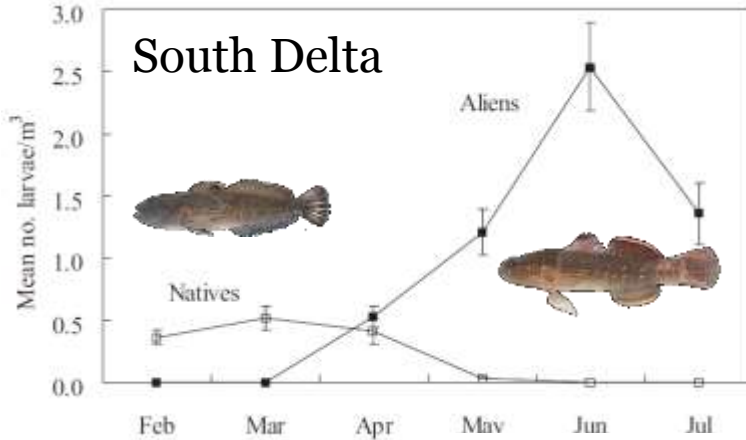
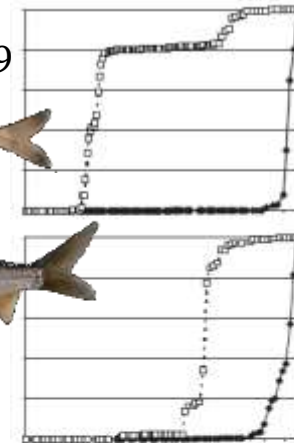


Figure: Cloern and Jassby (2012); concept Moyle and Bennett (2008)

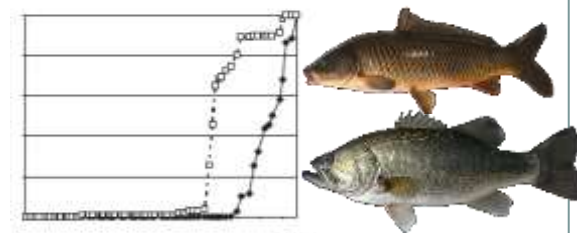
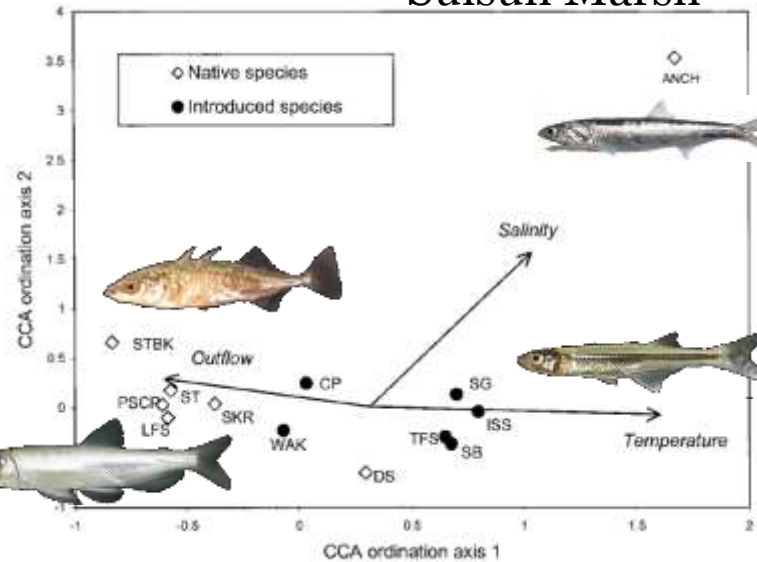
Dynamic habitat: temperature



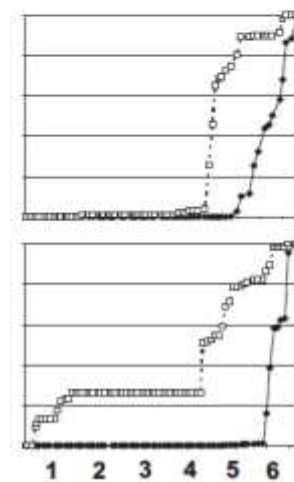
Yolo Bypass rotary screw trap



Suisun Marsh



2002



Stationary marsh habitat: open water interface

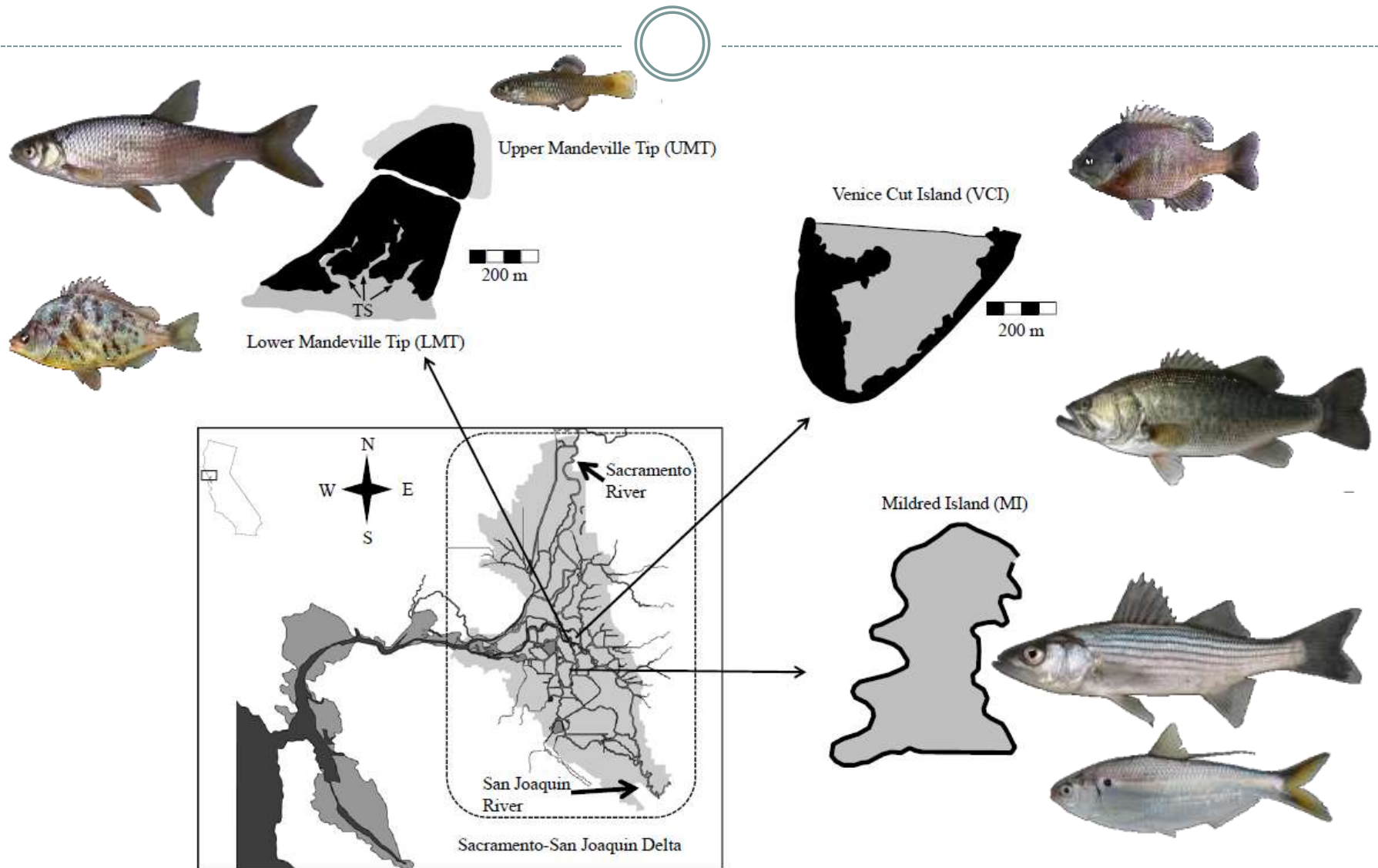


Figure from Grimaldo, Miller, Peregrin, & Hymanson (2012; SFEWS)

Thought experiment



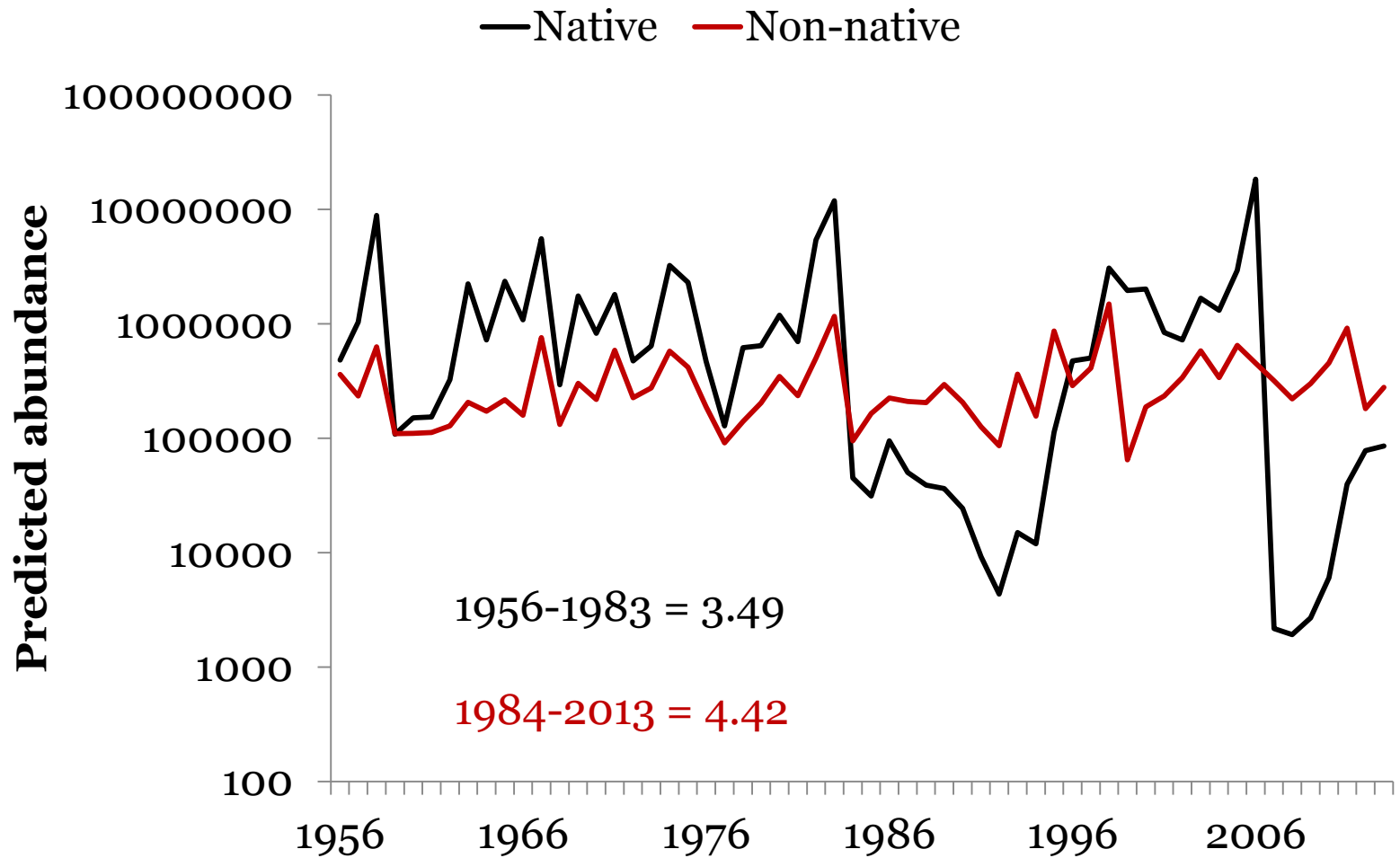
- **Conceptual model**

- $R = aSe^{-BS}$
- “*a*” and “*b*” are functions of flow
- A wee bit of extra density dependent ‘intraguild predation’ (always $\leq 2\%$ per capita; per Baerwald et al. 2012)

- **Application**

- “Native fish” = Apr-May Delta outflow (1956-2013)
- “Non-native fish” = Jun-Jul Delta inflow (1956-2013)

Thought experiment: raw result



What can we do? What should we do?



- 1. SYNTHESIZE FISH-HABITAT INFORMATION**
- 2. BROADER THINKING AND RESEARCH INTO “FISH-FLOW” RELATIONSHIPS**



Also...research clam control!