Delta Independent Science Board and Delta Plan Interagency Implementation Committee

Science Needs Assessment Pre-Workshop Discussion Seminar Series (Part 1 of 4) A Summary

April 28, 2020

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Background

The Delta Plan Interagency Implementation Committee (DPIIC) and the Delta Independent Science Board (Delta ISB) are planning a Science Needs Assessment Workshop to explore the rapid environmental change facing the Delta relative to climate and other change impacts. The goal of this workshop is to develop a science needs assessment that will inform a long-range science strategy for the Delta. The workshop, originally scheduled for April 27 to 28, 2020, has been postponed to October 5 to 6, 2020 due to a global pandemic. To help make progress with the science needs assessment, a four-part discussion seminar series was designed to generate dialogue around four key questions that serve as the workshop's foundation. Each seminar will promote discussion around one of the four questions below:

1. What do we know about projected climate change impacts for the Delta? (April 28)
2. What questions will that raise for management decisions? What do managers need to know? (June 3)
3. What science needs to be done to give management answers? (July 28)
4. What changes are needed for science governance, funding, and integration to do the needed science? (September 9)

The first part of this series occurred on April 28 and was facilitated by Ms. Amanda Bohl, the DPIIC coordinator. At the discussion seminar, Dr. Jay Lund and Dr. Steve Brandt of the Delta ISB provided an overview of the science needs assessment, while Dr. John Callaway, the Delta lead scientist, addressed climate change impacts in the Delta.

Discussion Seminar Summary

Science Needs Assessment Background

After a welcome and brief introduction to the virtual venue, Ms. Bohl introduced the first presenter, Dr. Lund, who described the events leading to the inception of the science needs assessment. Upon reviewing early drafts of the 2019 Delta Science Plan, the Delta ISB sent a letter to DPIIC in February 2019 expressing its concern that the rapid changes happening in the Delta needed greater consideration. The letter specified the need to plan for future science now in preparation for further rapid environmental changes. The Delta ISB recommended a strategic science needs assessment as the first step in achieving a long-range scientific strategy. DPIIC endorsed the development of the science needs assessment, which was incorporated into the Delta Science Funding and Governance Initiative effort.

Dr. Brandt then provided context for the Science Needs Assessment Workshop and explaining how the seminar series ties to the workshop's purpose. The workshop planning team determined a workshop would be an effective mechanism to develop the science needs assessment. A briefing paper prepared by the multi-agency workshop planning team summarized the rationale for pursuing a science needs assessment and outlined the workshop's structure. The workshop will last two days and focus on four main topics, each with its own panel discussion followed by breakout group discussions.

Dr. Brandt highlighted the two main goals of the workshop. One is to identify key science efforts that will provide answers and insights for likely management questions in the long-term. It is possible that the resulting assessment will feed into the implementation of the Delta Science Plan and the Science Action Agenda, which is due for its four-year update. While the Science Action Agenda largely focusses on mapping science that managers need now, the science needs assessment focusses on identifying the science we need to start now to meet the challenges of managers in the future. The second main goal of the workshop is to discuss how to organize the science enterprise to meet these complex and changing problems. Future science needs will likely be complex and require greater cross disciplinary integration and predictive power. The questions we want to answer: are we ready and are we organized well enough to achieve those scientific goals?

Dr. Brandt shared the successive questions that each of the four seminars in this series aim to discuss. The discussions stemming from these seminars will feed into the workshop in October.

Participants (84) were asked to answer a series of questions using the application Mentimeter. Ms. Bohl facilitated this question and answer session. Figures 1 through 3 show results for questions 1, 2, and 4 respectively.

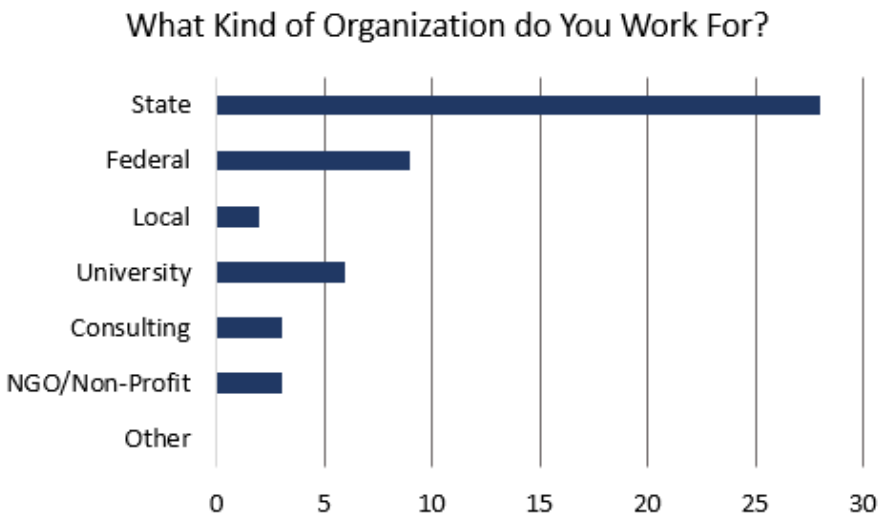


Figure 1: Responses to Question 1: "What kind of organization do you work for?" The majority of participants were affiliated with state organizations. N = 51

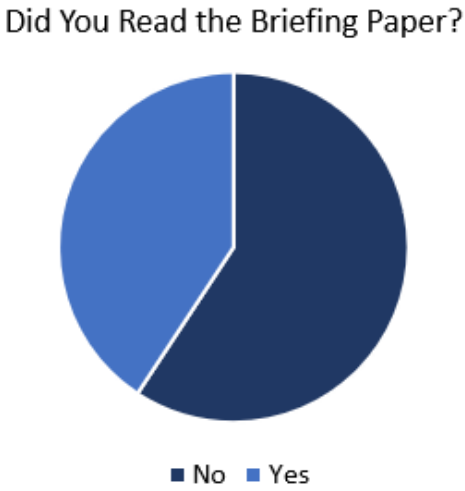


Figure 2: Responses to Question 2: "Did you read the briefing paper?" We wanted to know how many participants read the science needs assessment briefing paper to gain context for participants' prior knowledge of the workshop and related efforts. N = 54

Question three was open ended and allowed participants to submit more than one answer to the following question: Are there other questions or perspectives that the workshop should be considering? Answers listed below are modified for brevity and repetition. N = 34

- Environmental / social justice
- Tribal perspectives / engagement
- Cultural and demographic changes
- Connections to social and socio-economic issues
- Water supply reliability
- Framing for diverse audiences

- Human-environmental interactions
- Population and land use changes
- Sacrifices for resources and people
- Implementing outcomes with unsteady funding
- Scenarios of managed retreat
- Predictions possibilities / limitations
- Changes in contaminant types / sources
- Connection to bay and ocean
- Others exist, but focus on the planned topics for this workshop
- Independent science
- Multi-agency integrated modeling
- Delta scenarios
- Other factors anticipated to change besides climate
- Performance measures
- Improved science administration responsive to changing needs
- First question is critical in success of subsequent work
- Nothing to add at this time

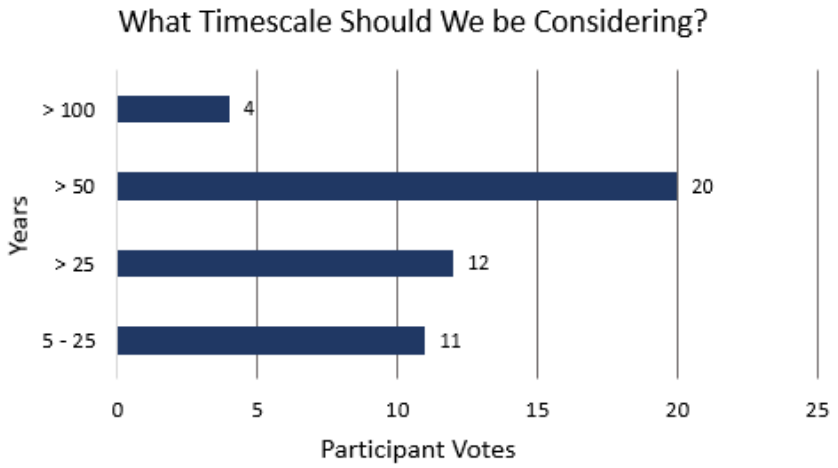


Figure 3: Reponses to Question 4: "What timescale should we be considering?" We wanted participant opinions about the timescale the Science Needs Assessment Workshop should consider for a long-range science strategy. N = 47

Climate Change Impacts

Dr. Callaway presented on projected climate change impacts for the Delta. To open, he showed a photo that gave an extreme example of how climate change has impacted St. Mark's Square in Venice, Italy. While the square floods a few inches multiple times a year, the photo depicts an instance in November 2019 where the square flooded three feet. The Delta and entire estuary were created by climate change events over a period of 15,000 years. Sea level rise inundation slowly led the California coast to migrate inland and thus create the inland delta system we see today.

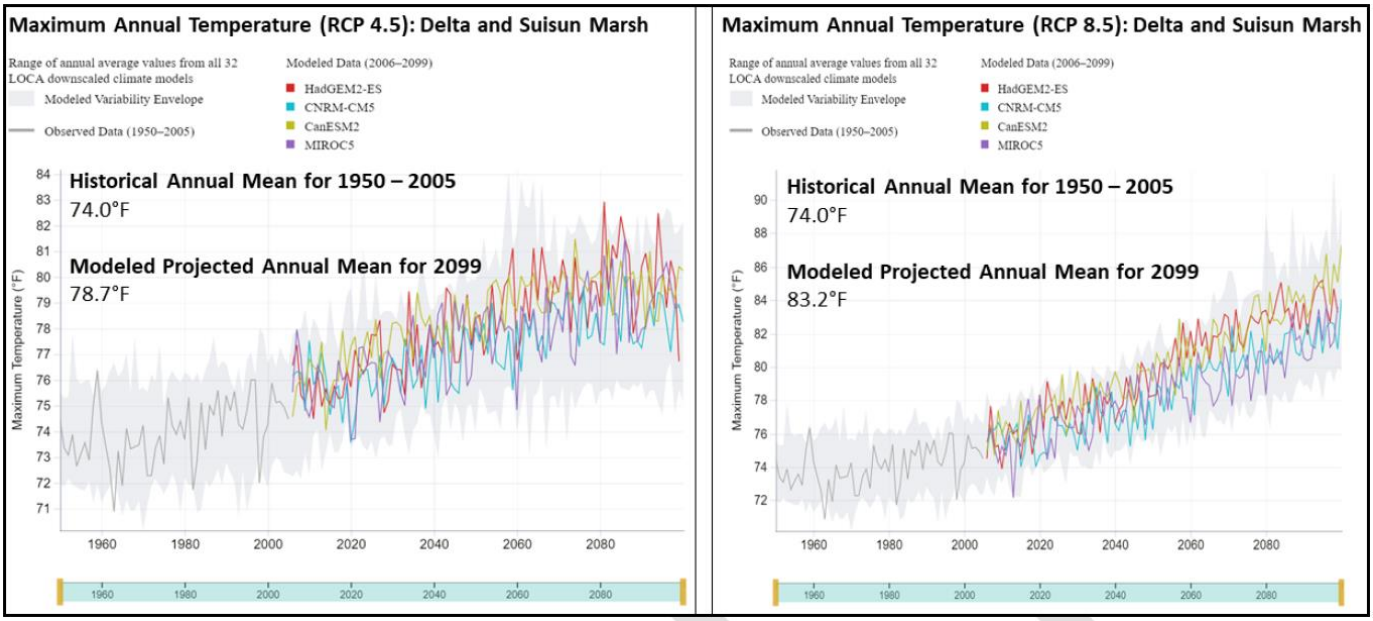
Dr. Callaway highlighted recent work on the topic of climate change impacts in the Delta. The first paper was by Michael Dettinger et al (2016) titled, Climate Change and the Delta, and was published in San Francisco Estuary & Watershed Science. The

Delta Stewardship Council also recently prepared a climate change synthesis paper, which was developed to inform the ecosystem amendment to the Delta Plan. Dr. Callaway encouraged participants to look to these resources for more details on the topic before continuing to introduce the three drivers of climate change that will likely have major impacts in the Delta. A rise in air and water temperature, changes in precipitation and runoff, and sea level rise. He underscored that the changes will not be very gradual, but instead occur through extreme events, and cause shifts in seasonal patterns.

There is a time frame issue in regards to climate change preparedness. The impacts will be more severe the further out we project; likewise, the uncertainty in the magnitude of those impacts will increase over time. We need to act now to prepare for the future, but operate knowing that no single timeline is correct or best. Rather, we need to be aware of the trade-offs among impacts, actions, and uncertainty.

While this seminar is focused on climate change, there are other factors that should be considered including demographics, land use, human/social responses, invasive species, contaminants and nutrient inputs, and pandemics. These other social, biological, and physical factors are important considerations; in particular, how humans respond to climate change will have a major effect on the future, but currently that response is a source of major uncertainty.

Dr. Callaway presented a set of plots (Figure 4) projecting annual mean air temperatures in the Delta until the end of the century. The two plots show two Intergovernmental Panel on Climate Change (IPCC) scenarios: one with a 4.5 degrees Fahrenheit projected increase and one with an 8.5 degrees Fahrenheit projected increase. Values from the latter represent a future should humans forego carbon emission mitigation efforts. Air temperature has been increasing since 1950. However, projected increases, shown on these plots, will be much greater. Water temperature will also increase, and this will be a major stressor for aquatic species in the Delta. There will be year-to-year variability, but the forecasted changes are relatively certain.



Note: On each graphic, the gray line (1950 to 2005) is observed data. The colored lines (2006 to 2100) are projections from 10 LOCA downscaled climate models selected for California. The light gray band in the background shows the least and highest annual average values from all 32 LOCA downscaled climate models. Source: CalAdapt.

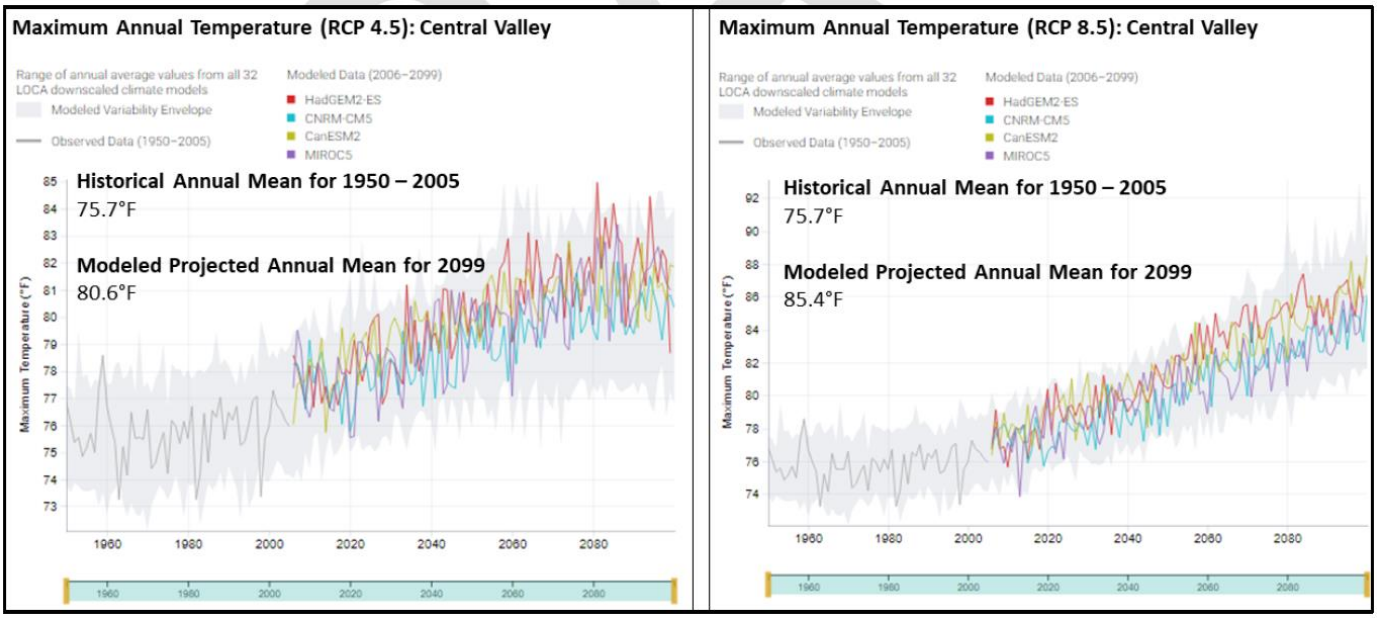


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Figure 4: Dr. Callaway used these plots to display maximum annual air temperature projections under two IPCC scenarios for the Delta and Suisun Marsh (top) and Central Valley (bottom). Source: Cal-Adapt 2017; Delta Stewardship Council's Climate Change Synthesis.

The projected temperature changes are going to lead to less snowmelt and precipitation occurring more often as rain even at higher elevations. This leads to earlier runoffs and decreased Delta inflows in the summer and fall. These shifts are fairly certain given their link to air temperature shifts; however, there is greater uncertainty about shifts in overall precipitation and runoff. Some models predict increases while others predict net decreases of precipitation. It is likely we will see more extreme events such as droughts and storm-related flooding.

Sea level rise will lead to higher water levels and greater rates of inundation in the Delta. There is a wide range in forecasts and as changes continue to accelerate uncertainty increases past the next two decades. With rising seas, salinity in the Delta will increase, and it's important to remember that subsidence is a major co-factor for flooding and inundation in the Delta. There will be substantial spatial variability in how the different factors associated with sea level rise will affect the Delta.

Dr. Callaway focused on three main areas where climate change will impact the Delta region. The first is water quality. Seasonally when flow is low, we will see greater salinity intrusion within the Delta. Managers will face decisions about releasing freshwater downstream to keep saline waters at bay and out of water intakes. Dissolved oxygen in the water will reduce as water temperature increases, creating further stress for aquatic organisms. Suspended sediment concentrations will be affected by runoff and more extreme events. In turn, this affects tidal wetlands and organisms that are affected by turbidity. He noted that these and other impacts will happen concurrently with other changes in factors such as contaminants, nutrients, and acidification.

The second impact is for habitat and species in the Delta. Aquatic communities will experience increased temperature and salinity stress. More instances of inundation of wetlands and floodplains can affect productivity in those habitats. Where possible, some wetlands may migrate to higher elevations, perhaps in Suisun Marsh, but not likely in many parts of the Delta. These stressors will interact with other factors like invasive species and their response to these changes, and large-scale restoration activities that have the potential to increase habitat availability and improve habitat conditions into the future.

Dr. Callaway also addressed the impacts that climate change in the Delta will have on humans. Our water management efforts will be affected by shifts in salinity and temperatures. The increased storm events will affect land use as flooding risks increase and levee failures occur. Shifts in growing season will impact agriculture and native species. And as mentioned earlier, these impacts will interact with other factors such as future water conveyance infrastructure, environmental regulations and other approaches to management in the Delta.

This presentation was meant to be a succinct tour of the general climate change impacts on the Delta, and further demonstrate the need to identify necessary science to address these issues moving forward.

Ms. Bohl asked a final question via Mentimeter. Question five was open ended and allowed participants to submit more than one answer to the following question: Is there any missing science that we need to discuss? N = 25

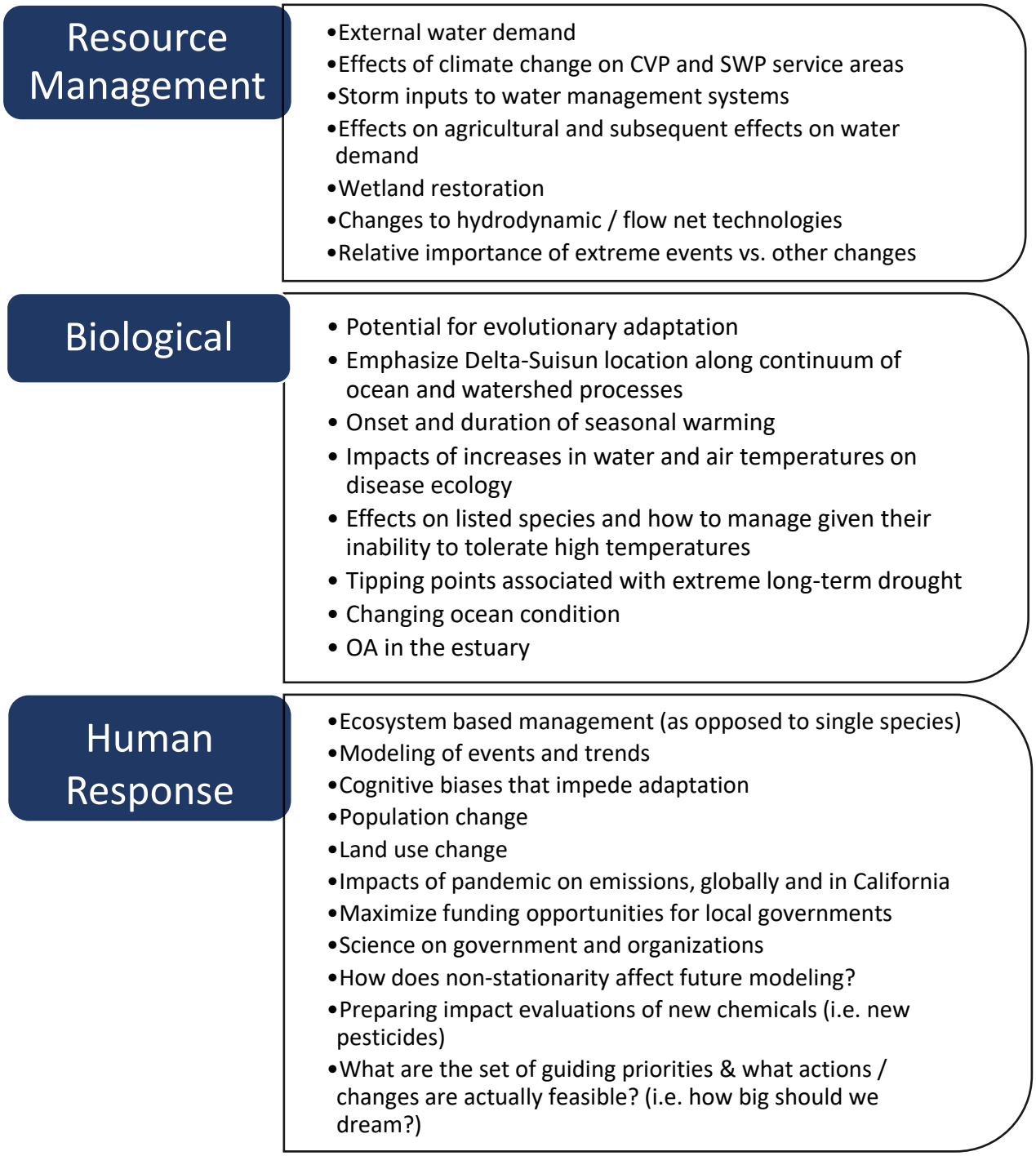

Figure 5: Participant ideas of other science that should be discussed are placed into three overarching categories. Answers have been modified for brevity.

Discussion Seminar Q & A

Participant Questions

- Do you have any thoughts about needed hydrodynamic modeling of sea level rise in the Delta?
    - Lund: Yes. We need more hydrodynamic modeling and more public domain modeling for it. While there is some work done to incorporate insightful modeling results into public discussions, resulting work isn't easy to find or access.
- Consider the possibility that the margins of the Estuary may be more dynamic and naturalistic or simply "wild" in the future than they have been in the last 200 years. What does this mean for native wildlife conservation and their future biogeography?
    - Brandt: As environmental conditions change, particularly temperature, the habitat features change in a way that will open the door to new invaders, while closing the door for organisms living on the margins. This is clearly a type of question that we hope managers will raise so we can discuss what kind of science we need to address it.
- What about effects on urban Delta populations? The lower San Joaquin River Flood Control Plan doesn't include sea level rise. Thinking of New Orleans as an example.
    - Lund: Sea level will rise whether it is included in a plan or not.

Participant Comments

- Identify Delta as both the "bottom" of great watersheds draining from the Western Divide as well as the regional "top" of the Pacific Ocean. The Delta will continue to be transitory and subject to what happens up and downstream.
- Much (most?) of that big uncertainty in 50 years is uncertainty that we have now because we don't know how society will change its greenhouse-gas emissions. That means that by 2050, we should know a lot more about the emissions, and by then those big uncertainties looking forward will be less than they are now. We will know better which path we're on and so by then the projections forward from then will be less uncertain…and assuming that our models are better by then our uncertainties will decline even more. So, those big late century uncertainties are not written in stone…when we are in the midst of those late century changes, there is hope that the uncertainties will be smaller. We won't always have this range of uncertainties, so plans should be able to take advantage of future (a few decades from now) reductions in uncertainties when they come.
    - Callaway: Regarding the comment about uncertainty shifting over time, we should be thinking on a 20 to 30 year time scale so that management efforts can have some significant effects. Then after the 20 to 30 years,

uncertainty around 2100 will have hopefully reduced and we can have better insight of the long-term uncertainty and where we might go forward.

- Almost all of the precipitation changes / runoff changes in the long haul are now known to reflect changes in extremes. So, those changing extremes are at the heart of nearly all of the precipitation changes. One form this will take is: More of the water resource will have to come from floods, with “normal” years and flows declining with time.
- [There is need to consider] effective environmental decision making.
- Opportunities for estuarine transgression (aka migration due to sea level rise) will change as sea level rise effects property values. CV is flat. Opportunities to accommodate sea level rise through transgression in CV are likely to increase over time.
    - Callaway: Regarding the comment about transgressions, it is true, things will change. There is an interaction between climate change, economic issues, and property values that will create opportunities for migration. It is important to consider how information about interactions between physical and social factors can improve our understanding and decision-making.
- If we focus on the more certain 20 to 30 years, then I worry that we would make a decision that is reasonable for the shorter time frame, but isn’t helpful, and may even be harmful at the 50-year timescale.
    - Callaway: Regarding the comment about timescales, I don’t think we should only think about 20 to 30 years. We should think across a range and avoid short-term actions that cut off long-term opportunities, but probably focus more short term where we have immediate effects and remain mindful of longer-term implications.
- Consider a space time, stepwise framework that links together what can be done now at less cost that “buys time” and leads to more costly and long-term adaptation in the future.
    - Bohl: This matter was talked about among the workshop planning team and during the Delta Science Funding Governance Initiative process. It was also addressed in the Delta ISB letter to DPIIC. We decided that our initial focus will encompass what we can manage right now, then in the long term, address issues from a watershed perspective. In this way, we can plan actions that we can implement now and link them to more long-term adaptations for the future. This assessment is essentially us addressing the first bit and figuring out how we can move forward to looking at the greater watershed.
    - Brandt: Adding to Ms. Bohl’s comment above, we will also in the future focus on connecting up with the estuaries on the other end of the Delta, opposite of the upland watershed. Both of these connections are key.

Next Steps

The next discussion seminar will be hosted on June 3, 2020.

Key Links

- Workshop and Virtual Discussion Series Flyer
- Science Needs Assessment Pre-Workshop Discussion Part 1 Recording
- Briefing Paper for the 2020 Science Needs Assessment Workshop