Linking tidal marshes, open water, novel ecosystems, and geography for fish recovery in the upper San Francisco Estuary

Peter B. Moyle
Center for Watershed Science
Department of Wildlife, Fish, and Conservation Biology
October 1014

Novel Ecosystems:Suisun Marsh and the Delta

A new reality

UC DAVIS
CENTER FOR WATERSHED SCIENCES

NOVEL ECOSYSTEMS

Most aquatic ecosystems in California

- Superficial resemblance to historic ecosystems
- Irreversibly altered
- Native + alien species
- Novel in structure and function?

NOVEL ECOSYSTEMS

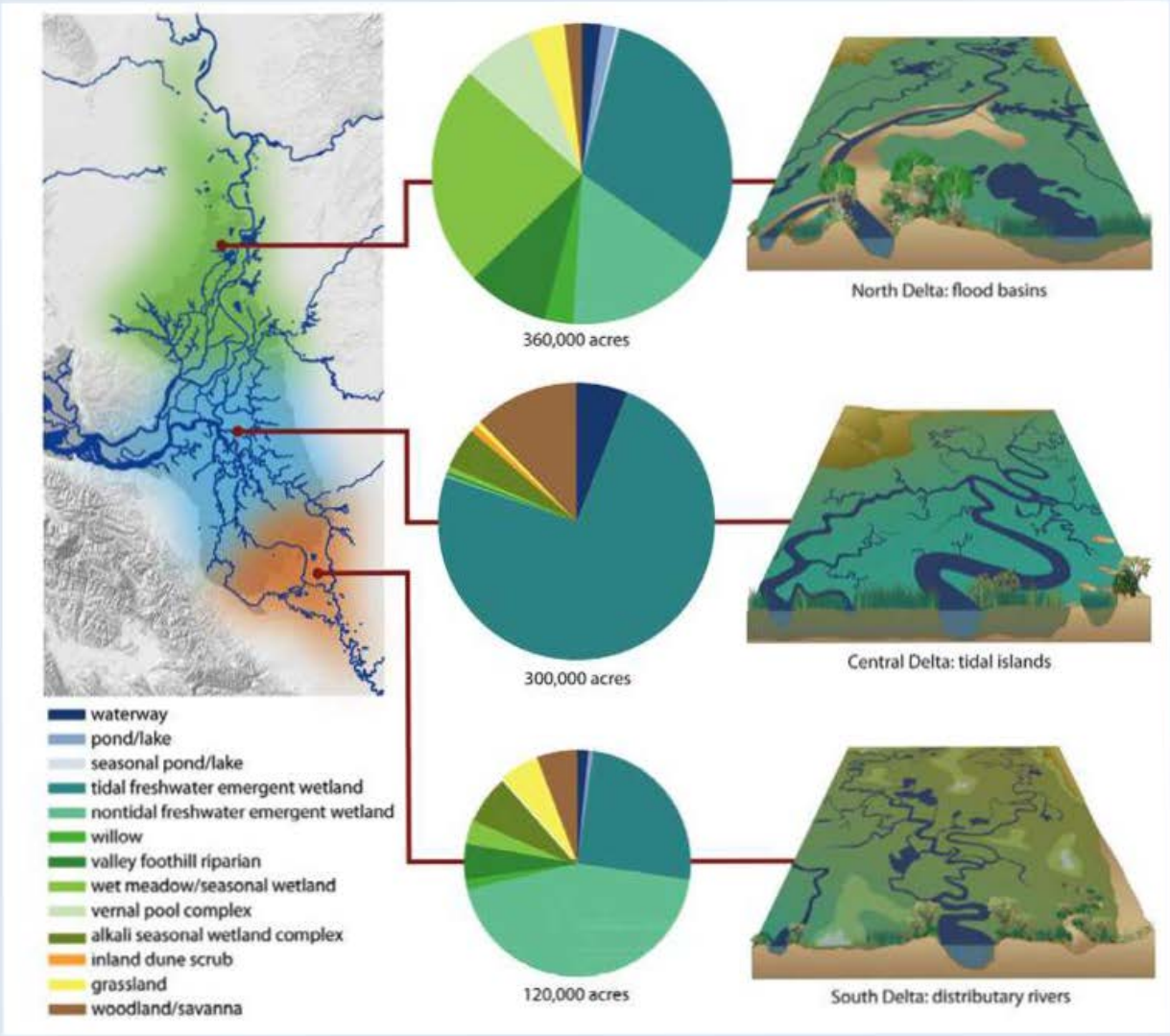
Most aquatic ecosystems in California

- Novel in structure and function?
- More species, in unprecedented combinations

Historic ecosystems limited as model for modern ecosystems

- Hint at conditions under which native species evolved

- Baselines are altered ecosystems?



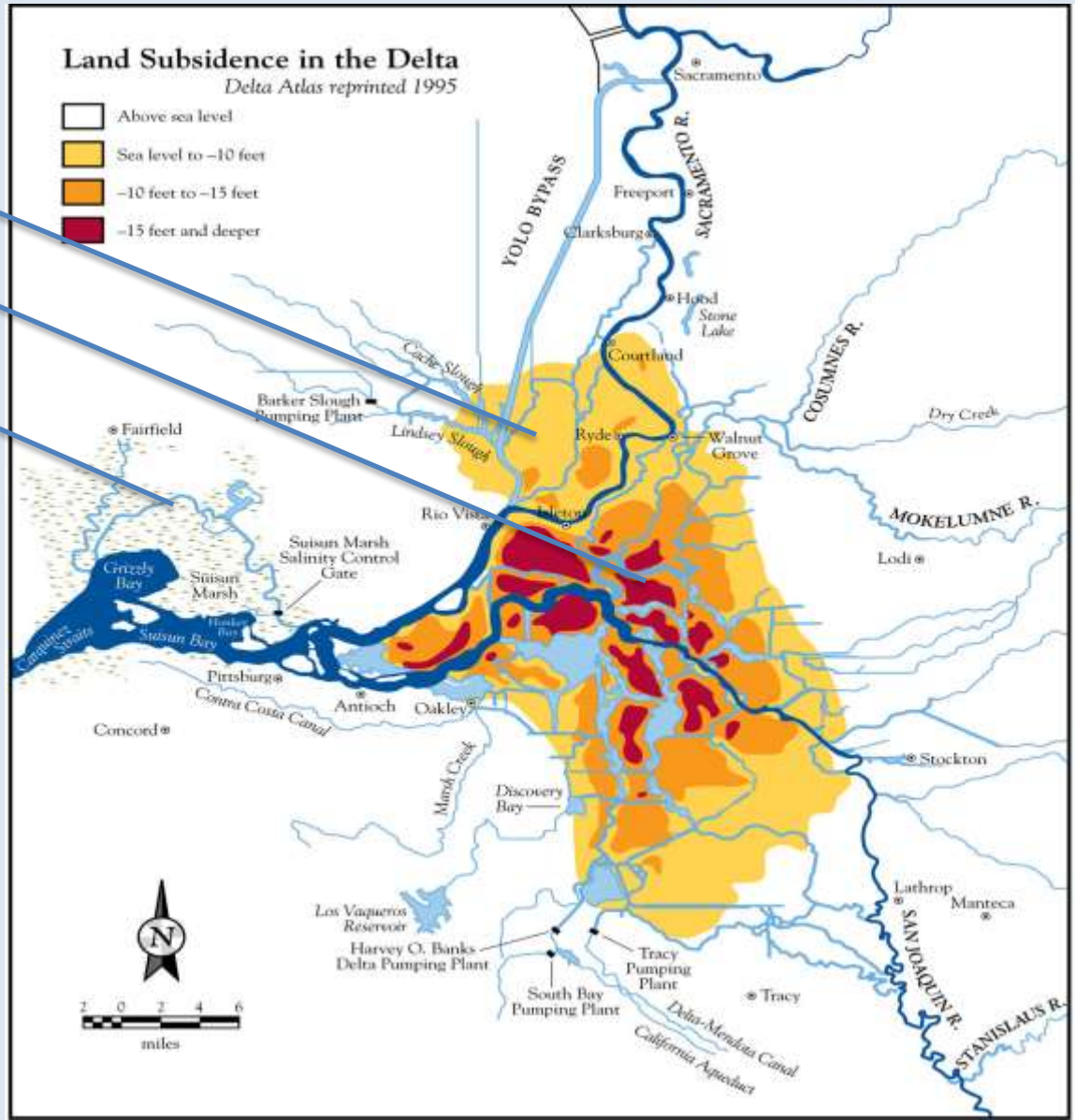
From Whipple et al. SFEI

Why emphasize novel ecosystems?

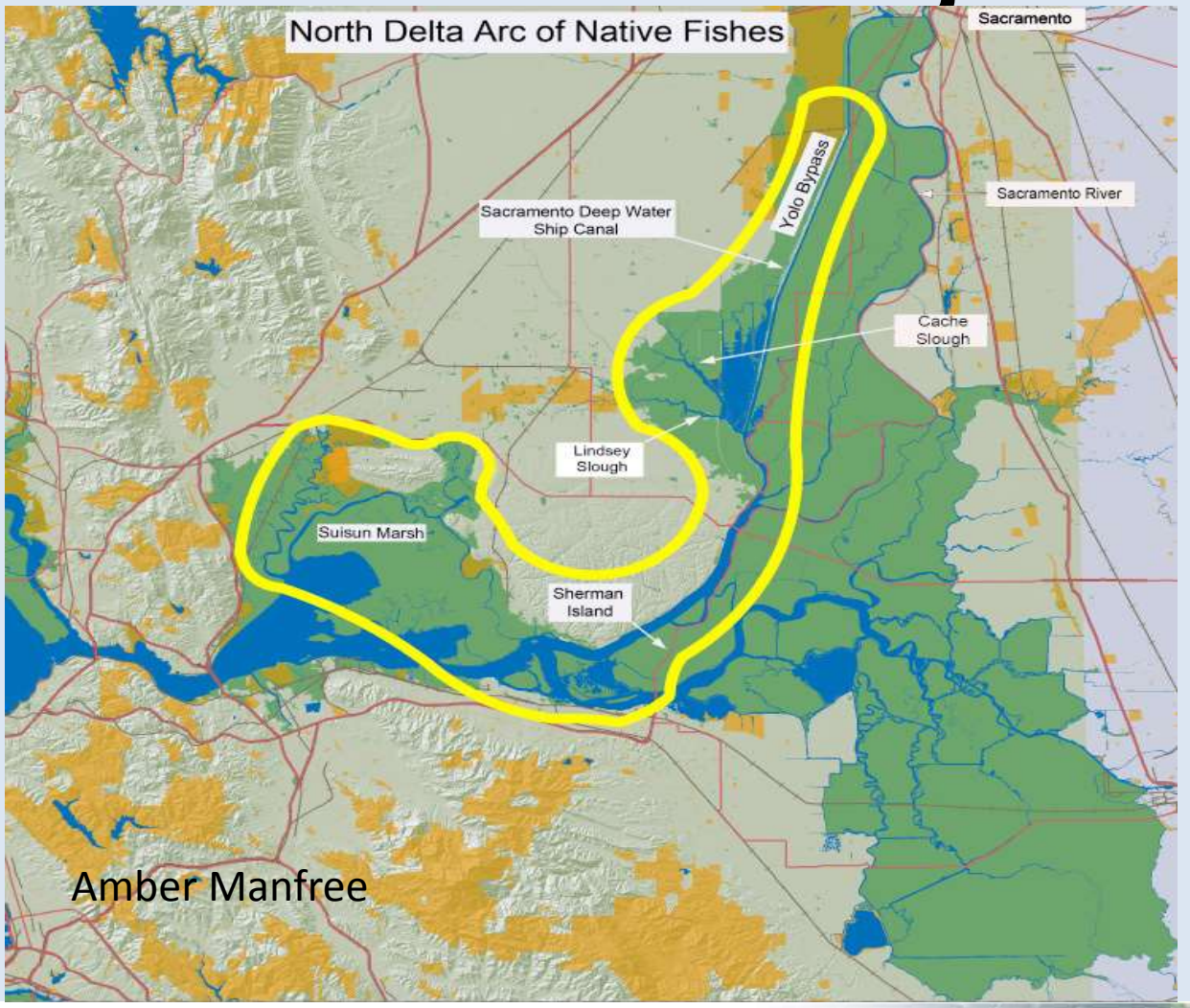
- Reality –the way things are
- We need novel approaches to conserve native species

Novel Ecosystems, this talk

- North Delta
- Central Delta
- Suisun Marsh



UC Davis Arc Project

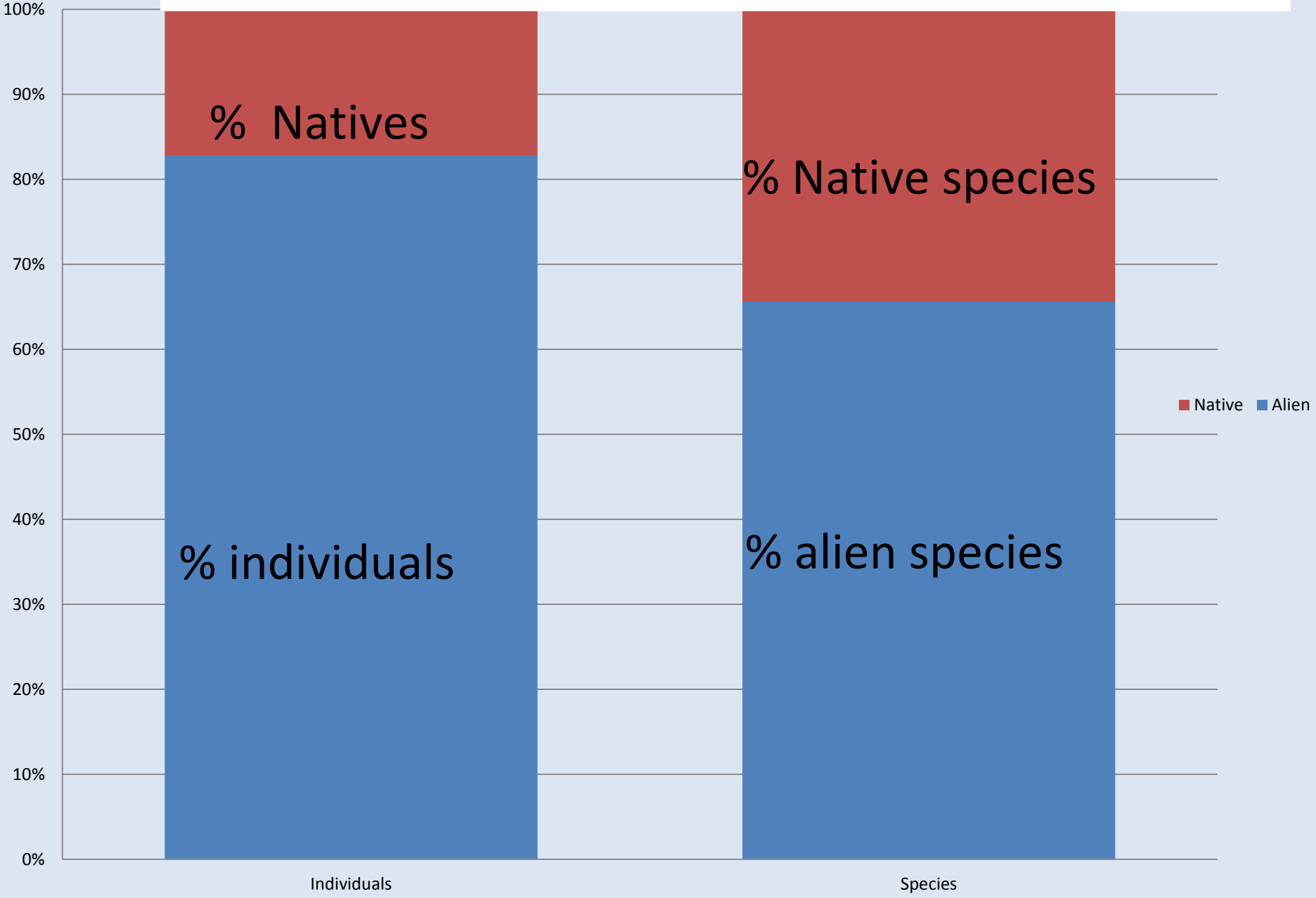


Amber Manfree

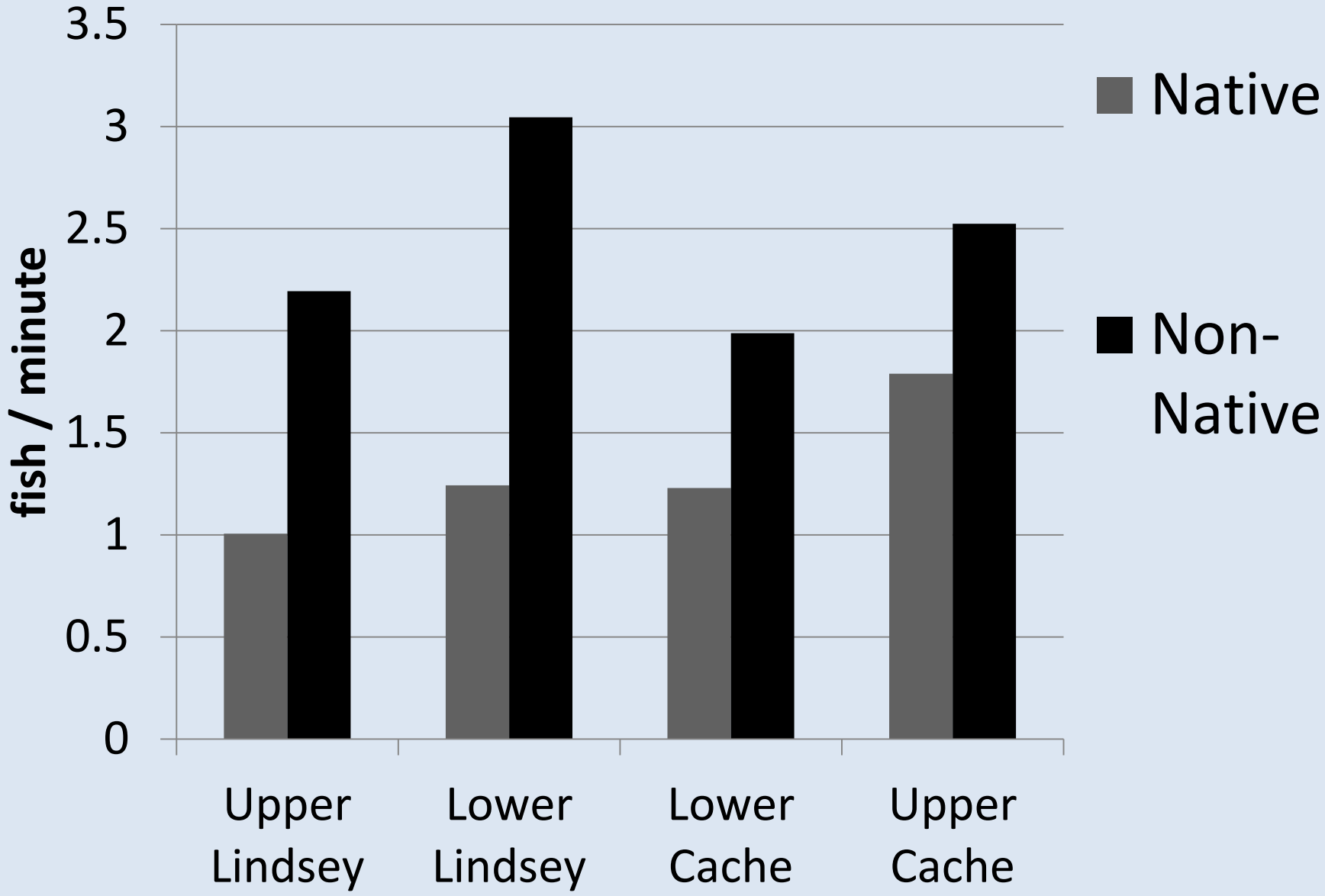
UCDAVIS
CENTER FOR WATERSHED SCIENCES

North Delta. Cache Slough complex

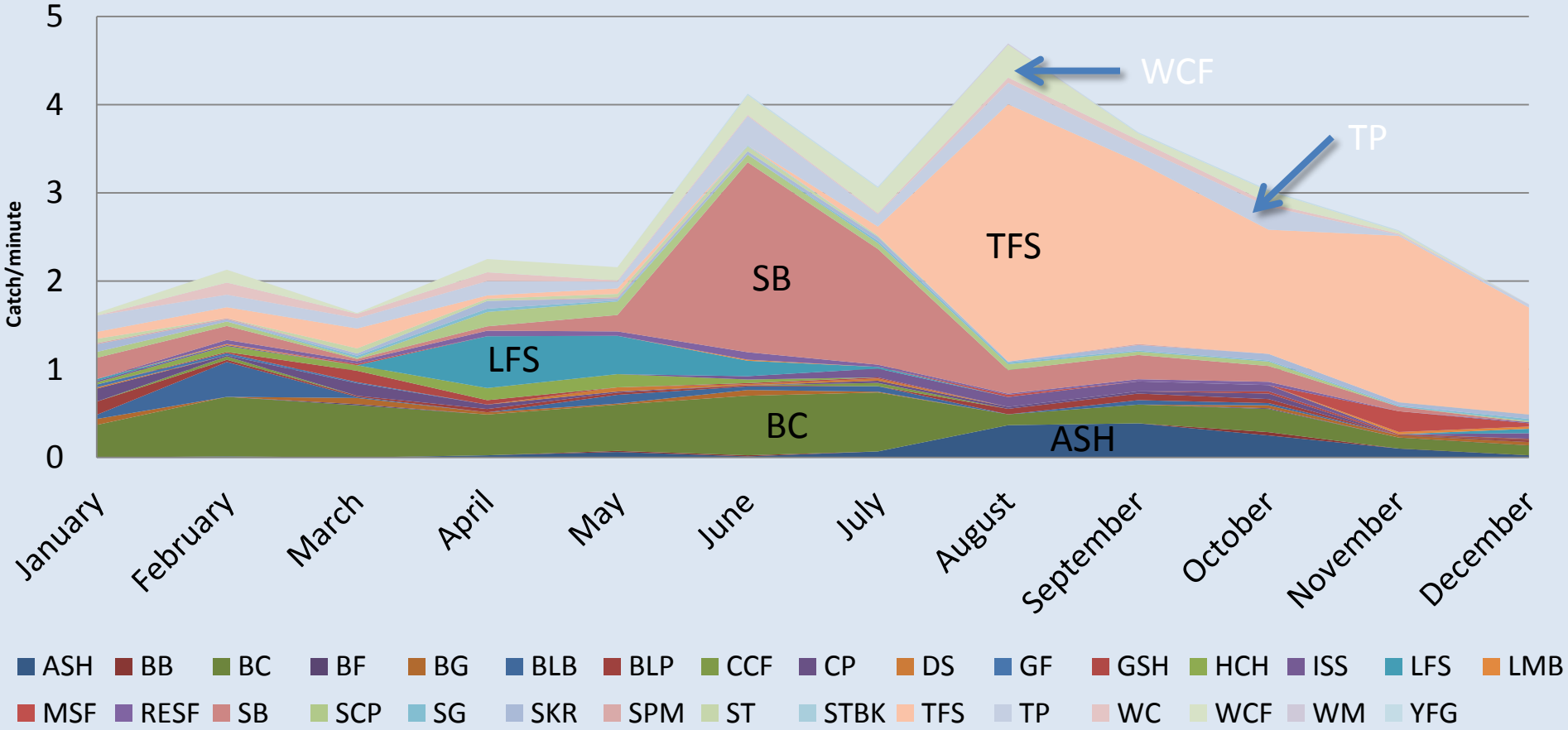
Fishes, Cache Slough Complex, Trawling



Native vs Non-native Fish: Electrofishing Cache Slough Regions



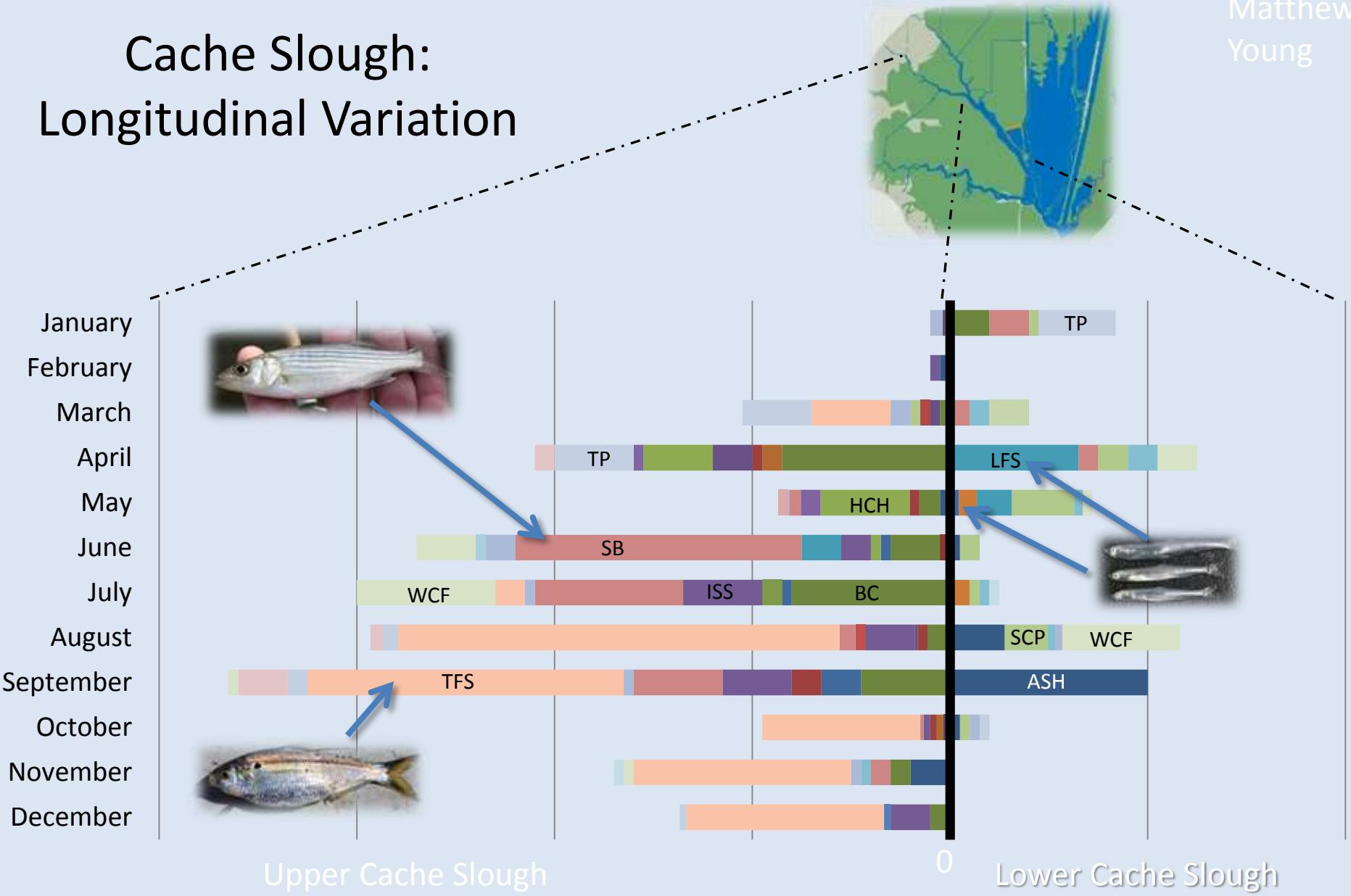
Seasonal shifts in species



Matthew Young

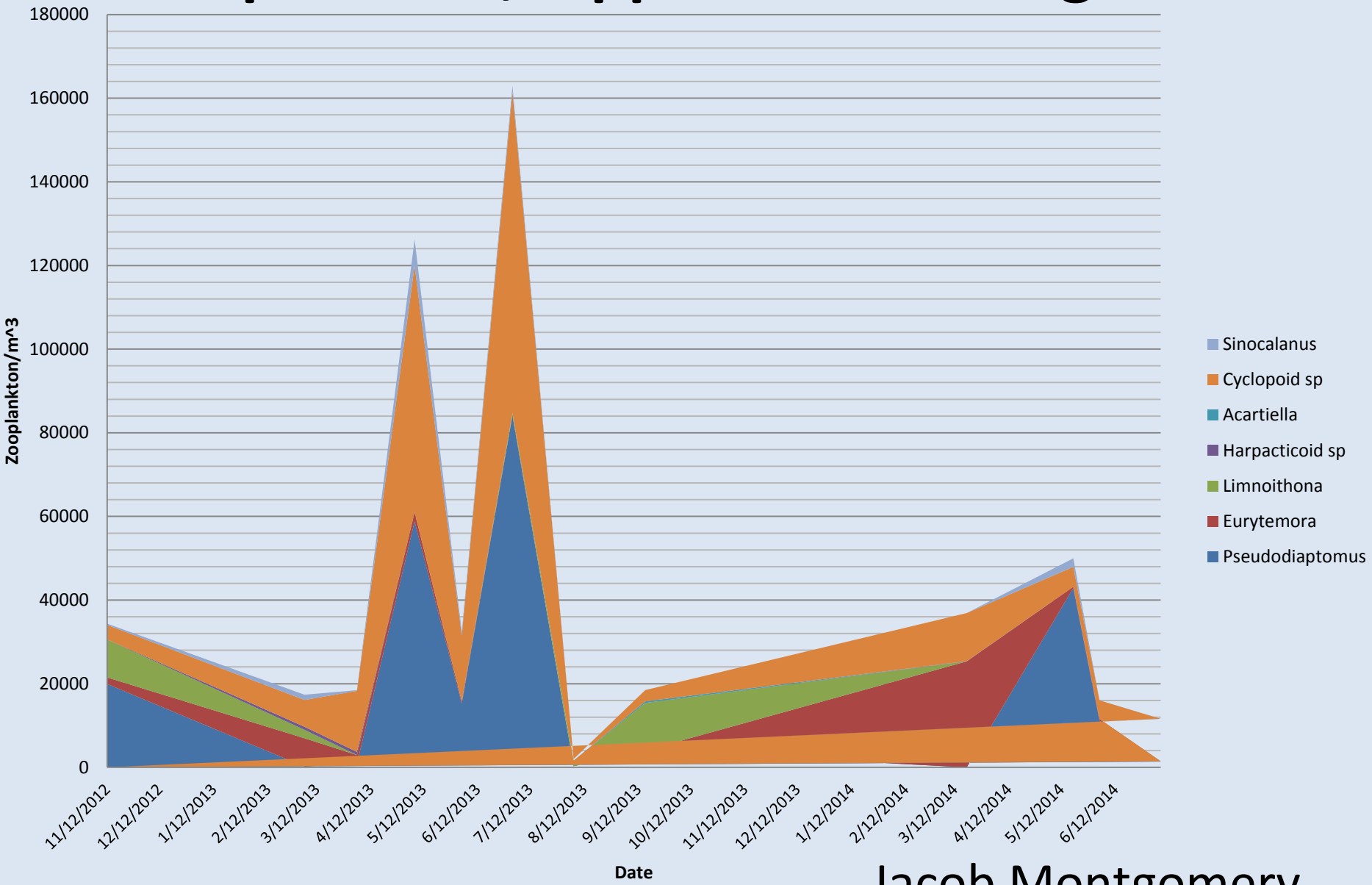
Cache Slough: Longitudinal Variation

Matthew Young



ASH BB BC BF BG BLB BLP CCF CP DS GSH HCH ISS LFS MQF
MSF RESF SB SCP SG SKR SPM ST STBK TFS TP WC WCF YFG

Zooplankton, upper Cache Slough

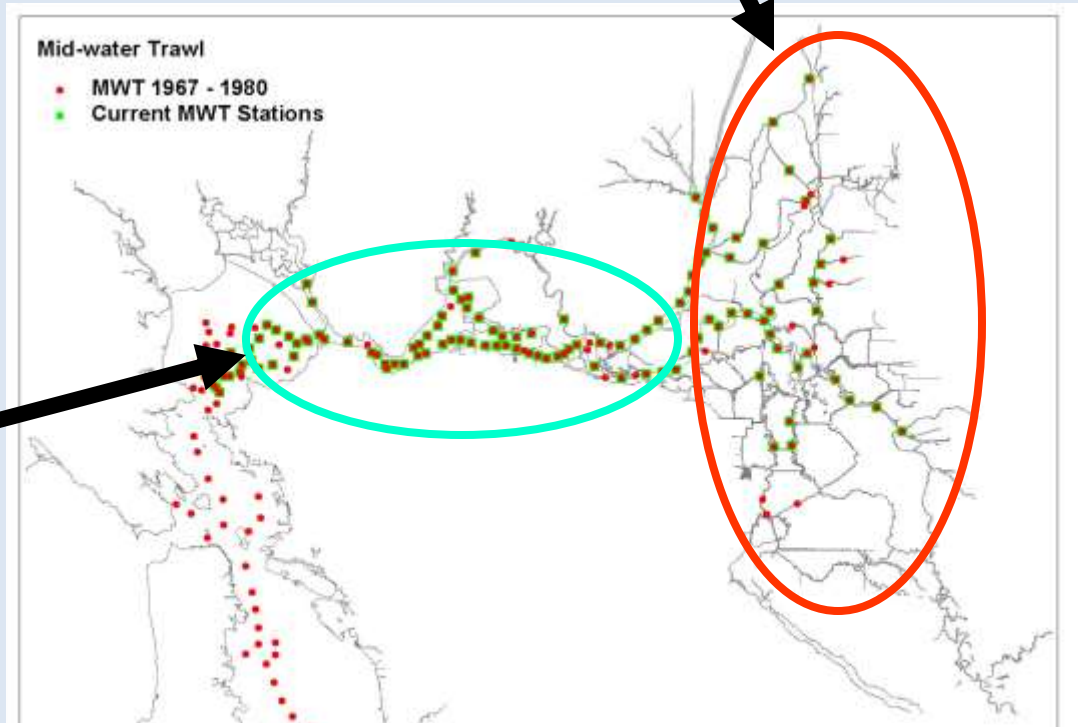


Jacob Montgomery

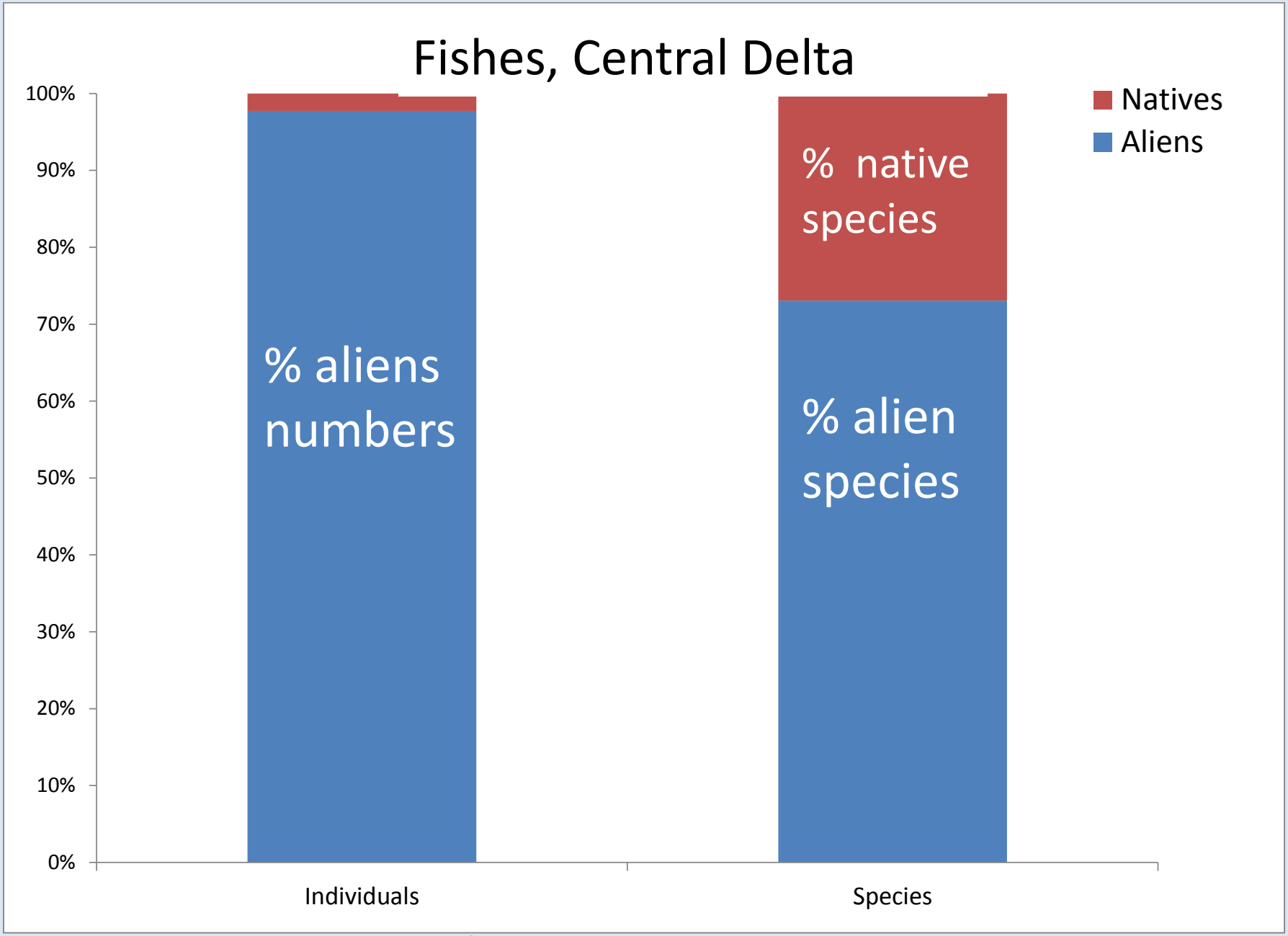
CENTRAL DELTA

Alien "ecosystem engineers" dominate

Overbite clam



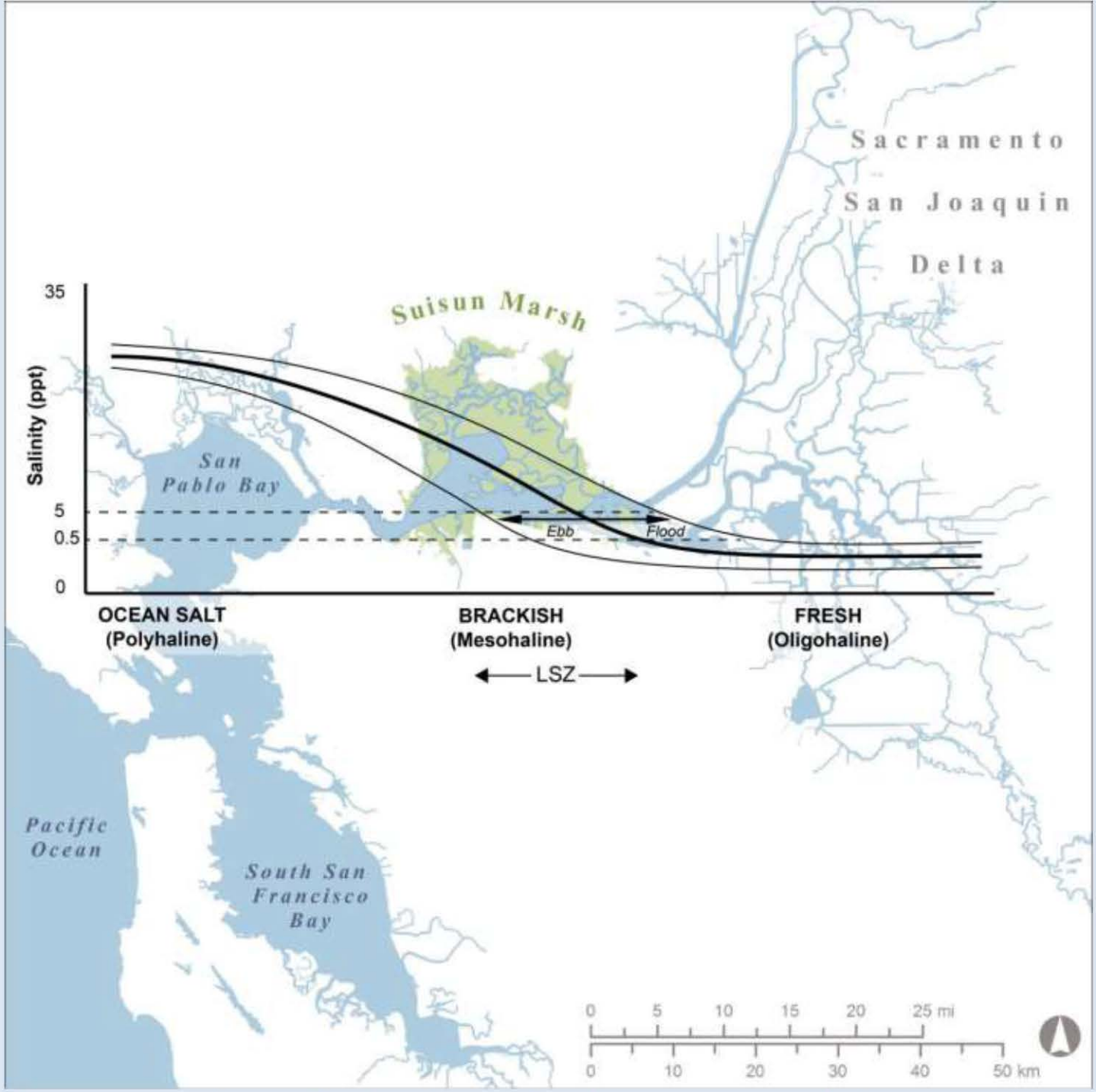
"MOST INVADED ESTUARY IN THE WORLD."

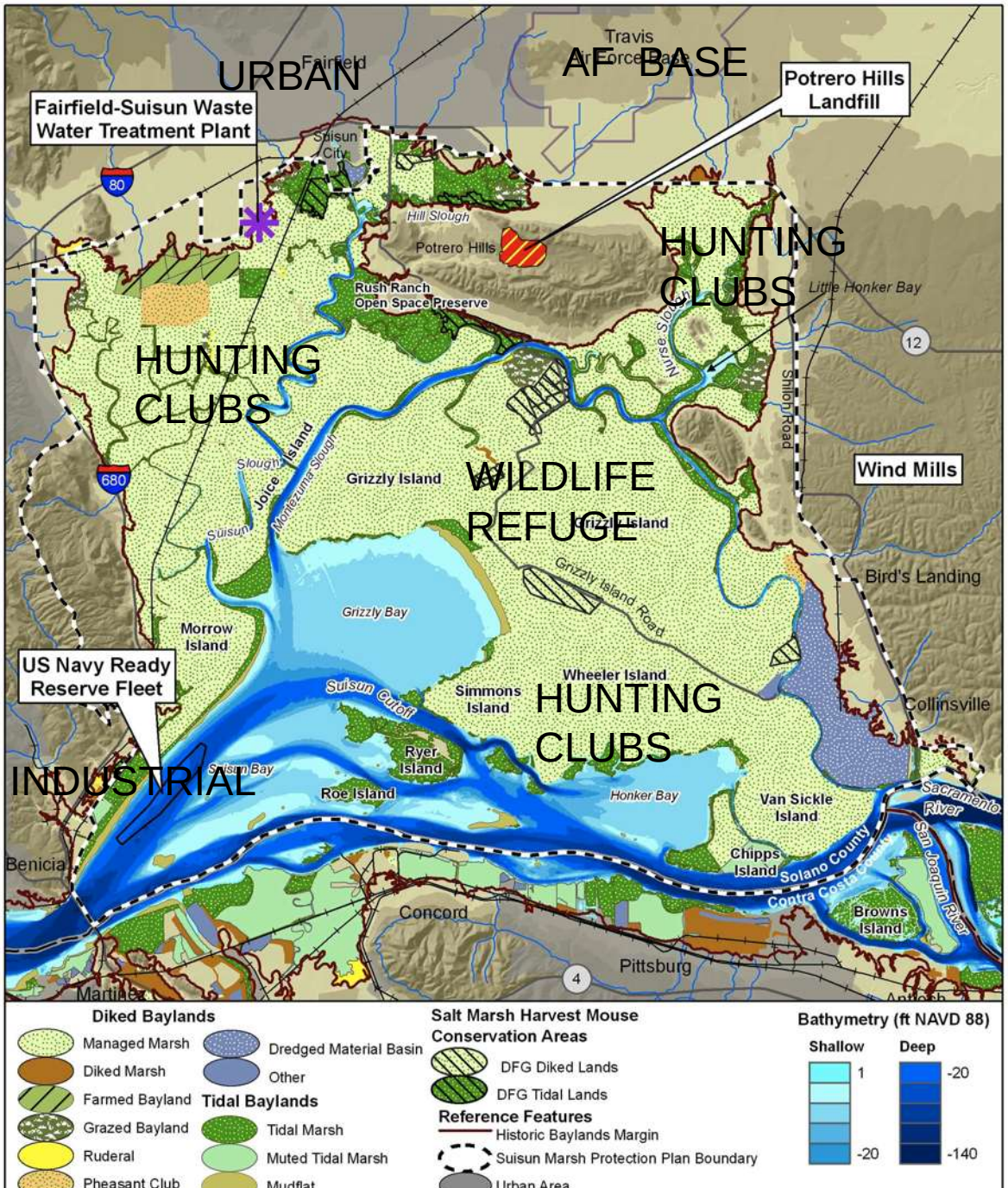


Fish, Central Delta, from Grimaldo et al. 2012

Seines in SAV

SUISUN MARSH Jan. 31, 2011

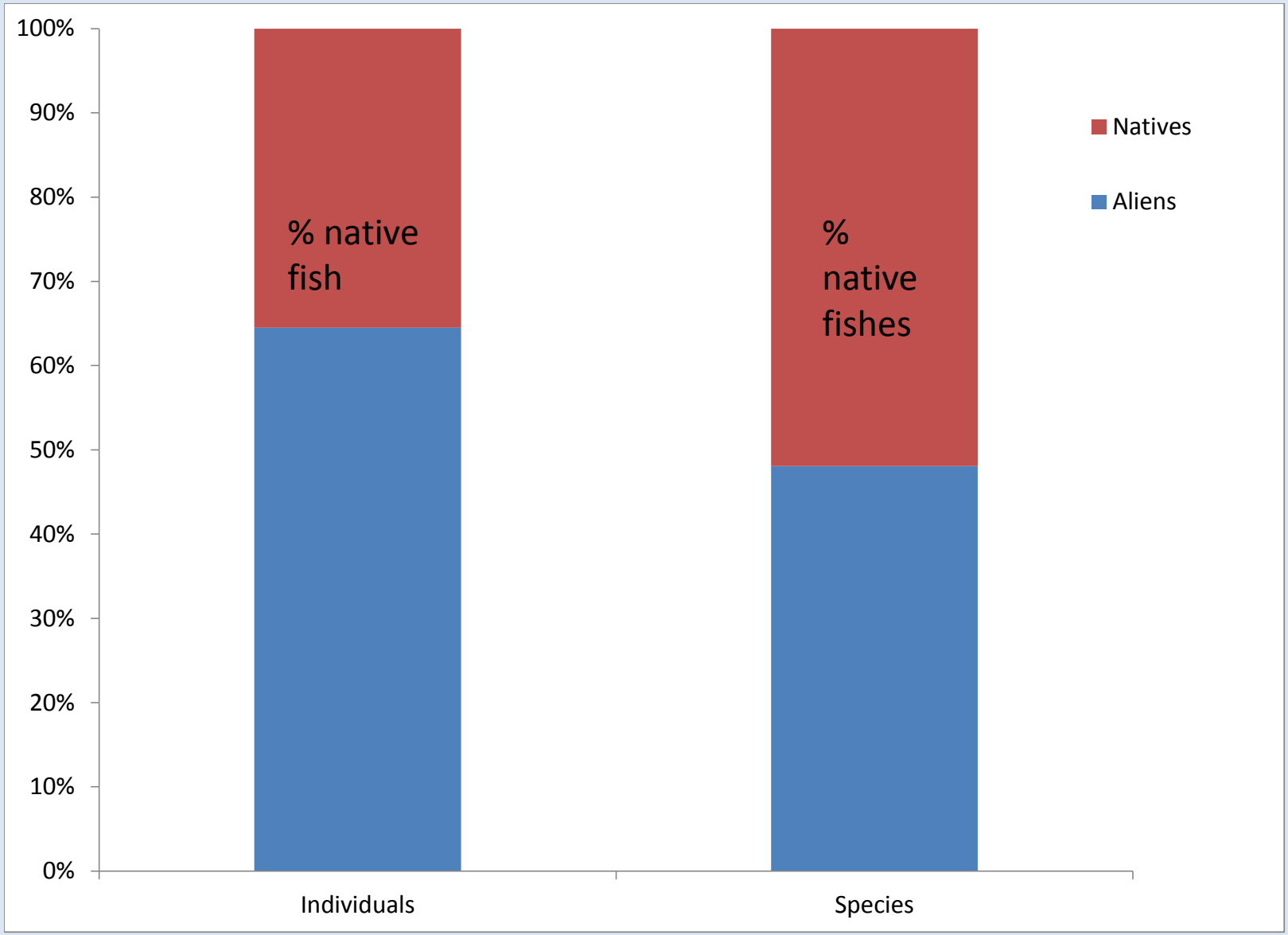

Sacramento
San Joaquin
Delta
Suisun Marsh
35
Salinity (ppt)
San
Pablo Bay
5
0.5
0
Ebb
Flood
OCEAN SALT
(Polyhaline)
BRACKISH
(Mesohaline)
FRESH
(Oligohaline)
LSZ
Pacific
Ocean
South San
Francisco
Bay
0 5 10 15 20 25 mi
0 10 20 30 40 50 km

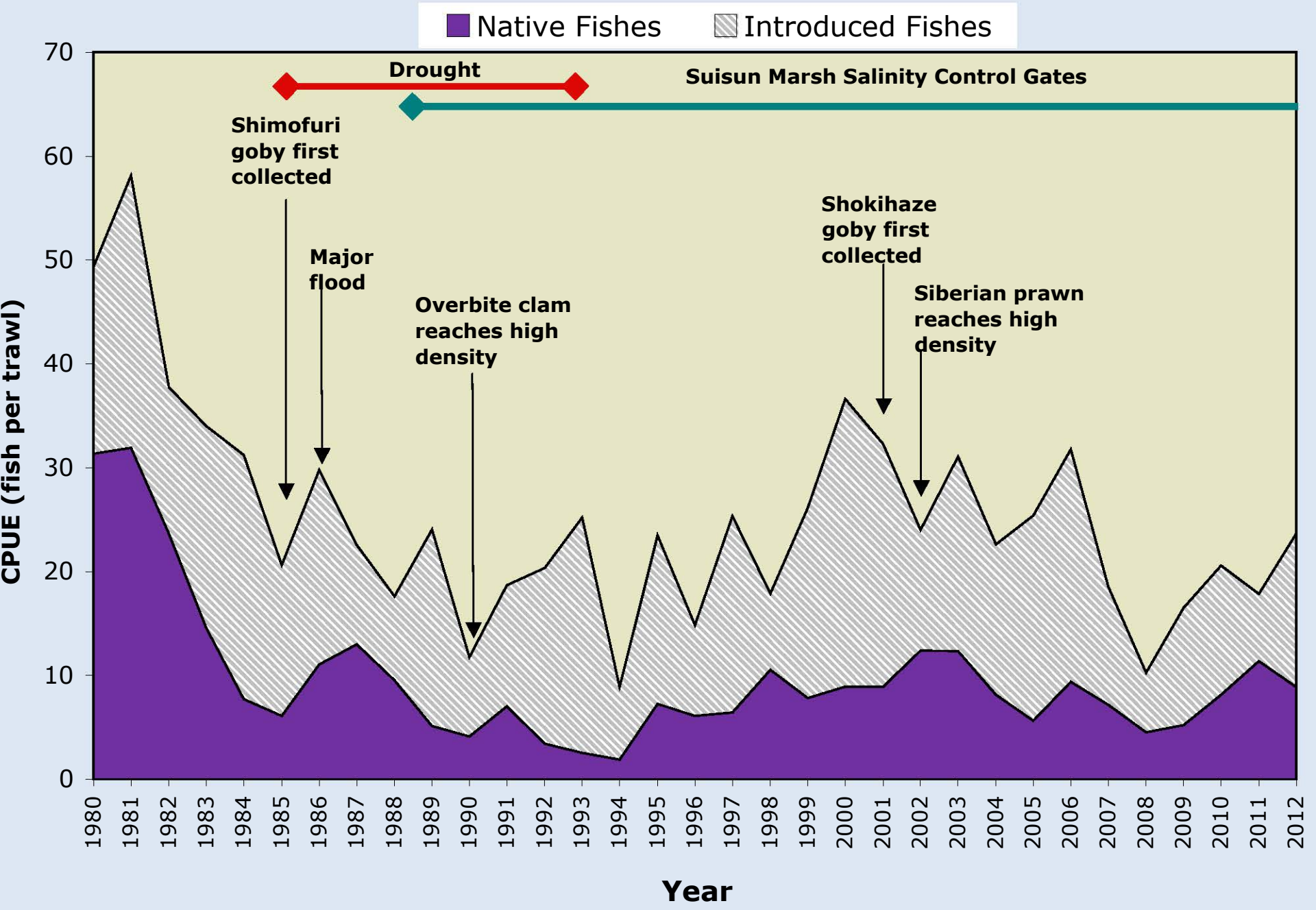


470 km²

370 km of dikes

Native vs alien fish: Suisun Marsh

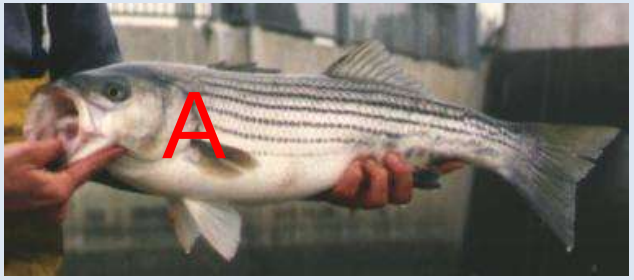



Native Fishes
Introduced Fishes
Drought
Suisun Marsh Salinity Control Gates
Shimofuri goby first collected
Major flood
Overbite clam reaches high density
Shokihaze goby first collected
Siberian prawn reaches high density
CPUE (fish per trawl)
0
10
20
30
40
50
60
70
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
Year

SURFACE

A is for Alien

MIDWATER



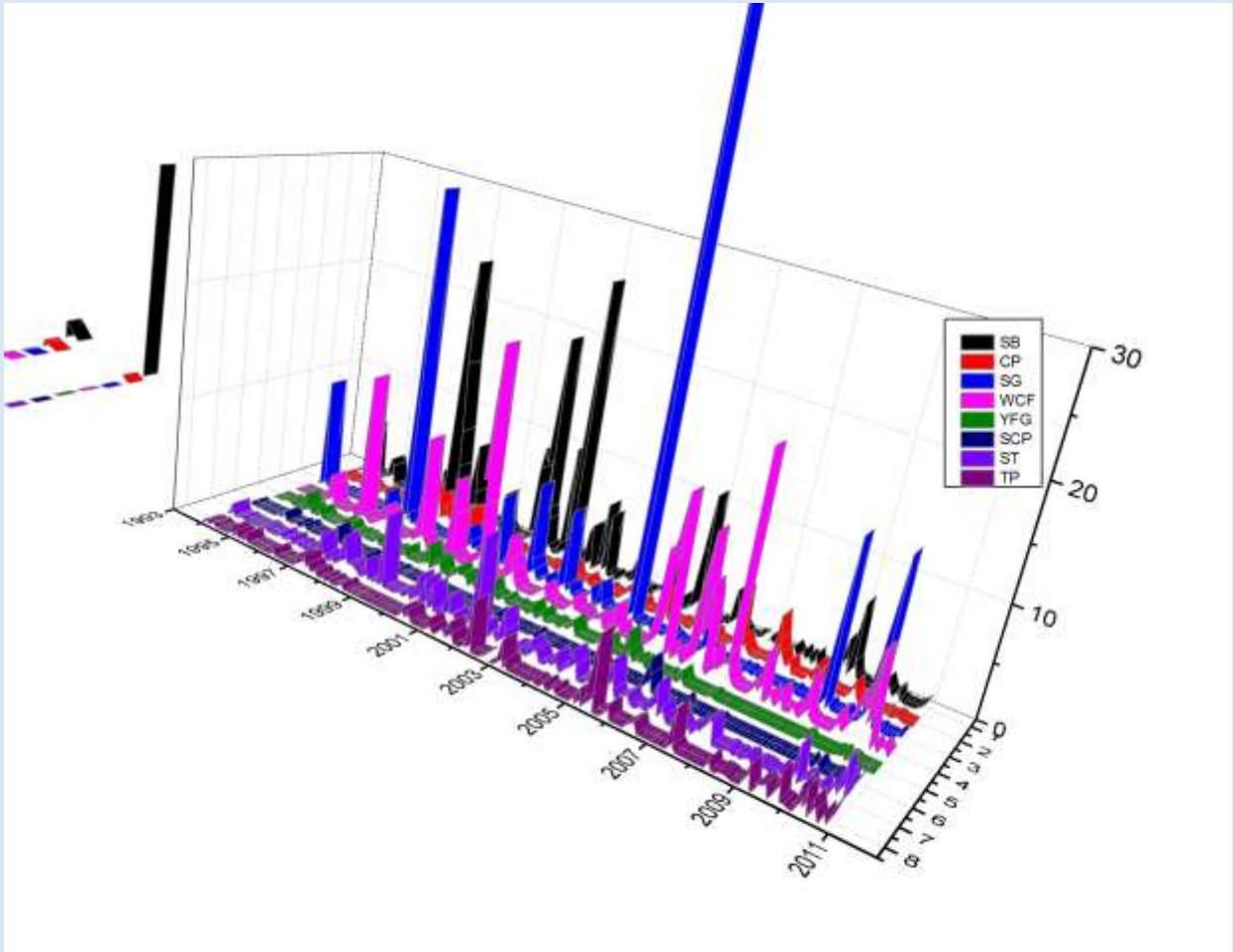
EDGE

BOTTOM

SOME MICROHABITAT SEGREGATION

CORE GROUP VARIES IN RELATIVE ABUNDANCE BY TIME AND PLACE

Denverton Slough dominant species 1993-2011



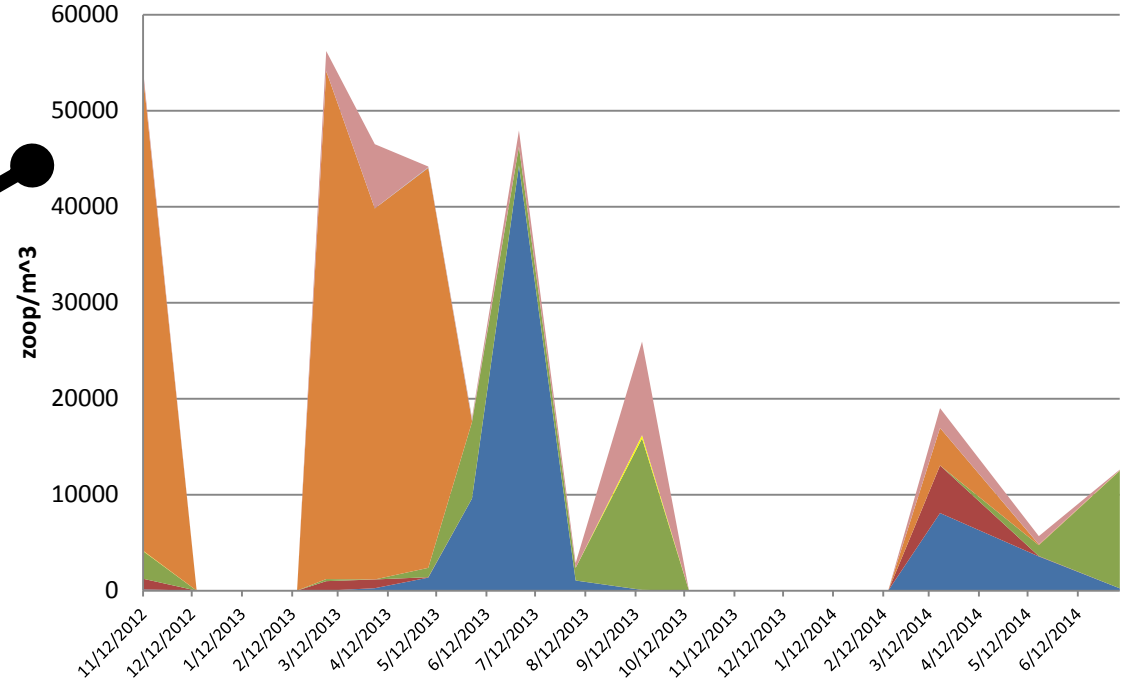
TOP TEN SPECIES 1980-89 vs 2002-12

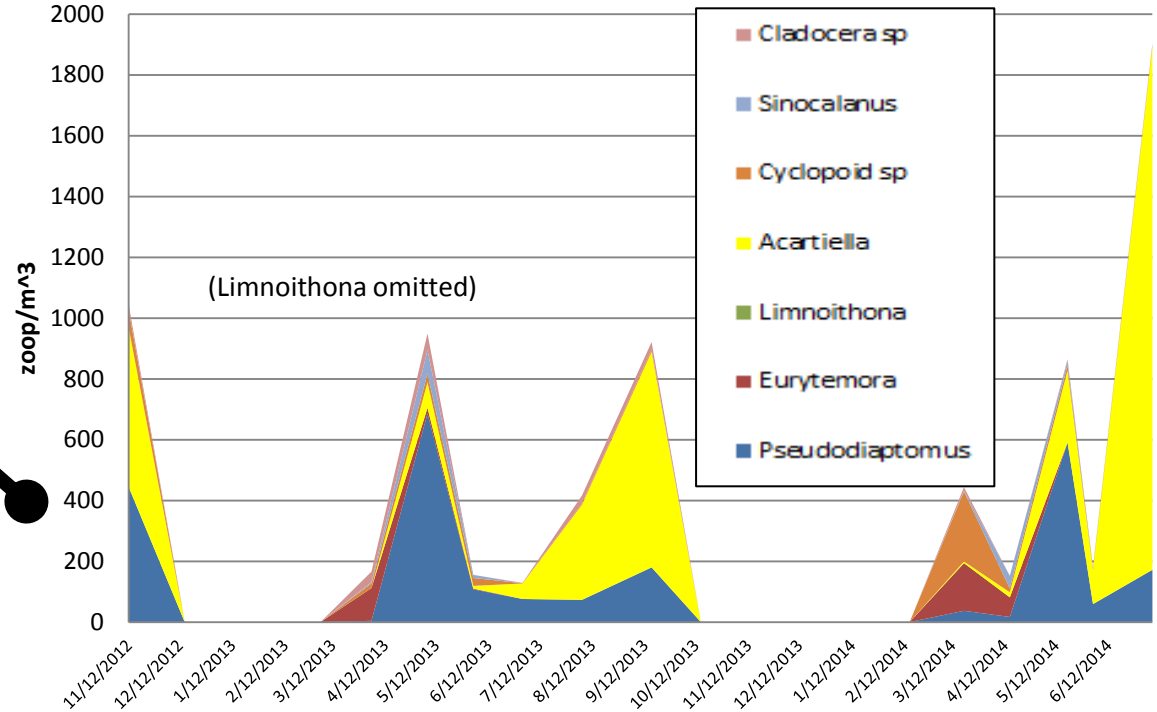
Otter Trawl		
Rank	First 10 Years	Last 10 Years
1	STRIPED BASS	STRIPED BASS
2	THREESPINE STICKLEBACK	SPLITTAIL
3	TULE PERCH	TULE PERCH
4	SPLITTAIL	WHITE CATFISH
5	LONGFIN SMELT	YELLOWFIN GOBY
6	PRICKLY SCULPIN	SHIMOFURI GOBY
7	YELLOWFIN GOBY	PRICKLY SCULPIN
8	COMMON CARP	THREESPINE STICKLEBACK
9	SACRAMENTO SUCKER	COMMON CARP
10	SHIMOFURI GOBY	BLACK CRAPPIE

Not in top ten in other time period

Major macro-invaders 1980-2012

Zooplankton Abundance





Jacob Montgomery

Conclusions -1

- Suisun Marsh and Delta are novel ecosystems
- Alien fishes and invertebrates dominate in most areas

Conclusions -2

- Tidal marsh structure and function variable and complex
- Pelagic tidal habitat also highly altered
- Tidal marsh habitat benefits native fishes most in Suisun Marsh

Implications

- Novel biotic assemblages will persist in all habitats
- Management for desirable species

Implications

- Passive restoration of tidal marsh unlikely to benefit most native fishes, but especially pelagic species.

Implications

Active management and monitoring of all restoration projects required for success

- Breach and leave rarely works

Luco Pond

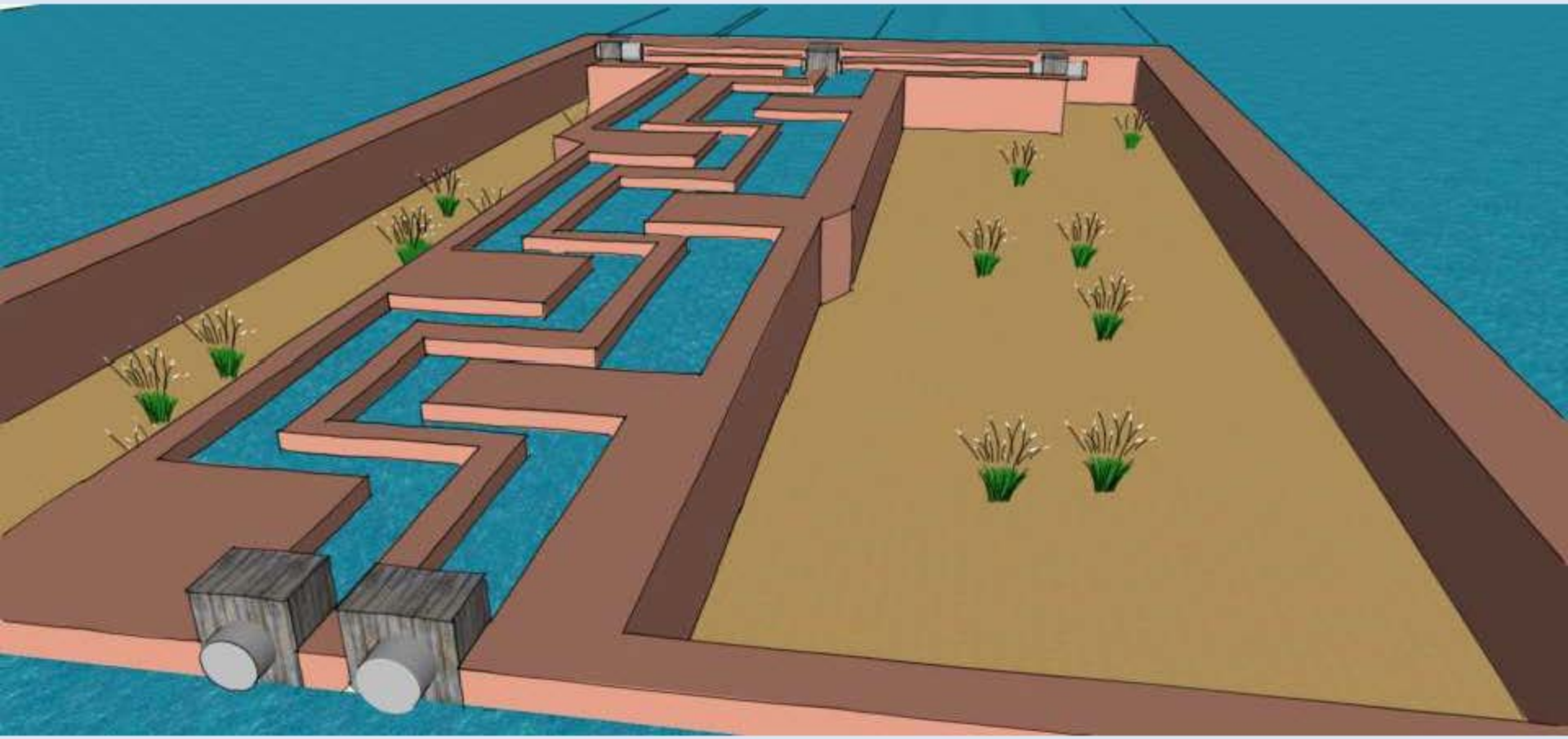
Managed wetlands:

Mixed residence time
Tidal Trapping
Ponding

Luco Pond

John Durand

Novel Ecosystems: Novel Management Approaches



John Durand

Thanks to the Arc crew and collaborators:

PIs:
Randy Dahlgren
William Fleenor
James Hobbs
John Durand

Research Specialists:
Kathleen Berridge
Amy Chandos
Chris Jasper
Filipe La Luz
Jacob Montgomery
Kyle Phillips
Melissa Riley
Teejay O'Rear
Martin Perales
Xien Wang
Brian Williamson

Graduate Students:
Denise DeCarion
Matt Young

CWS
Jay Lund
Cathryn Lawrence
Barbara Bellieu

Thanks to research sponsors …

DELTA SCIENCE PROGRAM

DELTA STEWARDSHIP COUNCIL

UC DAVIS
CENTER FOR WATERSHED SCIENCES

ECOSYSTEM RESTORATION PROGRAM
California Department of Fish & Wildlife
National Oceanic & Atmospheric Administration

DEPARTMENT OF WATER RESOURCES
STATE OF CALIFORNIA

CALIFORNIA DEPARTMENT OF FISH & WILDLIFE

SFCWA State and Federal Contractors Water Agency

S. D. BECHTEL, JR. FOUNDATION
STEPHEN BECHTEL FUND

…and supporters

Dixon Boat Club

U.S. FISH & WILDLIFE SERVICE
DEPARTMENT OF THE INTERIOR

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

CALIFORNIA WATERFOWL

Suisun Resource Conservation District

THANK YOU