Freshwater Flow:

The missing element in the Bay Delta Conservation Plan

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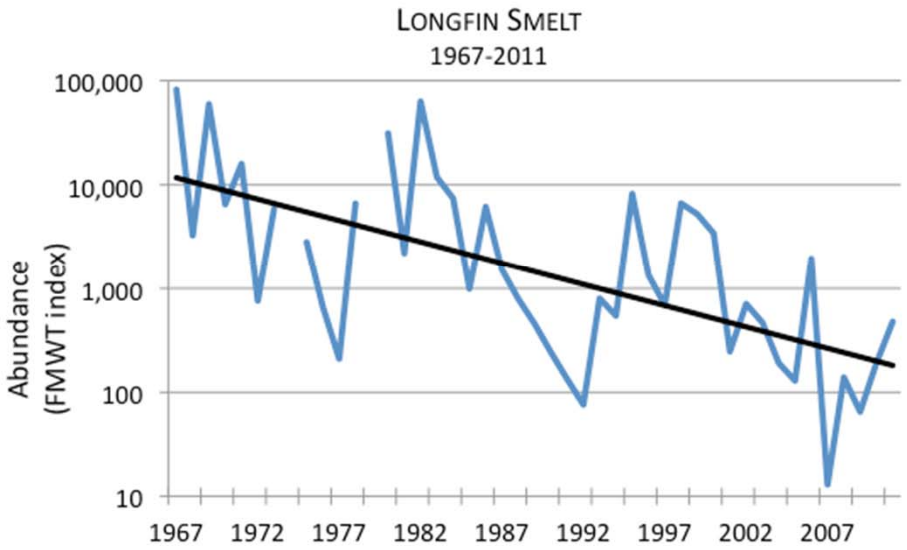
The Bay-Delta's Imperiled Public Trust Fisheries

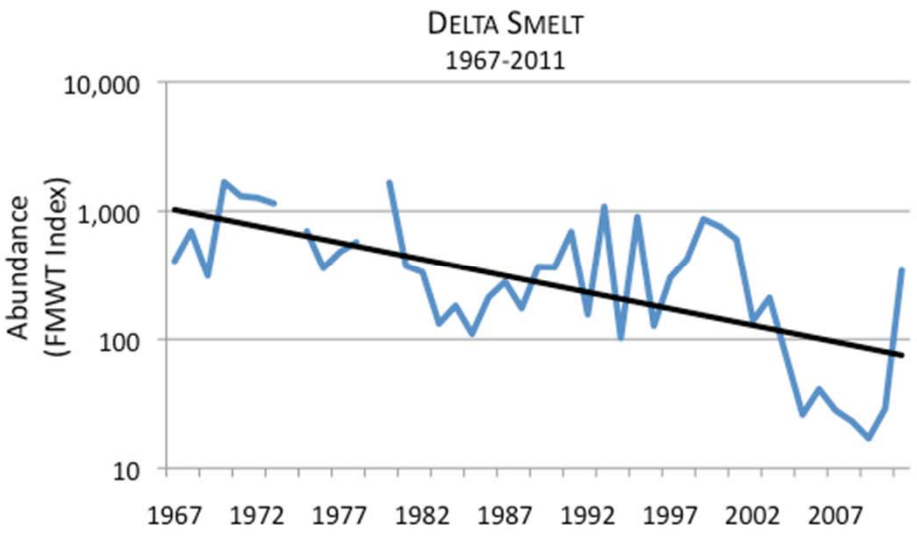
Species at or near all-time low abundances:

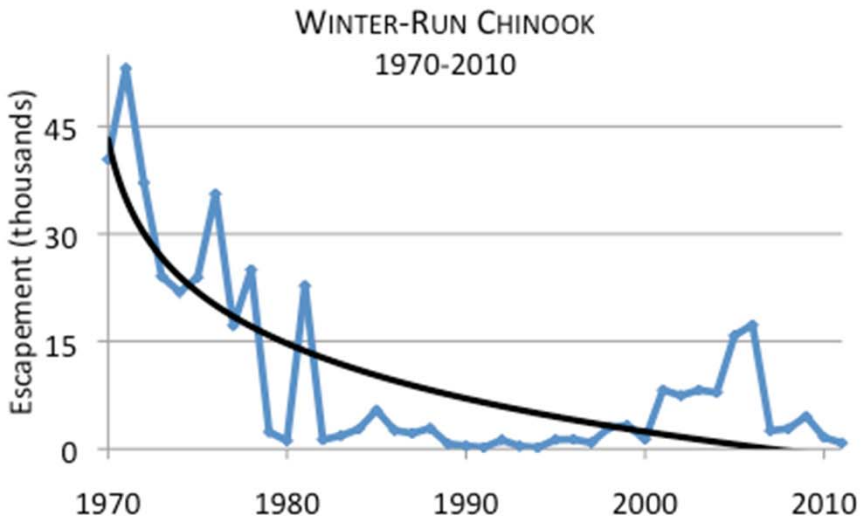
- Four unique Chinook salmon populations
- Central Valley steelhead
- Green sturgeon
- Delta smelt
- Longfin smelt
- Striped bass (YOY)
- Steelhead
- Shrimp and other prey species

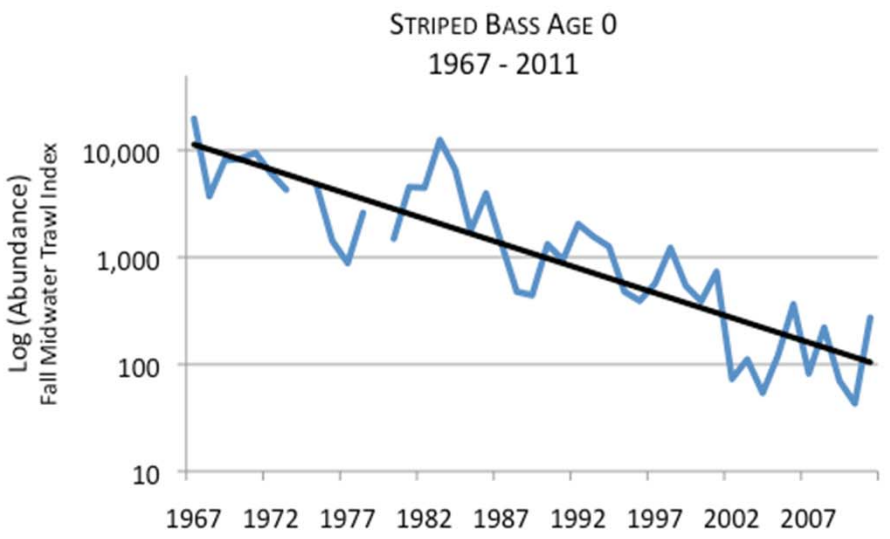
Bay-Delta's Public Trust Fisheries:

Parallel, Long-Term, Catastrophic Declines

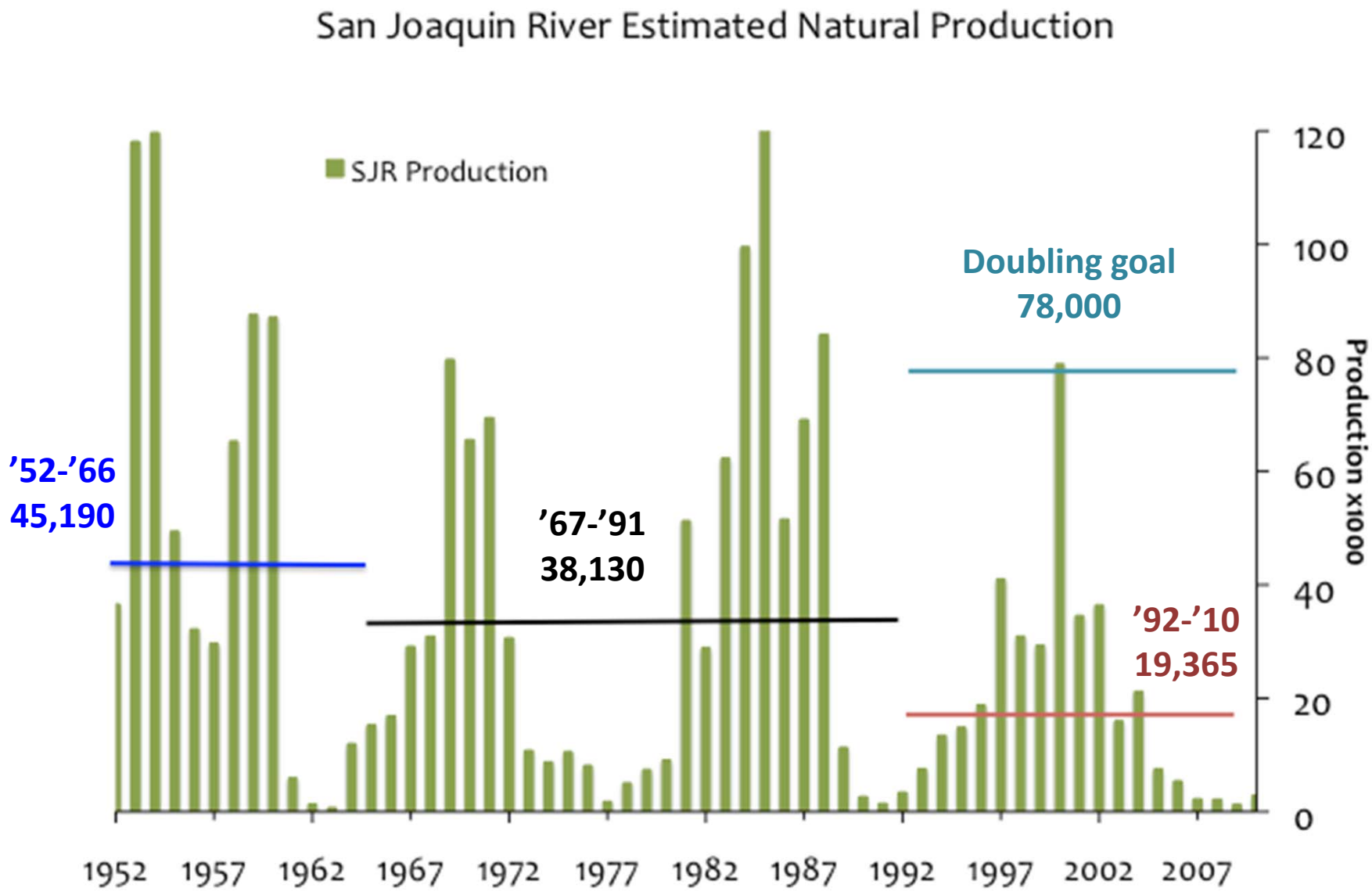


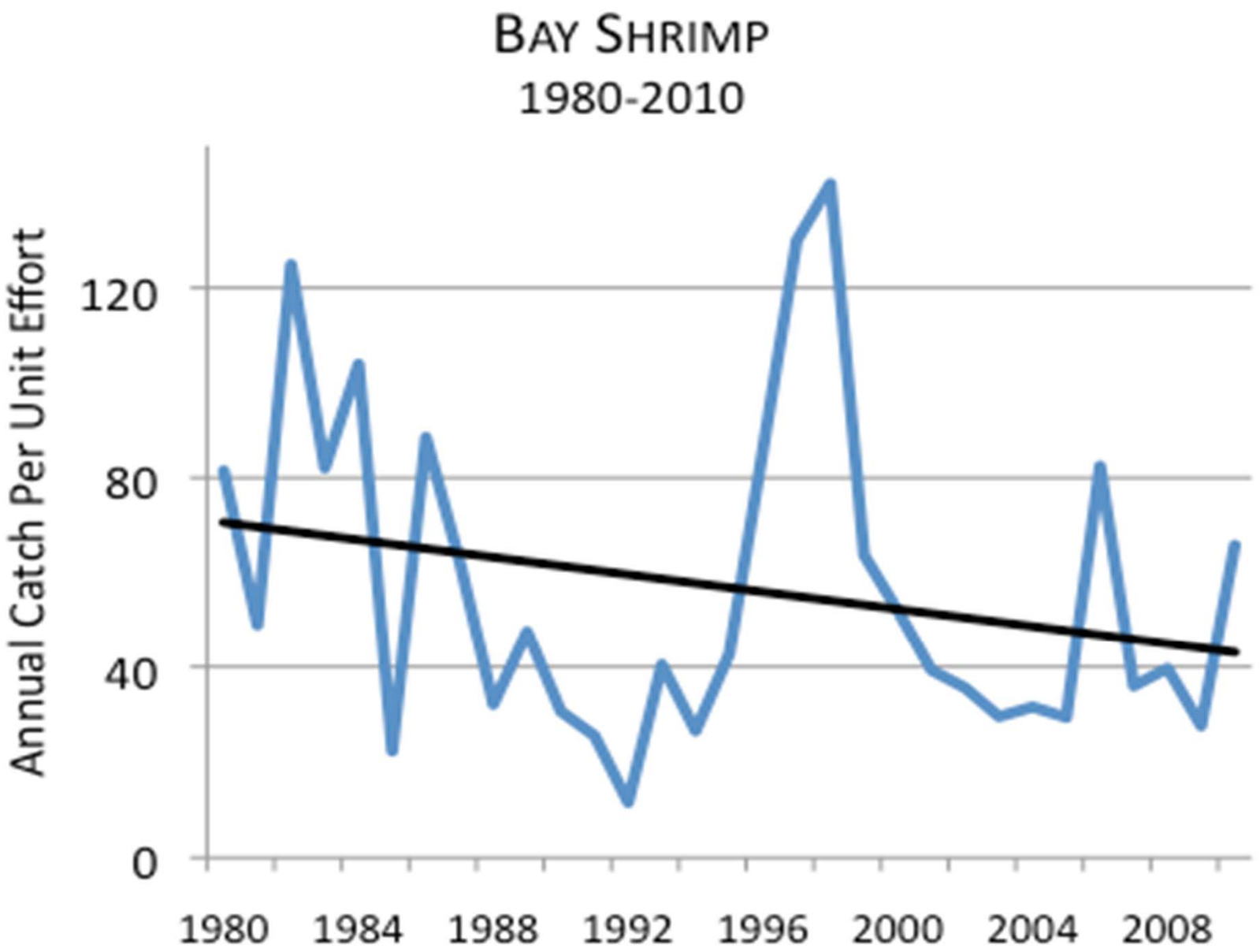






Decline of San Joaquin River Fall Run Chinook salmon




BAY SHRIMP
1980-2010
Annual Catch Per Unit Effort
120
80
40
0
1980
1984
1988
1992
1996
2000
2004
2008

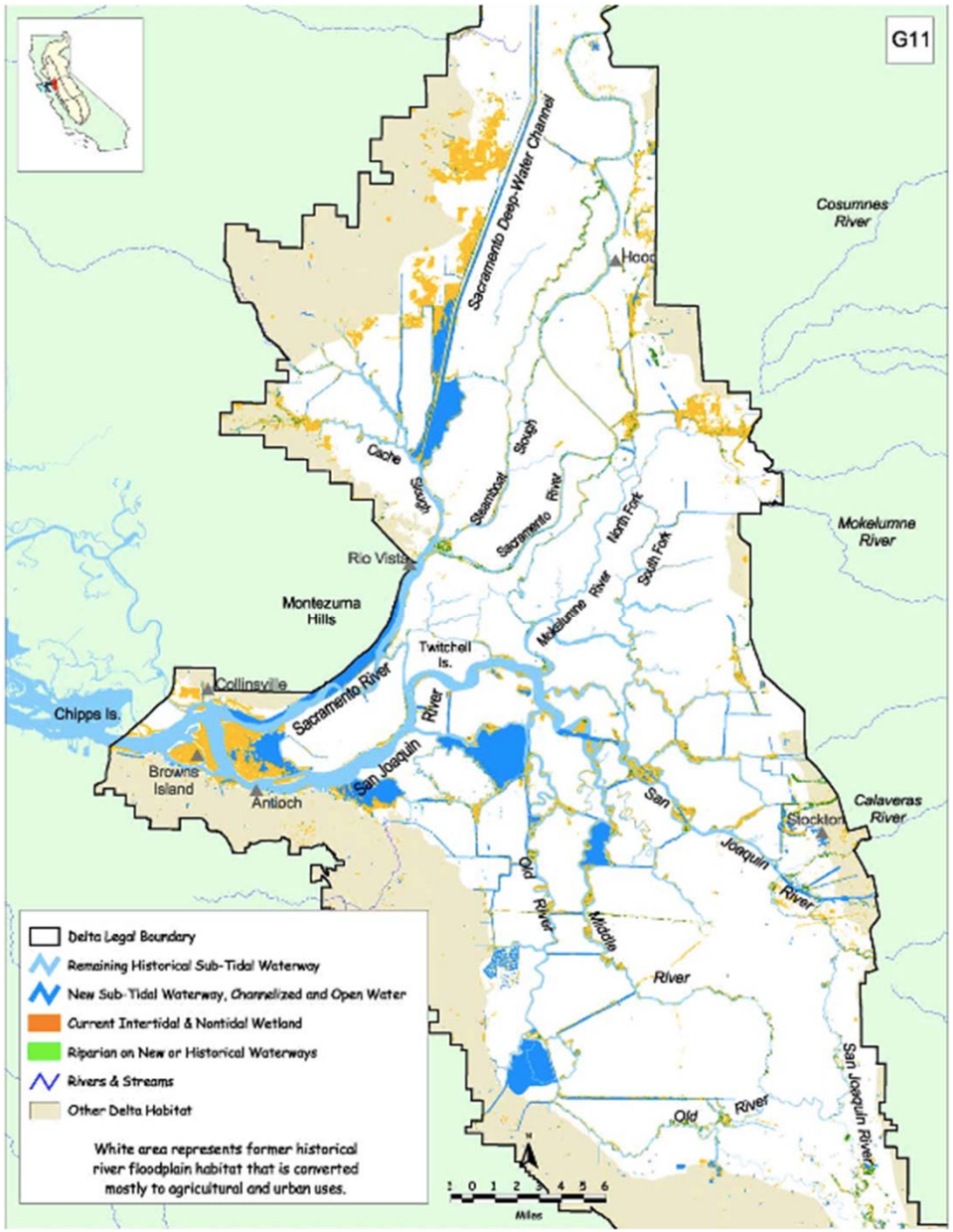
Bay-Delta Conservation Plan (BDCP)

Water exporter initiative to address:

- **Entrainment:** Build new water diversion w/ improved fish screening technology
- **Shallow Habitat:** Restore thousands of acres of tidal wetlands

In return for:

- 50 year ESA take permit



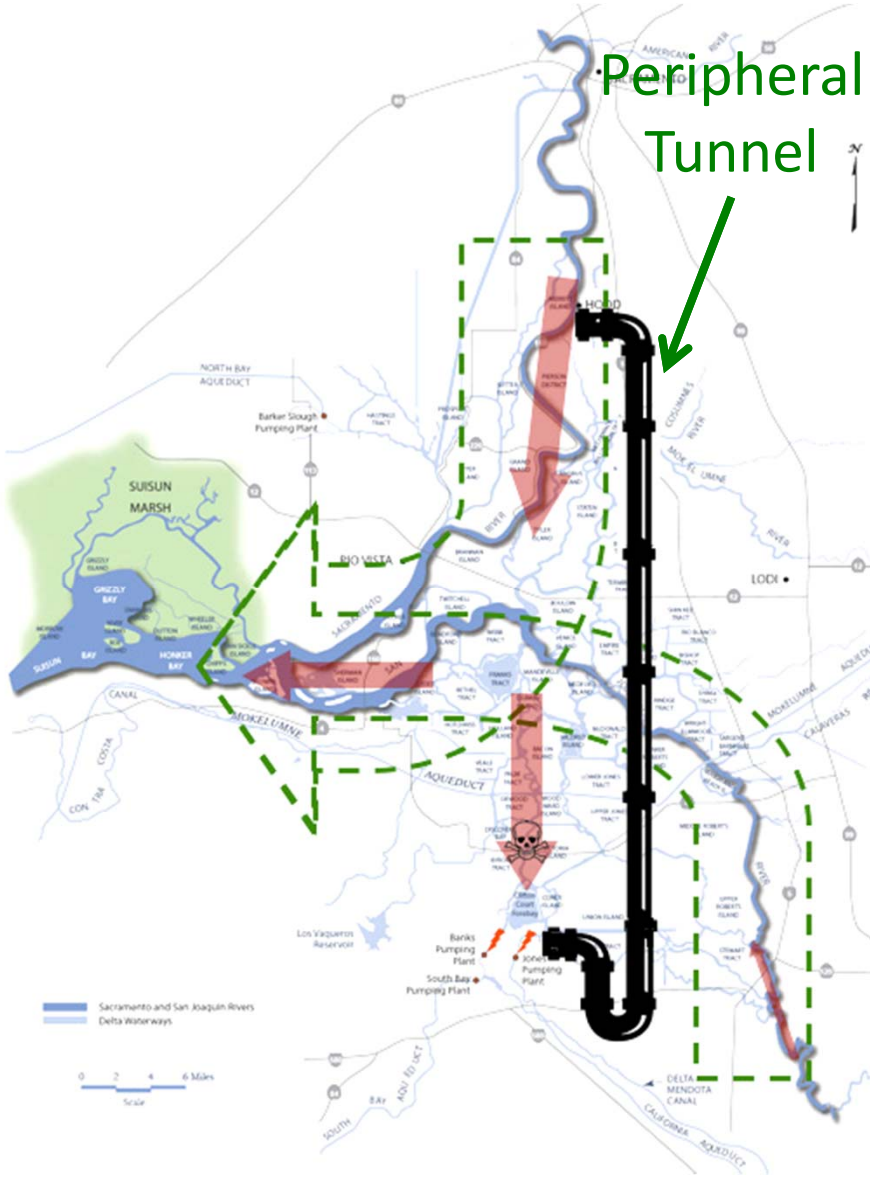
Bay-Delta Conservation Plan

Must

- Contribute to recovery of:
  - 12 fish species,
  - 23 terrestrial vertebrates,
  - 19 plant species, &
  - 7 invertebrates
- Improve *reliability* of water supply

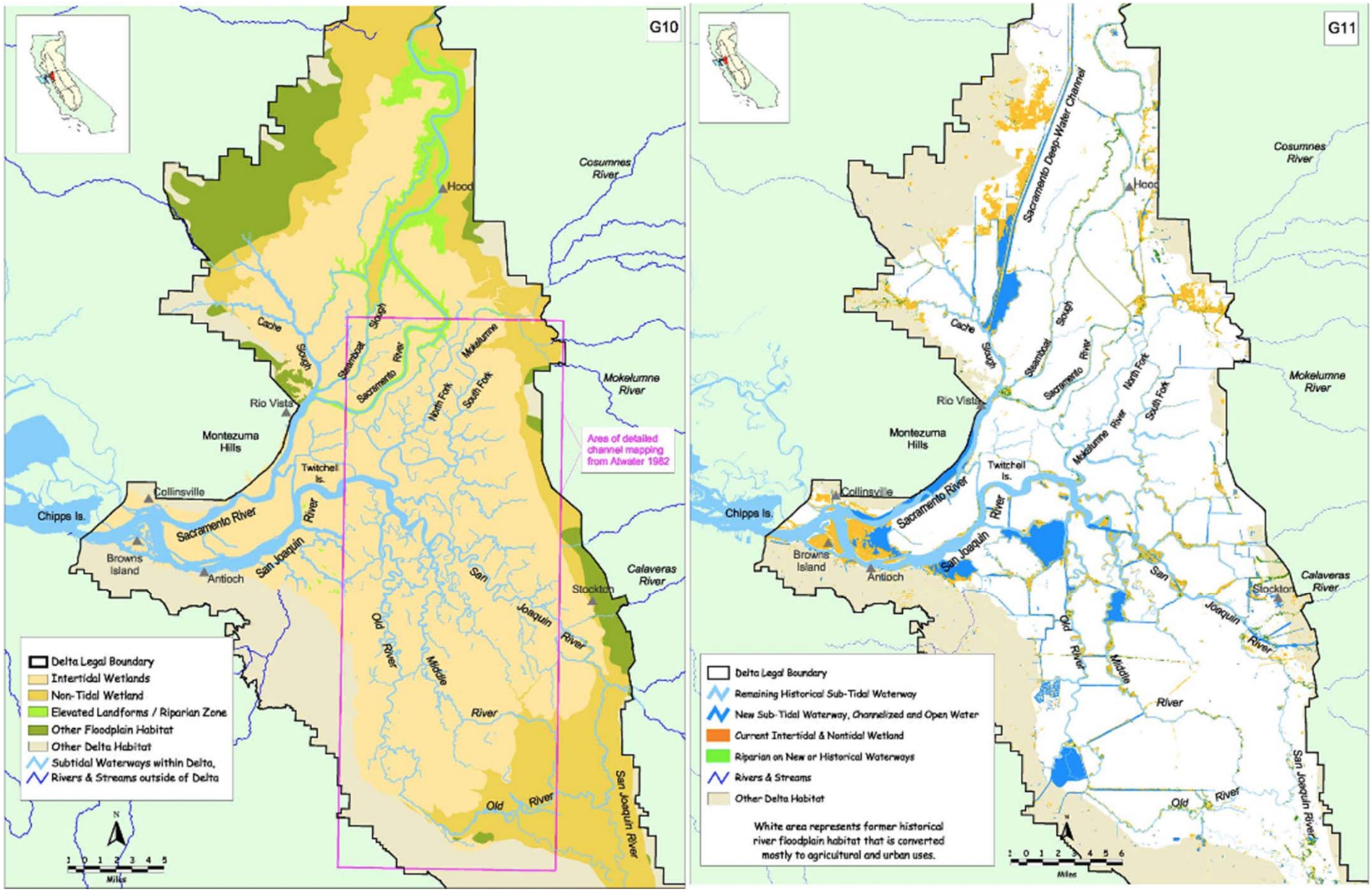
Assumes:

- New diversion eliminates "entrainment" problems
- Habitat restoration *more than compensates* for increased diversions



Restore Shallow Water Habitats

Only ~5% of historical wetlands and riparian habitat remains



Resolve Entrainment Problems

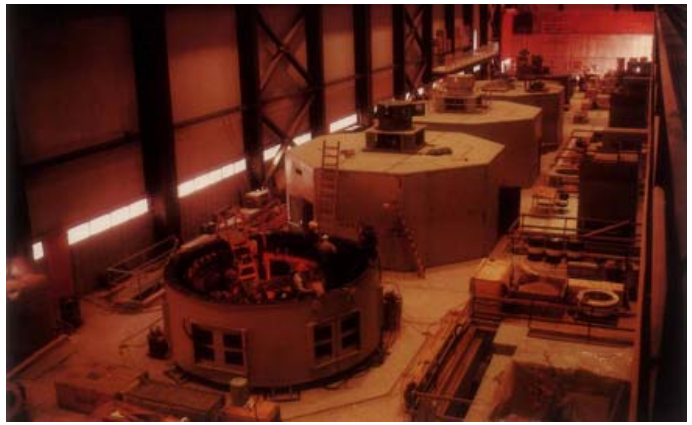
Location and Operation of South Delta Water Export Facilities are Problematic

- Abundance Effects
- Life History Diversity Erosion
- Habitat Destruction
- Loss of Productivity

Entrainment as a Multi-faceted Problem

Abundance Impacts

Measured fish “salvage” >9 x10^6 fish/yr at South Delta exports facilities



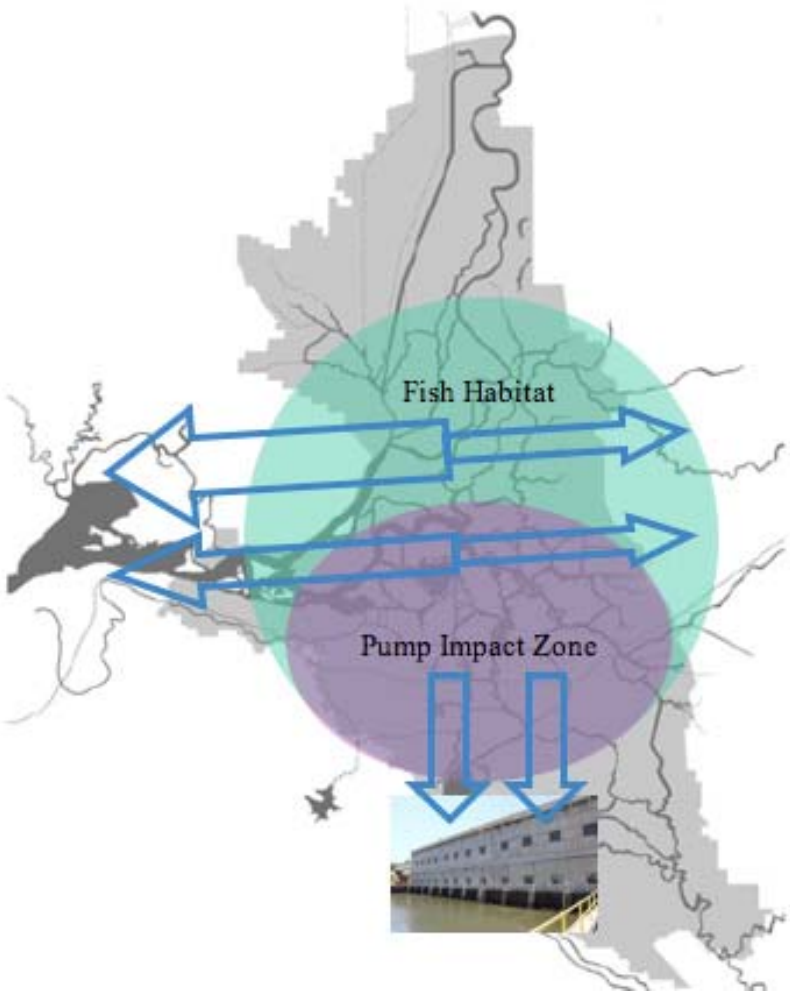
Actual mortality may be **>100x** measured

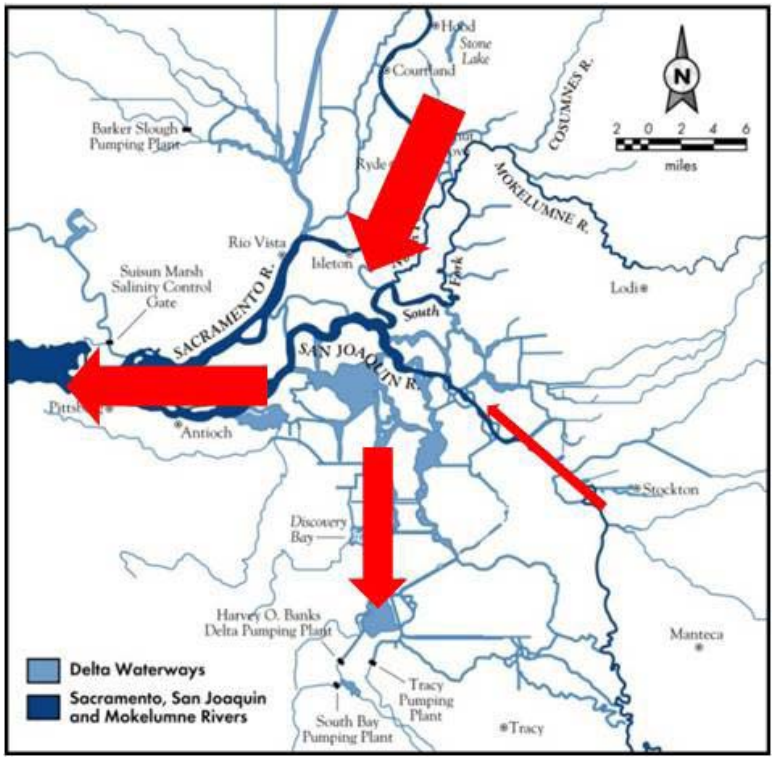
Selected Fish Species	1993-2011 Annual Salvage	
	Average	Maximum
American shad	1,022,700	2,510,184
Bluegill	127,133	394,952
Channel catfish	45,799	131,484
Chinook salmon (winter run) Chinook salmon (spring run) Chinook salmon (fall run) Chinook salmon (late-fall run)	51,955	183,890
Delta smelt	29,918	154,820
Green sturgeon	58	363
Inland silverside	62,838	142,652
Largemouth bass	54,180	234,198
Longfin	6,228	97,686
Prickly sculpin	76,403	274,691
Steelhead (Rainbow trout)	5,278	18,580
Redear sunfish	1,609	5,611
Riffle sculpin	155	798
Sacramento sucker	3,443	27,362
Sacramento splittail	1,201,585	8,989,639
Striped bass	1,773,079	13,451,203
Threadfin shad	3,823,099	9,046,050
White catfish	296,543	941,972
White sturgeon	151	873
Yellowfin goby	193,399	1,189,962

Average yearly salvage total: 9,237,444

Entrainment as a Multi-faceted Problem

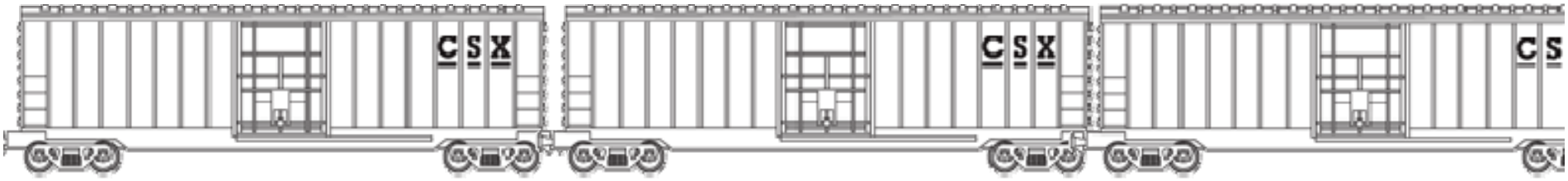
Habitat Destruction





Entrainment as a Multi-faceted Problem

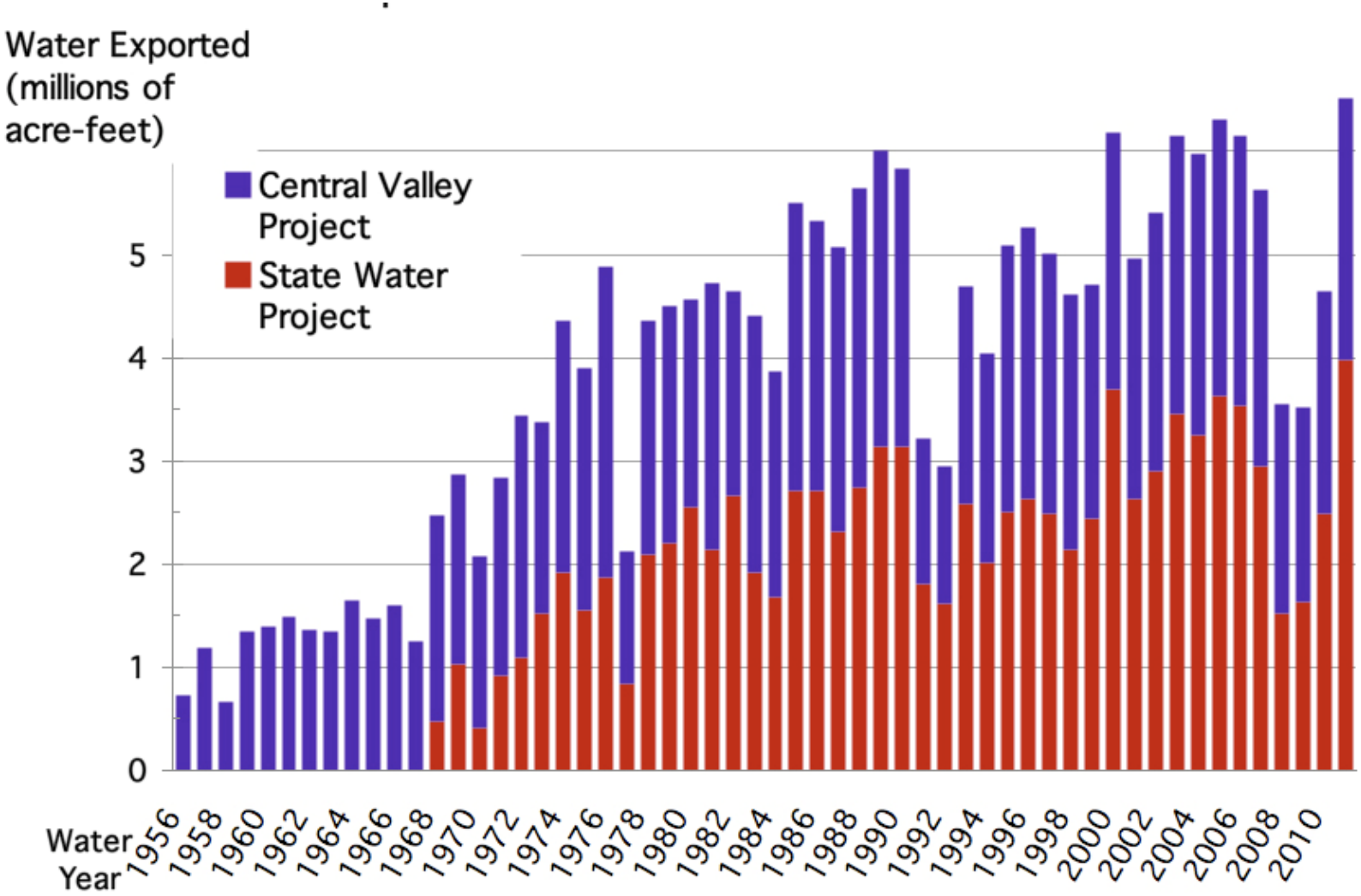
Productivity Impacts



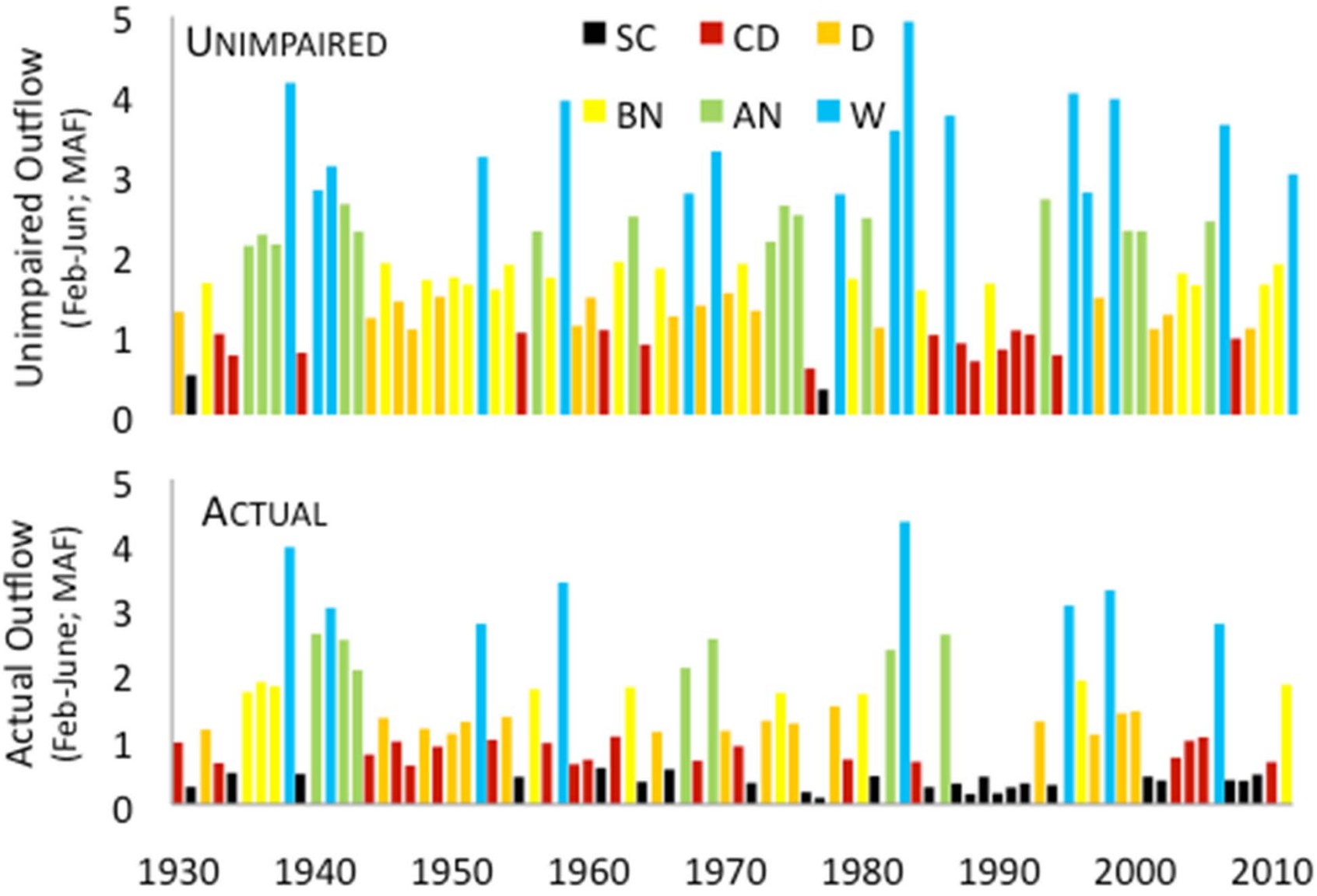
~three 50’ boxcars worth of water (& food) exported every second

“Water export from the Sacramento-San Joaquin Delta is a direct source of mortality to fish… and export plus within-Delta depletion alters system energetics of an already low-productivity ecosystem by removing phytoplankton biomass equivalent to 30% of Delta primary production.” [Cloern and Jassby 2012].

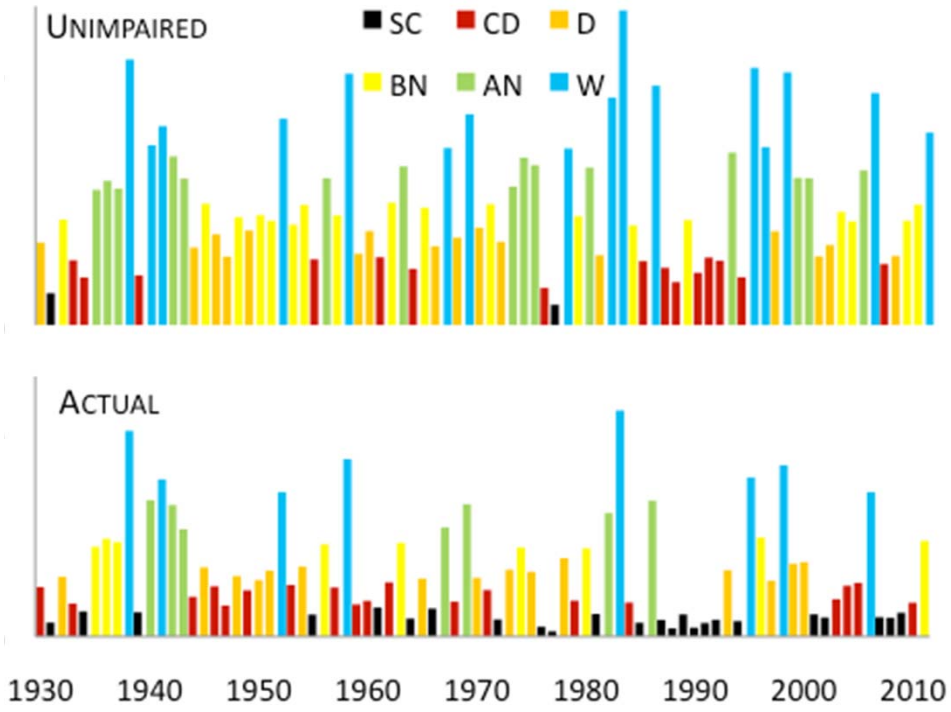
Changing Location of Diversion + Habitat Restoration do not Address the Bay-Delta's Biggest Problem ***Declining Freshwater Flow***



Bay-Delta Subjected to Persistent, Severe Drought



Dramatic Change in Frequency of Wet vs. Catastrophically Dry Years

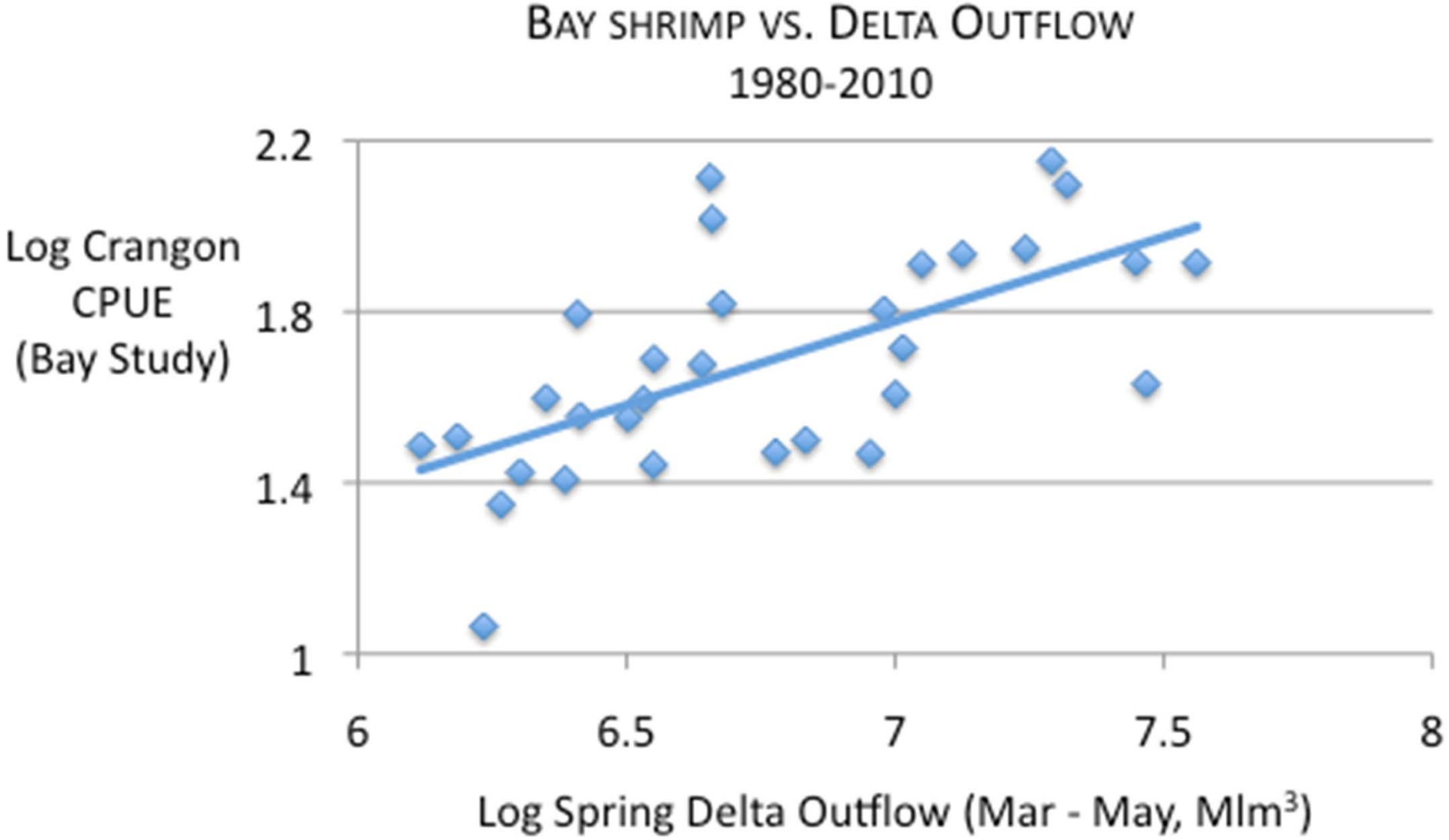


Hydrology Since 1967		
Yr Type	**Unimpaired**	**Actual**
Wet	11	4
Super-Critical	1	17

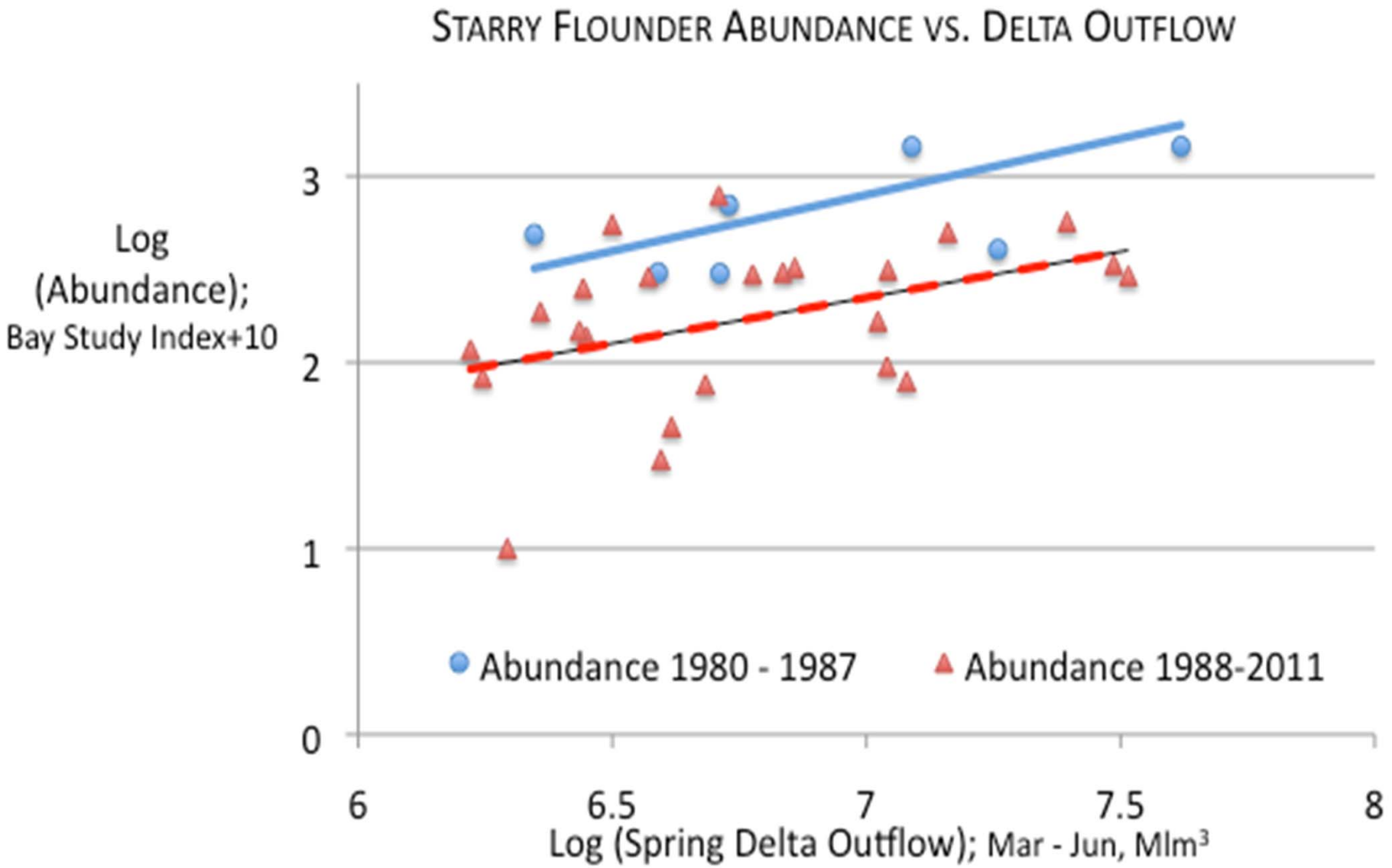
Water Year Type Classifications

- ~20% exceedence categories
- "Super Critical" (SC) = 97.5% exceedence

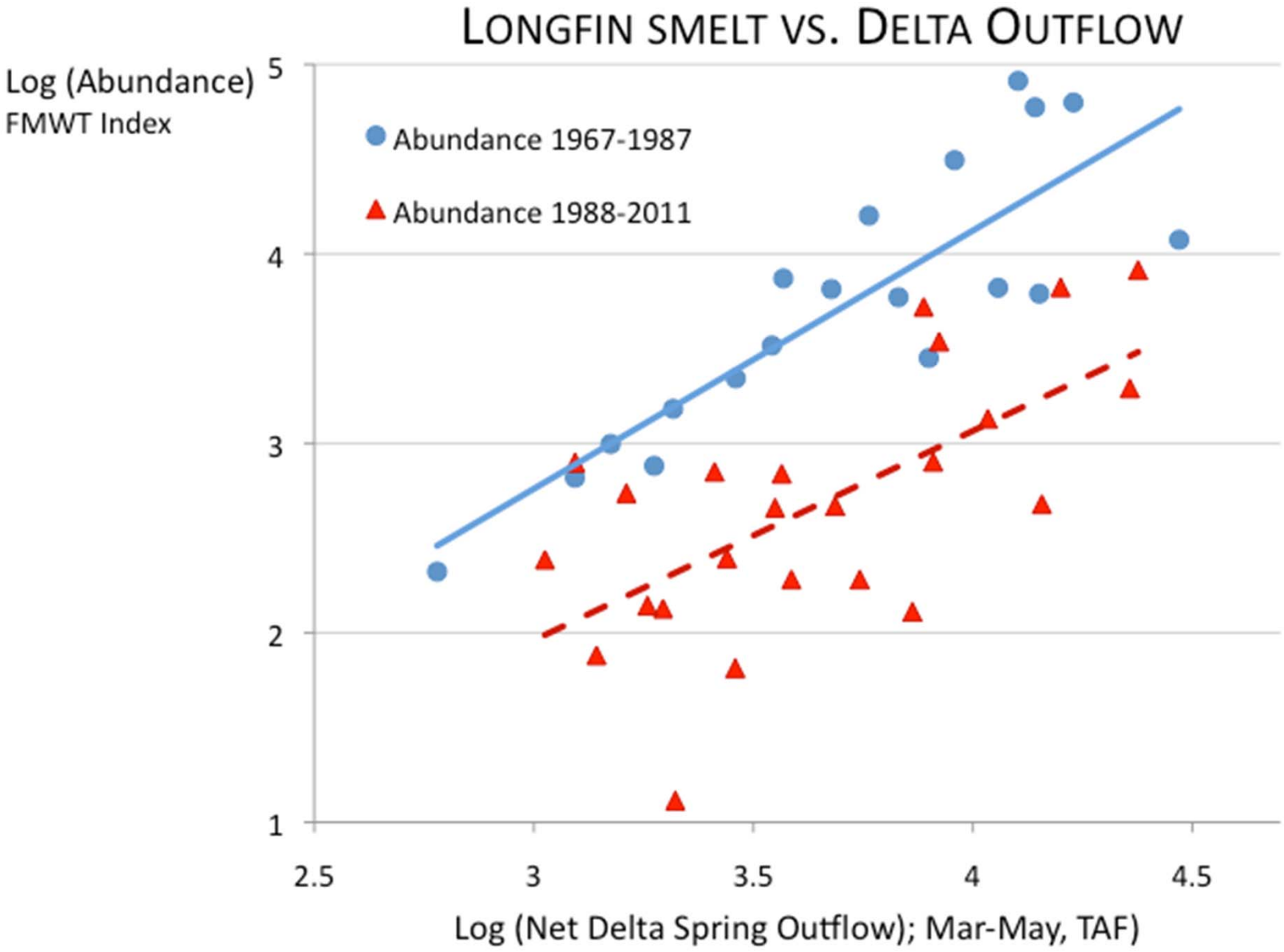
Delta outflows drive species abundance & ecosystem processes



Delta outflows drive species abundance & ecosystem processes



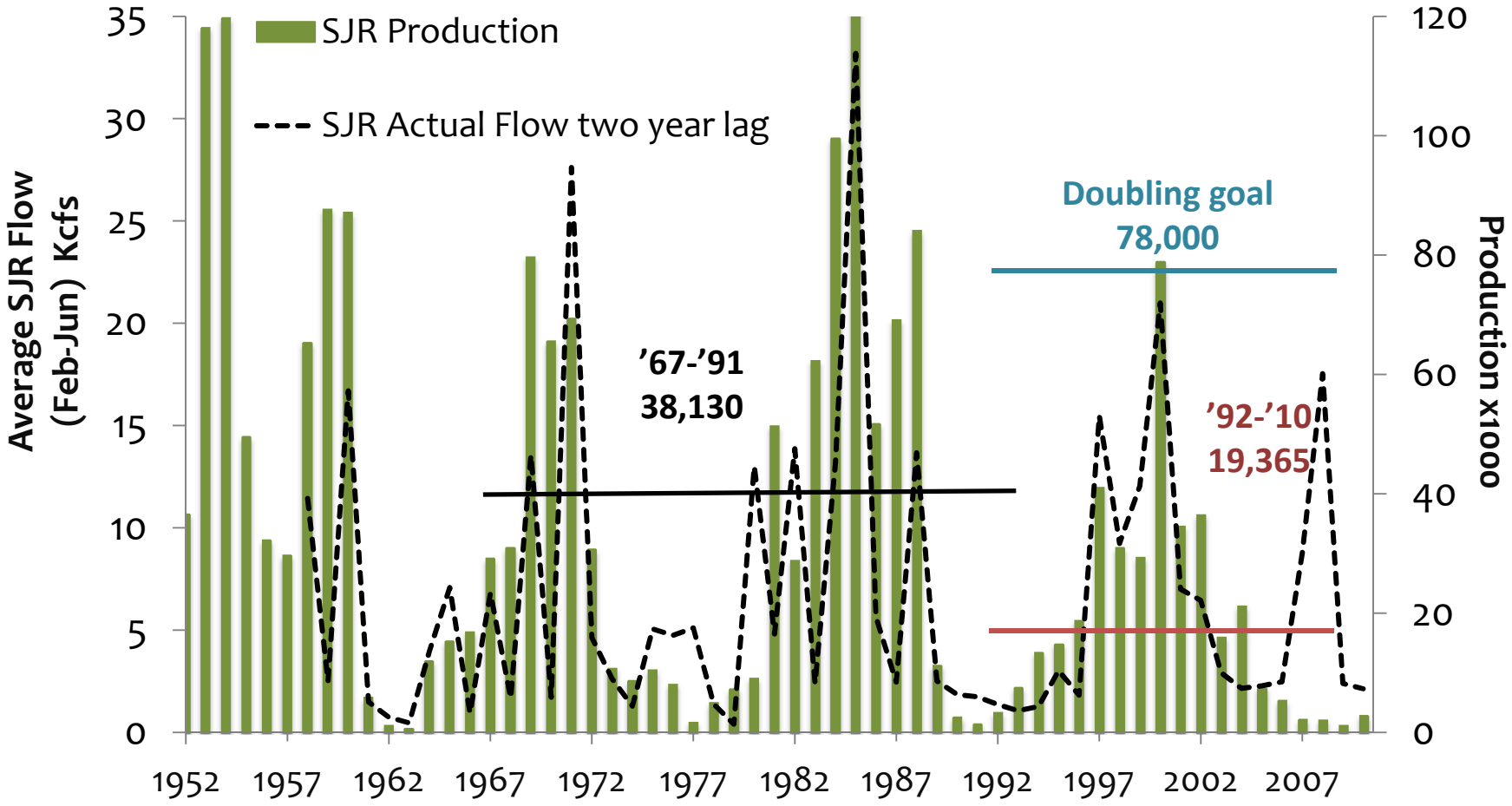
Delta outflows drive species abundance & ecosystem processes



San Joaquin Salmon and Flows

A shared history of decline

San Joaquin River Natural Chinook Salmon Production
vs. Vernalis Flow



What do these declining Delta species have in common?

Species	Native?	Life span (years)	Resident/Migratory?	Spawns Where?	Abundance correlated w/ Delta in-, thru-, out-flow?
Chinook salmon	Yes	3-5	Anadromous	River	**Yes**
Striped bass	No	4-10	Anadromous	River	**Yes**
Green sturgeon	Yes	Decades	Anadromous	River	**Yes**
Delta smelt* (Fall X_2)	Yes	1	Resident	Delta	**Yes**
Longfin smelt	Yes	1-3	Both	Delta/Suisun	**Yes**
Starry flounder	Yes	7-8	Catadromous	Ocean	**Yes**
Sac. Splittail	Yes	5-7	Resident	Shallow FW	**Yes**
Am. Shad	No	5-7	Migratory	River	**Yes**
Bay shrimp	Yes	1.5-2.5	Catadromous	Ocean	**Yes**
Calanoid Copepods	Yes/No	<1	Resident	Varies	**Yes**

Best Available Science Strongly Supports Restoration of Freshwater Flow Patterns as a Necessary for Ecosystem Restoration:

State Water Resources Control Board (2010) *"The best available science suggests that current flows are insufficient to protect public trust resources.* [p.2]

US Fish and Wildife Service (2010) *"…flow in the Delta is one of the primary determinants of habitat availability and one of the most important components of ecosystem function"*

California Department of Fish and Game (2010) *"Recent Delta flows are insufficient to support native Delta fishes in habitats that now exist in the Delta"*.[p. 94]

And

"… restoration for both salmon and steelhead in the SJR primarily hinges on obtaining sufficient magnitude, duration and frequency of spring time flows…"

San Francisco Estuary Project (2011) *"Scientists now consider poor freshwater inflow conditions to be one of the major causes for the ongoing declines of fish populations observed in the upper Estuary* [p.23].

National Research Council (2012) *"… if the goal is to sustain an ecosystem that resembles the one that appeared to be functional up to the 1986-93 drought, exports of all types will necessarily need to be limited in dry years, to some fraction of unimpaired flows that remains to be determined...*" [p. 105]

Problems for the BDCP

- Delta inflow and outflow are unchanged or reduced under most circumstance
  - Negative impacts to flow dependent species, particularly those that rely on Delta outflow

Table 11-4-7. Estimated Differences Between Alternative 4 (Scenario H3) and Baseline for Longfin Smelt Relative Abundance in the Fall Midwater Trawl or Bay Otter Trawl

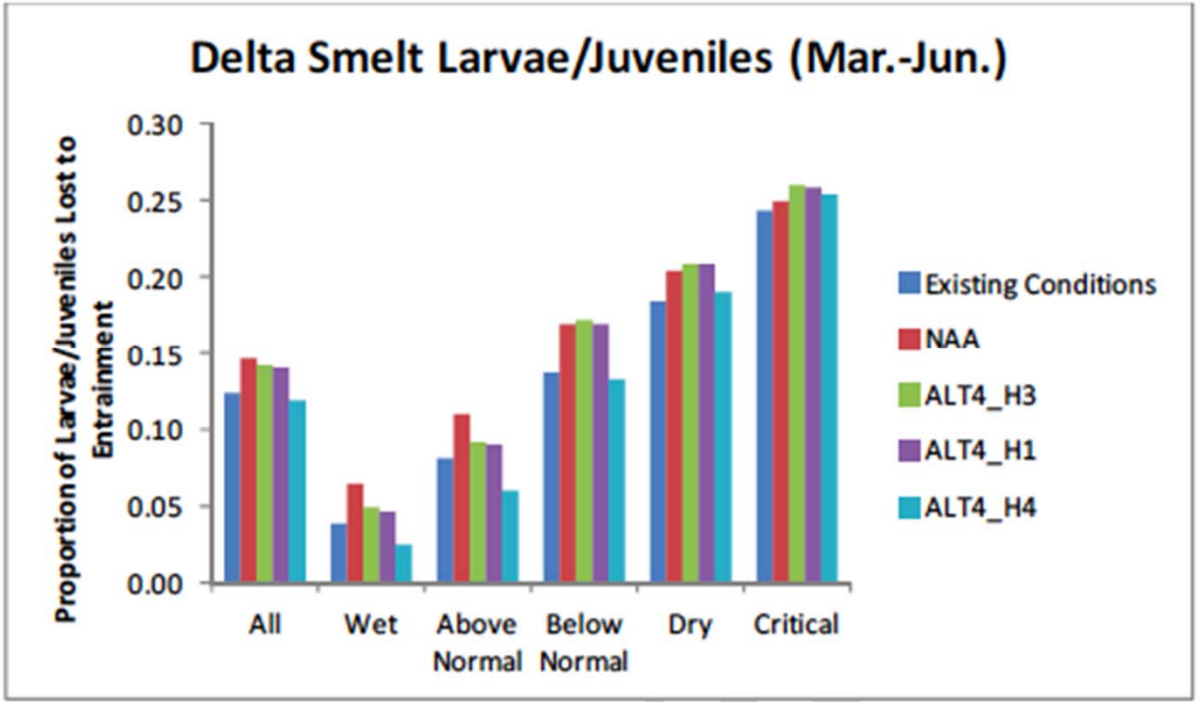
	Fall Midwater Trawl Relative Abundance		Bay Otter Trawl Relative Abundance	
Water Year Type	EXISTING CONDITIONS vs. A4	NAA vs. A4	EXISTING CONDITIONS vs. A4	NAA vs. A4
Scenario H3				
All	-1,604 (-31%)	-127 (-3%)	-5,149 (-36%)	-394 (-4%)
Wet	-6,068 (-33%)	297 (3%)	-24,982 (-39%)	1,166 (3%)
Above Normal	-3,414 (-40%)	-581 (-10%)	-11,999 (-46%)	-1,954 (-12%)
Below Normal	-1,484 (-35%)	-185 (-6%)	-4,569 (-40%)	-549 (-7%)
Dry	-584 (-28%)	-91 (-6%)	-1,576 (-32%)	-240 (-7%)
Critical	-156 (-16%)	-21 (-3%)	-363 (-19%)	-48 (-3%)
Scenario H1 (Low Outflow)				
All	-2,879 (-32%)	157 (3%)	-11,367 (-37%)	836 (5%)
Wet	-6,298 (-33%)	739 (6%)	-26,515 (-38%)	3,367 (8%)
Above Normal	-3,069 (-31%)	-72 (-1%)	-11,361 (-35%)	-224 (-1%)
Below Normal	-1,558 (-35%)	-220 (-7%)	-4,907 (-40%)	-702 (-9%)
Dry	-626 (-27%)	-113 (-6%)	-1,764 (-32%)	-313 (-8%)
Critical	-199 (-19%)	-29 (-3%)	-490 (-23%)	-71 (-4%)
Scenario H4 (High Outflow)				
All	-2,308 (-26%)	727 (12%)	-9,338 (-31%)	2,864 (16%)
Wet	-5,359 (-28%)	1,678 (14%)	-23,092 (-33%)	6,790 (17%)
Above Normal	-2,060 (-20%)	936 (13%)	-7,606 (-24%)	3,531 (17%)
Below Normal	-946 (-21%)	391 (12%)	-2,958 (-24%)	1,246 (16%)
Dry	-519 (-22%)	-6 (0%)	-1,453 (-26%)	-2 (0%)
Critical	-221 (-21%)	-51 (-6%)	-539 (-25%)	-120 (-7%)
	Relative abundance under Alt4 decrease 10% or greater			

Note: Based on the X2-Relative Abundance Regression of Kimmerer et al. (2009).

Operations may not be permitable

Problems for the BDCP

- Entrainment mortality is not significantly reduced for most species
  - Entrainment is not a problem under status quo conditions (???)



Conservation Measure #1 (New North Delta Conveyance) may not be a conservation measure

Problems for the BDCP

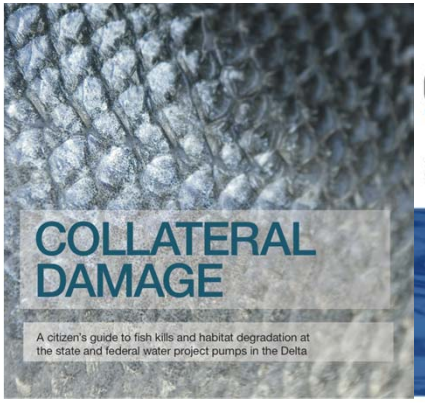
- Effects of Shallow Water Habitat Restorations:
  - Uncertain,
  - Unequally Distributed,
  - Occur in the Distant Future, and
  - Unlikely to Benefit Species that Do Not Use Shallow Water Habitats

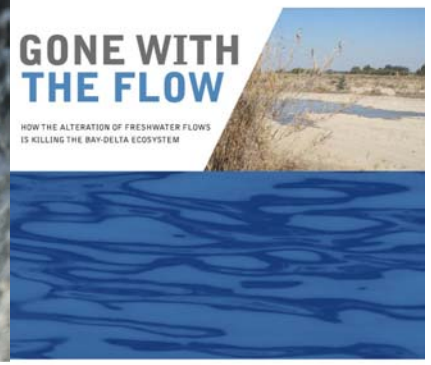
Habitat restoration and improvements to flow are *both* necessary – neither is sufficient alone and their effects are **not** interchangeable

Problems for the BDCP

- Shifting Baselines
  - Incorporates existing Biological Opinions selectively
  - Defines current export baseline differently when evaluating economic v. biological effects
  - Assumes existing infrastructure and operations will not be altered (e.g. in response to regional climate change)
  - Applies threshold of significant impacts in a systematically biased fashion

Administrative Draft Environmental Documents
Not Credible





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