CALFED Science Program - 2009 Proposal Solicitation Package (PSP) Priority Research Topics

Draft - Priority Research Topics (for discussion purposes only – based on previous solicitations and CALFED Science Program panels)

The Science Program is seeking research projects in 5 broad topic areas:

1. Ecosystem Responses to Climate Change
2. Invasive Non-native Aquatic Species
3. Food Webs and Water Quality
4. Coupled Hydrologic and Ecosystem Models
5. Water and Ecosystem Management Decision Support System Development

Topic 1: Ecosystem Responses to Climate Change

Need: The likely effects of climate change on Delta ecosystems are poorly understood. Research and modeling are needed to explore how species and their habitats will respond to future changes driven by climate change. Areas of interest include responses of primary production, habitat quality and connectivity, ecosystem function and ecosystem services. Connectivity may extend beyond the Delta to include critical events in the watersheds or the Pacific Ocean that impact Delta ecosystems. Models should have a spatial component and projects should incorporate a landscape perspective where appropriate. Projects that fit within a framework of ecological economics are particularly desired.

Possible questions to be addressed by the research:

- How will climate change affect the extent and quality of habitats critical for at-risk species? What are specific climate-induced drivers of change and responses of the habitat? How are these driver/response relationships best described (e.g., continuous, stepwise, linear, nonlinear)?
- What are the implications of future plausible scenarios of climate change by 2050 for management strategies and tactics? How can management respond to these factors in ways that are robust to additional change? What new opportunities to enhance habitat or ecosystem function may emerge from future climate change?

For fish species of concern (e.g. steelhead, winter and spring run salmon, green sturgeon, delta smelt, and longfin smelt), what effects will climate change have on:

a. supporting food webs and bioenergetics;
b. habitat suitability;
c. timing, availability, and quality of water;
d. aquatic organism distribution and composition (native vs. non-native, prey vs. predator) and fish migration (e.g., timing, location/route, potential barriers, entrainment)

Topic 2: Invasive Non-native Aquatic Species

Need**:** Invasive non-native aquatic species impact at-risk species, water quality, and ecosystem function. Non-native species can severely limit current and future management options including constraining water operations. There is a need for better understanding and model development that could a) assess the response of entrenched invaders and better predict successful establishment of future invaders under different management regimes or scenarios in the context of a changing environment (e.g., climate change, land-use change, catastrophic events) and b) link these responses to those at-risk native species and their habitats.

Possible questions to be addressed by the research:

- What are key factors allowing successful establishment and spread of invasive species? What are the trends in these key factors? Are these factors manageable?
- What ecological constraints do current species assemblages place on at-risk aquatic species?
- How might climate change, sea-level rise and likely future invasive species (e.g., zebra and quagga mussels (*Dreissena* spp.)) change the ecology of the Bay-Delta?
- Are there practical and effective options for preventing new invasions, eradicating or reducing existing invaders, and managing entrenched invaders to benefit at-risk species?

- Does nutrient addition contribute to the success of aquatic non-native organisms in the upper San Francisco Estuary? If so, what are the mechanisms that lead to invasive species success?

Examples of established and likely future invasives of particular concern are:

- *Corbula amurensis* (Overbite clam)
- *Corbicula fluminea* (Asian clam)
- *Dreissena* spp. (Quagga and Zebra mussels)
- *Egeria densa* (Common waterweed)
- *Esox lucius* **(**Northern Pike)
- *Limnoithona tetraspina* (copepod)
- *Microcystis aeruginosa* (cyanobacteria) blooms

Topic 3: Food Webs and Water Quality

Need**:** Food webs in the Delta have undergone substantial changes in the past few decades. The composition of the biota within these new and emerging food webs needs to be documented and the current and future interactions between key components of these new and emerging food webs need to be determined. The role of at-risk and non-native species in current and emerging food webs deserves more attention. The role of variable and changing water quality from contaminants and nutrient inputs needs to be studied with respect to aquatic food webs within the Delta.

Possible questions to be addressed by the research:

- What are the dominant pathways of energy flow in current aquatic food webs within the Delta?
- What are the roles of native and non-native species in primary production, secondary production, and tertiary production in Bay-Delta food webs?
- How has nutrient loading into rivers entering the Delta affected aquatic food webs within the main aquatic ecosystems of the Delta?
- What roles do contaminants and/or nutrients play in determining the structure of aquatic food webs with the Delta?

Topic 4: Coupled Hydrologic and Ecosystem Models

Need: Hydrodynamic models need to be linked to and coupled with ecosystem models such as those for at-risk species and Delta food web dynamics to better inform management planning and operations; for example to determine flow requirements for aquatic species and to assess potential outcomes of water management. Progress is needed in linking hydrodynamic models that provide information on discharge, water velocities, and inundation patterns with ecosystem models that simulate key ecosystem attributes such as nutrient uptake, rates of primary production, habitat responses to inundation, and fish behavior, growth, and predation. Ecosystem modeling also could be focused on food webs, predator-prey interactions, and nutrient availability effects on production dynamics.

Possible questions to be addressed by the research:

- What are the flow requirements throughout the annual hydrograph for optimal habitat configuration for at-risk fish species?
- How are hydrodynamic conditions and primary production rates and transport linked within aquatic ecosystems of the Delta?
- How are habitat requirements for aquatic organisms distributed spatially under different river flow regimes and tidal excursions?
- What hydrodynamic conditions are conducive to the establishment and success of invasive non-native aquatic species?

Topic 5: Water and Ecosystem Management Decision Support System Development

Need: The Bay-Delta ecosystem and water managers and policymakers need tools that translate state-of-the-science understanding of hydrodynamics and ecological functions into effective planning and management. These decision support systems should include visualization components that facilitate the communication of the complexity and interconnectedness of ecological and social systems and allow for assessment of system response to management alternatives along with changing natural conditions. Resource managers need to evaluate relative merits of alternatives using scientific information developed across a range of temporal and spatial scales. Focused research into the usefulness of particular tools will be helpful, but emphasis will be given to those

efforts that integrate emerging tools into a system of effective communication involving managers, scientists, policymakers, and tool developers.

Possible questions to be addressed by the research:

- What scientific information important to policymakers can be most readily provided through decision support tools and systems?
- How can state-of-the-science understanding be assembled and translated most easily into policy-relevant information? Are there available tools for facilitating this assembly that both policymakers and scientists will trust?
- What examples of successful decision-support systems can be tested or adopted for the Bay-Delta system?