From: Deirdre Des Jardins <ddj@cah2oresearch.com>
Sent: Friday, March 3, 2023 12:02 PM
To: Delta Council ISB <DeltaCouncilISB@deltacouncil.ca.gov>
Cc: Culberson, Steve@DeltaCouncil <Steve.Culberson@deltacouncil.ca.gov>

Subject: Reference on climate adaptation

Dear Delta ISB members,

This paper is referenced in my synthesis report, but I wanted to highlight it.

The 2008 recommendations from USGS climate scientist Mike Dettinger (now retired) & IEP lead scientist Steve Culberson on how to handle climate change challenges were prophetic, and are still profoundly relevant. We've seen much more rapid change than climate models projected. Climate impact projections were, and remain, uncertain, and there have been major surprises.

Internalizing Climate Change—Scientific Resource Management and the Climate Change Challenges

Table 1. Climate Change Challenges and Strategic Responses – San Francisco Estuary and Watershed Science

Challenges	Strategic Responses
1. Human-induced climate changes have already begun, and are expected to continue	• Require long-term monitoring commitments from restoration and resource-management activities • Increase climate-science literacy and education • Prioritize ecosystem adaptability in restoration efforts • Evaluate opportunities for operational responses
2. Changes will be multi-variate	• Support multi-disciplinary science • Encourage multi-variate climate modeling and monitoring
3. Changes will be geographically pervasive	• Ensure consistency of observational and analytical methods across the region • Focus on geographic connection • Expect California to be highly sensitive
4. Changes will be rapid	• Identify maximum rates of adaptability • Undertake manipulative experiments

Challenges	Strategic Responses
	• Consider artificial refugia and seed banking
5. Projections are, and will remain, uncertain	• Address more certain projections directly and less certain changes by increasing flexibility • Pursue risk-based decision-making • Support competing hypotheses • Explore contradictions • Develop and maintain multiple models of important subsystems • Reduce reliance on statistical models Adopt standard terminologies for uncertainty
6. Effects will interact	• Integrate models • Coordinate across scientific disciplines • Focus on extreme events • Consider energy and greenhouse consequences
7. Surprises are likely	• Emphasize prediction nonetheless • Balance predictive vs tracking strategies • Increase management flexibility • Expand diversity of response options

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"We aren't just failing to address the growing climate crisis to come; we're unprepared even for the impacts already here—in part because they keep surprising us with their intensity and in part because we can't seem to fathom our genuine vulnerability." – David Wallace Wells

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