From: Deirdre Des Jardins <ddj@cah2oresearch.com>
Sent: Wednesday, May 22, 2024 1:40 PM
To: Delta Council ISB <DeltaCouncilISB@deltacouncil.ca.gov>

Subject: Fwd: Western NA hydroclimate could be shifting back to a wet regime. What does that mean for the Delta ecosystem?

Question I asked Rosemary Hartman on climate shifts and regime shifts in the Delta.

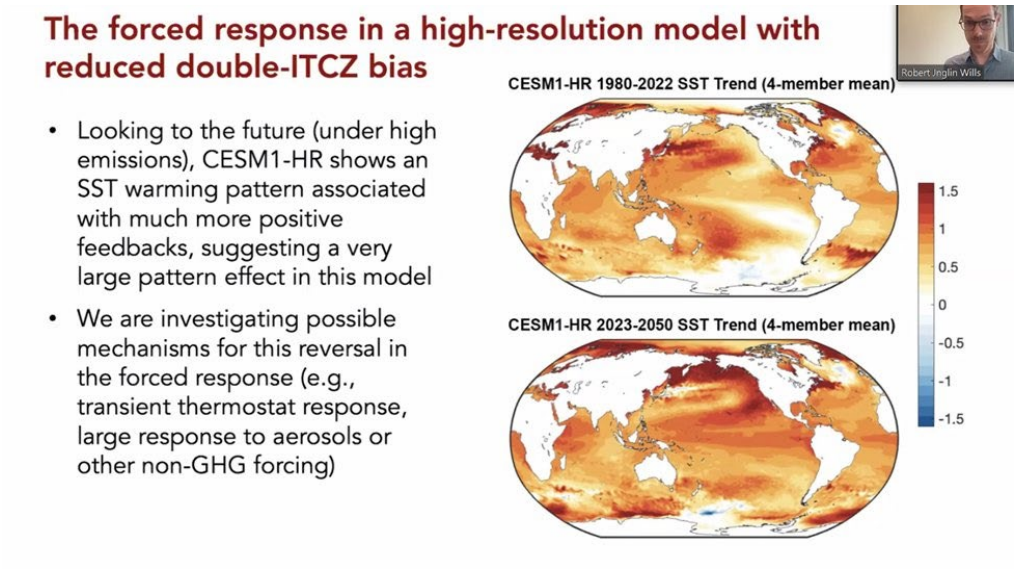
The more fundamental question is whether the climate shifts are resulting in shifts in the ecosystem response. This also be something to think about in response to the food web review.

---------- Forwarded message ---------
From: **Deirdre Des Jardins** <ddj@cah2oresearch.com>
Date: Wed, May 1, 2024 at 10:23 AM
Subject: Western NA hydroclimate could be shifting back to a wet regime. What does that mean for the Delta ecosystem?
To: Hartman, Rosemary@DWR <Rosemary.Hartman@water.ca.gov>

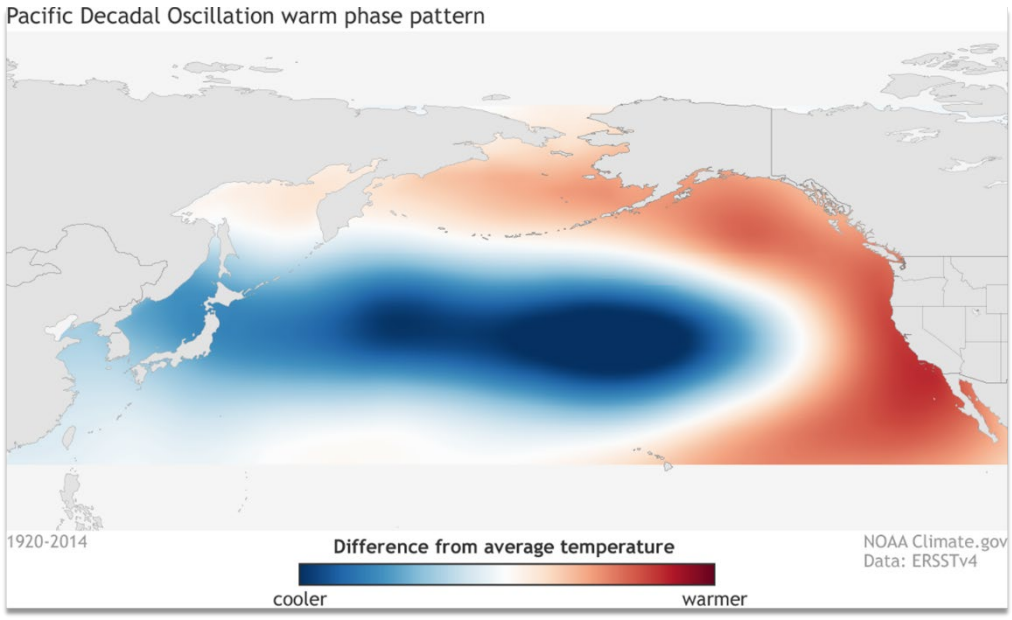
Hi Rosie

I just saw a [fire emoji fire emoji fire emoji] presentation by a leading climate dynamics researcher, Robert Jngln Wills, which indicated that our western North American climate could shift from the drier, droughtier 21st century precipitation regime to a wetter regime. I wanted to get you the info and also ask you about the wet and dry Delta ecosystem regimes that you found in the 2022 drought synthesis work that you led.

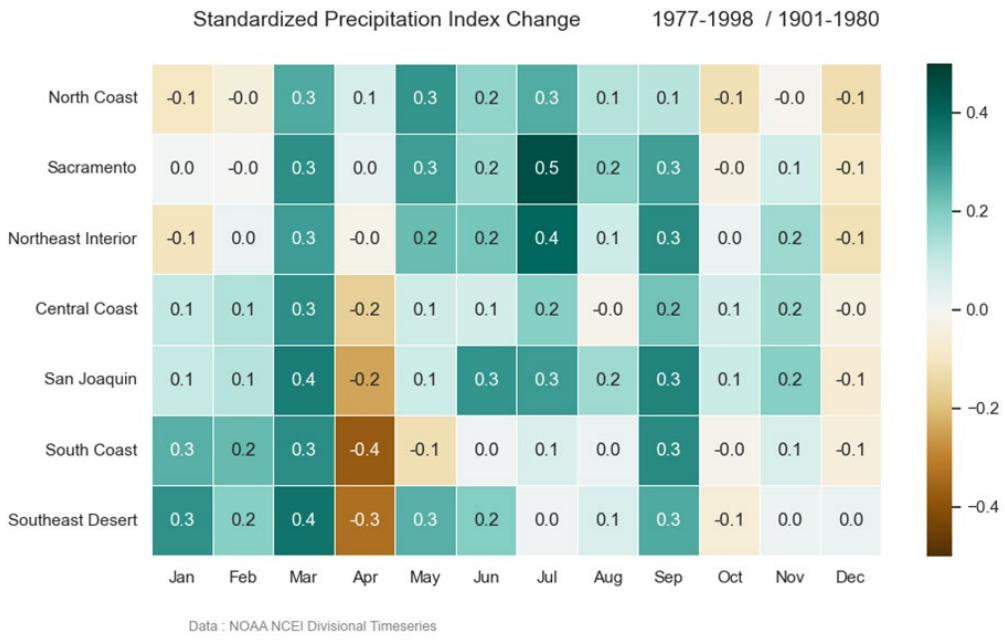
Wills presented the results of a new, very high-resolution modeling with the CESM1 global climate model showing forcing over the next three decades towards an El Nino like, warm Pacific Decadal Oscillation pattern in the eastern Pacific. This would be a reversal from the forced response in recent decades, which has been towards a cooler, La Nina like pattern with a cool PDO, associated with the megadrought in the Southwest.



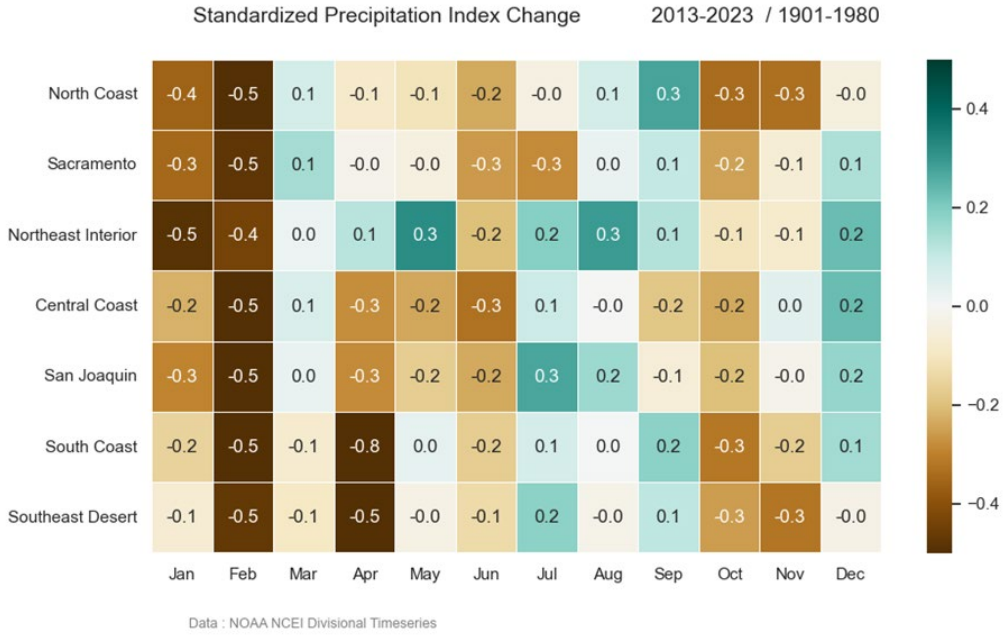
This is what the warm phase of the Pacific Decadal Oscillation looks like. Years with both a warm PDO and an El Nino have a higher probability of being wet years in western North America.



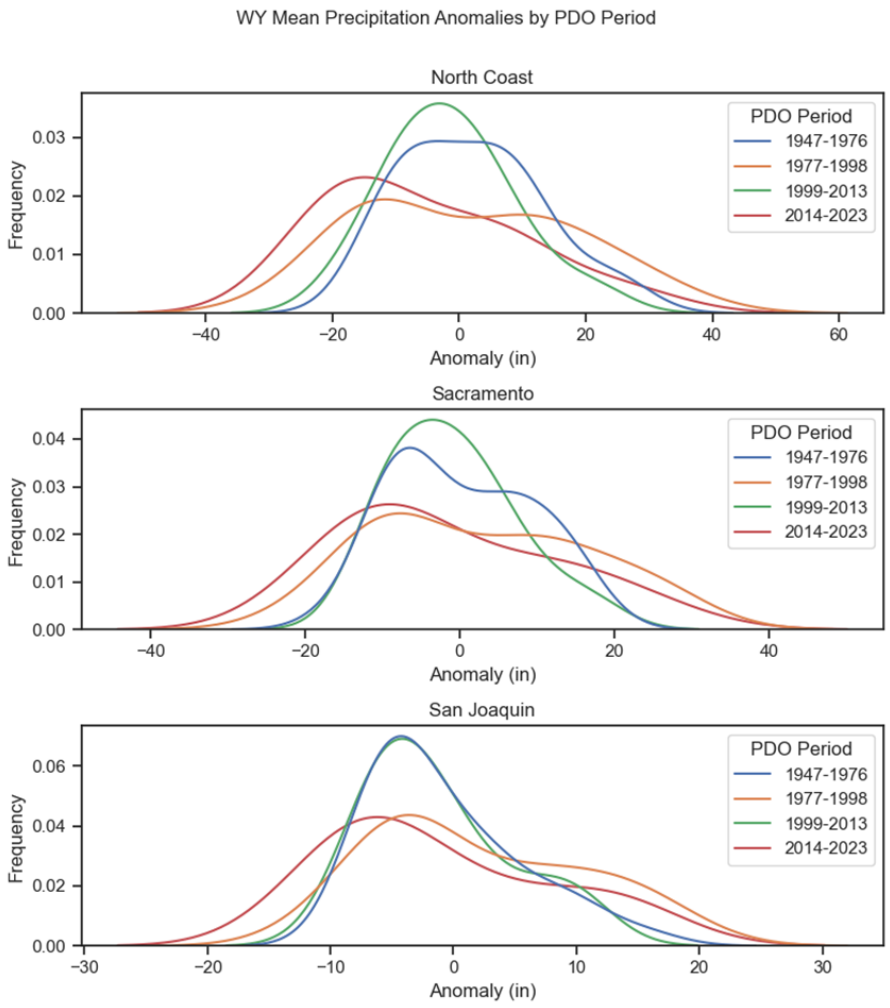
We had a warm Pacific Decadal Oscillation from 1977 to 1998, as well as more El Nino like trends in the tropical Pacific. That period was wetter on average, although there were some severe droughts. This shows the Standardized Precipitation Index anomalies relative to 1901 to 1980.



In contrast, this is the Standardized Precipitation Index for the last decade. It's been a very droughty decade across the western US.



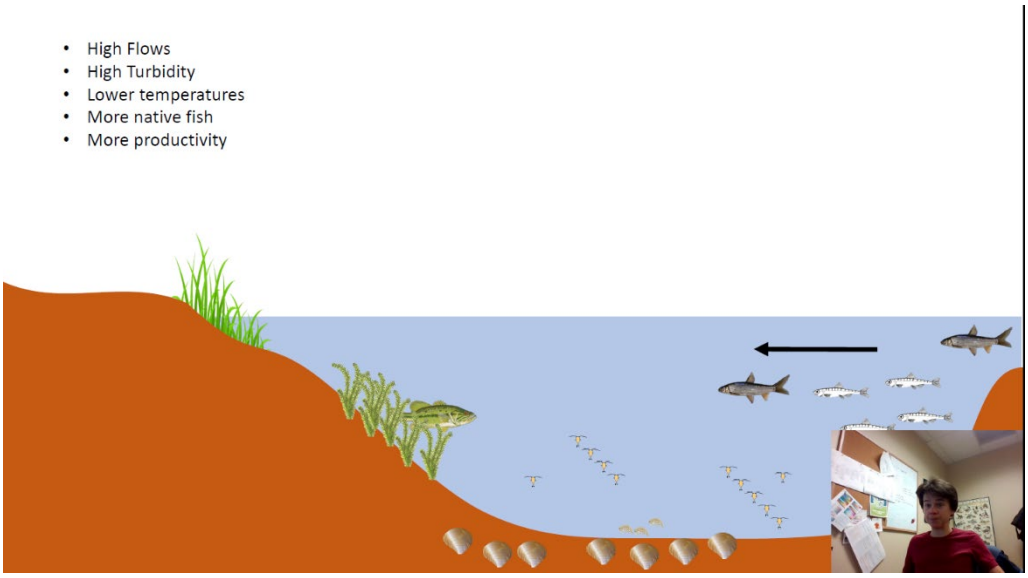
This graph shows the difference between the precipitation distributions for 1977 to 1998 (orange), and 2014 to 2023 (red). 1977 to 1998 had drier dries and wetter wets, but was overall wetter. 2014 to 2023 had much drier dries and fewer wetter wets. If the high resolution modeling verifies with other studies, we could shift back to a distribution more like 1977 to 1998 in coming decades.



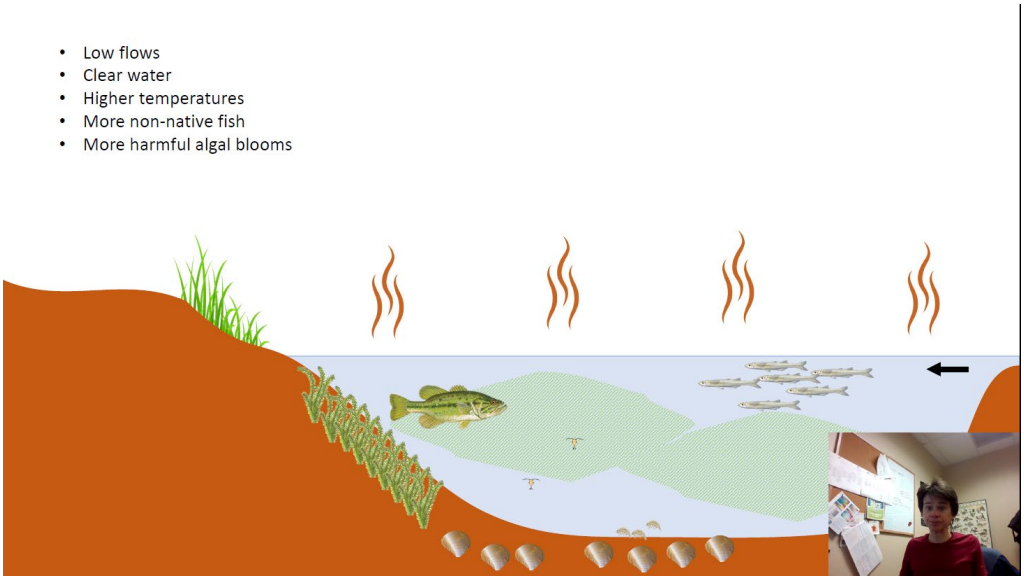
Your 2022 presentation of the IEP Drought MAST identified two regimes for the Delta ecosystem

[IEP Drought Impacts Report]

These were your slides showing the two Delta ecosystem regimes. This was the wet year regime that you found:



This was the dry year regime:



The slides are similar to the old and new regimes in the 2010 IEP POD MAST regime shift hypothesis. I asked you about the regime shift hypothesis during your 2022 presentation, and you said you thought the frequent droughts were preventing the ecosystem from shifting out of the new regime.

Old Regime	Environmental Drivers	New Regime
Variable, High	Outflow	*Variable, Lower*
To the west, Variable	Salinity gradient	*To the east, Constricted*
Complex, Variable	Landscape	*Simplified, Rigid*
Low, Variable	Temperature	*High, Uniform*
High, Variable	Turbidity	*Low, Less variable*
High P, low N	Nutrients	*Low P, High N (NH_4+)*
Few, Low	Contaminants	*Many, High*
Predation, Fishing	"Harvest"	*Predation and Entrainment*

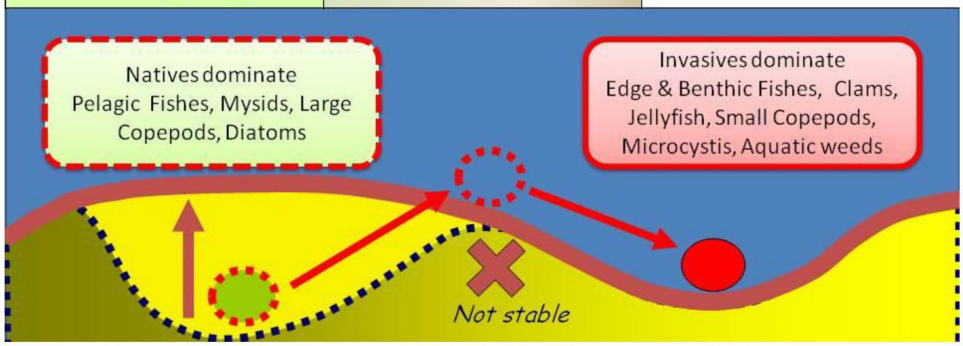


Figure 8. The ecological regime shift in the Delta results from changes in (slow) environmental drivers that lead to profoundly altered biological communities and, as soon as an unstable threshold region is passed, a new relatively stable ecosystem regime.

Your conjecture was consistent with Greg Gartrell's observation that the last time the Delta smelt population increased was during the period from 1995 to 2000, when the Delta freshened for extended periods. See Gartrell, G. Will Increasing Outflow in the Summer Increase Delta Smelt Survival?

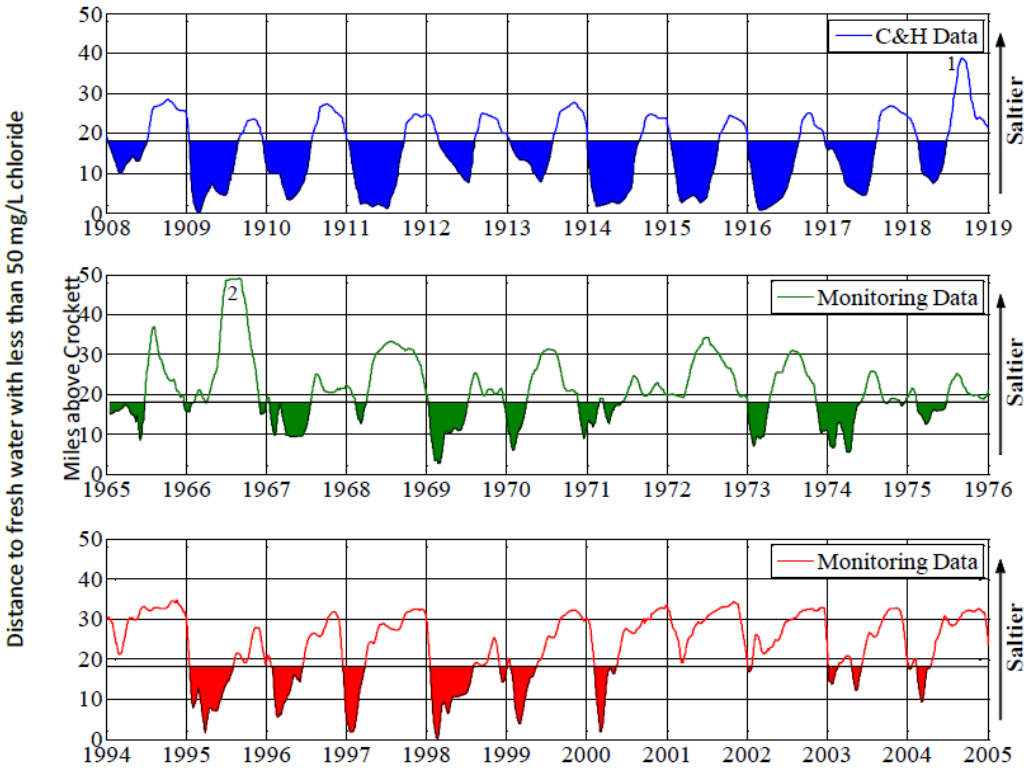


Figure 13. Reproduced from Figure 3-9, page 31 of reference 6, and described in that report as **"Distance to fresh water from Crockett**: Distance to fresh water is defined as the distance in miles upstream of Crockett to water with less than 50 mg/L chloride concentration. The horizontal line, at approximately 18 miles, is the distance from Crockett to the Delta [75 km from the Golden Gate]. The shading represents the spatial extent and duration of the presence of fresh water within Suisun Bay, downstream of the Delta." See reference 6 for data notes.

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Deirdre Des Jardins
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"The future enters into us, in order to transform itself in us, long before it happens" -- Rainer Maria Rilke

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