

MAY 2025

Agenda Item: 8
Meeting Date: May 22, 2025
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Delta Independent Science Board Update

Dr. Inge Werner, Chair
Dr. Bob Naiman, Member



**Delta
Independent
Science Board**

DELTA STEWARDSHIP COUNCIL

Who Are We?



Dr. Inge Werner
Ecotoxicology



Dr. Lisa Wainger
Economics



Dr. Diane McKnight
Biogeochemistry



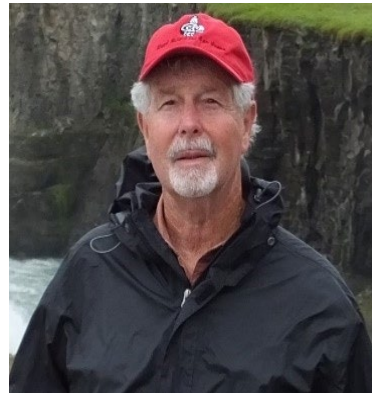
Dr. Virginia Dale
Landscape Ecology



Dr. Tom Holzer
Geology



Dr. Tanya Heikkila
Governance



Dr. Bob Naiman
River Ecology



Dr. Jayantha Obeysekera
Engineering



Dr. Anna Michalak
Engineering



Dr. Kenny Rose
Fisheries



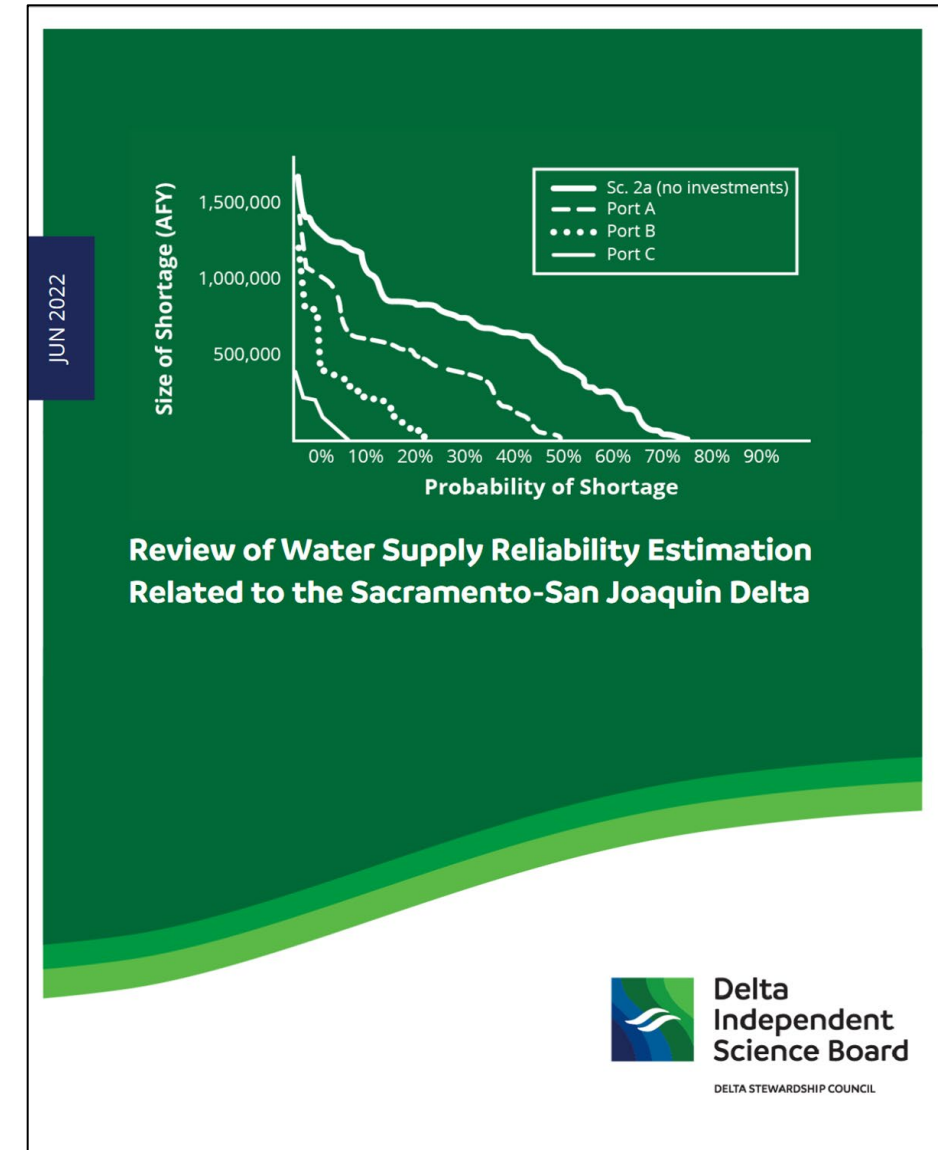
What We Do?

The Delta Reform Act (2009):

- ☐ Provide oversight of the scientific research, monitoring & assessment programs that support adaptive management in the Delta
- ☐ Provide independent advice on the Delta Plan

11 thematic reviews presented to the Council:

- ☐ Food-webs Review (2024)
- ☐ Water Supply Reliability Estimation (2022)
- ☐ Monitoring Enterprise (2022)
- ☐ Non-native Species (2021)
- ☐ Interagency Ecological Program (2019)
- ☐ Water Quality (2018)
- ☐ Delta as an Evolving Place (2017)
- ☐ Levees (2016)
- ☐ Adaptive Management (2016)
- ☐ Fish & Flows (2015)
- ☐ Restoration (2013)



Current Work

Completing two thematic reviews

- ❑ Subsidence
- ❑ Decision-making Under Deep Uncertainty

New activities

- ❑ Contaminants Monitoring Review
- ❑ Climate Science Symposium

Outreach & Communication of Completed Reviews

- ❑ Publication: Monitoring Enterprise Review (2022)
- ❑ Food-webs Review (2024)



May 2025

Advancing Scientific Understanding and Management of the Delta Through a Food Web Perspective

Robert J. Naiman
Member, Delta Independent Science Board



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What are Food Webs - and Why are They Important?

A complex **network** of organisms linked by feeding relationships

Food webs **regulate** the flows of energy, nutrients and contaminants through ecosystems. It is accomplished by interactions among species (e.g., predation) as well as by interactions of species with their environment

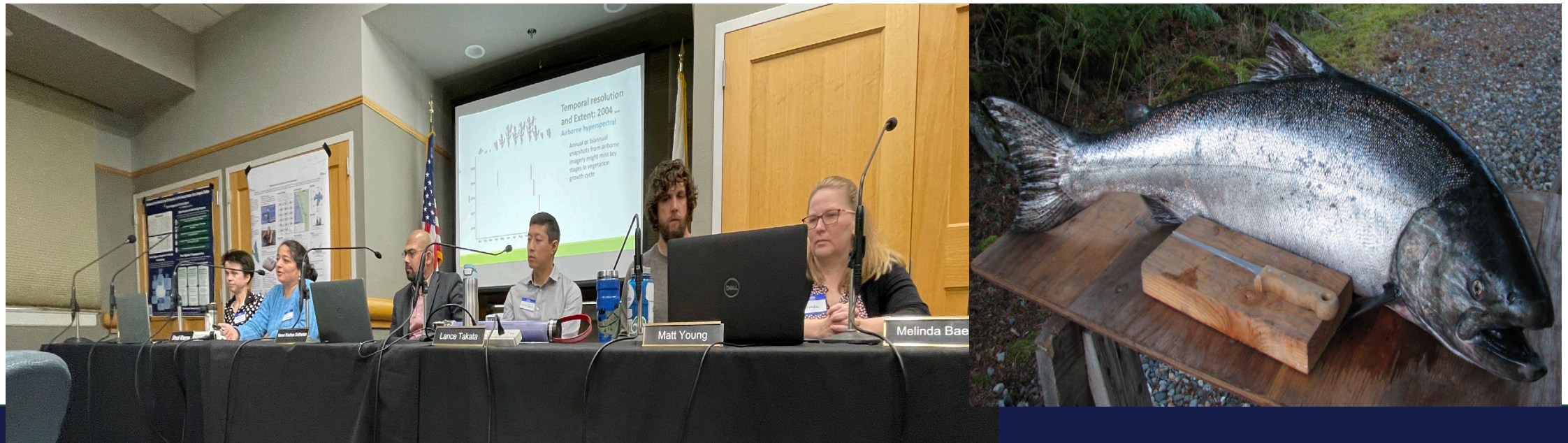
Basically, food webs reveal the “**physiology**” of the system -- describing how the ecological components shape carrying capacity, resilience and productivity

Review Objectives

(1) To assess how to better incorporate and advance food web knowledge in managing the Delta's aquatic ecosystem, and (2) to identify what tools are available or should be developed

Perspective:

Considered the full food web, with *a focus on upper trophic levels*



The Review, And The Report, Are Based On:

- Evaluation of existing literature
- Extensive discussions with the full spectrum of the Delta community
- Two-day workshop with over 100 participants
- Public comments



What Did We Discover?

Food Web Modeling in the Delta

- Several food web models already developed for Bay-Delta
- Focused primarily on the role of “*bottom-up*” processes structuring food webs
- Many Delta models that attempt to represent entire food web are limited in spatial/temporal coverage or are *conceptual* in nature
- Effective evaluations of effects of management or species population changes requires *quantitative* modeling, not just conceptual

RESEARCH


A Conceptual Model of the Aquatic Food Web of the Upper San Francisco Estuary

John Durand¹

Individual-level and Population-level Historical Prey Demand of San Francisco Estuary Striped Bass Using a Bioenergetics Model

Erik Loboschewsky¹, Gina Benigno², Ted Sommer², Kenneth Rose³, Timothy Ginn¹, Arash Massoudieh⁴, and Frank Loge^{1,*}

Analysis of pelagic species decline in the upper San Francisco Estuary using multivariate autoregressive modeling (MAR)

Ralph Mac Nally , James R. Thomson, Wim J. Kimmerer, Frederick Feyrer, Ken B. Newman, Andy Sih, William A. Bennett, Larry Brown, Erica Fleishman, Steven D. Culbertson, Gonzalo Castillo

Evaluating top-down, bottom-up, and environmental drivers of pelagic food web dynamics along an estuarine gradient

Tanya L. Rogers, Samuel M. Bashevkin , Christina E. Burdi, Denise D. Colombano, Peter N. Dudley, Brian Mahardja, Lara Mitchell, Sarah Perry, Parsa Saffarinia

What are the benefits of a food-webs approach?

The review examines five possible applications for improving natural resource management in the Delta. An example:

Management Question	Benefits of Food Web Approach	Suggested Priorities
<p>Ecosystem-Based Management (EBM)</p> <p>How do changes to environmental conditions affect food web interactions?</p>	<ul style="list-style-type: none">• Understanding food web dynamics advances effective EBM• Identifying key ecological species, often not the same as listed/regulated species• Examining food web responses to changing conditions reveals differential vulnerability of species to environmental changes	<ol style="list-style-type: none">1. Develop performance metrics that represent a holistic view of ecosystem function2. Connect laboratory or field experiments to evaluate sublethal effects of stressors on species into models3. Create a model/series of models (of appropriate spatiotemporal scales) designed to predict changes in species interactions over time

Science Gaps (Challenges)

- Quantify the **roles of most abundant fish species**
- Understand the dynamics of **detritus and their associated communities**
- Understand the **flows and consequences of contaminants**
- Improve the quality and consistency of food web data for **syntheses** and for public accessibility
- Evaluate the **roles of predatory birds and mammals**



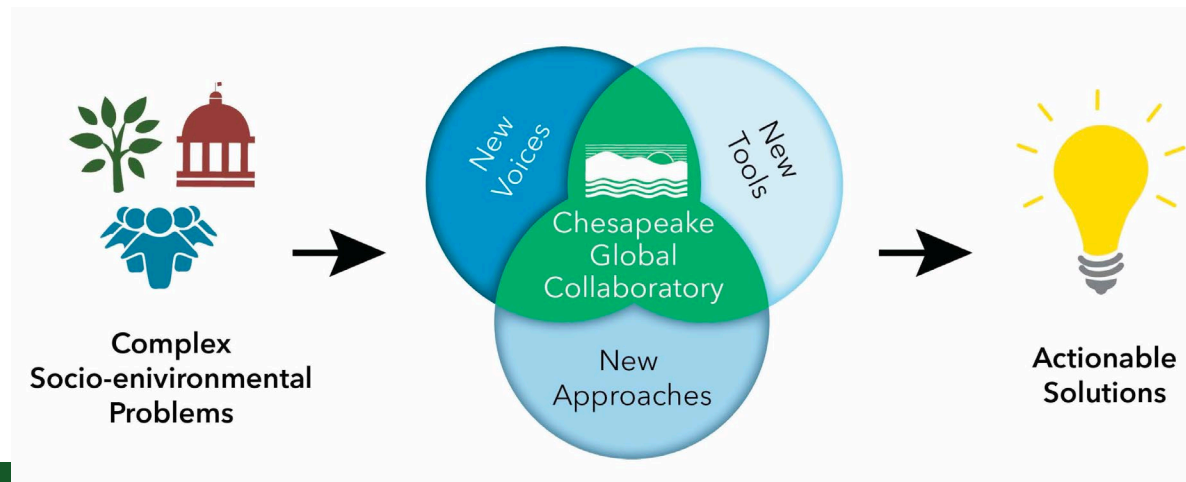
Recommendations & Moving Forward



Delta ISB Recommendations

1. Develop a comprehensive coordination and implementation plan for collecting, analyzing, and applying food web information

- Requires a **focused interdisciplinary collaboration** among agencies, universities, the public, and Indigenous Tribes
- Participants would **decide on key management needs and science questions**
- Where possible, **activities identified by the plan should be initiated as hypotheses and conducted as testable experiments**



Delta ISB Recommendations

2. Adapt Delta research and monitoring programs to explore key aspects of food webs

- Focus on **science gaps** and connecting to existing knowledge
- Food-web **data** need to be regularly updated, quality controlled, and made accessible
- Encourage and support on-going **syntheses** of existing food-web information



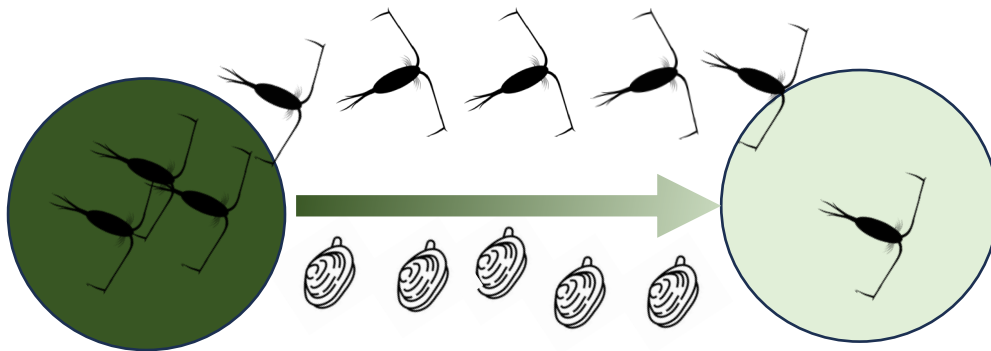
IEP Delta Juvenile Fish Survey

Data management, information sharing, and synthesis are pillars for a well-functioning science-management system

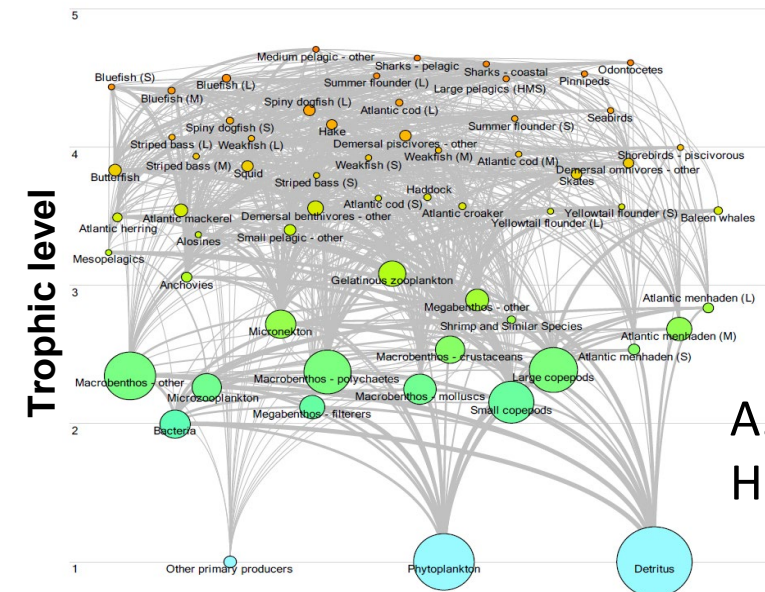
Delta ISB Recommendations

3. Employ appropriately scaled food web models as determined by management questions and key environmental drivers (e.g., temperature, flow)

- **Appropriately scaled** models incorporate **relevant processes and trophic levels** to learn relationships among environmental conditions and species of interest
- Use the *processes* of model development that have been employed in other large ecosystems as examples



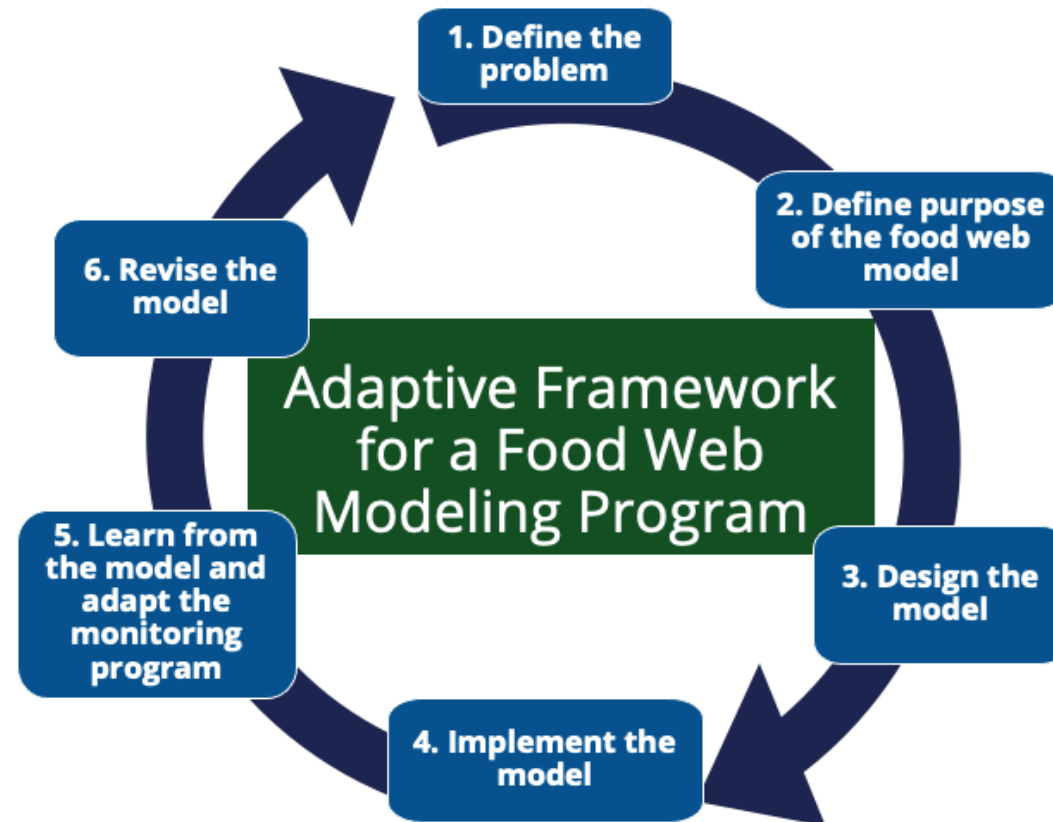
J. Durand, UC Davis



A. Buchheister,
Humboldt State

Delta ISB Recommendations

4. Link food web models to management questions and actions, monitoring, and empirical studies using an adaptive framework



“Take Home” Messages

- Advancing food web science in the Delta will **serve a broad range of management applications**
- Will **improve our ability to forecast effects of management actions and climate change on fish and other aquatic species**
- **Collaboration and adaptive management** will increase effectiveness and efficiency



Moving Forward

- These recommendations are **ambitious**, and will take time to be developed --- and they certainly will require multiple workshops and team-building activities
- IEP is already proposing a food-web synthesis that could address these recommendations for tidal wetland restoration
- As well, DISB has presented at the IEP Workshop, Bay-Delta Science Conference and the UC Davis-CMSI and Delta Science Program Symposium – **All were well received**
- Looking for other ways to implement the recommendations



UMCES

Interagency Ecological Program Synthesis Team

Food Web Synthesis Proposal

Rosemary Hartman, DWR, PI – Rosemary.Hartman@water.ca.gov

September 3th, 2024

Summary

The Interagency Ecological Program (IEP) Synthesis Team proposes a food web modeling project to assess effectiveness of tidal wetland restoration and other resource management actions. A food web model will allow quantitative estimates of benefits derived from management actions and will help clarify whether food web factors (food availability, predation) or physical factors (water quality, physical habitat availability) are driving changes to species of concern. **We are asking whether this effort would be useful to resource managers in the system and whether wetland benefits is an appropriate research topic to start with.** We are also soliciting particular management questions within this general topic you that you would find useful.

Thank you!

Questions?

Final Review Now Available!

