TESTIMONY OF
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BEFORE THE STATE WATER RESOURCES CONTROL BOARD

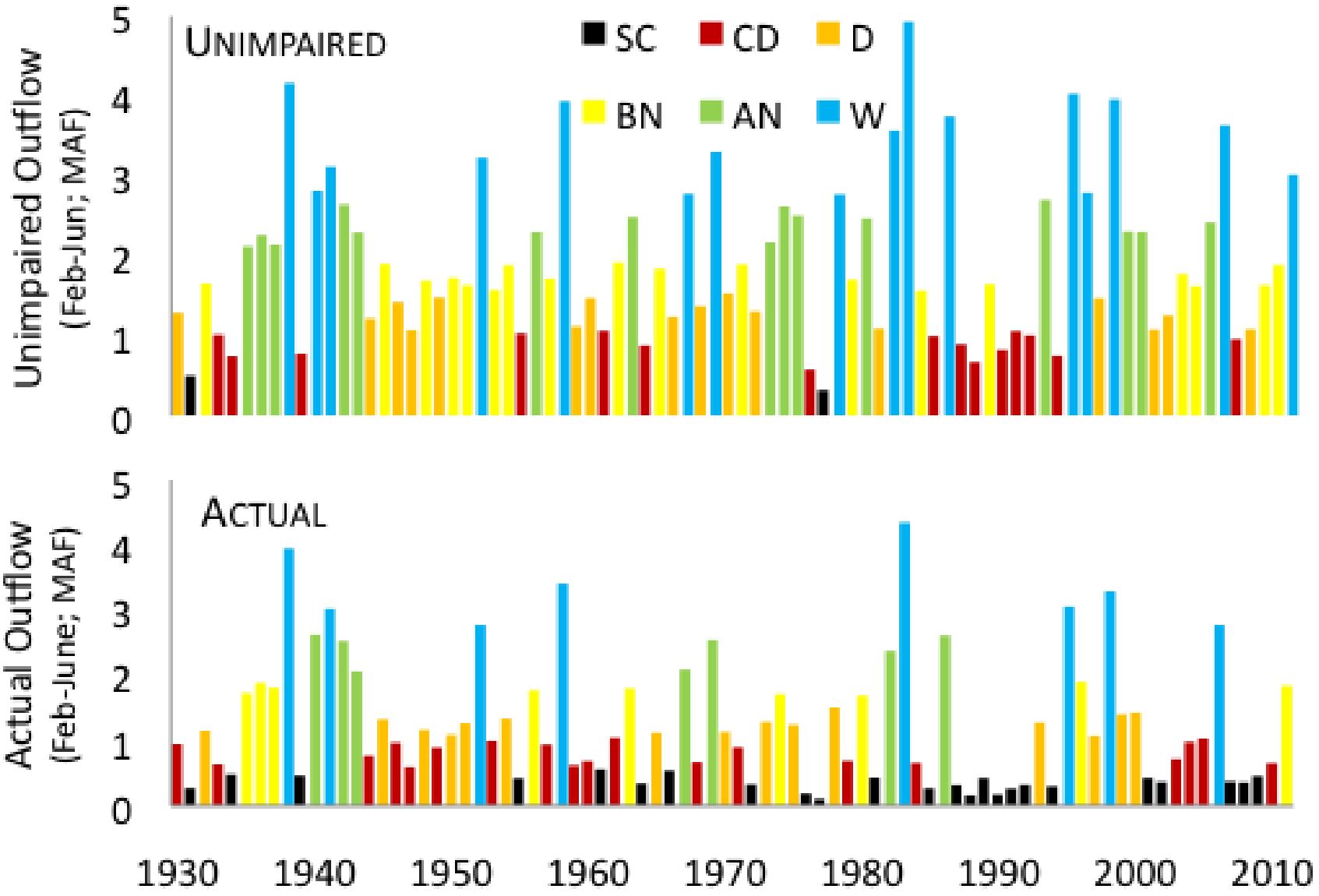
Regarding Flow Criteria for the Bay-Delta
Phase II – Low Salinity Zone

The Bay Institute

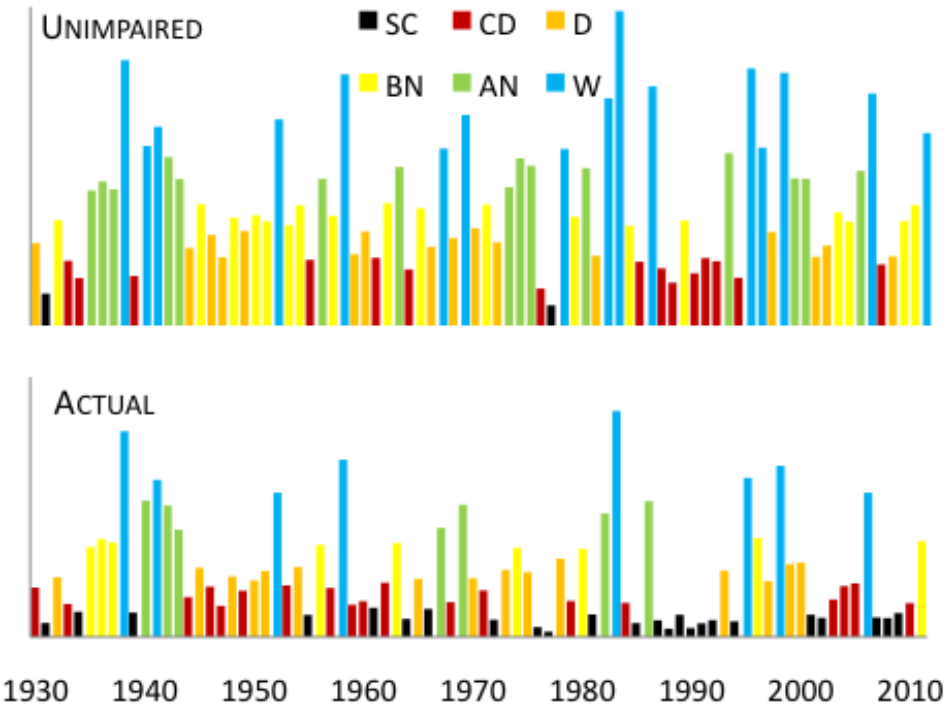
PREPARED FOR:

AMERICAN RIVERS
NATURAL RESOURCES DEFENSE COUNCIL
PACIFIC COAST FEDERATION OF FISHERMENS ASSOCIATIONS

Bay-Delta Subjected to Persistent, Severe Drought



Dramatic Change in Frequency of Wet vs. Catastrophically Dry Years



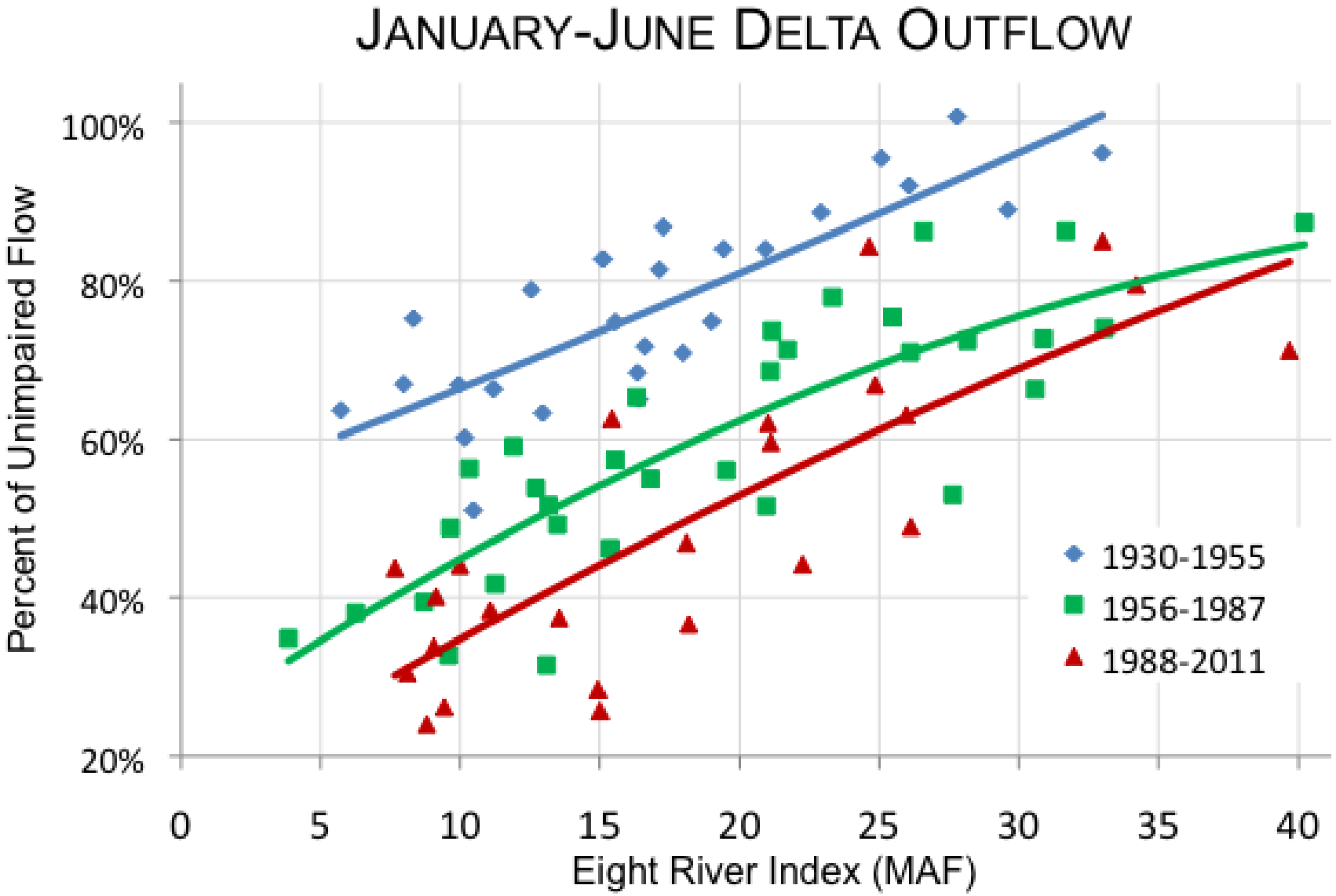
Hydrology Since 1967		
Yr Type	**Unimpaired**	**Actual**
Wet	11	4
Super-Critical	1	17

Water Year Type Classifications

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

Less Water for Fish

(especially when it's dry?!?)



Key Points

- Numerous Delta-dependent species are in long-term decline
- Delta outflows: the "master variable" driving abundance for numerous Delta species & ecosystem processes
- "Non-flow" stressors must be addressed, but they cannot substitute for flow
- Increasing water diversions reduce Delta outflows
- The Board's focus on tracking unimpaired flows is scientifically sound & ecologically appropriate
- The Board should employ adaptive management to adjust flow requirements as needed. This will require:
  - Identification of biological and physical outcome targets that are S.M.A.R.T.
  - Development of decision pathways to implement A.M.
  - Adaptive ranges that *include* flows currently believed necessary to support Public Trust resources

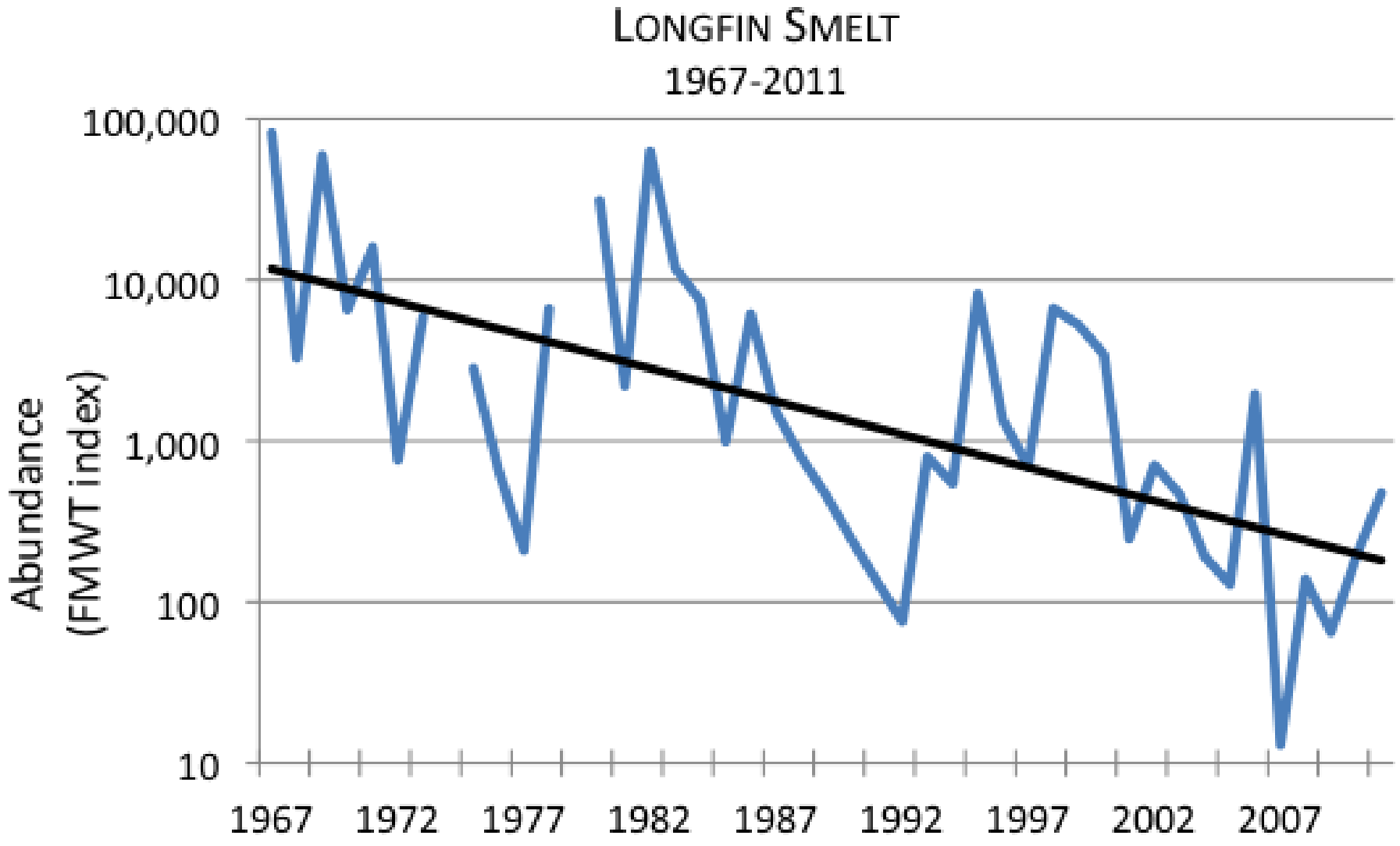
Numerous Delta species are in long-term decline

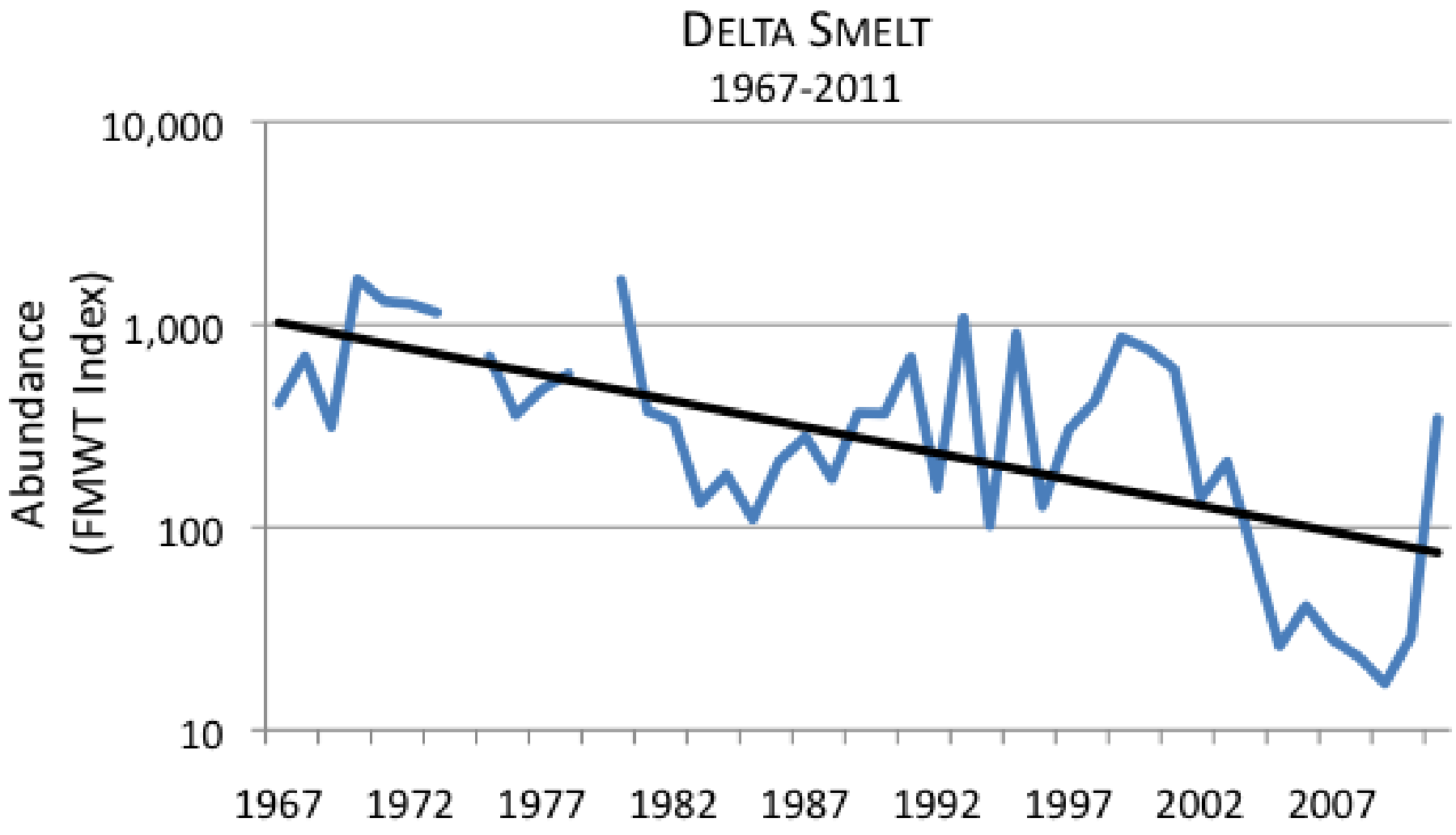
Species protected under the federal or state ESA

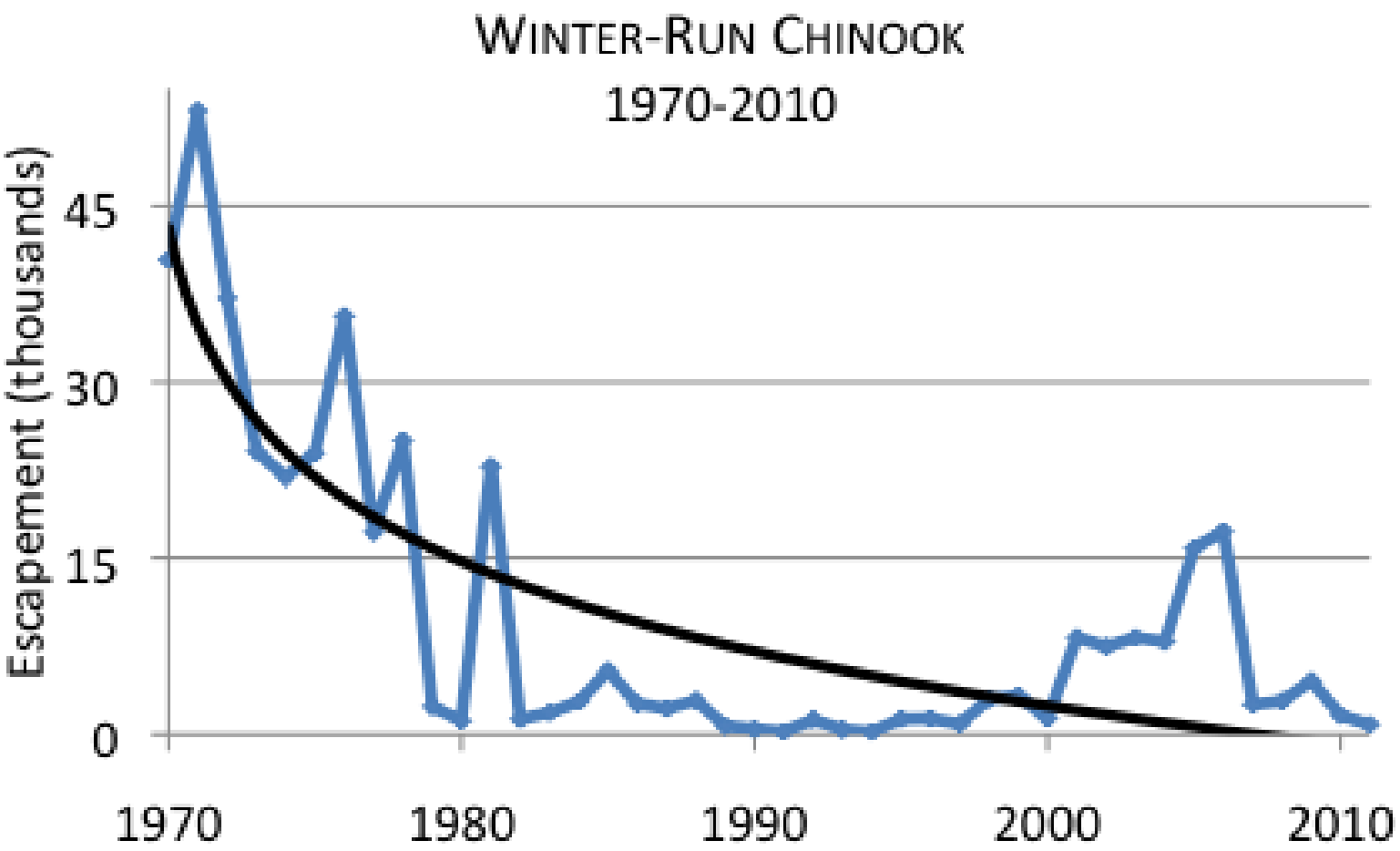
- Winter run Chinook salmon
- Spring run Chinook salmon
- Steelhead
- Green sturgeon
- Delta smelt
- Longfin smelt

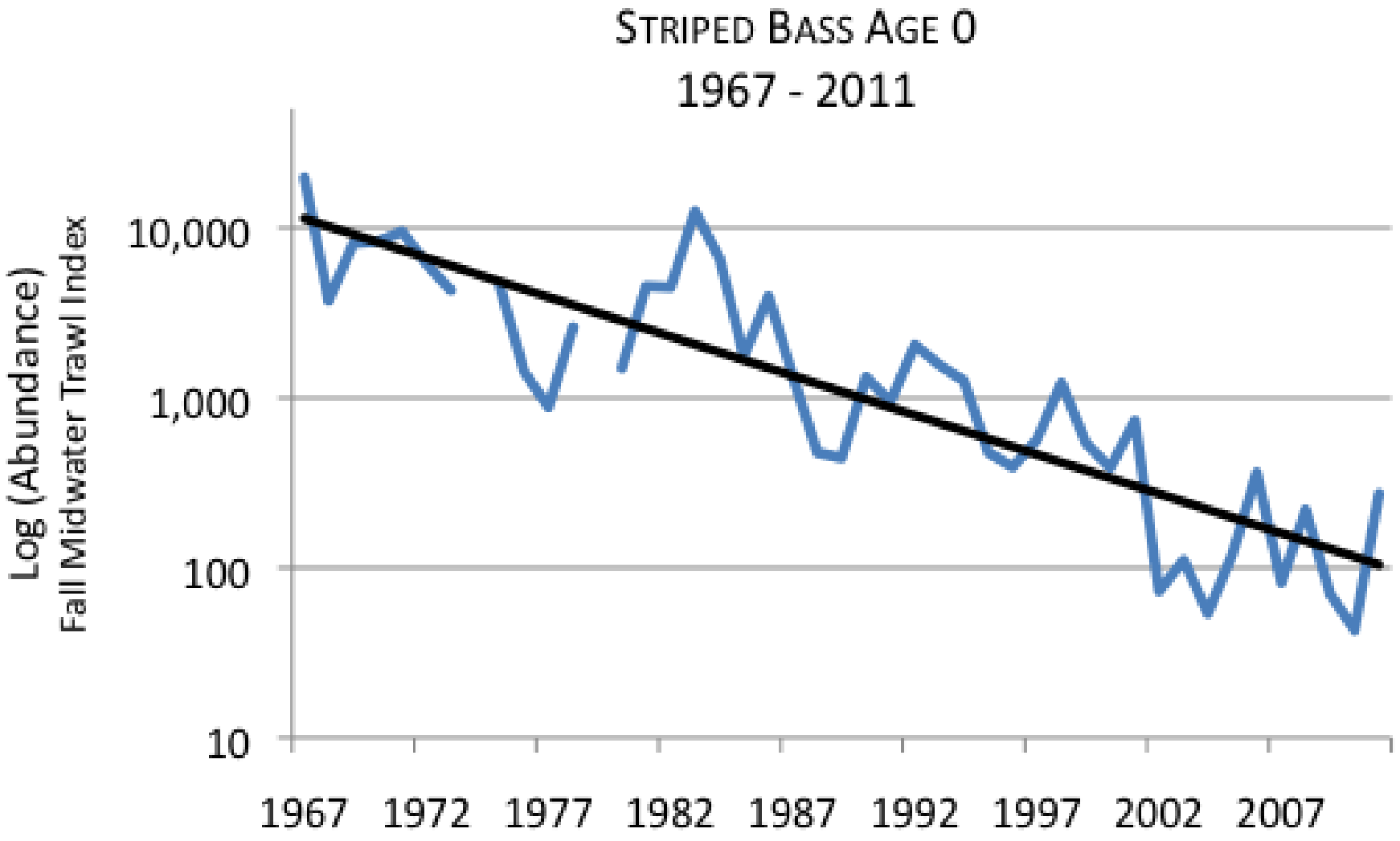
Non-ESA species declining too

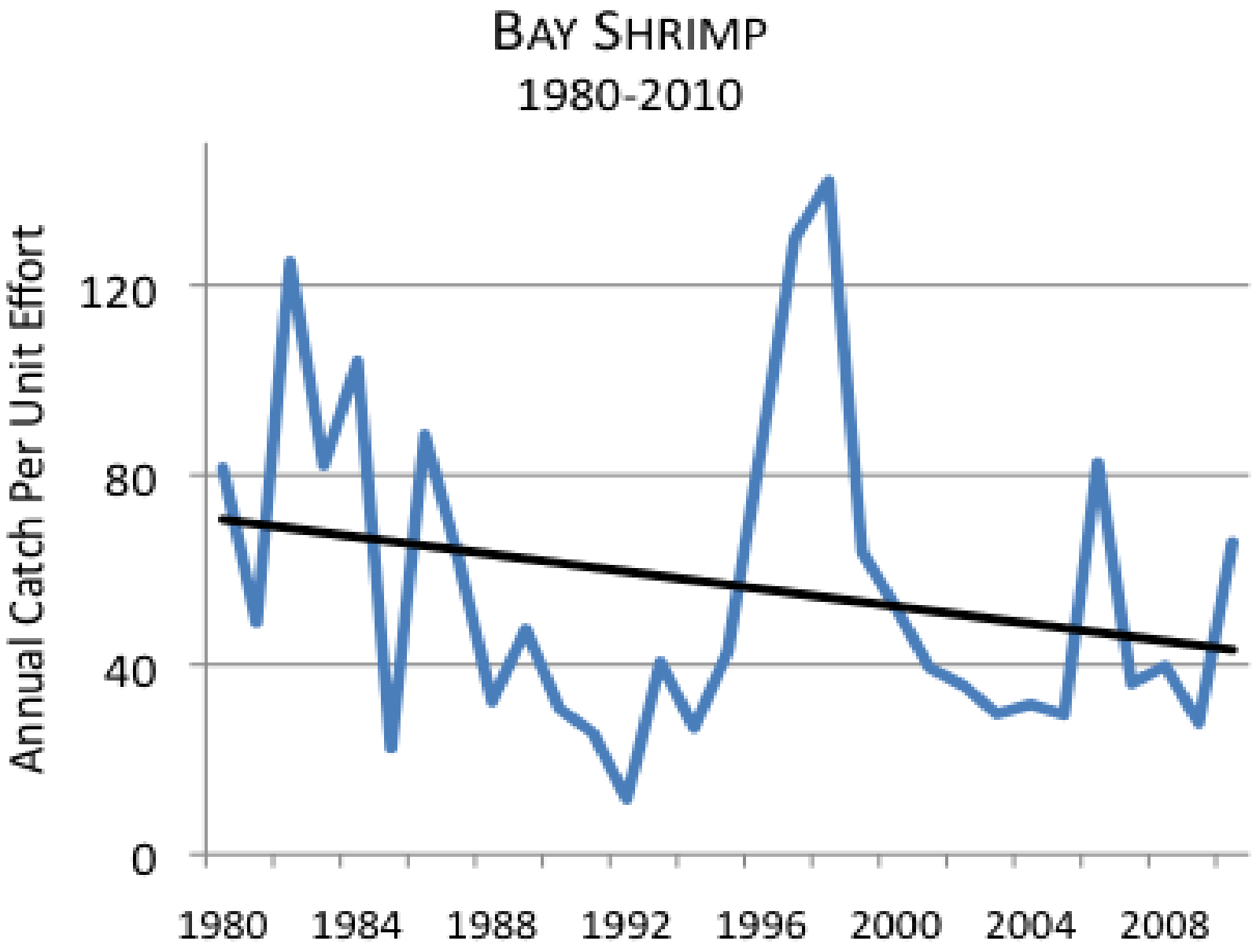
- Fall run Chinook salmon
- Striped bass
- American Shad
- Starry Flounder
- Mysid shrimp
- Bay shrimp
- Numerous invertebrate “prey” species


Longfin Smelt
1967-2011
100,000
10,000
1,000
100
10
Abundance
(FMWT index)
1967
1972
1977
1982
1987
1992
1997
2002
2007


Delta Smelt
1967-2011
10,000
1,000
100
10
Abundance
(FMWT Index)
1967
1972
1977
1982
1987
1992
1997
2002
2007


WINTER-RUN CHINOOK
1970-2010
Escapement (thousands)
45
30
15
0
1970
1980
1990
2000
2010

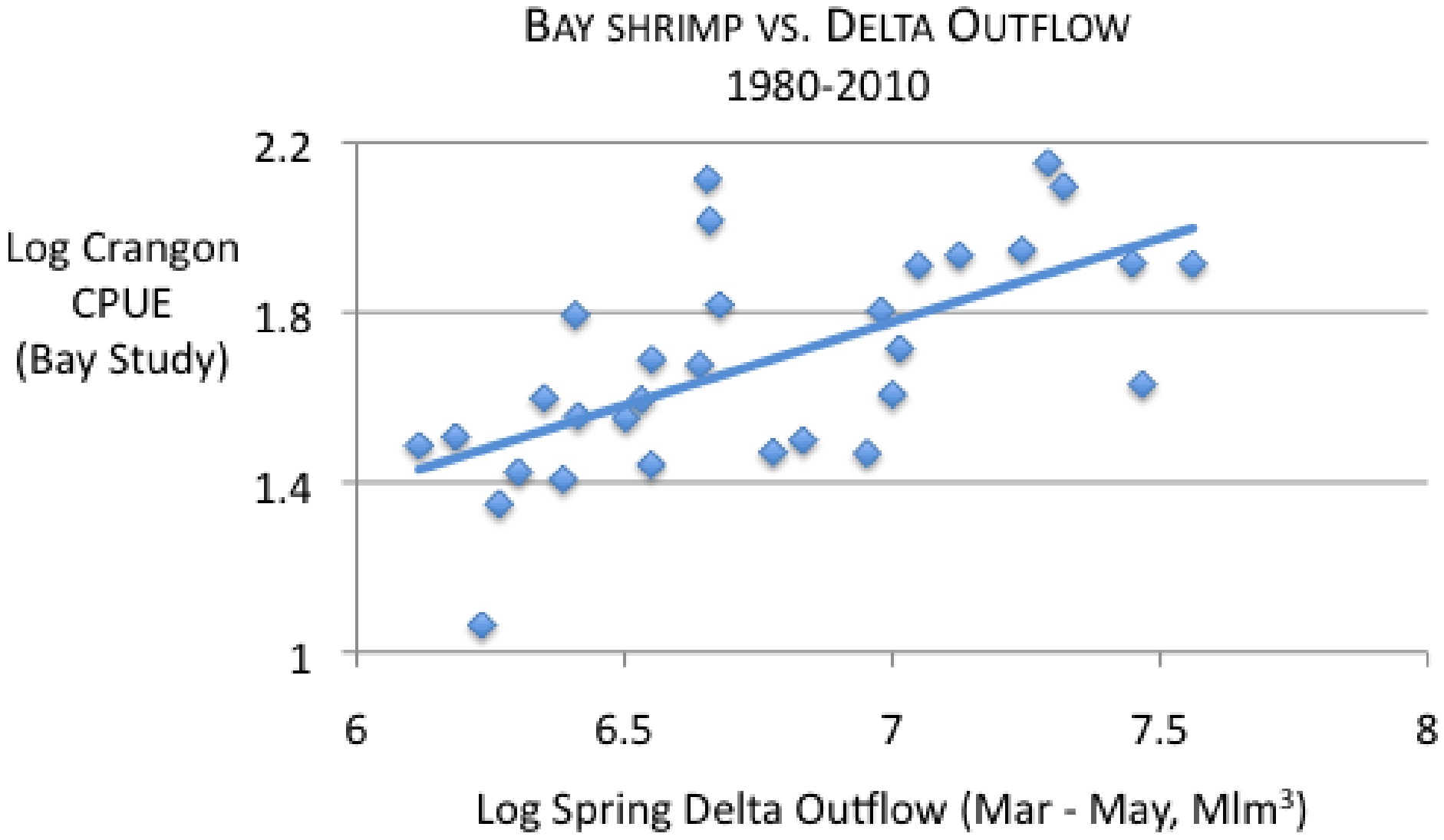

STRIPED BASS AGE 0
1967 - 2011
Log (Abundance)
Fall Midwater Trawl Index
10,000
1,000
100
10
1967
1972
1977
1982
1987
1992
1997
2002
2007

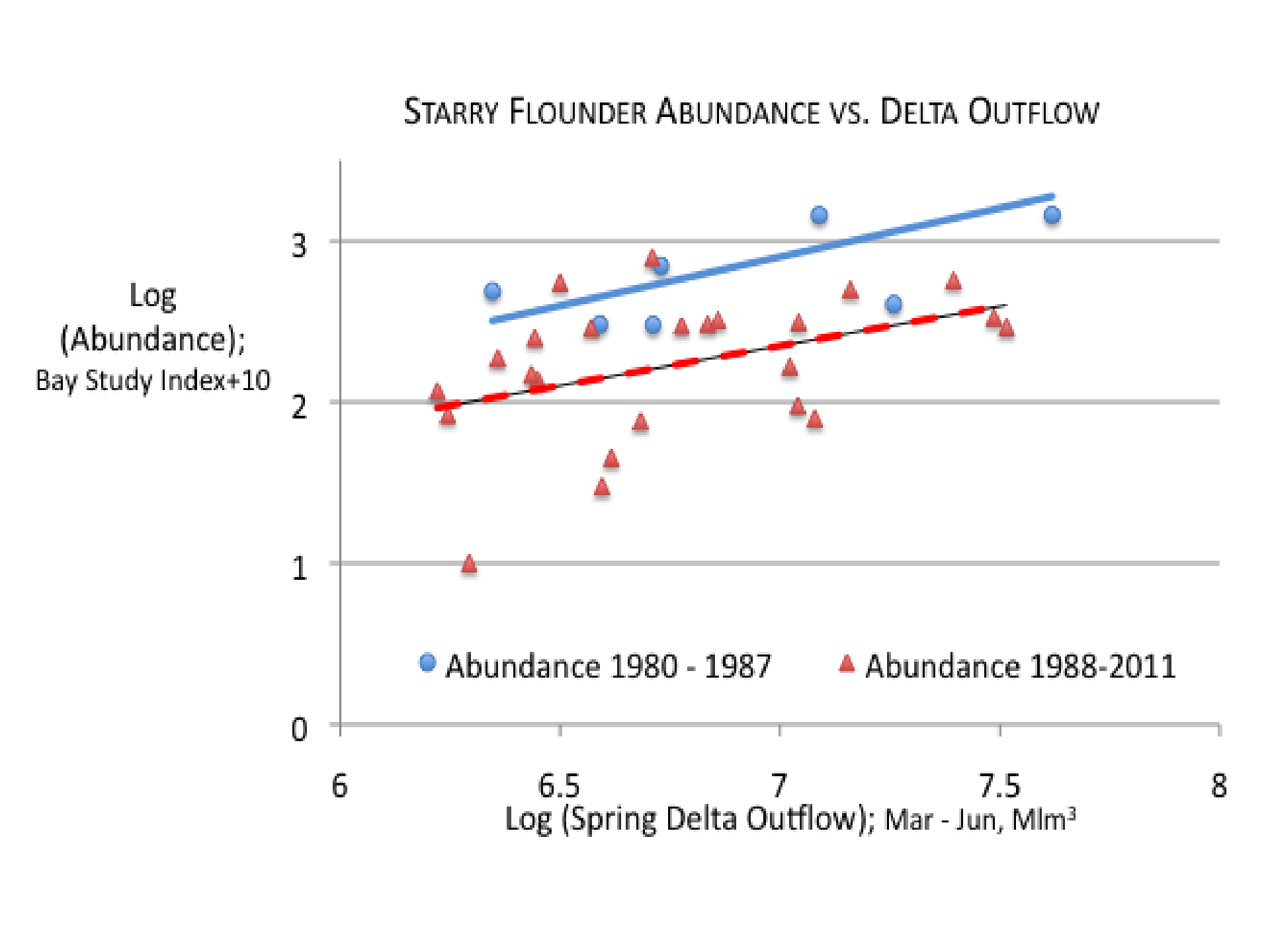

Bay Shrimp
1980-2010
Annual Catch Per Unit Effort
120
80
40
0
1980
1984
1988
1992
1996
2000
2004
2008

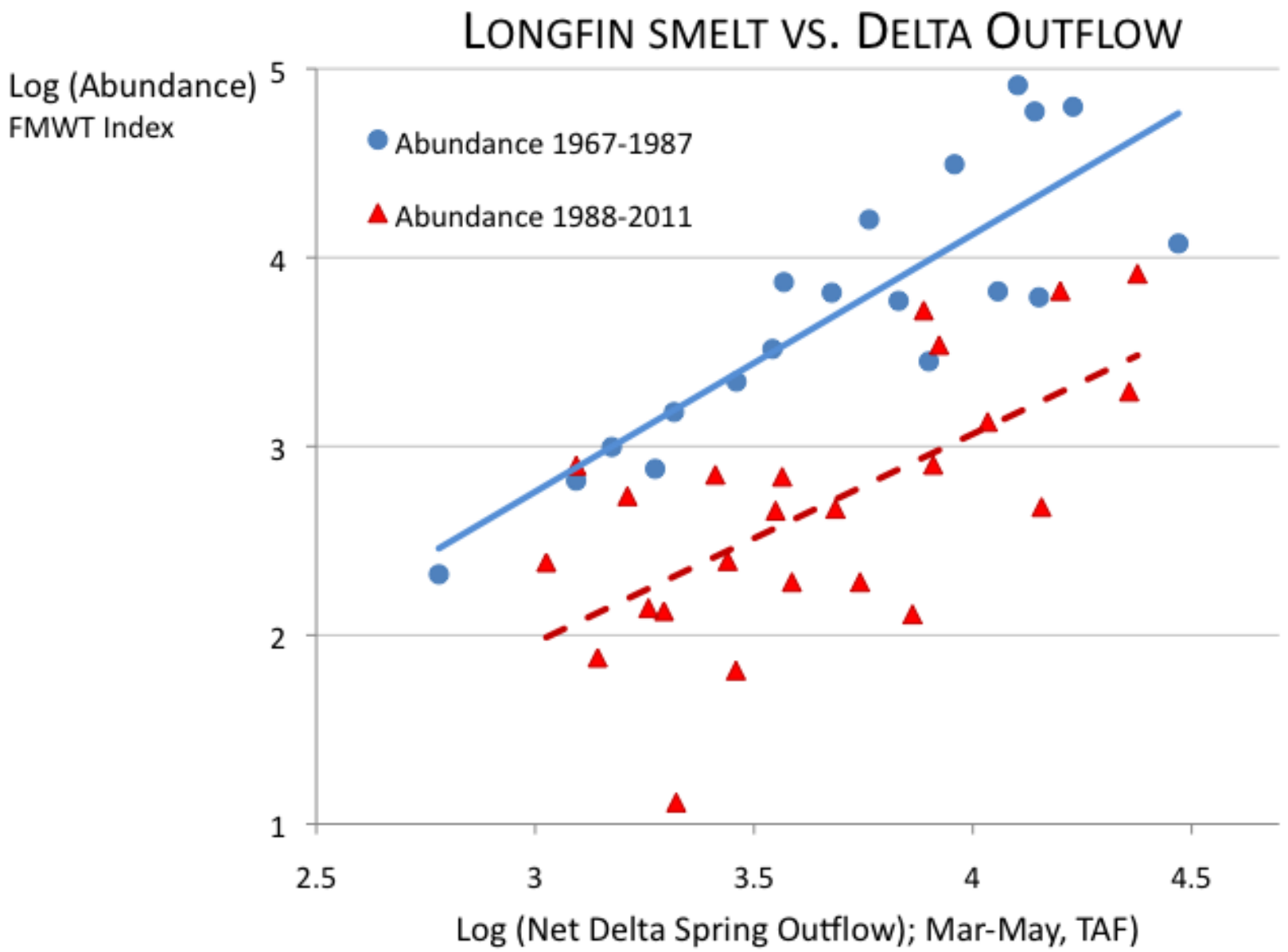
What do these species have in common?

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**

Delta outflows drive species abundance & ecosystem processes



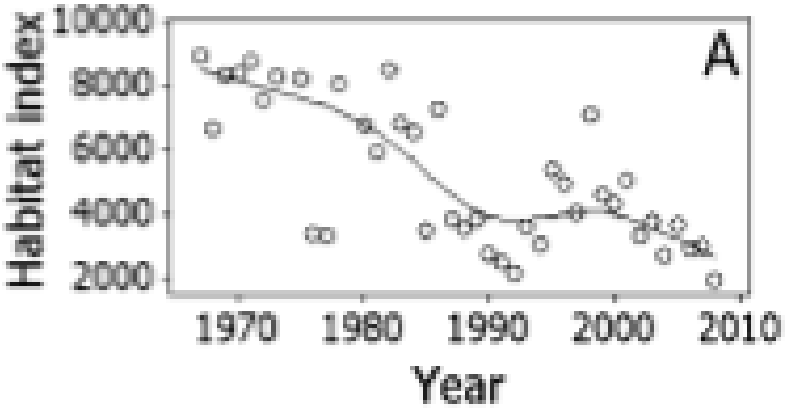

STARRY FLOUNDER ABUNDANCE VS. DELTA OUTFLOW
Log (Abundance); Bay Study Index+10
3
2
1
0
6
6.5
7
7.5
8
Log (Spring Delta Outflow); Mar - Jun, Mlm³
Abundance 1980 - 1987
Abundance 1988-2011



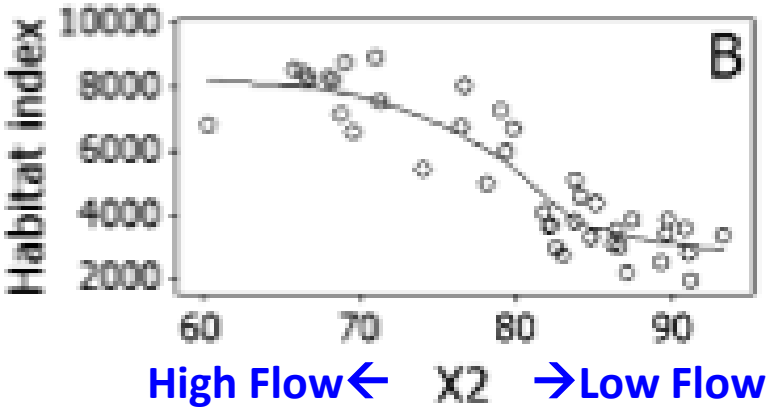
Strong flow-abundance relationship persists today:

Kimmerer 2002; Rosenfield & Baxter 2007; Sommer et al 2007; Kimmerer et al. 2009; Mac Nally et al 2010; Thomson et al. 2010; TBI et al. 2010; Rosenfield et al. in prep

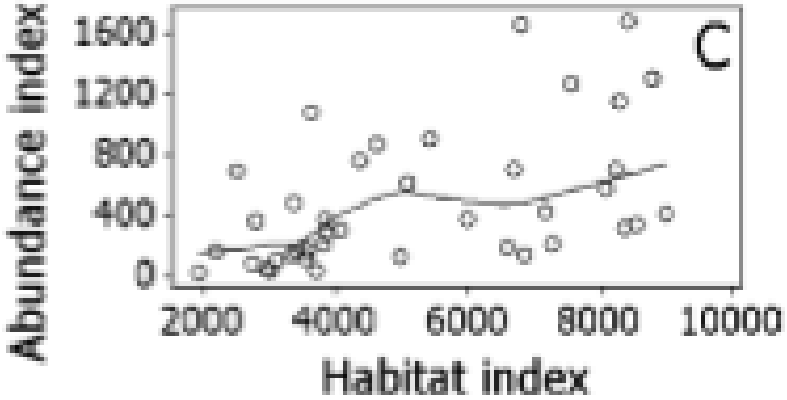
Delta smelt vs. Fall X_2 – Historical Correlation



Fall habitat declines steadily through time



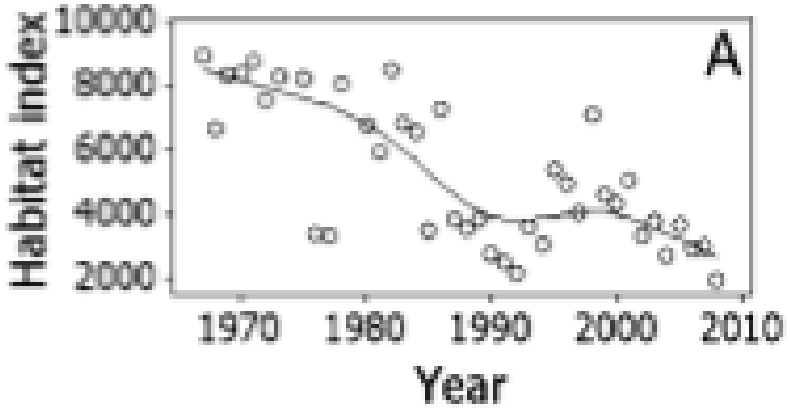
Fall habitat is a function of Delta outflow (~X_2)

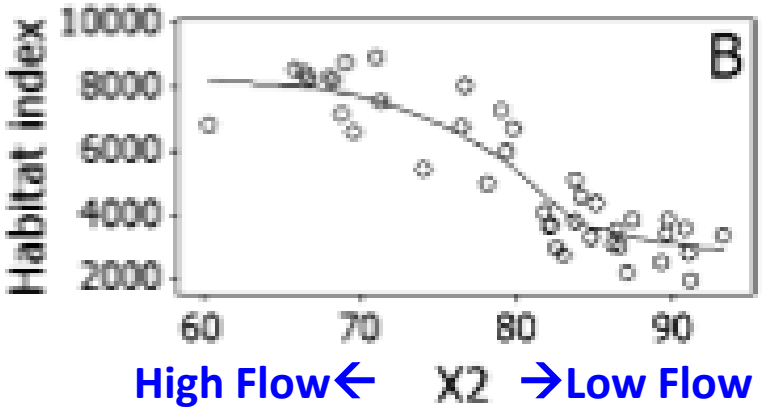


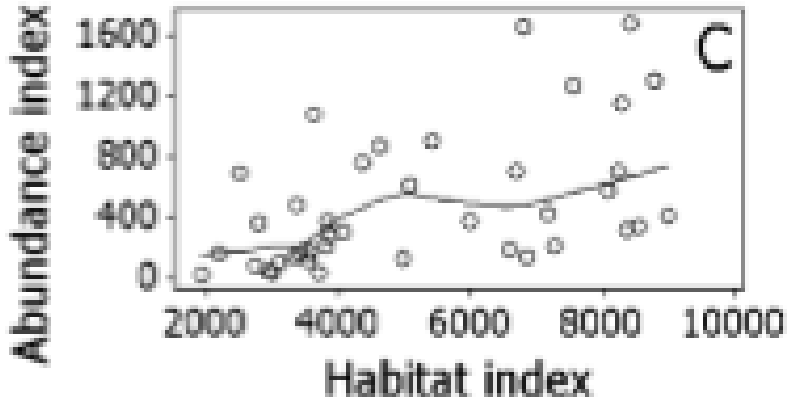
As fall habitat increases, higher abundances are possible and lower abundances are far less frequent

Modified from Feyrer et al (2010)

Delta smelt Fall X_2 – Targeted Research 2011







Preliminary results from year 1 of study suggest lower fall X_2 may:

- increase Delta smelt abundance & growth rates
- reduce clam grazing
- increase phytoplankton blooms

[*Sources:* Brown et al 2012; Thompson et al 2012; Teh et al 2012; Baxter et al 2012)

Figure modified from Feyrer et al (2010)

Mechanisms linking freshwater flow to viability (their use and abuse)

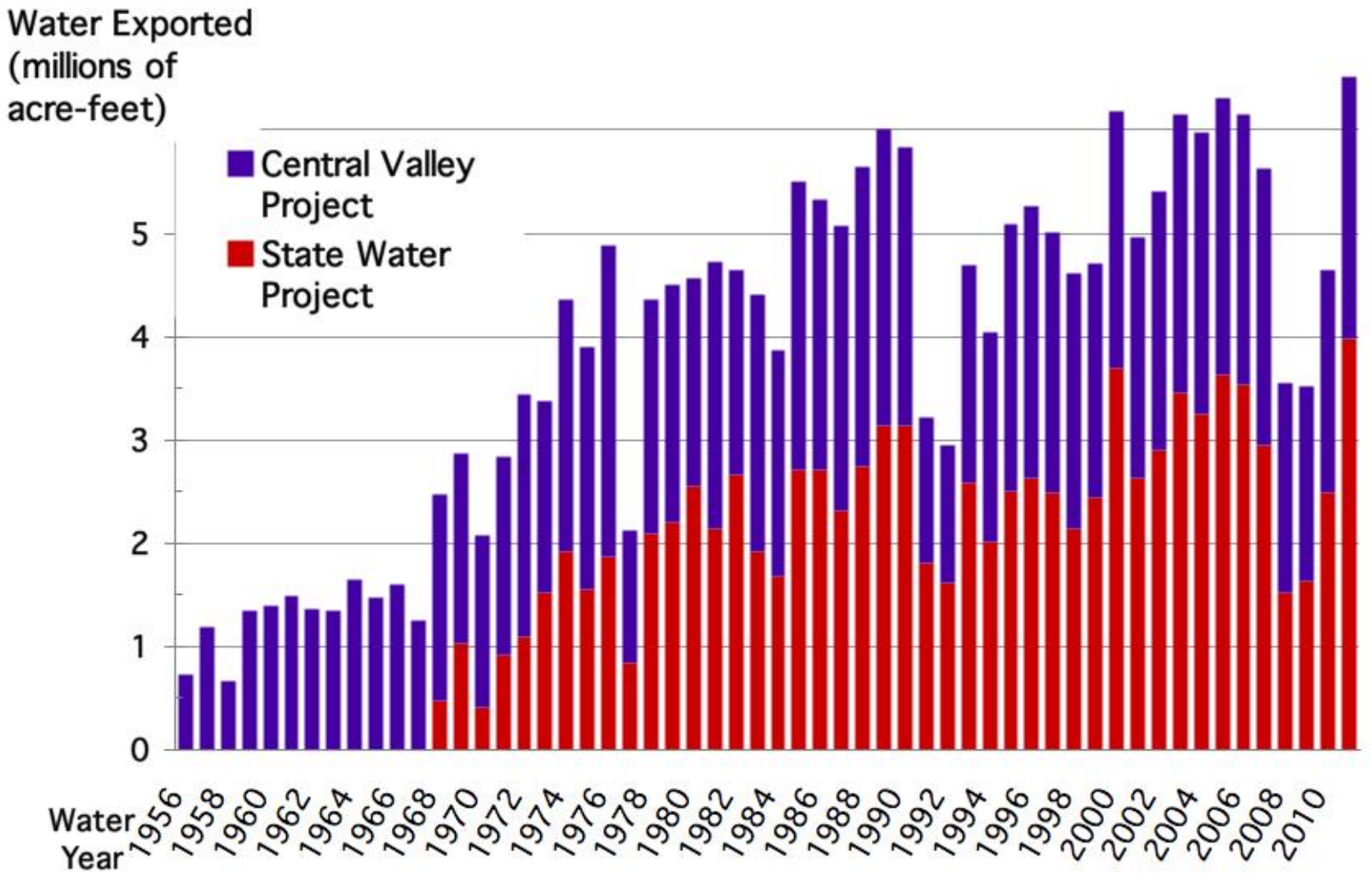
Questions:

1) Is the hypothetical mechanism for a given decline consistent observed patterns in the Delta?
   - Long and short-term multi-species declines?
   - Correlations between flow and abundance?

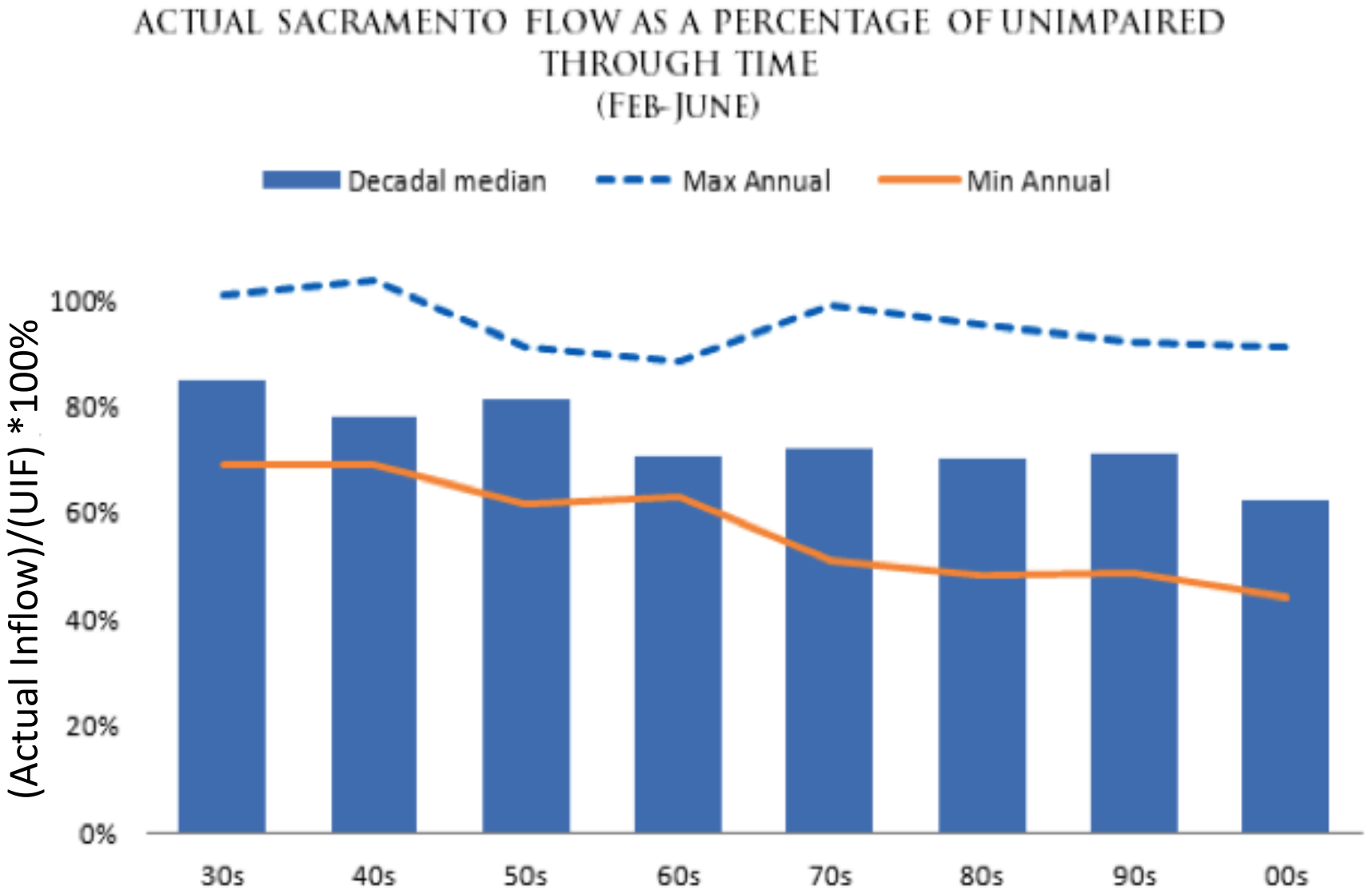
2) Can we manage Public Trust resources better by divorcing the mechanism from its connection to freshwater flow?
   - Can the mechanism be manipulated independent of flow?
   - How certain are we that a non-flow mechanism will work?
   - How long will it take to find out?

"… *flow and physical habitat interact in many ways, but they are not interchangeable*." State Board 2010, p.1

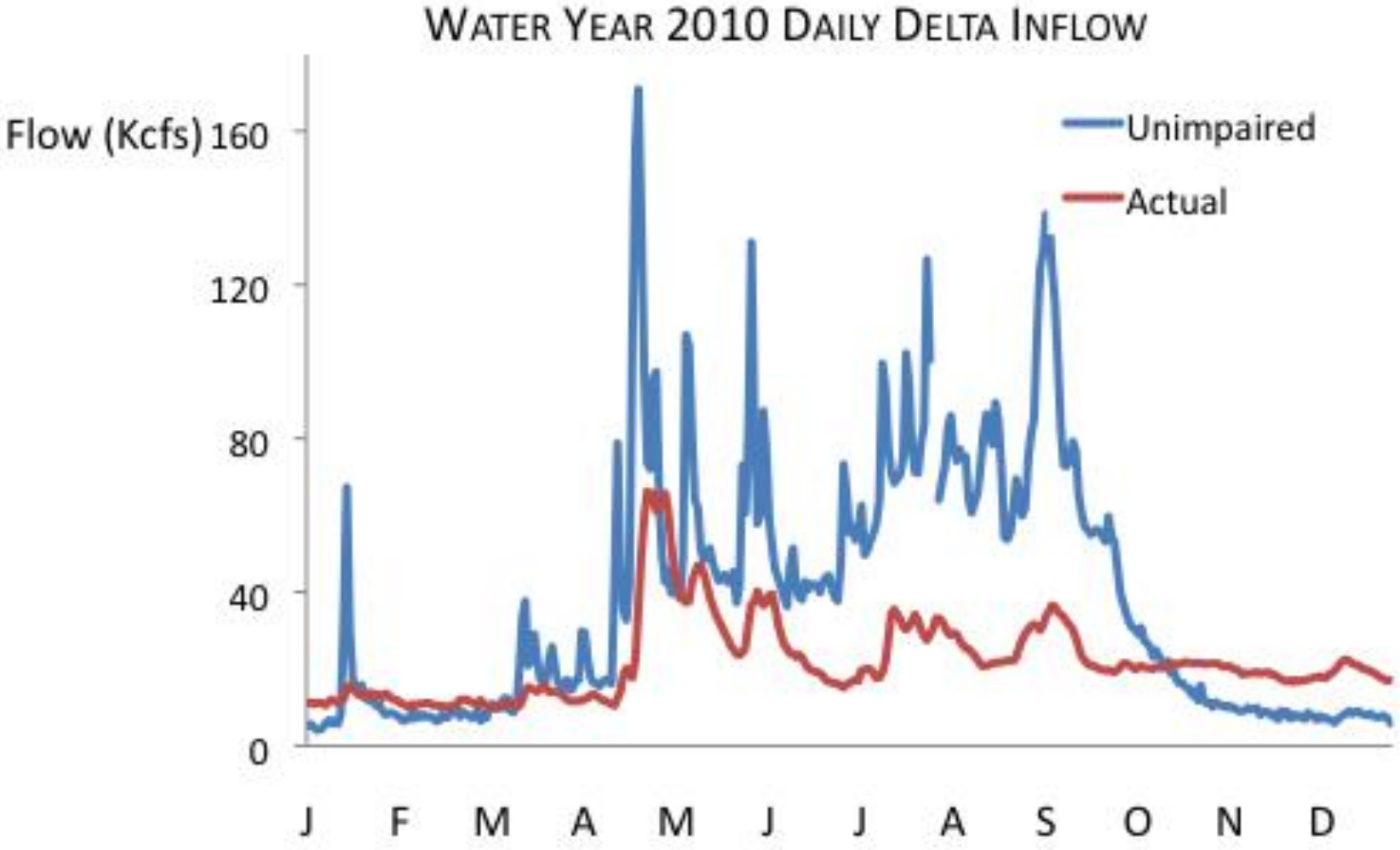
Increasing water diversions reduce Delta outflows, causing a perpetual drought for the ecosystem



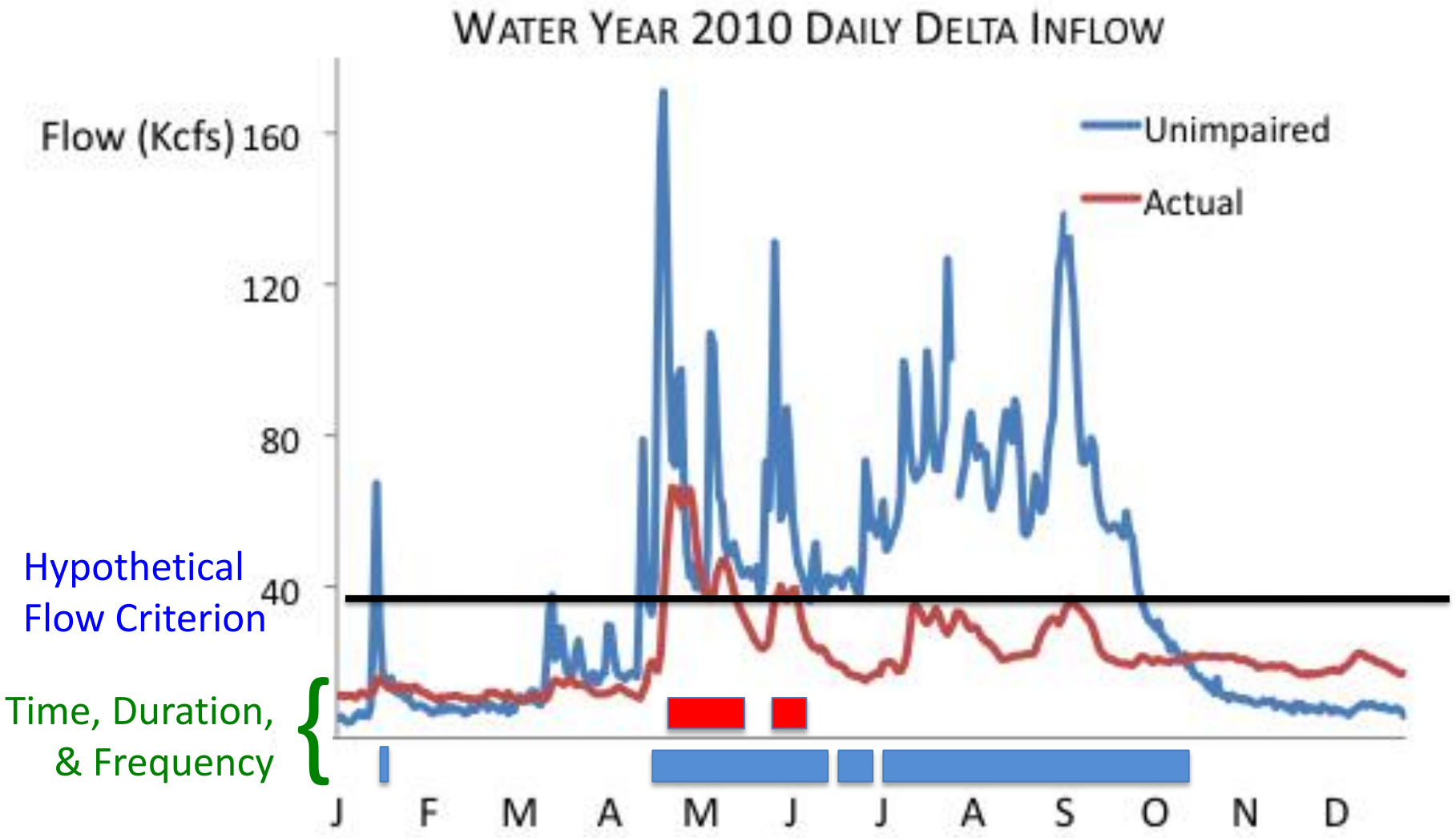
Upstream diversions reduce Delta inflow (and outflow)



Timing, duration, & frequency of critical flows as important as magnitude



Timing, duration, & frequency of critical flows as important as magnitude



Best Available Science Strongly Supports Flow Standards Based on:

- % Unimpaired Flow
- Narrow time window for averaging flows

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. Setting this level, as well as flow constraints for wetter years… is best done by the SWRCB, which is charged with protecting both water rights holders and the public trust*." [p. 105]

Best Available Science Strongly Supports Flow Standards Based on:

- % Unimpaired Flow
- Narrow time window for averaging flows

Richter et al. (2012) *"…a large body of scientific literature supports the 'natural flow paradigm' as an important ecological objective to guide river management*

The [percentage of flow] approach has several strong advantages over other approaches…[it] *is considerably more protective of flow variability than the minimum threshold standards. Minimum-threshold-based standards can allow flow variability to become 'flat-lined' as water allocation pressure increases and reservoir operations are designed only to meet minimum release requirements. …"*

Adaptive Management

Flow Standards are potentially well-suited to Adaptive Management

- Freshwater flow standards potentially have high magnitude and high certainty of positive effect
- They may be implemented (and revised) rapidly
- Changes do not involve abandoning sunk costs
- Costs and impacts can be distributed equitably

Adaptive Management

The 2010 flow criteria may not be sufficient to attain desired outcomes (or they may be more than enough)

- 75% Unimpaired Flow → low compared to standards elsewhere

"…recommendations for flow protection … typically resulted in a range of allowable cumulative depletion of 6% to 20% of normal to low flows… A moderate level of protection is provided when flows are altered by 11–20%... Alterations greater than 20% will likely result in moderate to major changes in natural structure and ecosystem functions…" [Richter et al. 2011]

"There is sufficient scientific information to support the need for increased flows to protect public trust resources; while there is uncertainty regarding specific numeric criteria, scientific certainty is not the standard for agency decision making." State Board 2010, p.4

Adaptive Management Requires Development of:

1) Logical & transparent planning framework (eg. Logic Chain)
    - Articulates desired outcomes, key assumptions, and uncertainties to be studied and narrowed
    - Actions, adaptations, and efforts to reduce uncertainty are in service to achieving pre-determined outcomes (Goals) which are defined by S.M.A.R.T. (Specific, Measureable, Achievable, Relevant (to the Goal), & Time Bound) Targets
2) Clear decision pathways (e.g. management triggers)
    - When will progress be evaluated? What circumstances call for a change? Who makes that decision? Based on what information?
3) Adaptive ranges that do not fall short of minimum flow criteria needed to attain ecological goals & SMART targets

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