COMPREHENSIVE (PHASE 2) REVIEW AND UPDATE TO THE BAY-DELTA PLAN

Workshop 2: Bay-Delta Fishery Resources

Report of the Invited Panel

Panel Members

Randy Baxter
CA Dept Fish and Game

Brad Cavallo
Cramer Fish Sciences

Eric Danner
SW Fisheries Science Center
NMFS

John Largier
Bodega Marine Laboratory
UC at Davis

Kenneth Rose
Louisiana State University

Ted Sommer
CA Dept Water Resources

Questions

- What additional scientific information should the State Water board consider to inform potential changes to the Bay-Delta Plan relating to Bay-Delta fishery resources, and specifically pelagic fishes and salmonids that was not addressed in the 2009 Staff Report and the 2010 Delta Flow Criteria Report?

- How should the State Water Board address scientific uncertainty and changing circumstances, including climate change, invasive species and other issues?

Process Used by Panel

- Panel selected by Delta Science Program (Lead Scientist)
- Multiple conference calls
- Initial ideas from each individual panel member
- Collate, consolidate, and synthesize into a single document
- Iterate drafts among panel members
- Submit report
- Present report to Board (today)

Report Organization

- Theme 1: Implications of science for management
- Theme 2: Need for improved science to reduce uncertainty
- Theme 3: Key emerging science

Today's Presentation

- The process (done)

- A speaker representing the Panel summarizing the report for each of the three themes

- Brief statement by each Panel member
  – As individual not representing the Panel

1.1 – Multiple species, correlations, and non-linear responses

- Objectives can have different effects on the species of concern
  - Avoid simply overlaying objectives
  - Consider synergistic effects
  - Avoid unintended consequences

- Objectives affect each other
  - Management for X2 affects cold water pool which affects temperature management for downstream salmonids

- Biological responses to objectives are often non-linear
  - Response to increased flow is different at low vs high flow

1.2 – Monitor effectiveness

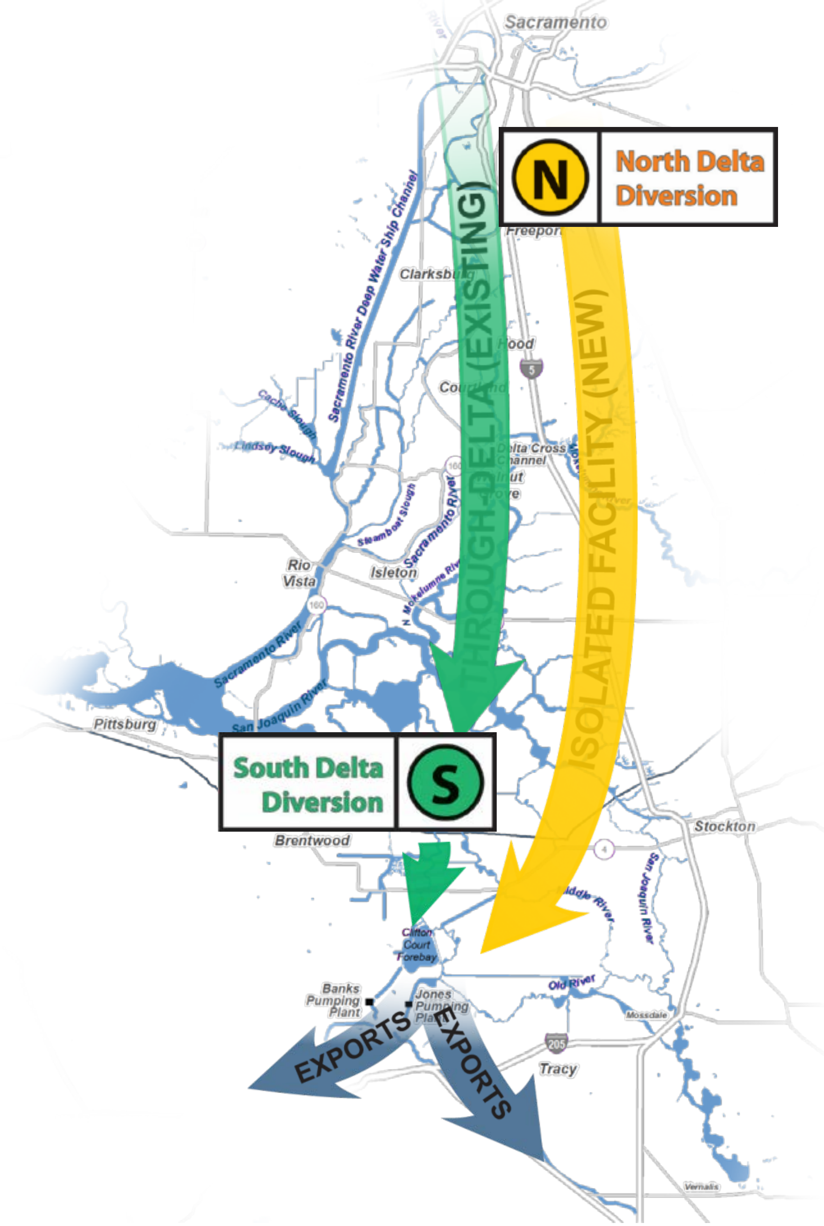
- In critical cases, go beyond compliance monitoring to “effectiveness” monitoring
  - Measure biological benefits
  - e.g., salinity and fish growth

- Added benefit of forcing habitat to be defined in specific terms

1.3 – Water quality under future configurations

- Anticipate infrastructure changes (e.g., dual conveyance), planning actions (e.g., reservoirs), and climate change

- Start now to plan how to do analyses
  - What information (data) will be needed
  - Start collecting



1.4 – Use summary indicators of hydrology for very specific purposes

- Summary measures (outflow, I/E) do not describe of how water is routed within the system

- Specifics of where, when, and how much water matter to fish

- Need to confirm relevance of summary measures in each case

1.5 – Proceed

- New data, analyses, and models are continuously being developed, e.g.,
  - 2-D and 3-D hydrodynamics
  - Fish life cycle models

- Do not wait for the next analysis

- Board should proceed using:
  - Well-documented, readily available, and transparent models and data
  - A process so new developments can be inserted

1.6 – State the beneficial uses of water affected by objectives

- Reminder: clearly show how biological objectives will affect other beneficial uses

- Clarity and transparency

1.7 – Consider the short-term variability

- Objectives often based on aggregate values (e.g., monthly values)
- Average or sum can mask different short-term (e.g., daily) variability
- Such short-term variability can be critical to fish responses

1.8 – Consider other stressors

- While separating flow from other stressors (e.g., contaminants) is prudent and practical…

- Flow is related to many of these stressors

- Care should be used with an approach that separates flow from other stressors

Part 1 Summary
Implications for Management

- Multiple species, correlations, and non-linear responses
- Monitor effectiveness
- Water quality under future system configurations
- Use summary indicators of hydrology for specific purposes
- Proceed
- State the beneficial uses of water affected by objectives
- Consider the short-term variability
- Consider other stressors

2. Improving Science
… to improve policy & management

- *Uncertainty can be reduced …*

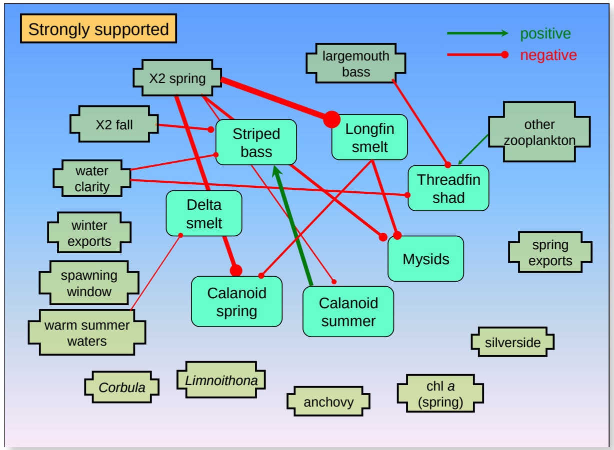
… Uncertainty in expected outcome of
policy choices and management options

… Improved scientific understanding and
knowledge

2.1 – Models

Models to assess benefits for specific species on sufficiently fine time and space scales

- Model aims …
  - ✓ Quantify expected benefits
  - ✓ Identify unintended consequences
  - ✓ Evaluate trade-offs among objectives



MacNally et al. 2010

- Resolve the scale of fish-environment interactions …
  - ✓ Seasonal or annual flow
  - ✓ Tributary or main stem or delta flow
  - ✓ Multiple life stages
  - ✓ Resolve population processes
  - ✓ Data details retained when used in model
  - ✓ Includes primary factors other than flow rates

2.2 – Field Evaluation

Experimental evaluation of flow-related management actions

- Flow-related management actions can be used as experiments
  - ✓ Include extremes in flow
  - ✓ Iterative learning – eventually outcome matches expectation
  - ✓ FLaSH is an example; also Mokelumne River study

Artwork from Sacramento Bee

- Aim of field evaluation …
  - ✓ Confirm that benefits realized
  - ✓ Improve mechanistic understanding
  - ✓ Reduce uncertainty in assessment of benefits
  - ✓ Refine water-quality objectives

2.3 – Ocean Forcing

Ocean variability influences Bay-Delta habitats and fishes

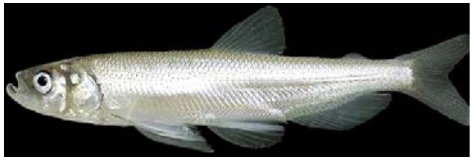
- Anadromous fish…
  - ✓ Ocean survival of salmonids key to population dynamics
- Ocean dispersal & ocean-bay connectivity …
  - ✓ Benthic species connected to ocean via dispersal
  - ✓ Major shift in 1999 explained by shift in ocean conditions
- Trophic subsidy (nutrients & plankton) …
  - ✓ Coastal upwelling supplies nutrients and plankton
  - ✓ Gravitational circulation carries ocean material far into Bay

2.4 – Nutrients

Resolve effect of nutrient types and ratios on ecosystem

- Shift in phytoplankton community …
  - ✓ Long-term changes in species composition
  - ✓ Reduced food value for zooplankton

- Changes in nutrient loading …
  - ✓ Increased wastewater loading has led to higher ammonium
  - ✓ Possible cause of changes in phytoplankton



- Influence on fish …
  - ✓ To date no quantitative link through to fish
  - ✓ Possibly a link for some species, life stages or regions
  - ✓ Other environmental stressors change in parallel

2.5 – Entrainment

Refine assessment of entrainment effects on fish populations

- Quantifying proportional entrainment …
  - ✓ High uncertainty in both entrained and abundance numbers
  - ✓ Untested assumptions in calculations
- Influences on entrainment rate …
  - ✓ Monitor explanatory variables in parallel with entrainment
- Impact of entrainment on fish populations …
  - ✓ Models to assess population effect

2.6 – Population Diversity

Diversity influences how population responds to management

- Diversity important to population fitness …
  - ✓ Chinook, delta smelt, splittail and other fish show diversity
  - ✓ Populations can respond to changing conditions
  - ✓ Resilience in face of climate change
- Identify and describe diversity …
  - ✓ Fish monitoring and laboratory experiments
  - ✓ Habitat diversity (spatial & seasonal)
  - ✓ Environmental drivers – which parameters important?

    e.g., frequency, duration, timing, and rate of change of flow

PART 2 – SUMMARY

Improving Science

Priority science to reduce uncertainty.

- Models to assess benefits of management
- Field evaluation of flow changes
- Assessment of ocean forcing
- Assessment of change in nutrients & plankton
- Improve knowledge on entrainment
- Focus attention on population diversity

3. Key Emerging Science:

3.1 Pelagic fishes more flexible than previously understood

- Age-0 striped bass now found primarily on shoals

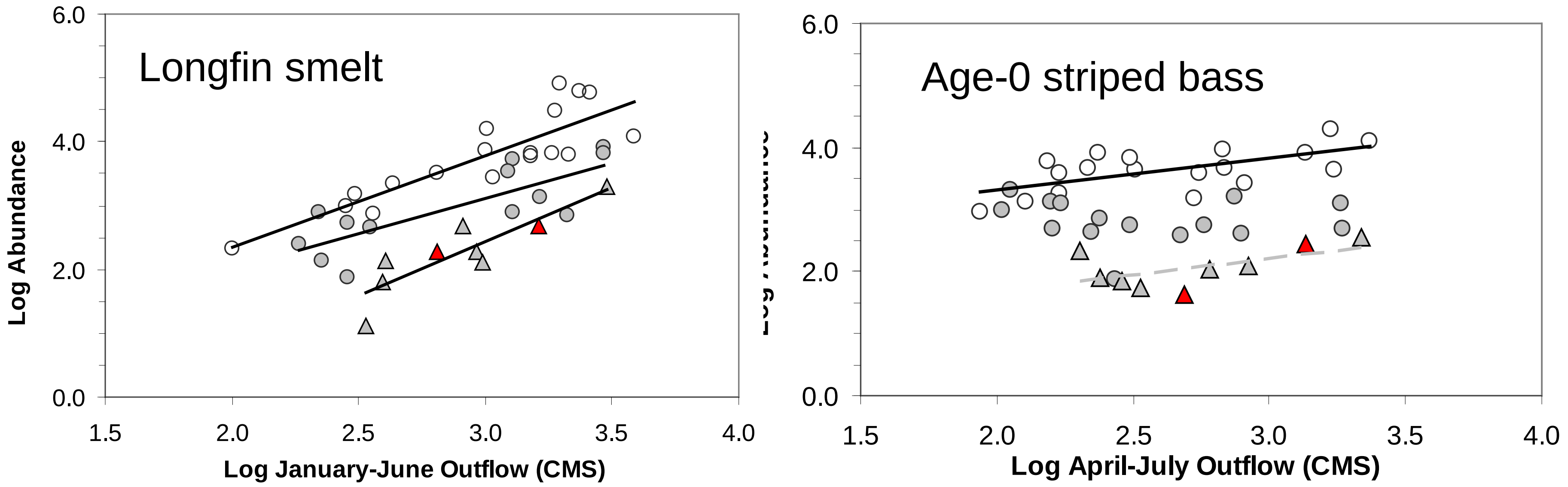
- Age-0 longfin smelt distribution shifted downstream in deep water

- Threadfin shad currently found primarily in Cache Sl. Region

- Delta smelt found in Cache Sl Region as well as low salinity zone in summer-fall

3.2 Regime change may mute beneficial flow effects

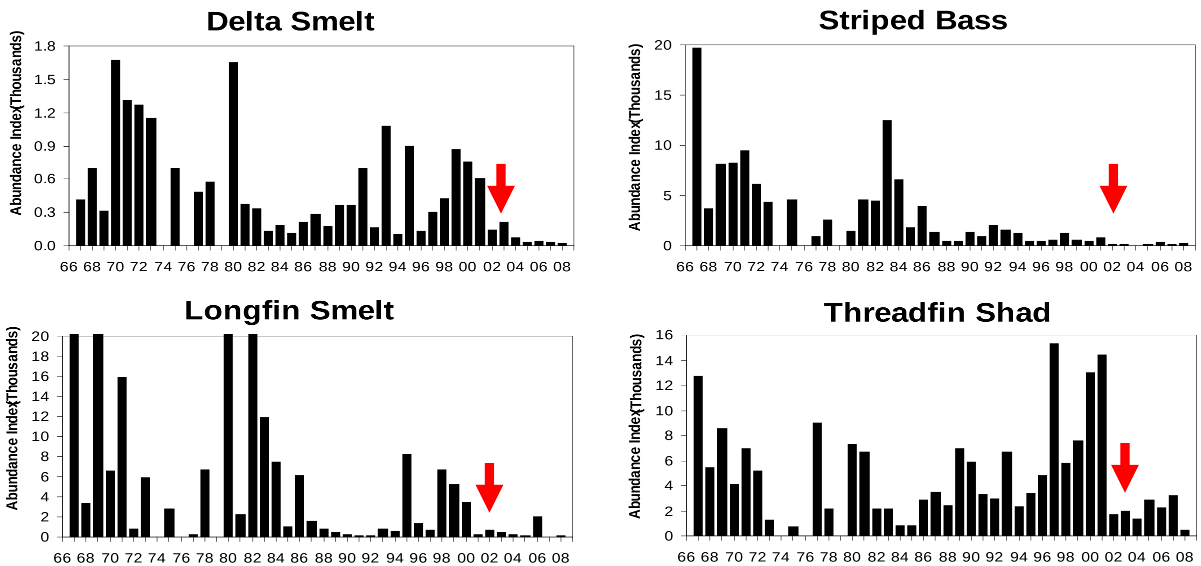
- Several flow abundance relationships now muted



After Baxter et al. 2010, Fall Midwater Trawl abundance-outflow relationships updated for 2010 and 2011, revised DayFlow delta outflow estimates, and POD declines after 2002

3.2 Regime change may mute beneficial flow effects

- Simultaneous downward shift in fish species abundances (POD) reflects regime shift



- Multiple, substantial changes: increased aquatic weed, introduced inshore predators, harmful algal blooms & jellyfish

- Large-scale changes needed to shift regime toward move favorable conditions… unlikely to achieve former regime

3.3 Improved juvenile salmon survival in Delta requires broad-scale improvement in shoreline and riparian habitat

- Juvenile salmon – predation contributes to poor thru-Delta survival; exacerbated by poor habitat

- Habitat needs: broad shallow areas w/low velocity + terrestrial or emergent vegetation; better access to floodplains

- Current limited habitat requires substantial increase in area and improvement in connectivity

3.4 Sub-daily hydrodynamics may be more important to juvenile salmonids than previously understood

- Delta water exports are managed as though “net” negative flows are broadly harmful to juvenile salmonids

- Mark-recapture studies and scientific literature – no consensus on importance of tidal “net” flows to juvenile salmonids

- Recent acoustic telemetry studies and hydrodynamic analysis suggest sub-daily flow variability appears to be important to juvenile salmonids

3.5 Managing for salmonid life-history diversity

- Currently managing for large smolts and rapid thru-Delta passage during brief spring period

- Life-history diversity important to hedge bets

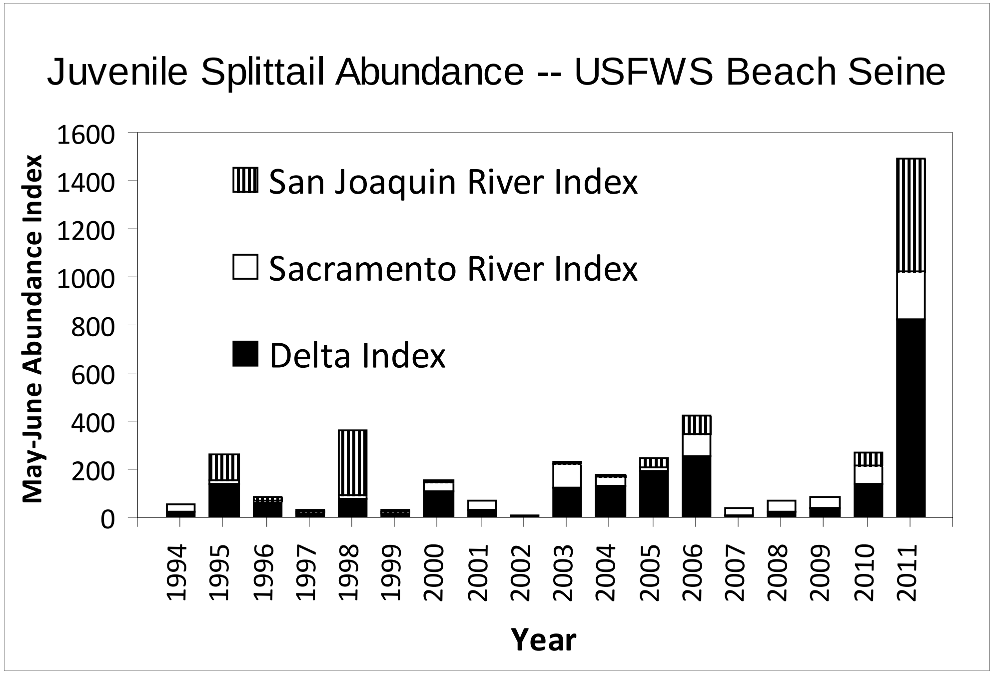
- Management hindrances
  - Lack of variable flow regime
  - Poor, homogenous Delta rearing habitat
  - Hatchery practices
  - Ocean harvest

3.6 San Joaquin River inflow is more important than previously understood

- Despite limited flow contribution to downstream regions

- Data suggests source of important calanoid copepod – summer and fall fish food

- Native fishes -- juvenile splittail abundance contribution relatively high



3.7 Biological models are available to enhance understanding and guide management

- Factors in decline of Chinook salmon and pelagic species are known
- Relative importance of factors uncertain
- Life cycle models useful:
  - to assess relative importance of factors
  - to explore trade-offs in alternate mgmt actions

Part 3 Summary

Key Emerging Science:

- ***Pelagic fishes more flexible than previously understood***
- ***Regime change may mute beneficial flow effects***
- ***Improved juvenile salmon survival in Delta requires broad-scale improvement in shoreline and riparian habitat***
- ***Sub-daily hydrodynamics may be more important to juvenile salmonids than previously understood***
- ***Managing for salmonid life-history diversity***
- ***San Joaquin River inflow is more important than previously understood***
- ***Biological models are available to enhance understanding and guide management***