Delta Interior Inflows and Related Stressors

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- Also on Outflows
- Bay-Delta Fishery Resources (2012)

Process

- March
  - Background and key material provided
  - Did some gathering on our own
- April 16-17, 2014 – workshop
- Panel spent next day on issues and conclusions
- Sections assigned to 1-2 members
- Editor-in-Chief Healey collated and edited
- Circulated among members multiple times

Report Organization

- Executive Summary
  - Summarize responses to charge questions
- Main text is by topic
- Ecosystem-problem but papers and presentations (reasonably) focused on:
  - Salmon and steelhead
  - Delta smelt

Topic	Relation to Charge Questions
Quality of science and statistics	1, 2, 4, 5
Delta geometry and hydrology	2b, 3, 5b
Turbidity	2a, 2b, 3, 4a, 4b
Flow metrics	2a, 4a, 4b
Primary and secondary production	2b
Fish behavior cues	2a, 4, 5a
Invasive species and food webs	2b, 3
Entrainment and salvage	2b, 4a, 4b, 5a
Fish population dynamics	3, 5a
Programmatic science and adaptive management	4a, 4b, 5a, 5b

Charge Question 1

- *What are the key studies and synthesis reports that the State Water Board should rely on in making their decisions on interior Delta flow requirements?*

Answer 1

- Not a comprehensive review
- Much excellent science
- "The Panel was concerned that little experimentally validated quantitative guidance on flow management was available to the Board."
- Too often correlation-based

Charge Question 2

- *Interior Delta flows have been altered in many ways, including timing, magnitude, variability, and in some cases, net direction. What are the relationships between these altered interior Delta flows and native fish survival, abundance, spatial distribution, migration, and life history diversity?*

Answer 2

- Complex mix of interacting factors affecting native fish vital rates and spatial distributions
  - e.g., altered flows includes velocities, sediment, nutrients,
- Keep in mind historical context – pre-1900
- Decoupling of flow from historical variation in availability and access to habitat (e.g., marsh and floodplains)
- Seasonal cycles shifted and dampened
- Movement of LSZ up-estuary

Answer 2a and b

- Lack of connection from “flow” to what fish perceive
- Understanding of fish movement and migratory patterns improving but still not sufficient on the with-in Delta scale
  - Minutes to hours; meters
  - Technology rapidly improving
- Know about interior Delta flows (CFD) but not how flows affect the interior Delta ecosystem

Charge Question 3

- *How do non-flow stressors such as predation, physical habitat, fisheries management, and water quality interact with interior Delta flows to affect the issues discussed in Question 2?*

Answer 3

- Significant fraction of POM exported
- Successful invasions during drought periods
- Predation important but not clear what proportion of total mortality (difficult to isolate) due to major changes in habitat
- Predation related to entrainment continues to be assumed to be important but not well quantified

Charge Question 4

- *What metrics of interior Delta flows (such as OMR and QWEST flows, and export-inflow ratios) are most useful to assess, predict and manage impacts to fish and the ecosystem?*

Answer 4

- Cautious about tidally averaged metrics related to flow (OMR, QWEST)
- Evidence for entrainment of Delta smelt related to OMR
- Insufficient to determine a precise threshold
- A lot of uncertainties but a relationship persists
- Should be used with proper respect of the uncertainties

Charge Question 5

- *What changes to interior Delta flows or other stressors would be most effective for improving survival, abundance, spatial distribution, and/or life history diversity of native fish and the ecosystem?*

Answer 5

- Consider hydrograph over entire year
- Link between interior Delta and LSZ?
- Ranking of stressors not helpful
  - Too interrelated and confounded
- OMR and Delta smelt entrainment
- Adaptive Management
  - Great idea and concept
  - Yet to be done effectively
  - Hybrid approach (multiple lines of evidence)

Additional Key Findings and Statements from Topics

- Interior flows dramatically altered – wicked
- Tides very important
- Can link interior flows to local responses but difficult to population

Additional Key Findings and Statements from Topics

- Determining what is the best scientific information
- Scientific method, data collection, statistics, and modeling
- Formal meta analysis or similar structured approach
- Precise thresholds especially challenging
- Additional comments on best practices

Additional Key Findings and Statements from Topics

- Use of unimpaired flows as informative but not definitive
- Timing and volume important but also
  - Availability of habitat (marsh-like)
  - Transport of sediments and nutrients
- Care about the sloppy use of “turbidity”
  - Consider the fish

Additional Key Findings and Statements from Topics

- Move away from only considering flow and ratios based on correlations to velocities, transport (PTM), and behavior (sensory to reactions)
- Not clear how interior Delta actions affects primary and secondary production (local and down-estuary)
- Interior Delta still too much of black-box for fish
  - Much progress being made
  - Time for coupled new data collection and new CFD modeling

Additional Key Findings and Statements from Topics

- Say what is meant by
  - Flow
  - Abundances and indices
  - Effects
    - growth, mortality, reproduction, movement
    - Life stage, location, biological scale
- AM
  - Coerced?
  - Can be done effectively but not yet

Additional Key Findings and Statements from Topics

- Food web changes – no need to say more!

- Estimation of salvage and entrainment
  - Need to be improved
  - New studies needed to retroactively add uncertainty so can use historical database

Additional Key Findings and Statements from Topics

- Modeling
  - Statistical and life cycle
  - Expectations

- Programmatic science
  - Use multiple, individual studies to address a large, complex problem
  - Foundation, transformation, leakage

Concluding Remarks

- Suggestions threaded throughout the text
- Some process for follow-up?
- We hope this helps