San Francisco Bay Delta Ecosystem Changes & the Low Salinity zone

SWRCB San Francisco Estuary low-salinity zone workshop

California Department of Fish & Game

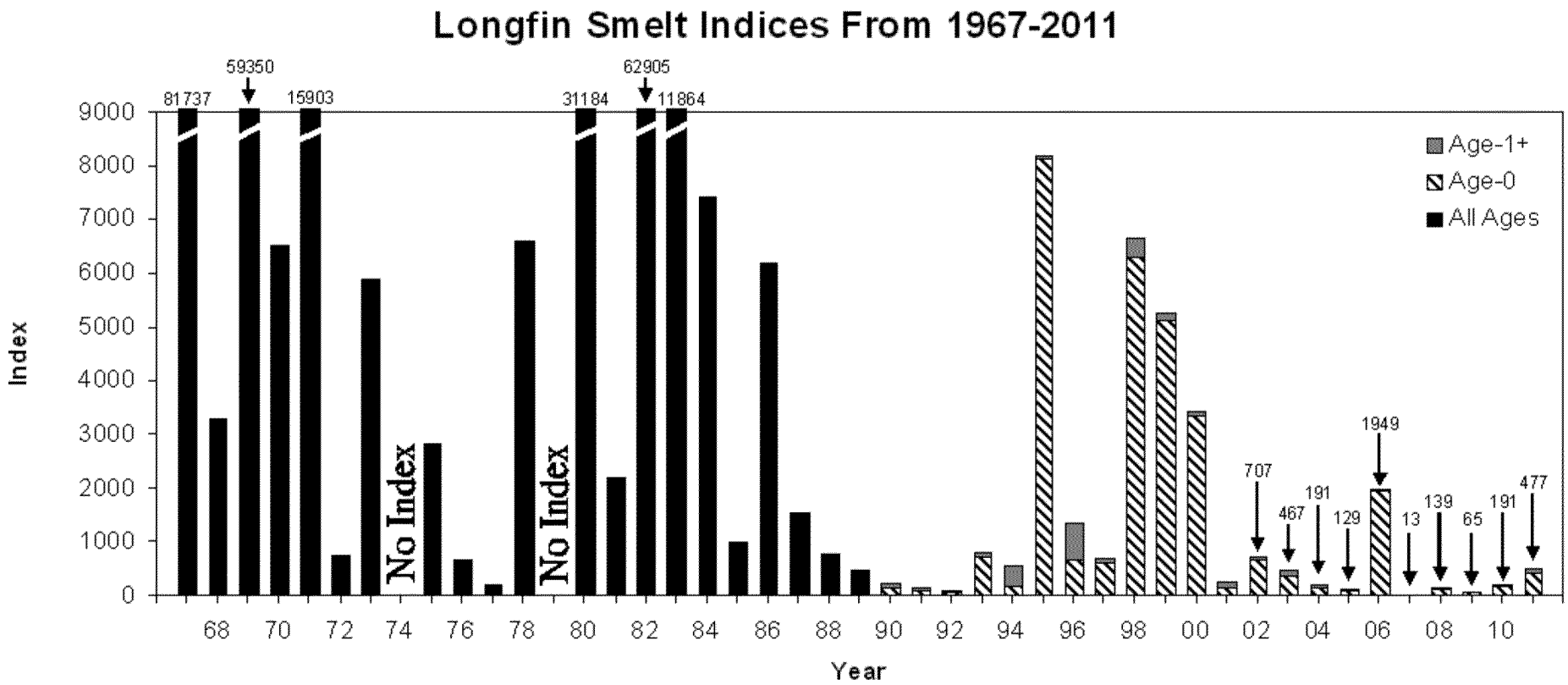
September 5, 2012

SMELT SPECIES ARE AT RISK:

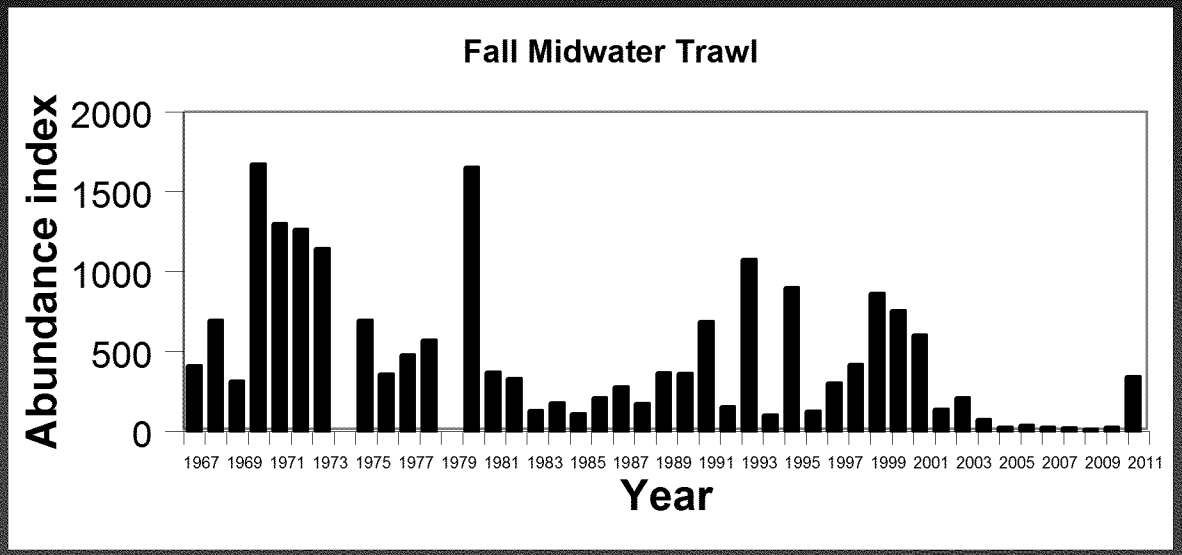
LISTING ACTIONS SINCE 2006

- January 2010: Delta smelt moved from threatened to endangered status under CESA
- April 2010: USFWS finds that delta smelt warrant endangered status under federal ESA
- April 2010: Longfin smelt listed as threatened under CESA
- April 2012: USFWS finds that the listing of the longfin smelt Bay-Delta DPS is warranted

SMELT SPECIES ARE AT RISK:
Longfin Smelt Status



SMELT SPECIES ARE AT RISK:
Delta Smelt Status



- Recent fall indices averaging ~10% of previous 30 years
- Increased frequency of record lows
- Substantial, negative changes in summer-fall juv. Habitat
- food supply degradation….
- Substantial proportional loss to entrainment
- Recent OMR measures appear effective
- Encouraging “bump” in fall 2011 index.

LFS W-S FLOW NEEDS

TEXTUAL TECHNICAL POINTS

D. SMELT FALL X2 NEEDS

COMPOSITE OF GRAPHS, PLUS TECHNICAL POINTS

CURRENT BD PLAN DIFFICIENCIES

TEXTUAL POINTS

KEY SOURCES OF ADDITIONAL INFORMATION

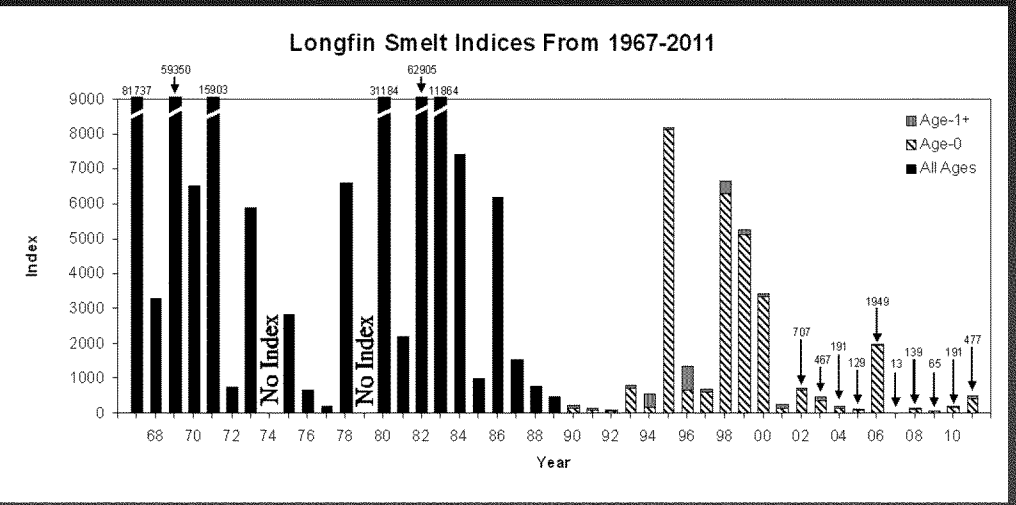
Available

- 2010-2012 Listing Documents

Pending

- FLaSH Study Results
- BDCP Effects Analysis, etc.

ENCOURAGING 2011SMELT FLOW RESPONSE

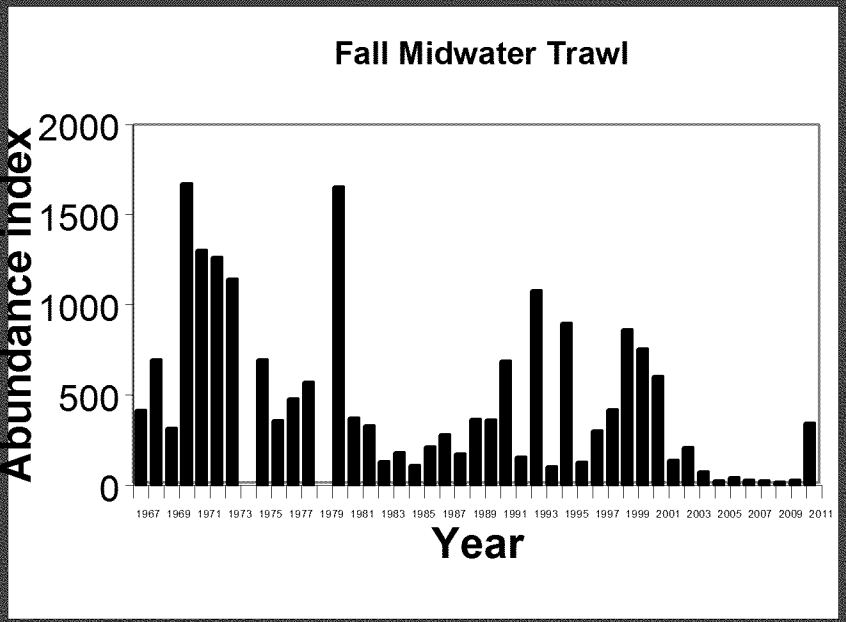


LFS Recruitment Ratios
(FMWT/FMWT-2yrs)

2006	2010	2011
10.2	1.3	7.3

D. Smelt Recruitment Ratios
(FMWT/20mm)

2006	2010	2011
4.1	7.6	42.9



GOOD NEWS, 2011 RESPONSE

D. SMELT TREND GRAPH,PLUS TEXTUAL POINTS,including OMR-entrainment improvements

ADAPTIVE MANAGEMENT

2-3 figures to come from John S., including “CIRCLE FIGURE”

Loose Ends

- LFS trend graph(s) for slide 2
- Need to list and understand references for points in slide 2.
- Ask MN/EF about using MN's slide in my slide 3, and making his point
- Request/Insert (into slide 2) D-1641 unimpaired flow %s.
- Decide exactly what to say about degraded DS food resources.

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U.S. Fish & Wildlife Service

September 5, 2012

Key points

1. Please see April 2012 key points
2. We suggest the Board model a range of flow objectives that could be incorporated into the WQCP
3. OMR flows contribute to the entrainment risk of adult delta smelt
4. OMR flows drive entrainment of larval delta smelt
5. Multiple factors have contributed to the long-term degradation of the LSZ. However, Delta outflow is still an extremely important aspect of habitat suitability for delta smelt

Adult entrainment

Adult delta smelt are salvaged during spawning migrations

- Salvage ≠ entrainment

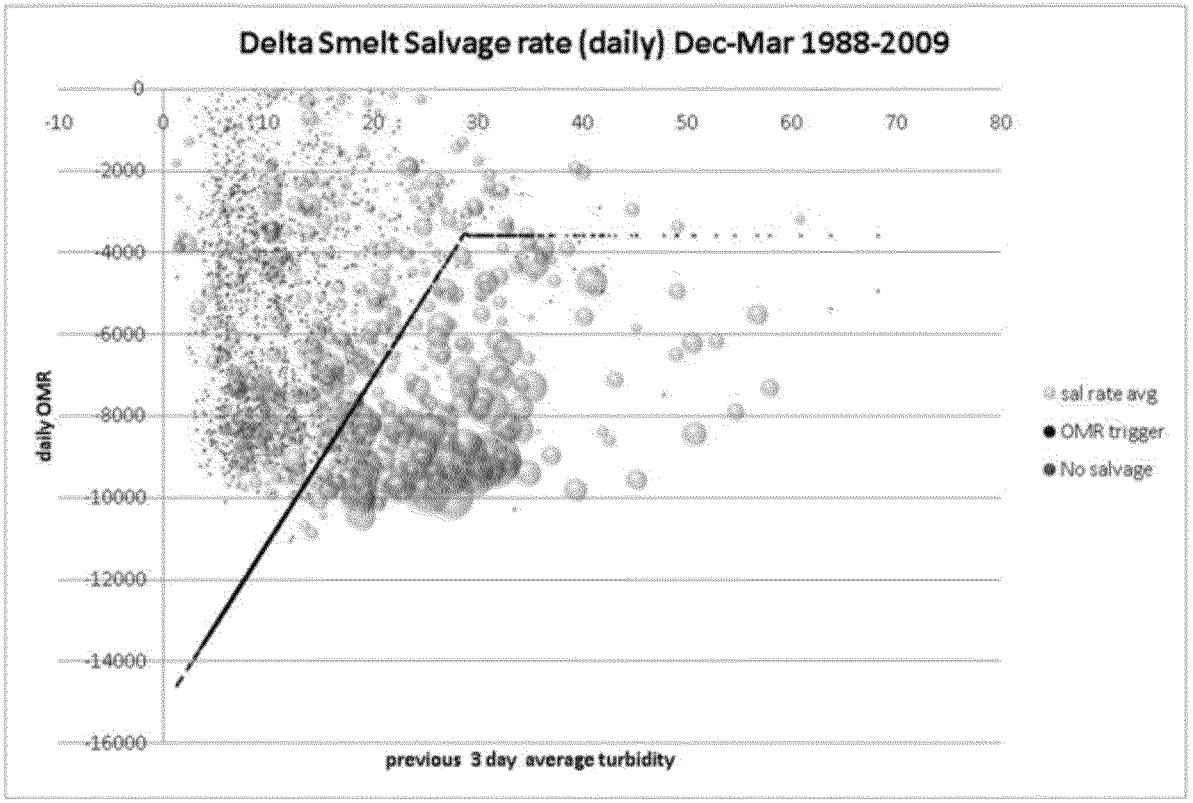
Entrainment is 'caused' by a combination of factors

- Smelt use Delta hydrodynamics to help them get to staging habitats
- Project ops influence Delta hydrodynamics and thus entrainment risk

Some spawning occurs in the SJ River

- The entrained fish have not spawned

High adult delta smelt salvage tends to happen in association with negative OMR flows and high turbidity



Source: Declaration of Dr. Richard Deriso

The OMR flow-turbidity combinations that appear to prevent high salvage depend on the time scale the data are averaged over

Time step (days)	Starting OMR (cfs)		Turbidity threshold (NTU)		Alternative OMR
1	-3000	Until	13	Then	-1900
7	-5200	Until	23	Then	-1900
14	-3300	Until	25	Then	-2500
24	-4600	Until	29	Then	-3600
28-31	-4200	Until	No threshold	Then	-4200

Source: USFWS unpublished data analysis

Modeling methods basically agree about drivers and magnitude of larval delta smelt entrainment

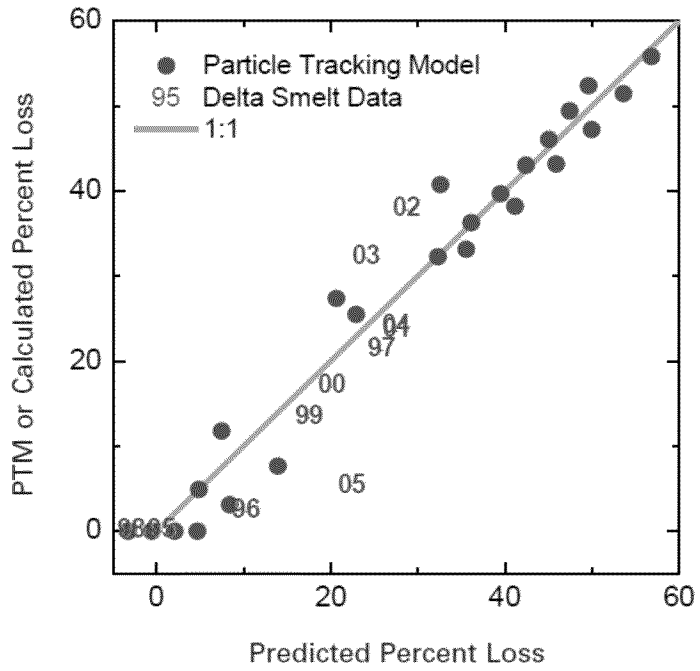
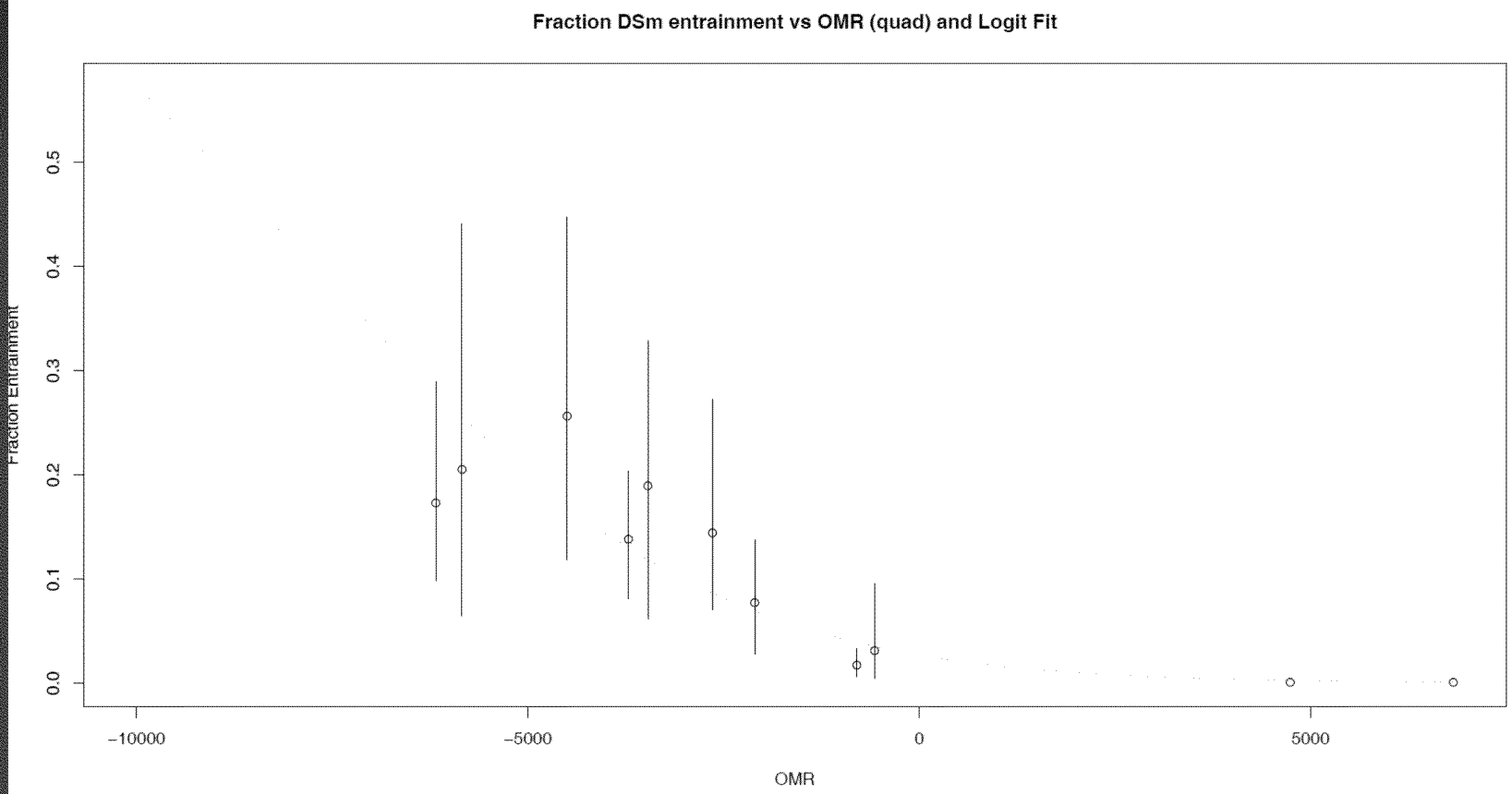


Figure 16. Larval/juvenile delta smelt. Predicted percent loss to the population by regression using log of Delta inflow and log of export flow as predictors (with interaction), and particle-tracking model results as the dependent variable (circles), with the line indicating a 1:1 relationship. The regression is:

Source: Kimmerer (2008) San Francisco Estuary and Watershed Science

...and OMR is (or indexes) the driver very well



Source: USFWS unpublished data analysis

When carrying capacity is not exceeded, entrainment can contribute to decline

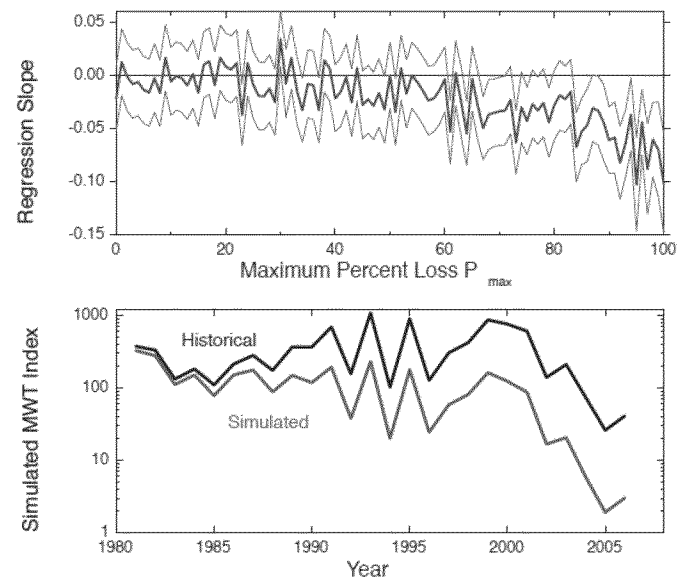
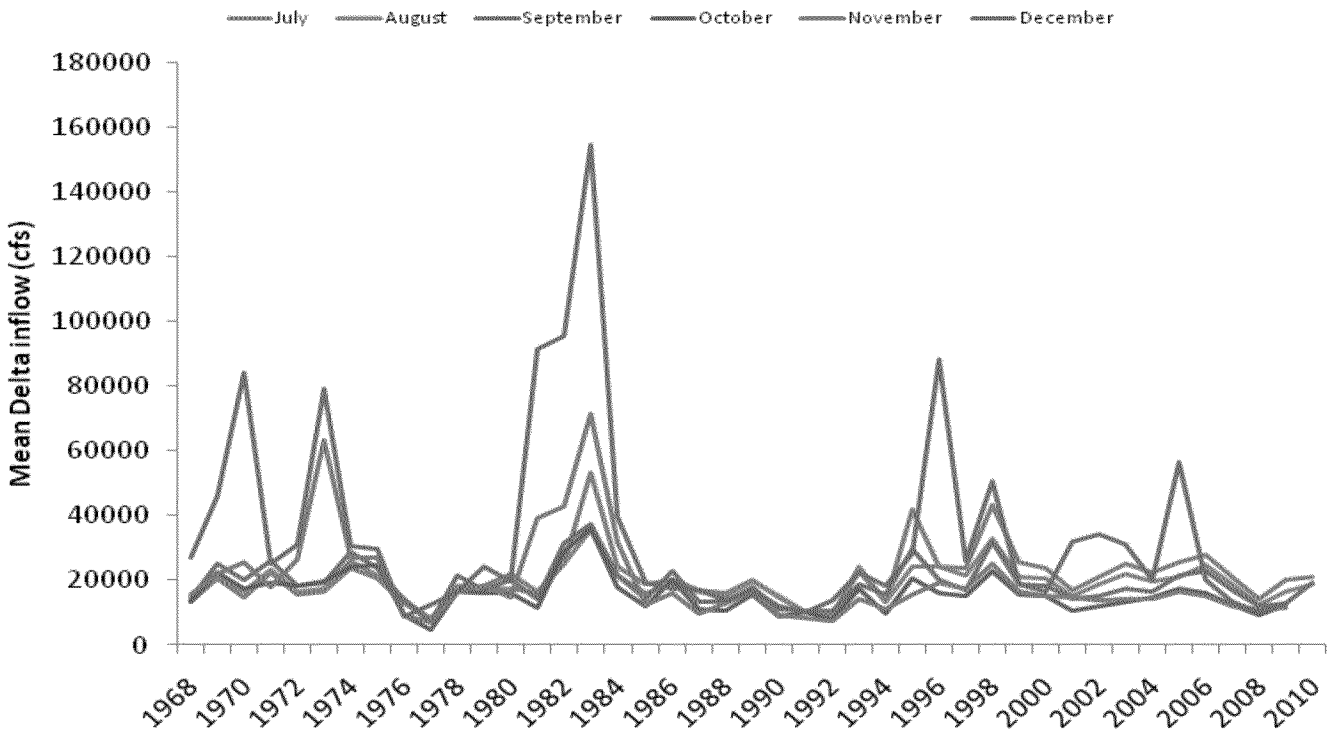


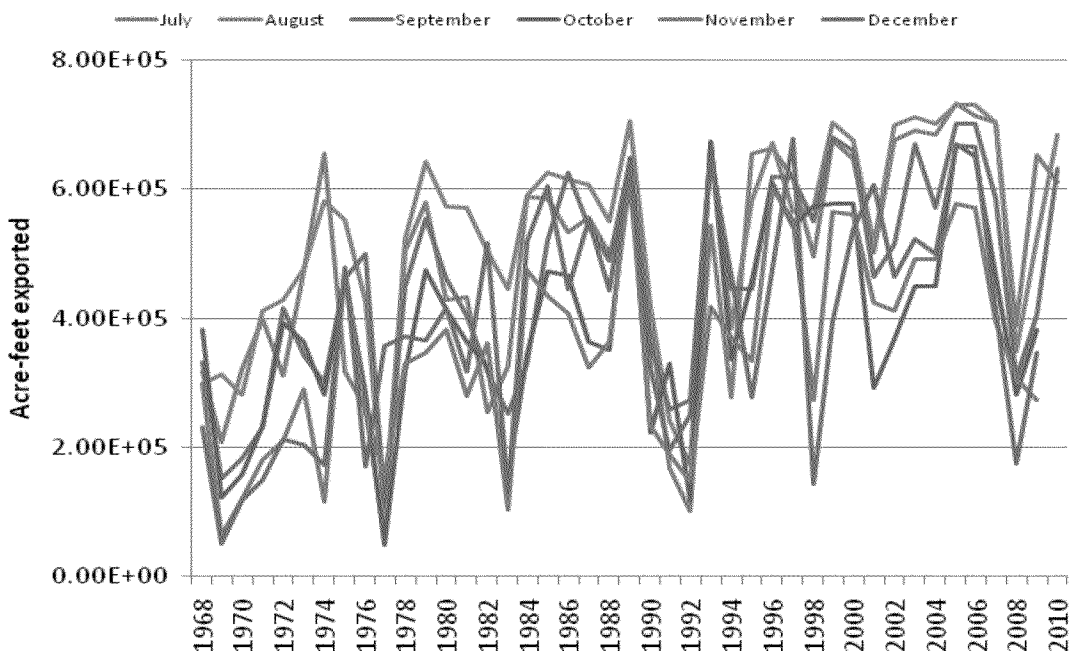
Figure 3 Results of simulation of ability to detect export loss through regression analysis. Upper panel: individual simulation results giving the slope (thick blue line) and 95% confidence limits (thin red lines) for regressions of the stock-recruit index on southward OMR flow. Lower panel: trajectory of the fall midwater trawl index (upper line) and the same index with a 20% P_{max} value imposed for the entire time series (mean P_L ~10%). This is for illustration only (see text), and does not imply anything about the cause of the decline in delta smelt.

Source: Kimmerer (2011) San Francisco Estuary and Watershed Science

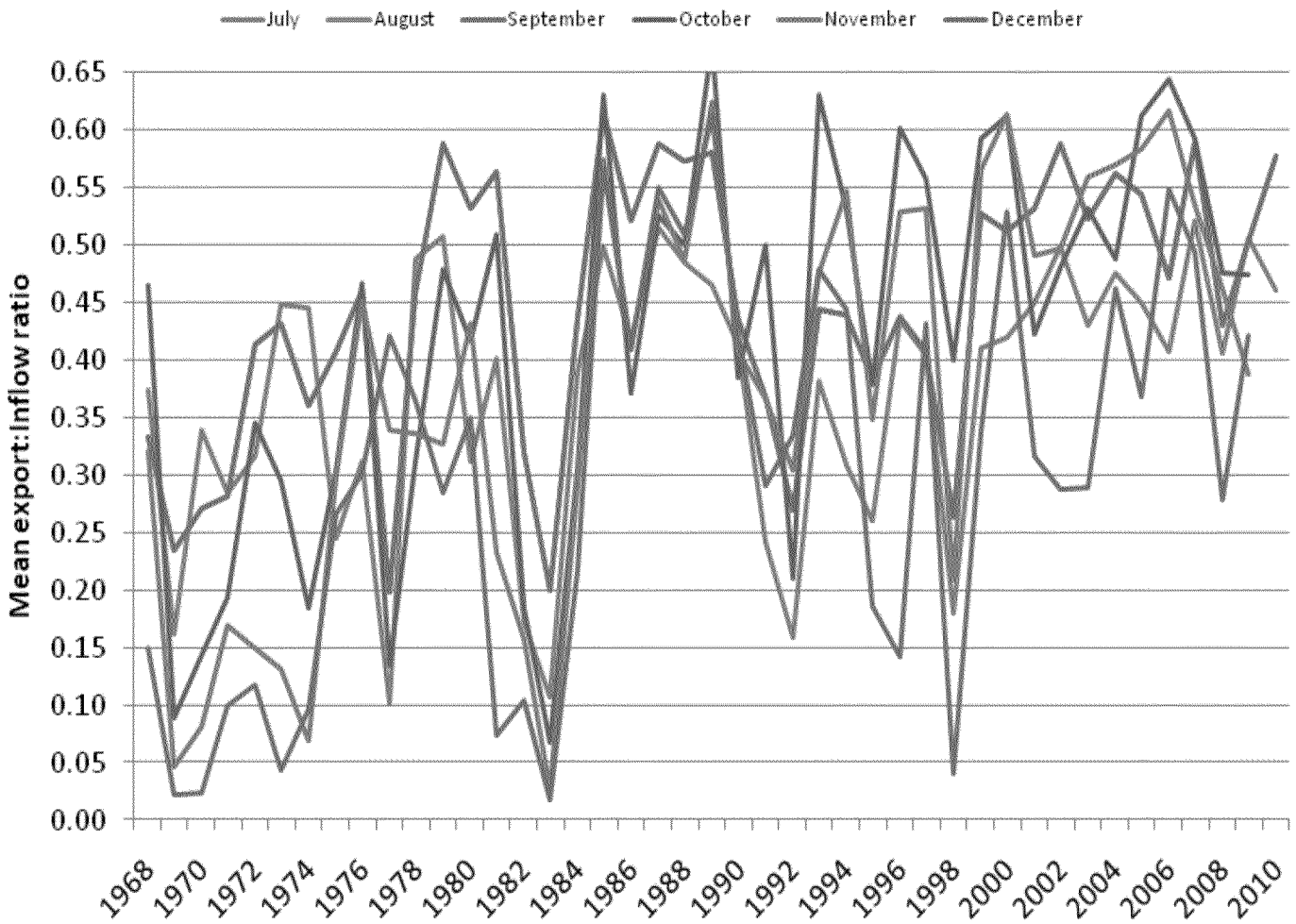
Time series of summer-fall Delta inflow



Time series of summer-fall exports



Time series of summer-fall E:I ratios



Feyrer et al. (2011)

- Fall habitat suitability has declined
- Fall habitat suitability is closely, but nonlinearly related to X2
- Fall habitat suitability correlated with abundance

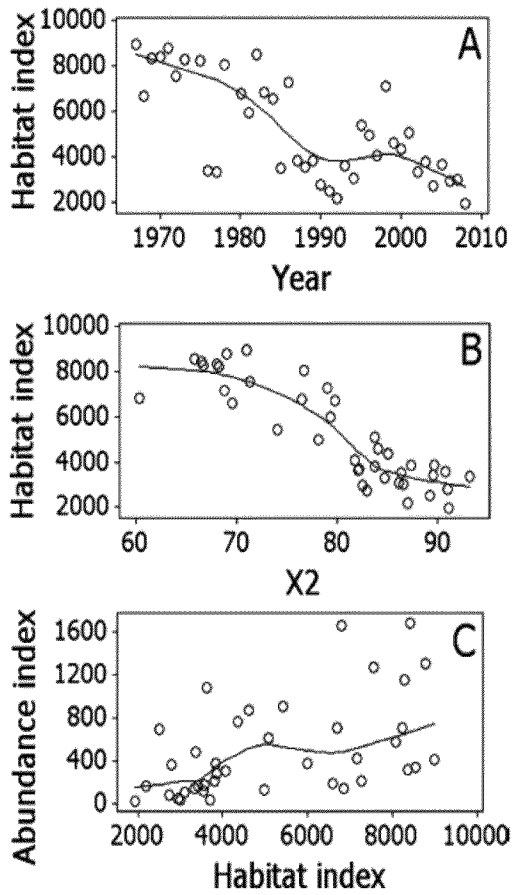


Fig. 2 Plots of the habitat index time series (**a**), relationship between *X2* (km) and the habitat index (**b**), and relationship between the habitat index and delta smelt abundance measured as the fall midwater trawl index. Curves are LOESS smooths

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U.S. Environmental Protection Agency

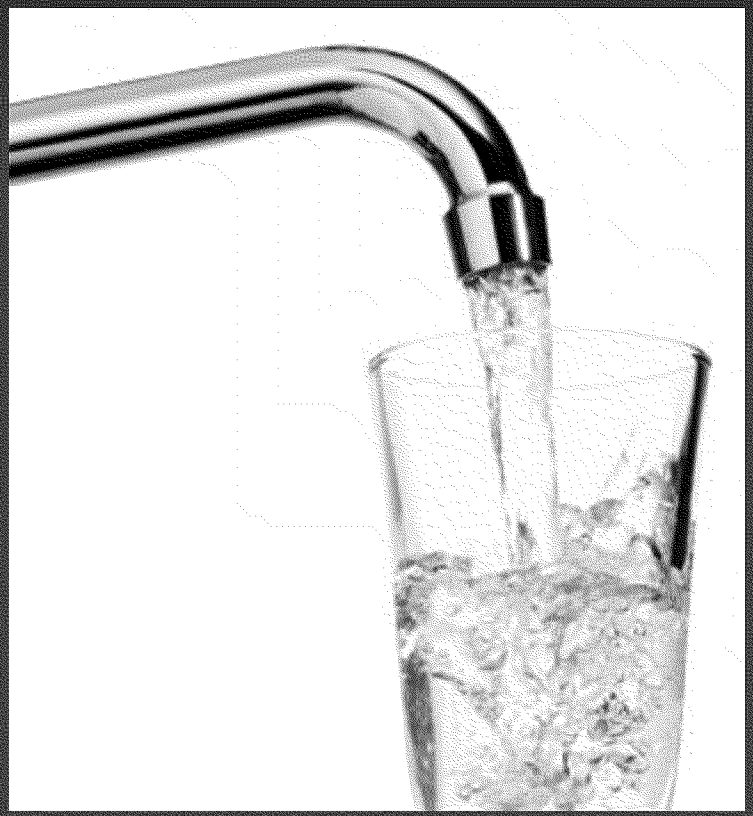
September 5, 2012

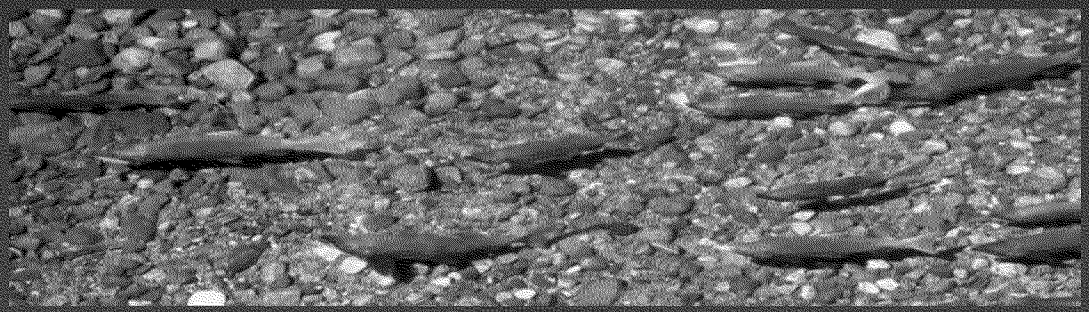
Outline

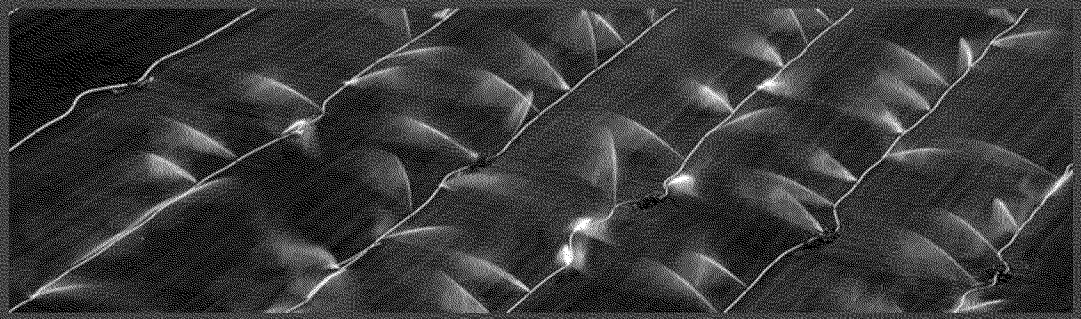
- Clean Water Act
- New information
- Bay-Delta Basin Plan

Clean Water Act

Water Quality Standards





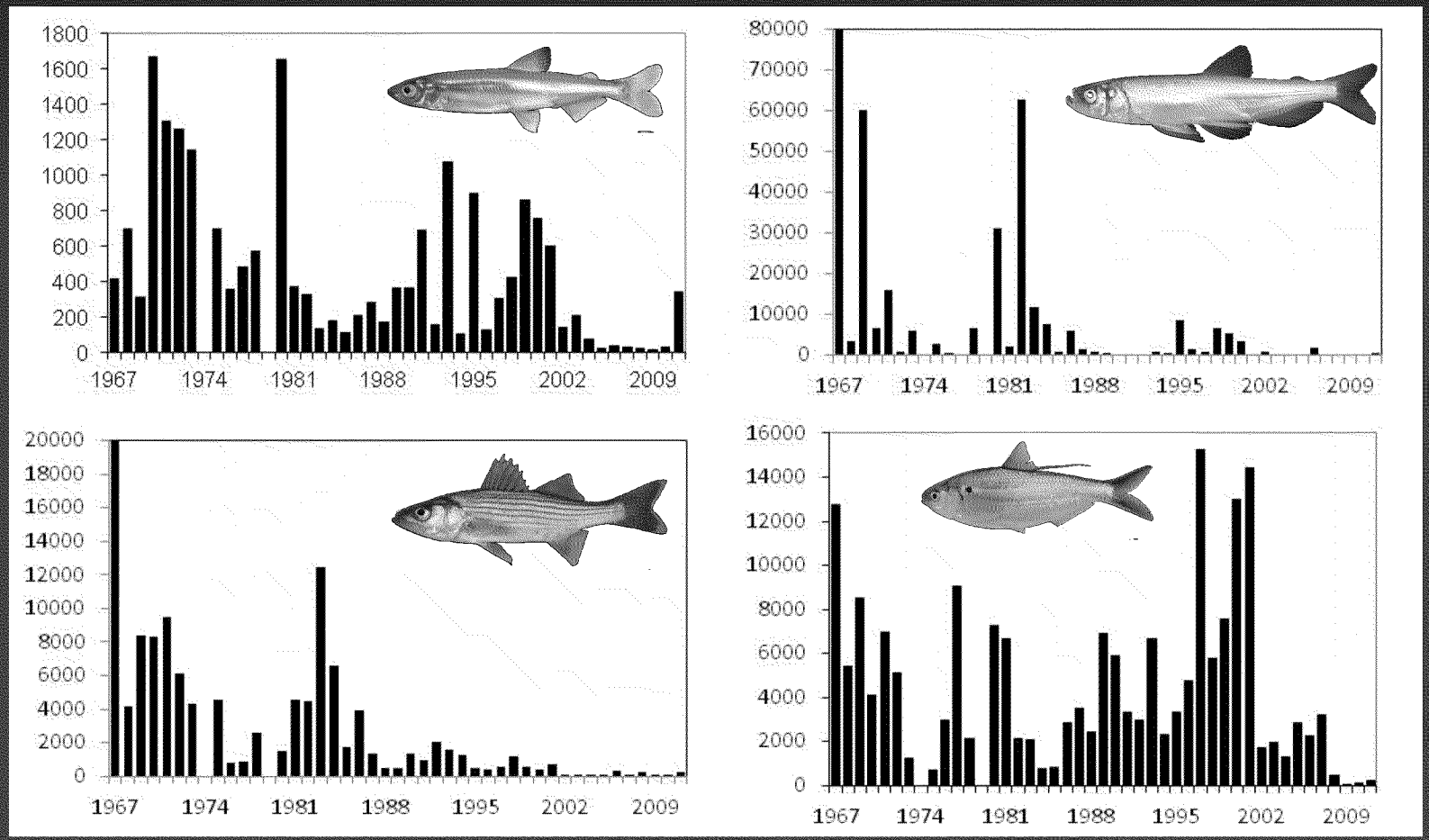


New Information

EPA SF Bay Delta Action Plan

www.epa.gov/sfbaydelta/actionplan

Aquatic life beneficial uses are not adequately protected



Source DFG 2008 Fall MW Trawl -- No sampling 1974 and 1979

New Information
EPA SF Bay Delta Action Plan

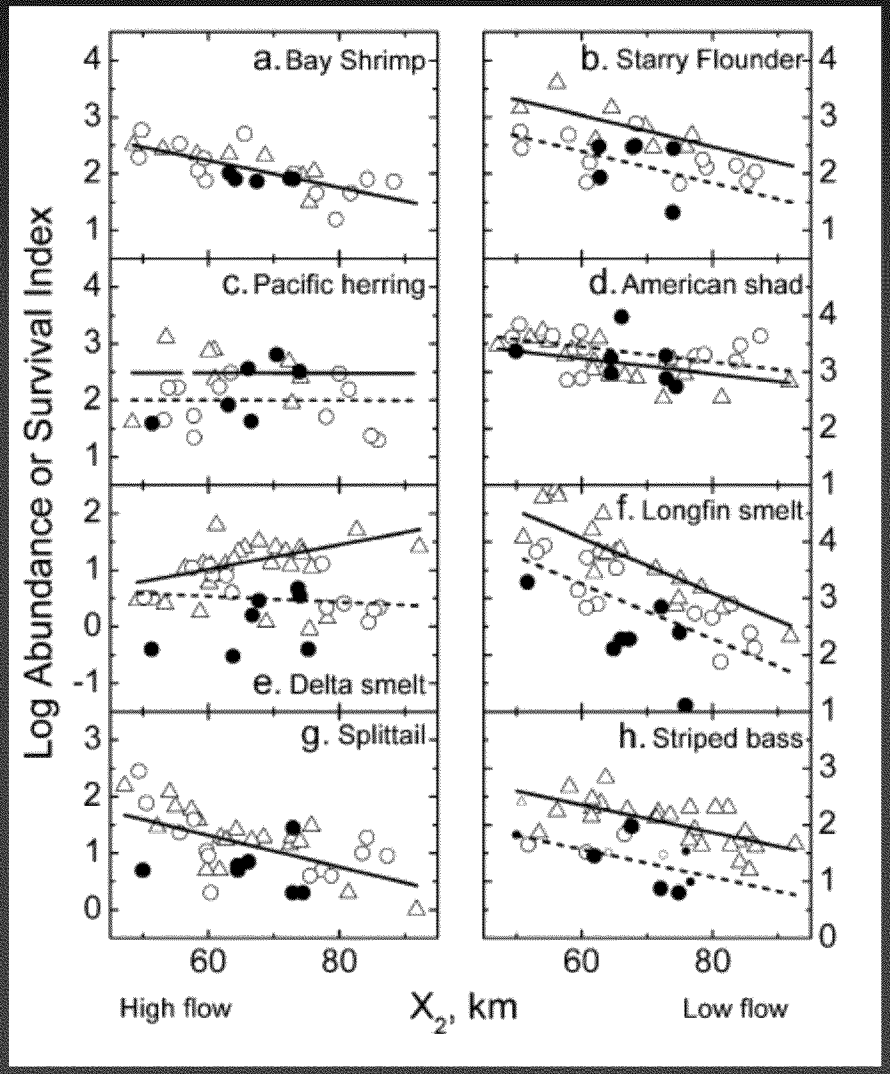
First priority: Update estuarine aquatic life objectives

Table 3 (continued)
WATER QUALITY OBJECTIVES FOR FISH AND WILDLIFE BENEFICIAL USES

COMPLIANCE LOCATIONS	INTERAGENCY STATION NUMBER (RKI [1])	PARAMETER	DESCRIPTION (UNIT) [2]	WATER YEAR TYPE [3]	TIME PERIOD	VALUE
DELTA OUTFLOW						
		Net Delta Outflow Index (NDOI) [8]	*Minimum monthly average [9] NDOI(cfs)*	*All*	*Jan*	*4,500 [10]*
				All	*Feb-Jun*	*[11]*
				W,AN	*Jul*	*8,000*
				BN		*6,500*
				D		*5,000*
				C		*4,000*
				W,AN,BN	*Aug*	*4,000*
				D		*3,500*
				C		*3,000*
				All	*Sep*	*3,000*
				W,AN,BN,D	*Oct*	*4,000*
				C		*3,000*
				W,AN,BN,D	*Nov-Dec*	*4,500*
				C		*3,500*
RIVER FLOWS						
Sacramento River at Rio Vista	*D-24 (RSAC101)*	*Flow rate*	*Minimum monthly average [12] flow rate (cfs)*	*All*	*Sep*	*3,000*
				W,AN,BN,D	*Oct*	*4,000*
				C		*3,000*
				W,AN,BN,D	*Nov-Dec*	*4,500*
				C		*3,500*
San Joaquin River at Airport Way Bridge, Vernalis	*C-10 (RSAN112)*	*Flow rate*	*Minimum monthly average [13] flow rate (cfs) [14]*	*W,AN*	*Feb-Apr 14*	*2,130 or 3,420*
				BN,D	*and*	*1,420 or 2,280*
				C	*May 16-Jun*	*710 or 1,140*
				W	*Apr 15-*	*7,330 or 8,620*
				AN	*May 15 [15]*	*5,730 or 7,020*
				BN		*4,620 or 5,480*
				D		*4,020 or 4,880*
				C		*3,110 or 3,540*
				All	*Oct*	*1,000 [16]*
EXPORT LIMITS						
		Combined export rate [17]	*Maximum 3-day running average (cfs)*	*All*	*Apr 15- May 15 [18]*	*[19]*
				All	*Feb-Jun*	*35% Delta inflow [22]*
			Maximum percent of Delta inflow	*All*	*Jul-Jan*	

New Information

Evaluation & Support for X2



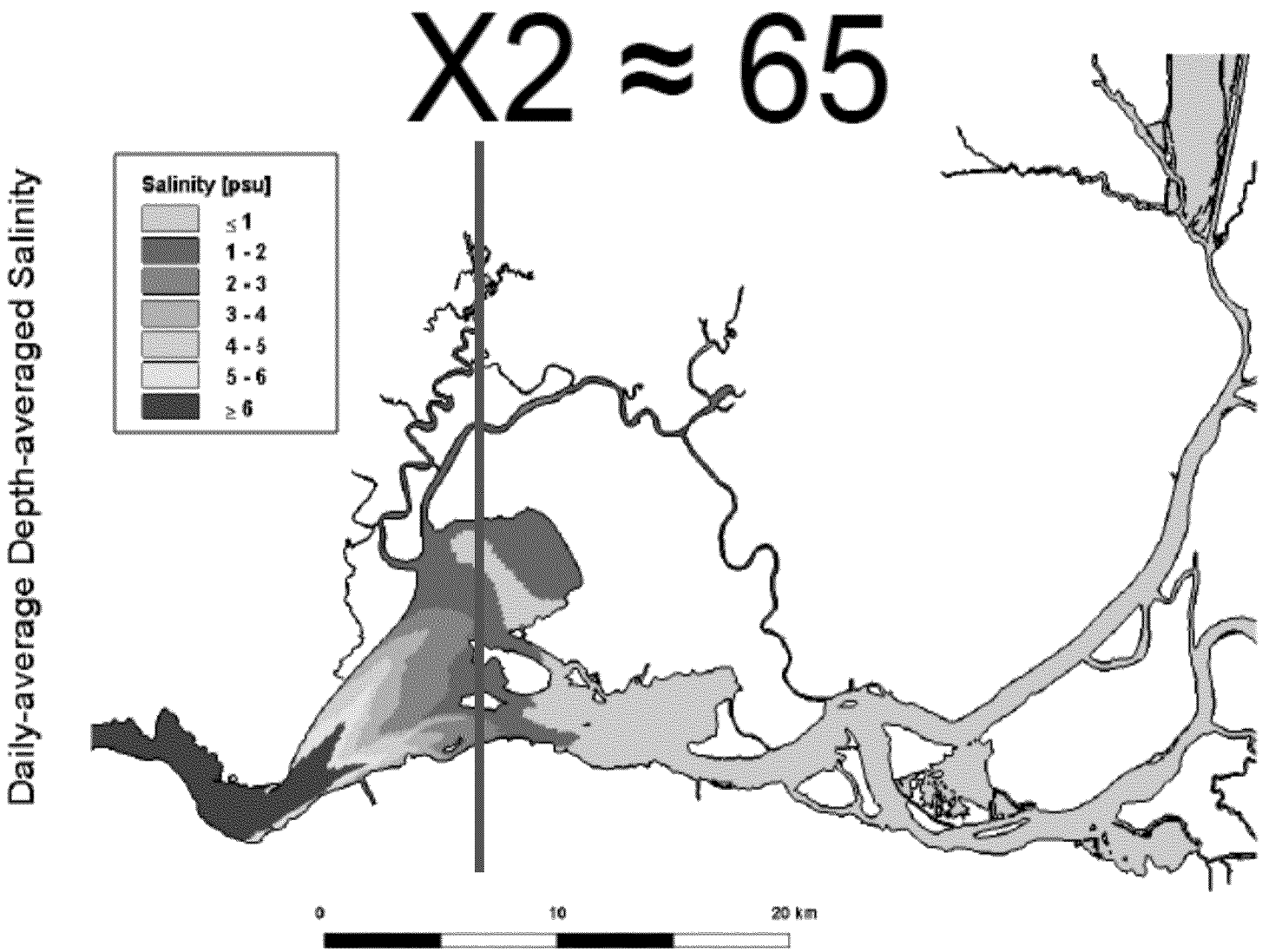
Kimmerer 2002MEPS

National Research Council (2012)

- The abundance of SF Bay Delta estuarine species increases when X2 is located farther downstream.
- "sufficient reductions in outflow due to diversions would tend to reduce the abundance of these organisms."

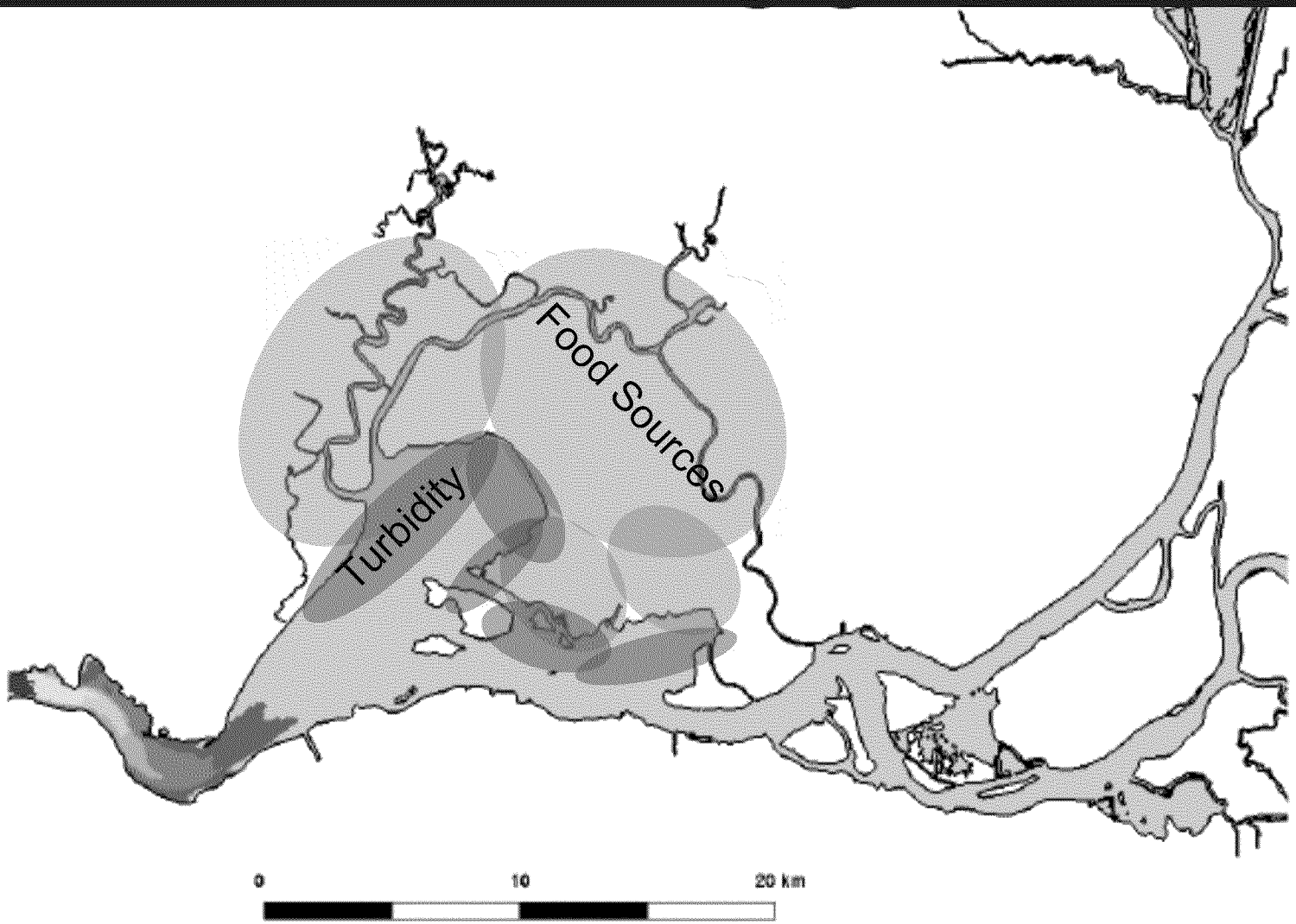
New Information

Three-dimensional LSZ Modeling



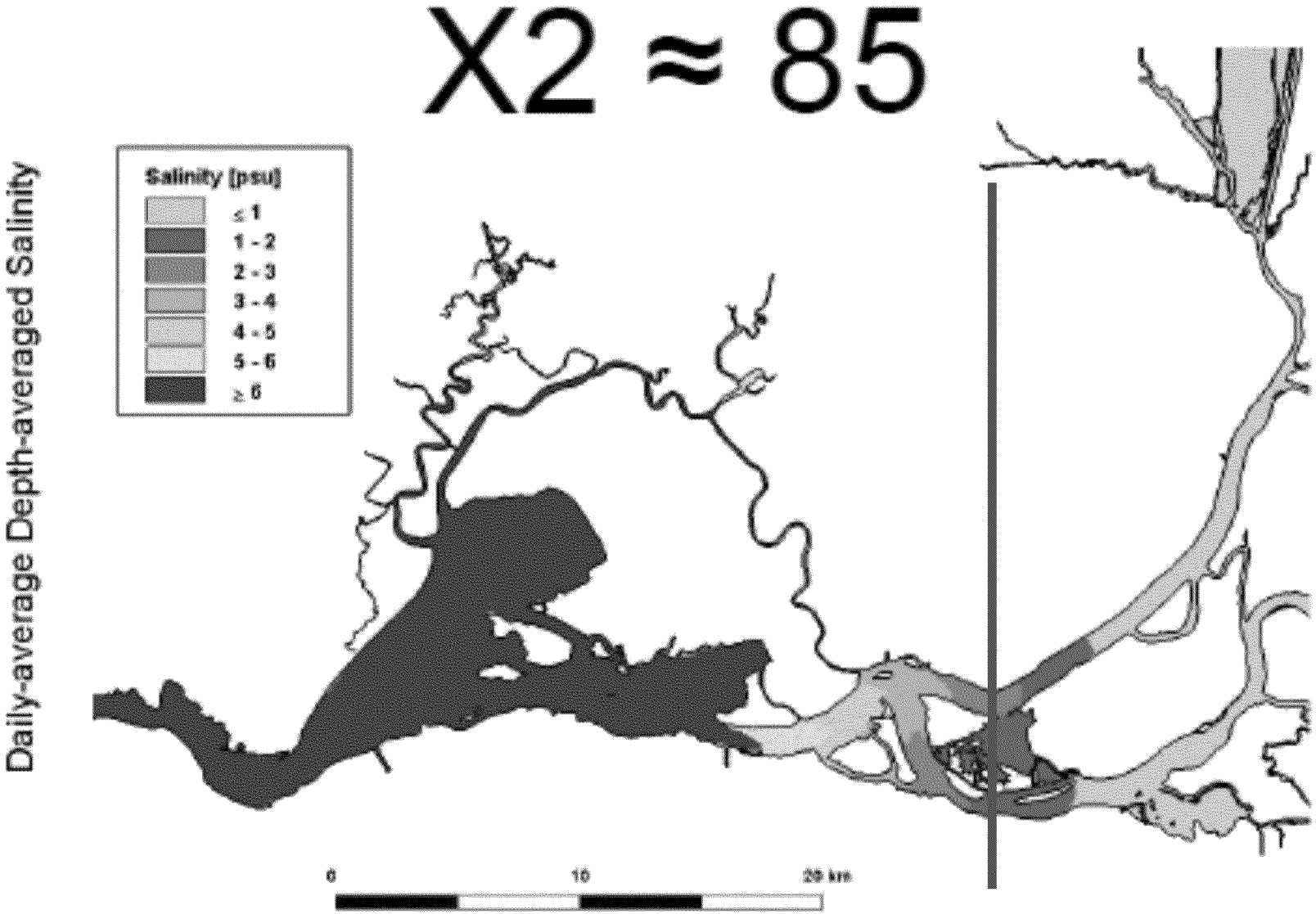
Source Delta Modeling Associates Low Salinity Flip Book. June 15, 2012. Version 0.9.

Location of LSZ



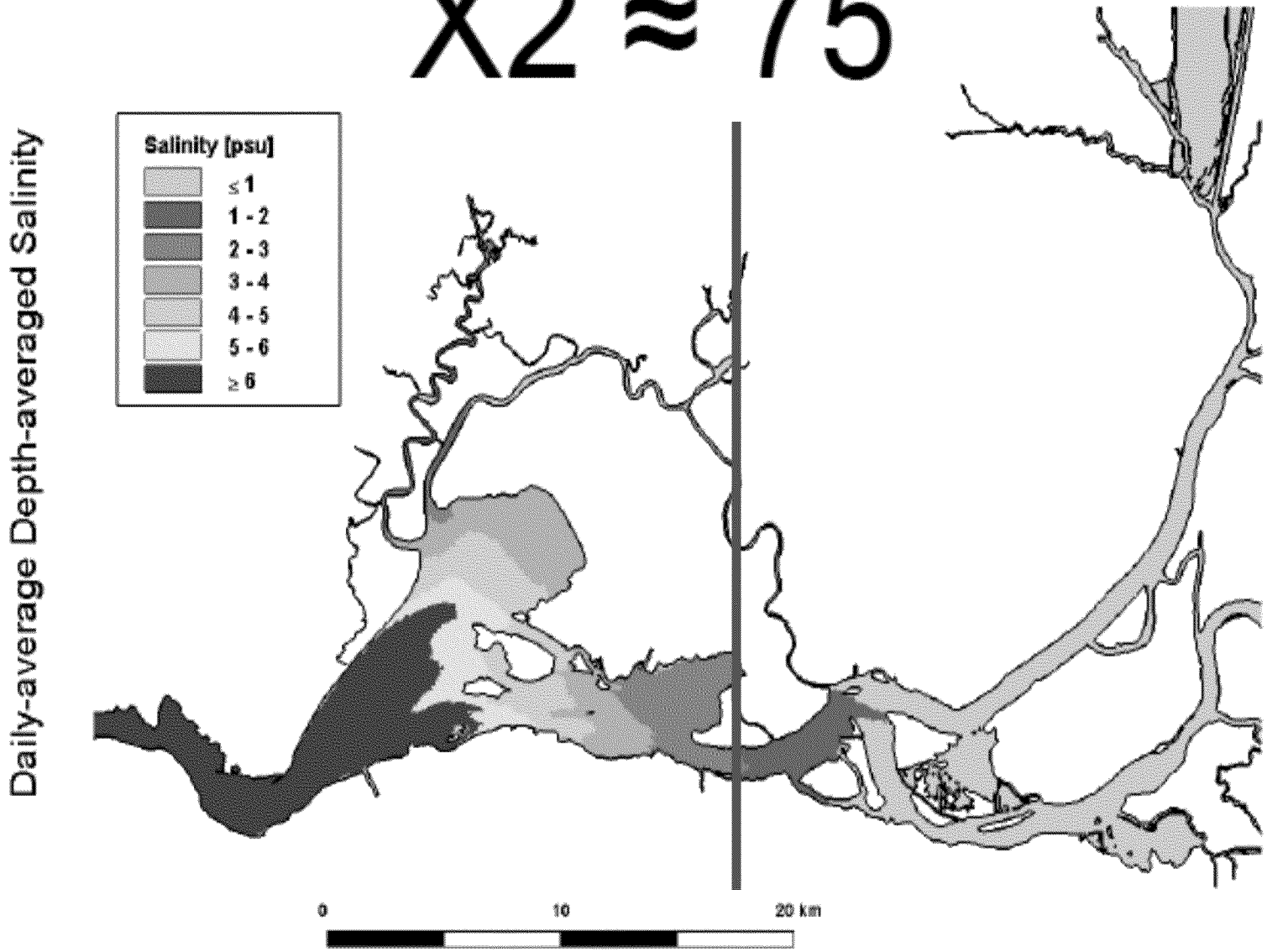
Source Delta Modeling Associates Low Salinity Flip Book. June 15, 2012. Version 0.9.

X2 ≈ 85



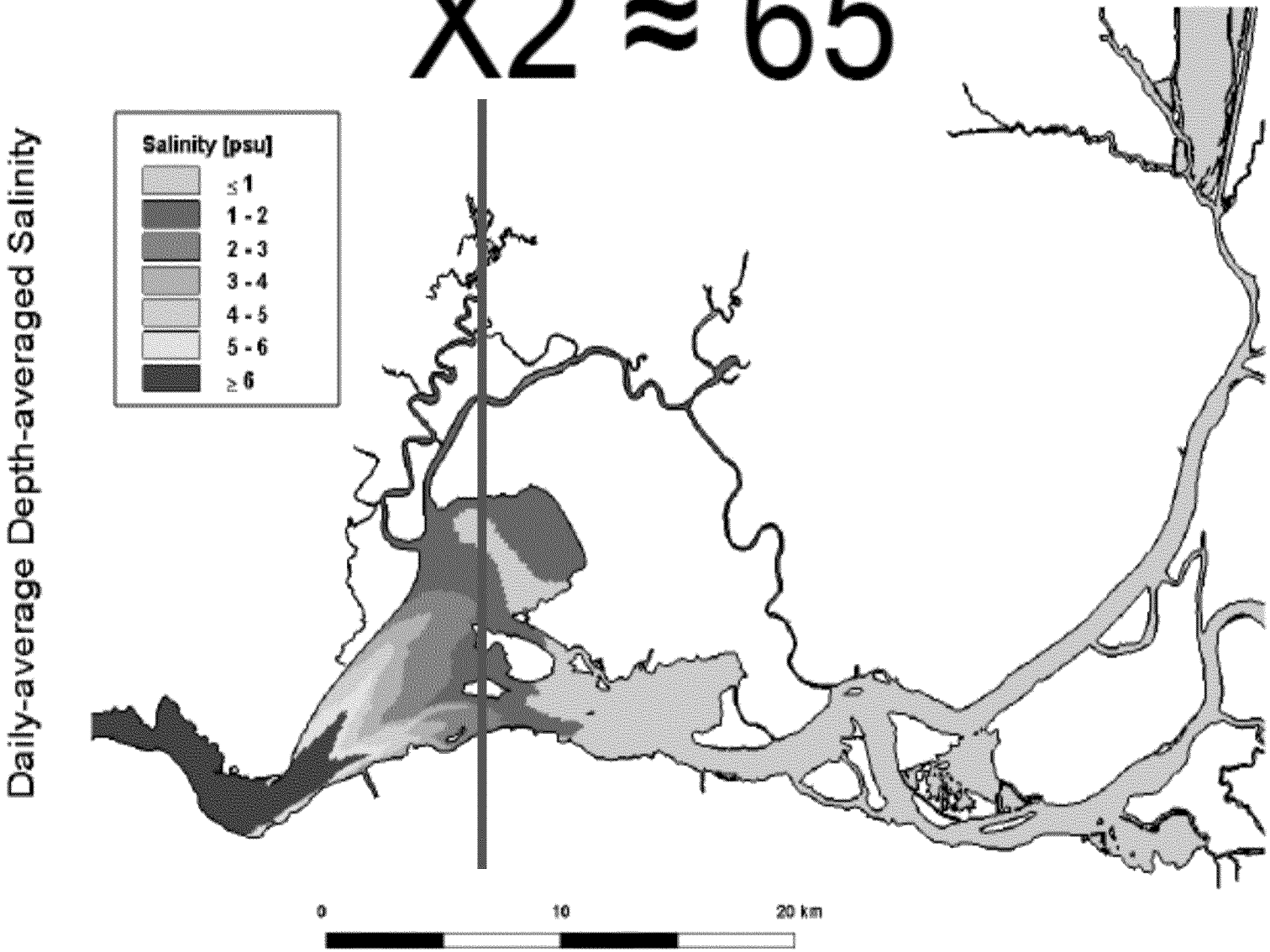
Source Delta Modeling Associates Low Salinity Flip Book. June 15, 2012. Version 0.9.

X2 ≈ 75



Source Delta Modeling Associates Low Salinity Flip Book. June 15, 2012. Version 0.9.

X2 ≈ 65



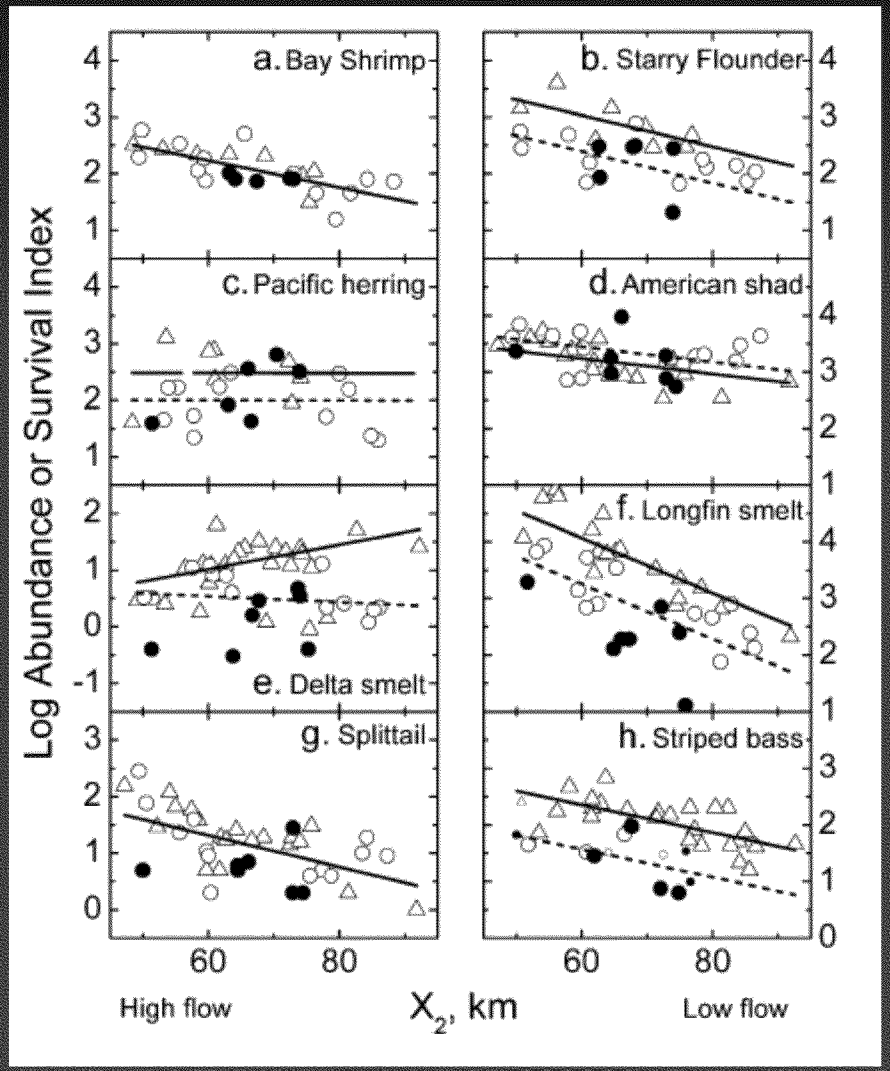
Source Delta Modeling Associates Low Salinity Flip Book. June 15, 2012. Version 0.9.

Low Salinity Zone

- 65 km ≤ X2 ≤ 74 km
  - Access to food and turbidity are maximized
- X2 > 80 km
  - Access to food and turbidity are limited

New Information

LSZ is important year-round



Kimmerer 2002MEPS

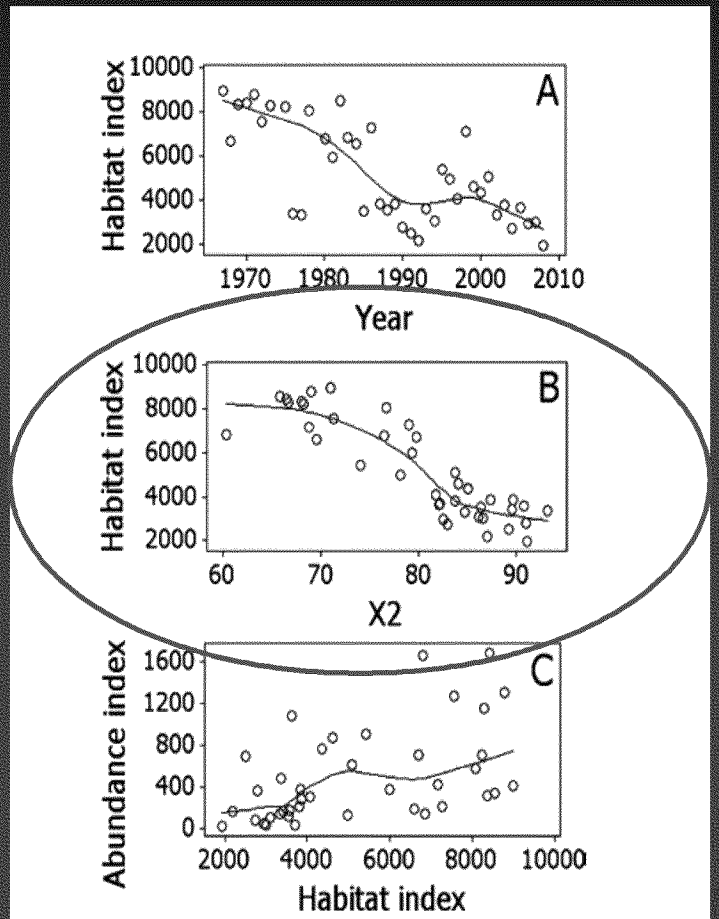


Fig. 2 Plots of the habitat index time series (**a**), relationship between $X2$ (km) and the habitat index (**b**), and relationship between the habitat index and delta smelt abundance measured as the fall midwater trawl index. Curves are LOESS smooths

Feyrer et al (2011)

LSZ is important year-round

Longfin Smelt

Highest since 2006

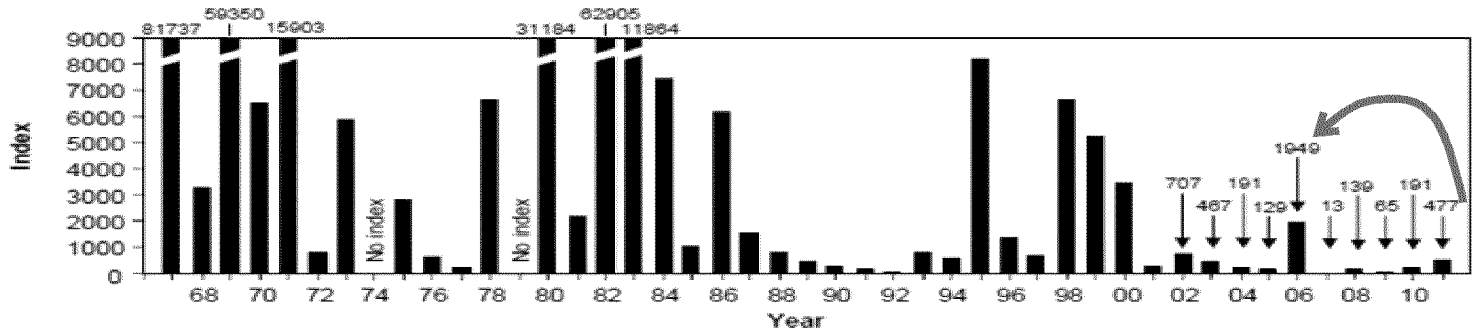
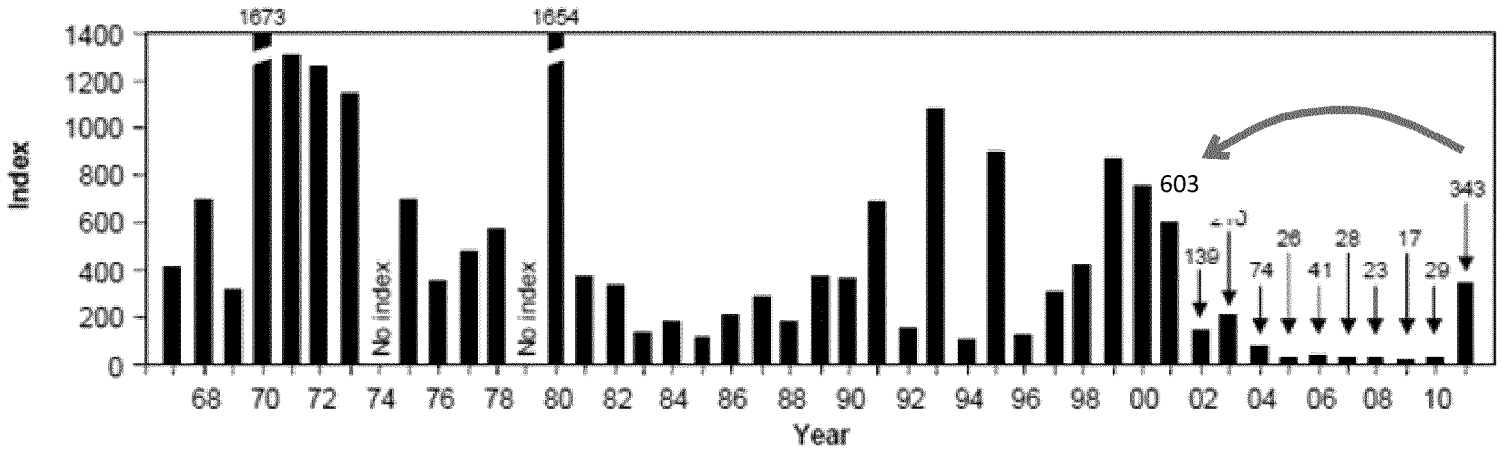


Figure 4. Longfin smelt FMWT annual abundance indices, 1967-2011.

Delta Smelt

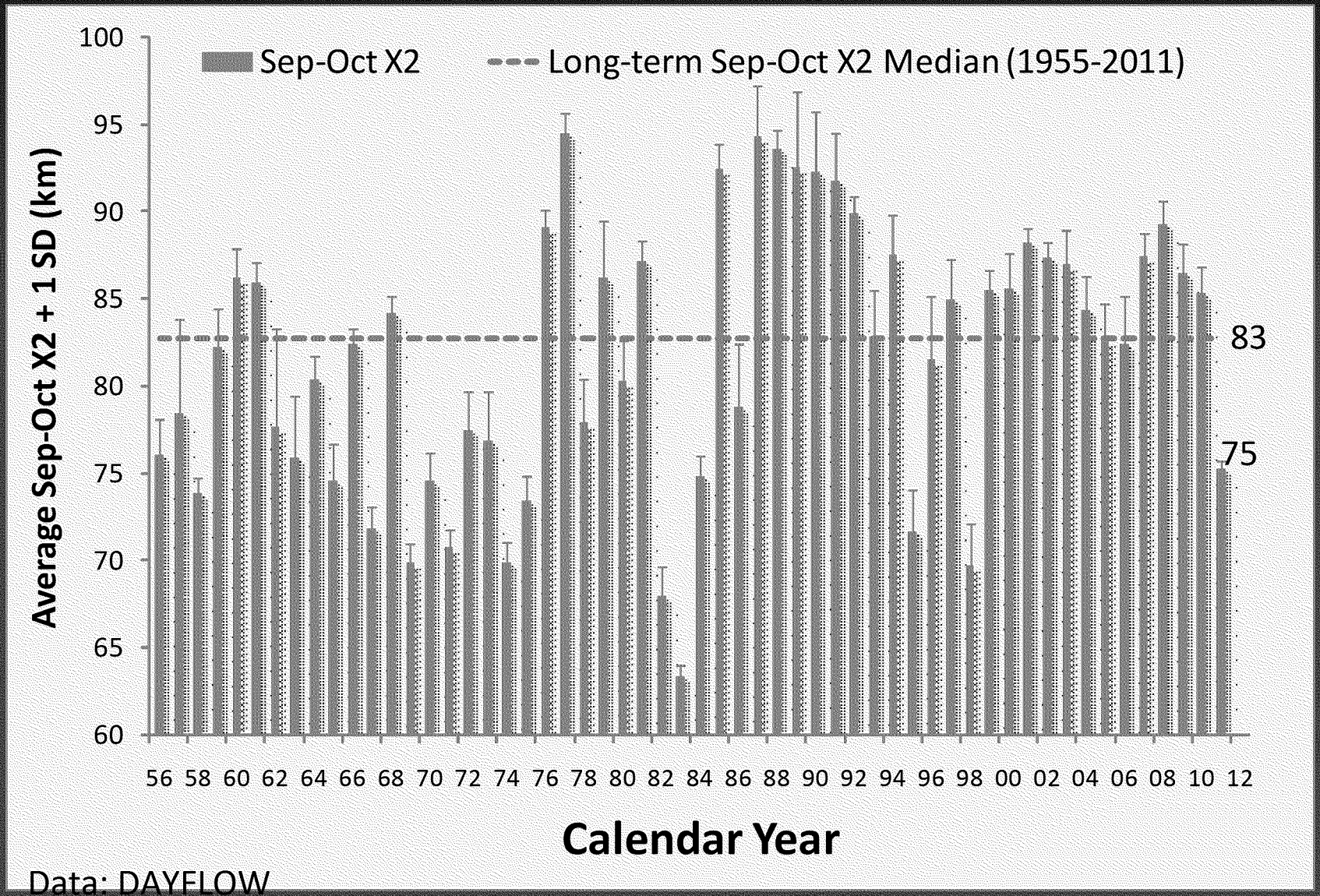
Highest since 2001



Source DFG 2008 Fall MW Trawl -- No sampling 1974 and 1979

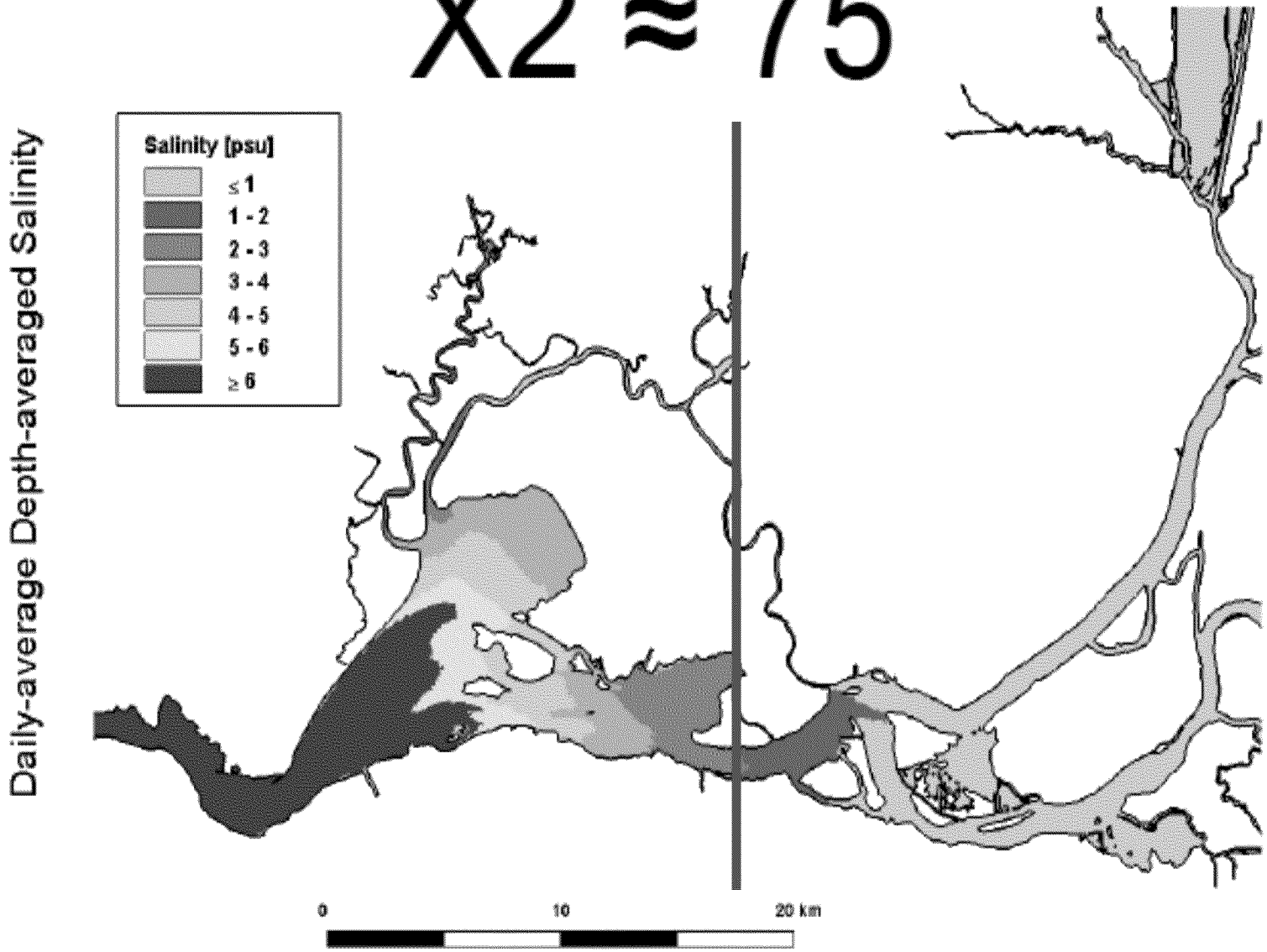
Low Salinity Zone in the Fall.

(September-October)



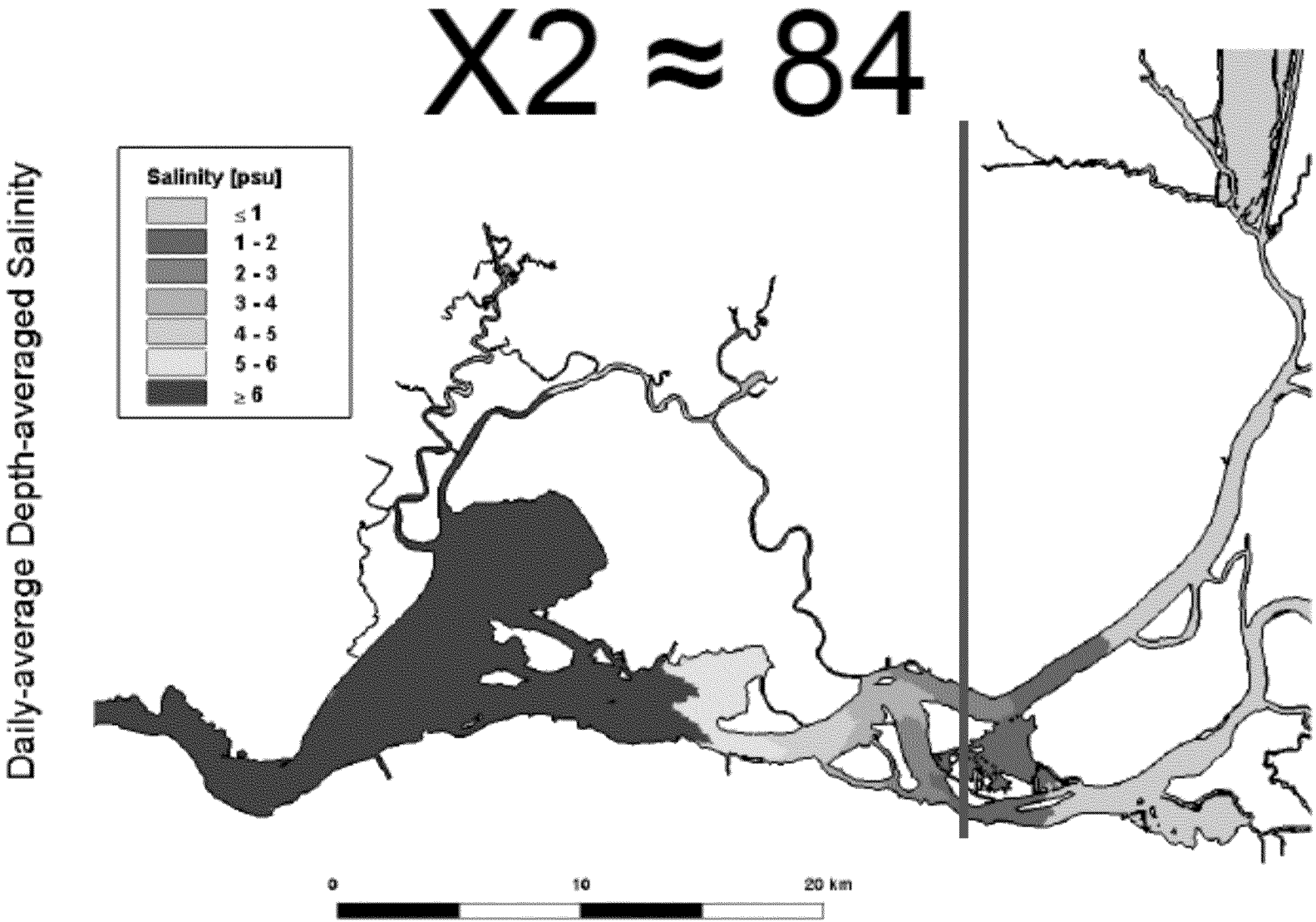
Data: DAYFLOW

X2 ≈ 75



Source Delta Modeling Associates Low Salinity Flip Book. June 15, 2012. Version 0.9.

X2 ≈ 84



Source Delta Modeling Associates Low Salinity Flip Book. June 15, 2012. Version 0.9.

Changes to Bay-Delta Plan

Start with existing recommendations

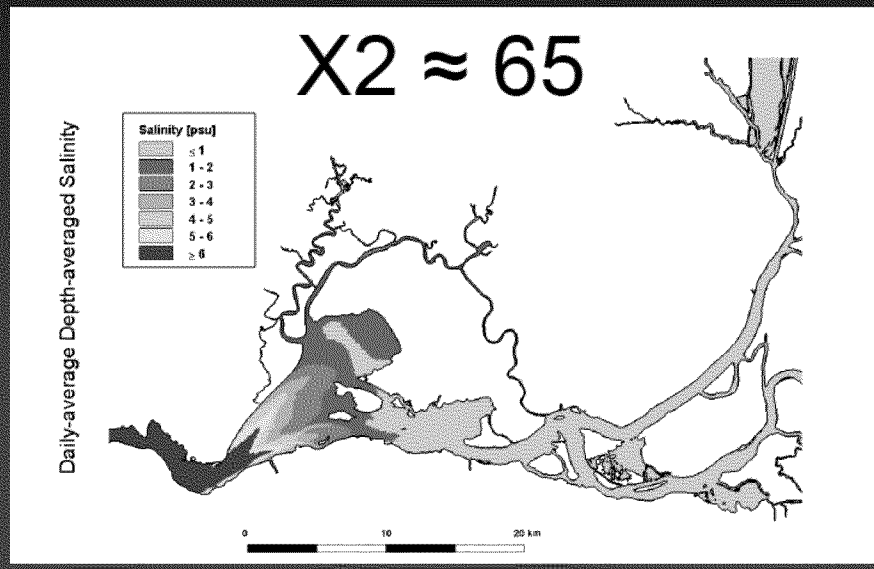
Table 20. Delta Outflow Summary Criteria

Delta Outflows	
Category A	
Water Year (O N D J F M A M J J A S)	**Criteria**
	1) Net Delta Outflows: 75% of 14-day average unimpaired flow
Category B	
Water Year (O N D J F M A M J J A S)	**Criteria**
	2) Fall X2 a. Wet years: X2 less than 74 km (greater than approximately 12,400 cfs) b. Above normal years: X2 less than 81 km (greater than approximately 7,100 cfs)
	3) Net Delta Outflows: 2006 Bay-Delta Plan Delta Outflow Objectives - applies during critical, dry, and below normal years
Basis for Criteria and Explanation	

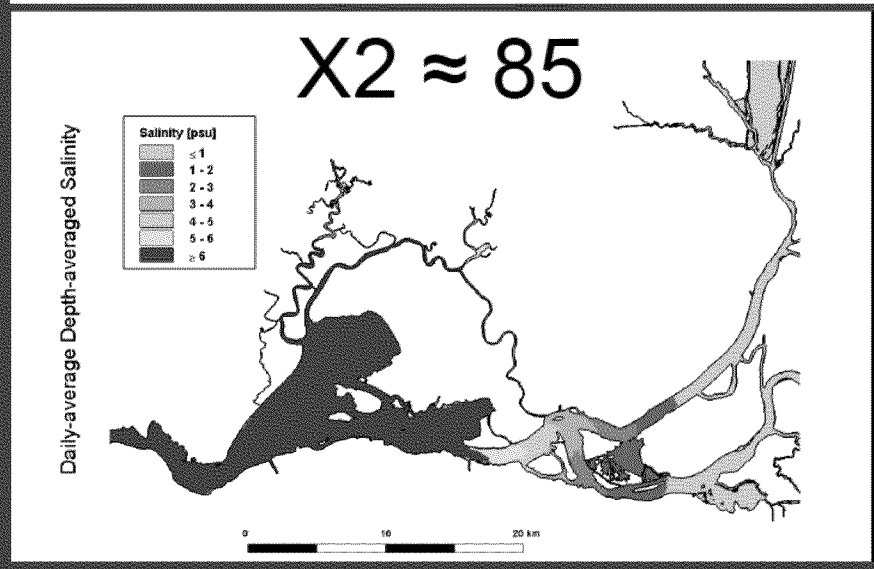
1) Promote increased abundance and improved productivity (positive population growth) for longfin smelt and other desirable estuarine species
2) Increase quantity and quality of habitat for delta smelt; fall X2 requirement limited to above normal and wet years to reduce potential conflicts with cold water pool storage, while promoting variability with respect to fall flows and habitat conditions in above normal and wet water year types; expected to result in improved conditions for delta smelt, however, the statistical relationship between fall X2 and abundance is not strong; note 2) above regarding need for improved understanding concerning the fall X2 action also applies
3) Fish and wildlife beneficial use protection

Connect Flow to Essential Habitat Elements

Net Delta Outflow at
65 % Unimpaired flow



Net Delta Outflow at
35 % Unimpaired flow



Summary

- Aquatic life beneficial uses are not protected.
- X2 relationships between flow and abundance have overwhelming scientific support.
- Freshwater flows are important year-round for aquatic life.
- Connect percent unimpaired flows to habitat elements.
- The Bay-Delta Plan update – including the critical flow decision – needs to provide better protection for aquatic habitat.