ERP Proposal Application Instructions

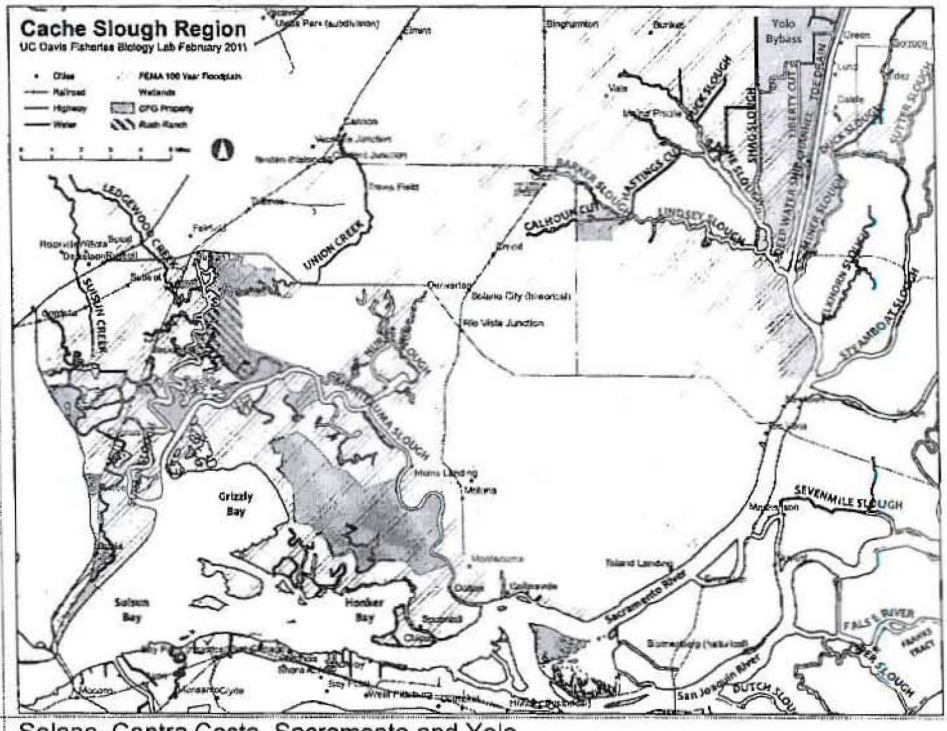
All of the fields in the application form are required for all projects, except where specifically noted. Any supplementary information must be included at the end of this application. For forms and examples, please see Appendix B.

To check a box, right click on the box and highlight "Properties." Click on the circle next to "Checked." Click "OK."

Section 1: Summary Information

1. Project title:	*The Role of Life History Variability on the Population Resiliency of Delta Smelt and Longfin Smelt*
2. Applicant name:	*Dr. James Hobbs*
3. Contact person:	*Dr. James Hobbs*
4. Address:	*Dept. of Wildlife,Fish and Conservation Biology, UC Davis* *One Shields Ave. .*
5. City, State, Zip:	*Davis Ca. 95616*
6. Telephone #:	*530-752-0205*
7. Fax #:	*530-752-9364*
8. Email address:	*jahobbs@ucdavis.edu*
9. Agency Type:	Federal Agency ☐ State Agency ☐ Local Agency ☐ Nonprofit Organization ☐ University (CSU/UC) ☒ Native American Indian Tribe ☐
10. Certified nonprofit Organization:	Yes ☐ No ☐ If yes, specify the nonprofit organization registration number: *See www.pd.dgs.ca.gov/smbus/nonprofit*
11. New grantee:	Yes ☒ No ☐
12. Amount requested:	*Amount requested from DFG, from detailed budget.*
13. Total project cost:	*Sum of amount requested plus all cost share funds and services, from detailed budgetl.*
14. Topic Area(s):	*1)Shallow water habitat; 2) At-risk species assessment; estuary foodweb productivity; harvestable species assessment; hydrodynamics, sediment transport and flow regimes; non-native invasive species*
15. ERP Project type:	1) Research; 2) Monitoring).
16. Ecosystem Element:	1) Delta sloughs; 2) Bay-Delta aquatic foodweb; Bay-Delta hydrodynamics; essential fish habitat).
17. Water Quality Constituent:	1) Salinity; 2) Turbidity and sedimentation; nutrients and oxygen depleting substances).
18. At-Risk species benefited:	*Delta Smelt, Longfin Smelt*
19. Project objectives:	*Determine the critical nursery habitats and migration history for delta smelt and longfin smelt*
20. Time frame:	August 1, 2012-July 31, 2015

Section 2: Location Information

1. **Township, Range, Section: and the 7.5 USGS Quad map name.**	Suisun Marsh: Quadrangles Fairfield South, Vine Hill, Denverton, Honker Bay Sherman Island: Quadrangles Antioch North, Jersey Island Cache Slough complex: Quadrangles Rio Vista, Liberty Island, Dozier,
2. **Latitude, Longitude (in decimal degrees, Geographic, NAD83):**	Latitude 38-01.133—38-20.015 N Longitude 121-39.344—122-06.370 W
3. **Location description:**	Suisun Marsh is located to the south of Fairfield, along the northern fringe of Suisun Bay. Sherman Island is a flooded island located to the east of Suisun Marsh, near the confluence of the Sacramento-San Joaquin Rivers. The Cache Slough complex includes Liberty and Cache Slough, Liberty Island and the toe drain of the Yolo Bypass). 
4. **County(ies):**	Solano, Contra Costa, Sacramento and Yolo
5. **Directions:**	Suisun Marsh and Sherman Island can be accessed by trailered boat using Hwy 12 and Grizzly Island Rd to drive to public access boat launches in Suisun City and Belden's Landing. Sherman Island can also be accessed by trailered boat using Hwy 12 to Hwy 160, and taking Sherman Island Rd to Sherman Island County Park, where public access boat ramps are available. Cache Slough complex and the toe drain of the Yolo Bypass can be accessed by trailered boat using Hwy 12 to Rio Vista, where Rio Vista Boat Launch offers public access to a boat ramp.
6. **Ecological Management Region:**	*Delta*
7. **Ecological Management Zone(s):**	Sacramento-San Joaquin Delta
8. **Ecological Management Unit(s):**	North Delta
9. **Watershed Plan(s):**	BDCP, Delta Vision Plan, CALFED Ecosystem Restoration Program

10. Project area:	88 miles x 100 ft.
11. Land use statement:	*Describe current and anticipated future (next 5 years) land uses in the watershed.*
12. Project area ownership:	% Private___70____ % State___10_____ % Federal__20_____ *Enter ownership percentages by type of ownership.*
13. Project area with landowners support of proposal:	Project will be restricted to open access public waterways.

Section 3: Landowners, Access and Permits

1. Landowners granting access for project: (Please attach landowner provisional access agreement[s]): *List and reference attached access agreements. Also map ownerships on attached project maps and diagrams. See sample forms in PSP Appendix B.*	
2. Owner Interest: *not applicable*	
3. Permits:	*DFG scientific collection permit, state and federal ESA take permits. I have the DFG scientific collecting permit and am appying for the take permits.*
4. Lead CEQA Agency:	*not applicable*
5. Required Mitigation:	Yes ☐ No ☒ *Is the work in the proposed project required as mitigation pursuant to CEQA or other authority? (See PSP Part III I. Environmental Compliance) Check and explain if yes.*

Section 4: Project Objectives

1. List task information:

Achieve recovery of at-risk native species dependent on the Delta and Suisun Bay as the first step toward establishing large, self-sustaining populations of these species; support similar recover of at-risk native species in San Francisco Bay and the watershed above the estuary; and minimize the need for future endangered species listings by reversing downward population trends of native species that are not listed.

Objective 1: *Achieve, first, recovery and then large self-sustaining populations of the following at-risk native species dependent on the Delta, Suisun Bay, and Suisun Marsh: Central Valley winter-, spring- and fall/late fall-run chinook salmon ESUs, Central Valley steelhead ESU, delta smelt, longfin smelt, Sacramento splittail, and green sturgeon.*

Objective 3: *Enhance and/or conserve native biotic communities in the Bay-Delta estuary and its watershed, including the abundance and distribution of the following biotic assemblages and communities: native resident estuarine and freshwater fish assemblages, anadromous lampreys, and estuarine plankton assemblages.*

This study will describe what habitats of the bay-delta system are critical for the recovery of delta smelt and longfin smelt, and will provide data for evaluating the restoration of habitats in the study areas.

2. Additional objectives:

Describe any additional objectives not described above.

3. Source(s) of above information: *List references*

Section 5: Conflict of Interest

To assist ERP staff in managing potential conflicts of interest as part of the review and selection process, we are requesting applicants to provide information on who will directly benefit if your proposal is funded. Please provide the names of individuals who fall in the following categories:

- Persons listed in the proposal, who wrote the proposal, will be performing the tasks listed in the proposal, or who will benefit financially if the proposal is funded; and/or
- Subcontractors listed in the proposal, who will perform tasks listed in the proposal, or will benefit financially if the proposal is funded.

Primary Contact for Proposal: Dr. James Hobbs
Primary Investigator Dr. James Hobbs
Co-Primary Investigator:
Supporting Staff:
Subcontractor:

Provide the list of names and organizations of all individuals not listed in the proposal who helped with proposal development along with any comments.

Last Name	First Name	Organization	Role
Bennett	William	UC Davis, JMIE	Advisor
Baxter	Randy	DFG	Advisor
Sommer	Ted	DWR	Advisor

Section 6: Project Tasks and Results Outline

1. Detailed Project Description

Problem Statement

Despite a very active research program investigating the decline of pelagic fishes in the San Francisco Bay-Delta, including delta smelt (Hypomesus transpacificus) and longfin smelt (Spirinchus thaleichthys), the abundance indices of these fishes continue to

decline, resulting in a flurry of lawsuits and controversial court decisions reminiscent of days prior to the Bay-Delta Accord (Sommer et al 2007, Baxter et al 2008). At the heart of the controversy is disagreement over the effects of freshwater exports on the threatened delta smelt population. Recent research has shed new light on both the quantitative impacts of State and Federal water projects and the qualitative effects of selective mortality on life-history attributes of delta smelt, such as spawn timing and size-at-age (Kimmerer, 2007, Bennett 2008). In addition, my research has identified different migration behaviors among individuals for each species. Delta smelt have been found to reside in freshwater habitats in the North Delta year round rather than move to the low salinity zone, and longfin smelt critical habitat has reduced considerably since the POD (Hobbs et al 2010). To effectively manage and restore the native smelt populations we must first understand the mechanisms responsible for their decline and develop conservation strategies to promote population resilience.

Solution

I propose to explore the diversity of movement patterns for delta smelt and longfin smelt as a strategy for population resilience in the face of habitat variability due to climate and management actions to protect smelt from extinction. Understanding the diversity of life-history traits and movement's patterns of delta smelt will provide important insights into the causes and potential solutions for the decline of pelagic organisms throughout the San Francisco Bay-Delta estuary.

Key areas requiring further study include:

1) how smelt move among different habitats,
2) how flow and temperature influence movements among habitats,
3) how fishes of different life histories are impacted by export operations, and
4) how life history diversity is associated with population resilience.

With the advance in otolith geochemical techniques, life-history patterns in estuarine fish are being revealed. Several estuarine species including striped bass and white perch from the Chesapeake and Hudson Bays exhibit variable life-history migrations (population contingents) that have been associated with variable recruitment success (Secor 1999, Kraus and Secor 2005). Depending on the productivity of the brackish versus freshwater habitats during wet and dry years, the success of different contingents using freshwater habitats and estuarine habitats can vary. The authors suggest the advent of life-history contingents is an evolutionary mechanism to adapt to a variable climate. My research has shown that similar life history patterns exist in the delta smelt and longfin smelt (Figure 1).

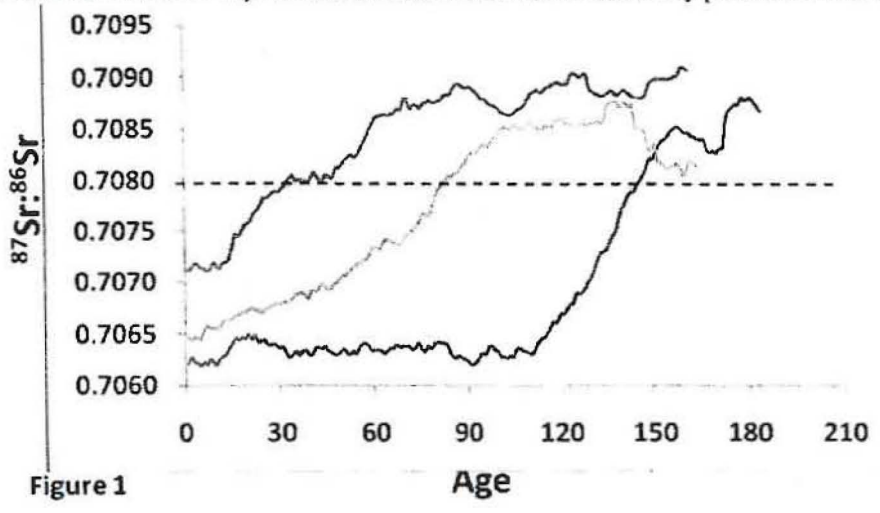


Figure 1

Profile analysis of strontium isotope ratios . I; Late (>150 dph) II; Middle (~90dph) and III Early migrants (<30dph). Dotted line depicts the strontium isotope ratio of brackish water

The contribution to the adult population of fish rearing as juveniles in freshwaters and low-salinity waters varies inter-annually as a function of freshwater outflow. However, the selective advantage of variable life-history strategies may be in question in a highly modified estuary where large volumes of freshwater are extracted resulting in a persistent risk of entrainment to individuals that remain in freshwater delta habitats. In addition, rearing in the delta may not be advantageous as water temperatures can increase quickly to lethal levels (Swanson et al 2000, Feyrer et al 2007). The cues for migration for delta smelt are not completely known; however, it is likely that movements from fresh to brackish water are associated with freshwater flow and water temperature. By completing a thorough examination of life-history migrations during high, normal and low outflow conditions and variable water temperatures, we can elucidate the mechanisms determining migration timing and provide resource managers with additional tools to minimize the salvage of delta smelt at export facilities in the south delta.

2. Background and Conceptual Models

Justification

My proposed study will build upon the foundation of research I have developed using otolith microchemistry to (1) reconstruct the movement patterns of smelt from their natal habitats, upstream along the Sacramento and San Joaquin Rivers, to their low-salinity adult habitats in Suisun Bay and (2) explore population structure and recruitment dynamics to explain the current decline of smelt.

For this study, I propose to quantify the life-history diversity of delta smelt and and longfin smelt and compare these data to freshwater flow and temperature to reveal possible mechanisms responsible for the evolution of variable life-history contingents, and the relative success of these contingents in years with very different environmental conditions. I will use all specimens that I have currently prepared for natal origin analysis (from 1999-2008; approximately 1000 individuals) and all available samples from future collections. Quantifying the movement patterns of delta smelt from years of varying freshwater outflow, temperature, and abundance will provide key insights into the habitat requirements of delta smelt and elucidate the role of life-history diversity in the resiliency of the population.

The delta smelt and longfin smelt, along with several other pelagic fishes, has undergone a massive decline in abundance since 2002. Population declines in conjunction with increased freshwater exports and adult fish salvage has led to several law suits by environmental groups (NRDC), and resulted in freshwater export reductions of up to 50%, which will place a major restriction of agricultural and economic activities in California. Several mechanisms have been proposed for the pelagic organism decline, including increase ammonia levels from urban sewage treatment plants, increased use of pyrethroid pesticides, blooms of toxic algae, declines in zooplankton prey, interactions with non-native species, and increased freshwater exports, just to list a few (Sommer et al 2007, Baxter 2009). This crisis has led to major policy renovation and potential ecosystem restoration that may include an alternative freshwater conveyance system (peripheral canal). To make wise restoration decisions regarding the configuration of freshwater exports, develop new flow criteria, including increasing salinity variability within the delta and restore key spawning habitats, we must understand how delta smelt and longfin smelt utilize different areas of the delta under the current delta configuration. Our proposed research directly addresses the first priority area of the current CALFED ERP RFP and will add in the conceptual model regarding how physical and biological variables are associated with the salvage of delta smelt at the SWT and CVP in the south delta.

Conceptual Model.

To understand how the current ecosystem state shapes the smelt populations, it is imperative to examine the environmental conditions associated with the success of different life-history contingents of the population. The movement of juvenile fish from freshwater habitats to brackish habitats is either a function of the passive dispersal due to physical conditions (e.g. flow) or is a behavioral decision to migrate to the estuary. White perch (*Morone americana)* from the Hudson Bay Estuary exhibit a similar pattern in life-history diversity, and it has been suggested that growth during the early life-history is the primary mechanism driving migrations downstream to the estuary (Kraus and Secor 2005). For example, Secor (1999) found that striped bass (*Morone saxatilis*) individuals experiencing rapid growth (good conditions and/or competitive advantage) during the early life history were more likely to remain in the river as resident fish, while those exhibiting poor growth (e.g. poor growing conditions and/or inferior competitors) were more likely to exhibit active search behaviors for locating food and, were thus, more likely to disperse downstream. However, individuals originating in different habitats may experience variable flow and temperature regimes which can also influence behavior and the tendency to move downstream. For delta smelt and longfin smelt, it remains unclear what mechanisms are responsible for driving the variable life-history patterns we have observed. However, here we hypothesize that restoration actions in tidal freshwater habitats will result in more freshwater resident fish and an overall increase in the abundance of smelt in the estuary.

Objectives and Hypothesis.

Following our conceptual model, our primary objective is to address questions regarding the mechanisms responsible for different life-history patterns and hypotheses designed to broaden our understanding of the role of t life-history diversity. Hypothesis testing in this regard will constitute falsification of alternatives. These include but are not limited to:

Questions regarding life-history diversity and population persistence

1. Does life-history diversity vary inter-annually (2011-2013)?

   H_1: Life-history diversity is greater pre-2002 vs. POD years.
   H_0: There is no inter-annual difference in life-history diversity
2. Does life-history diversity vary with smelt abundance/persistence?

   H_1: Life-history diversity is greater during years of greater abundance.

H_0: There is no difference in association with abundance.

3. Do life-history patterns vary in association with freshwater outflow?

   H_1: High freshwater outflow increases freshwater residence.
   H_0: There is no relationship between flow and freshwater residence.

4. Are life-history patterns associated with differential entrainment potential?

   H_1: Freshwater residents have higher entrainment potential.

   H_0: All contingents are impacted equally by exports.

Questions regarding mechanisms of life-history contingency

5. Is migration timing associated with water temperature?

   H_1: Delta water temperatures >20□C will be associated with movement to brackish water.
   H_0: No effect of water temperature on the timing of movement to brackish water will be detected.

6. Is migration timing associated with freshwater outflow?

   H_1: Fishes born during higher outflow will move to brackish habitats earlier than fishes born during low outlfow.
   H_0: There is no difference in life-history diversity during differing outflow.

7. Does life-history contingency vary in association with early life growth rate?

   H_1: Freshwater contingents will have the fastest growth rates

   H_0: No difference in growth rates among contingents will be detected.

3. Approach and Scope of Work

I propose a 3 year study to examine the inter-annual variability of life history contingents for the delta smelt and longfin smelt by analyzing the otolith ^{87}Sr:^{86}Sr from the core to edge to determine habitat use by methods we developed in previous research for fish collected during CDFG Tow-net, Midwater Trawl and Kodiak Trawl surveys from 1999-2008 (Hobbs et al. *2010*). In this study we will focus on three periods, spring-summer (Summer Tow-net Survey, Fall Midwater Trawl Survey and Bay Study, Winter-Spring Kodiak Trawl for delta smelt and the USFWS Chipps Island Trawl for longfin smelt. I will evaluate the contingent status of individuals with respect to hatching date, growth rate, natal origin, freshwater outflow, freshwater exports and mean delta water temperature to explore relationships between life-history patterns and climate variables. The integration of otolith strontium isotopes ^{87}Sr:^{86}Sr to determine life-history patterns, combined with classic otolith age and growth techniques) is a novel approach for assessing the selective effect of freshwater exports and exploring the factors that will support population resiliency and guide managers in restoration strategies for the delta smelt.

Task 1: Otolith Geo-Chemistry

The otolith ^{87}Sr:^{86}Sr approach to determine habitat use is a relatively new tool for fisheries managers. Freshwater ^{87}Sr:^{86}Sr ratios vary due to the geological composition and age of a water shed, resulting in unique isotopic signatures of nearby watersheds that differ geologically (Barnett-Johnson 2008). Our previous research on this technique in the Bay-Delta has established a very precise model of freshwater ^{87}Sr:^{86}Sr ratios associated with the volume of Sacramento and San Joaquin River water entering the system (figure 2a). In addition, the strontium isotope ratio ^{87}Sr:^{86}Sr technique can accurately reflect estuarine salinity as a mixture of freshwater strontium isotope ratios with the globally stable marine strontium isotope ratio (0.7092)(figure 2b).

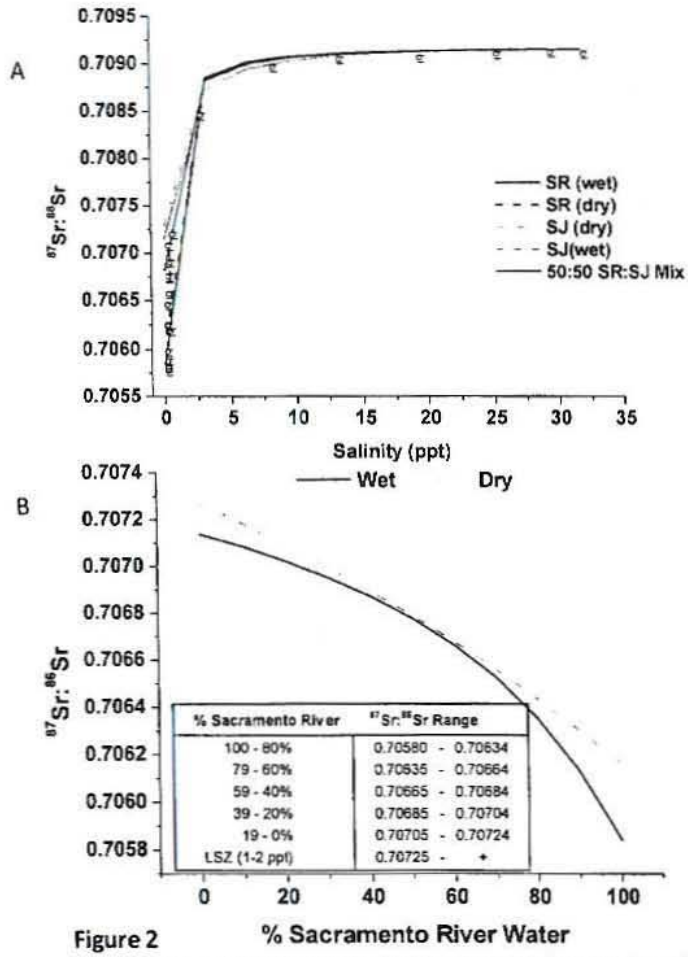


Figure 2
A. the mixture of the strontium isotopes ratios across the estuarine salinity gradient. With different hydrologies of the delta. B. The mixing curve for Sacramento River and San Joaquin River water in the delta.

At the Interdisciplinary Center for ICP-MS at UC Davis, we have pioneered production scale analysis of laser ablation multi-collector ICP-MS for otolith $^{87}Sr:^{86}Sr$. Laser line scans with a New Wave Nd:Yag system will be assessed from the core natal region of the otolith to a the edge, with strontium isotope ratios measured on a Plasma Nu multi-collector ICP-MS in a time resolved mode such that strontium isotope ratios are measure at a 40μm resolution, equivalent to a period of 5-10 days of otolith growth.

Task 2: Otolith growth back-calculations

The back-calculation of fish size-at-age will be conducted using methods we established in previous research (Hobbs et al. 2006). Briefly, otolith increments will be enumerated and widths quantified on thin section preparations with digital imaging and analysis. Back-calculation of fish size will be made with an allometric model of fish size and otolith size with modifications due to a step change in otolith and fish size relationships during metamorphosis to the juvenile stage (Hobbs et al. 2006). This technique can be applied to situations where total age of fish may not be possible due to formation of annual growth bands during the winter, such as individuals collected during the Kodiak trawl survey; where total age or birth date will not be resolvable.

Task 3: Data integration and analysis

Patterns in strontium isotope ratios of otoliths and habitats will be determined with strontium isotope models for freshwater and brackish water developed in previous research (figure 4a,b). Life history contingents will be classified based on the age of estuarine entry, with fish residing in freshwater <30 days as early migrants, for ~90 days as late migrants, and for longer than 150 days as freshwater residents. The diversity of life-history contingents will be quantified as the proportion of each contingent in the Summer Tow-net Survey, Fall Midwater Trawl, and Spring Kodiak Trawls for years where samples are available.

Data for freshwater outflow and delta water temperature will be summarized weekly from the long term monitoring stations in the CDEC (California Data Exchange Center, http://cdec.water.ca.gov). and dayflow models (http://www.iep.ca.gov/dayflow/). Logistic regression of physical variables, hatch date, and natal origins will be used as explanatory variables to examine the

mechanisms for contingent membership. Next the diversity of contingents will be regressed in relation to the population abundance and salvage to understand the role of contingent diversity in population resilience.

4. **Deliverables**.

Project proposals must include a clear list of the deliverables that your project will produce and submit. Deliverables can include presentations, workshops, seminars, educational programs, project summaries, websites, databases, reports, maps, and publications, and other products to be prepared and delivered to DFG. All completed projects will need to submit a Final Report as a deliverable. All watershed evaluation, assessment, and planning, and monitoring projects need to submit detailed assessments/monitoring reports as project deliverables. Any project that creates/compiles GIS or GPS data will need to submit these as project deliverables on compact disc.

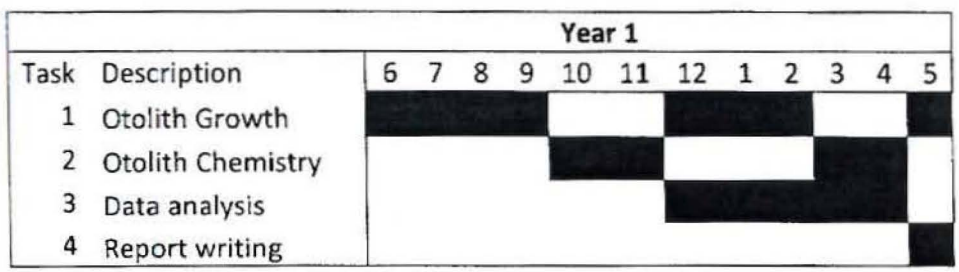
Deliverable for the project will include:

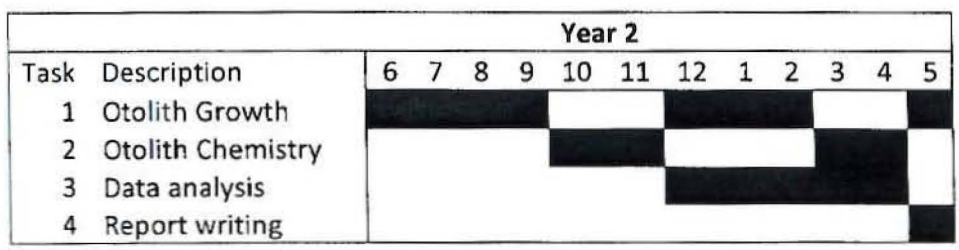
Oral presentations for the Delta Science Program Biennial Conference, which I have presented at in the past two meetings. To the American Fisheries Society, Cal-Nevada Chapter meetings and National meetings. To the Interagency Ecological Program annual meeting.

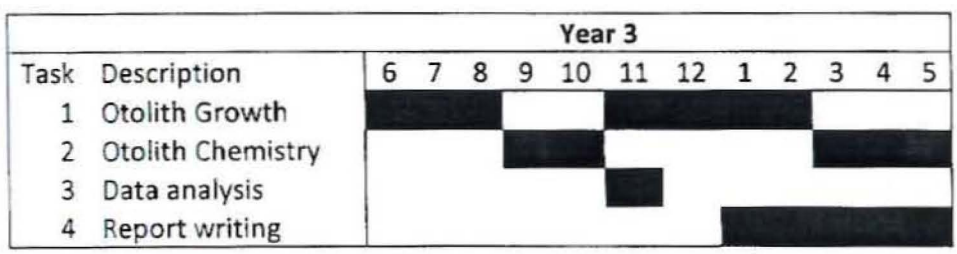
Annual progress reports, and two peer reviewed publications.

Databases of age and growth information will be provided to DFG and DWR, and other University collaborators and agency staff upon request.

Below is a schedule of work to be performed.







5. **Feasibility**

The research plan proposed is a continuation of ongoing research funded by the Interagency Ecological Program. I have a demonstrated publication record that and I have demonstrated with pilot data the established patterns of life-history contingents, and have provided some insights to the mechanisms and resulting impacts of freshwater exports on the resultant phenotypes of successful recruits. I have a well established publication record regarding fish otolith geo-chemistry and have been working on delta smelt issues for 10 years, having completed a PhD and Post-doctoral fellowship leading up to this project. The proposed research will take advantage of samples already collected in CDFG surveys, many of which have already been prepared for otolith age and geo-chemistry analysis from my post-doctoral fellowship research. The samples are currently housed and covered under State and Federal permits to UC Davis (Dr. Bill Bennett and Dr. Peter Moyle, and the IEP take permit).

Proposed work will start in June 2011 with Task 1: Otolith collections and preparation. Task 2: Otolith microchemistry work at the Center for ICP-MS will take place in spring (March-April) and fall (October-November). Task 3 will take place intermittently but primarily in the fall after Task 2 is complete in November. Task 4 reporting will take place in the fall and I will provide all products and preliminary reports on time and present results at the Calfed Science Conferences in the Fall. In year 2 I will have a manuscript describing the life history diversity role in population resilience. In year 3 I will have a manuscript describing the mechanisms

6. Relevance to the CALFED ERP

This section comprises two parts:

Relevance to this PSP — Describe how your proposal directly meets one or more of the needs identified in the priorities of this PSP. Identify all "possible questions to be addressed by the research" from the priorities that your proposal addresses and incorporates. Summarize other questions your proposal may answer that, although not found in the Priorities, address a need from the priorities. Describe how your proposal meets other priorities described in section II of this PSP such as the need for synthesis, integration, and collaboration.

Relevance to CALFED Issues Outside this PSP — If applicable, explain how your proposal addresses ERP needs not mentioned in this PSP. Describe how the project will link back to or complement larger CALFED goals and efforts. Identify any synergistic, CALFED-wide benefits, including how your proposal complements projects or programs in other areas within the Bay-Delta system. Explain any relationship between your proposal and past CALFED actions or investments.

This project is directly related to the CALFED goals to restore and protect native and threatened species (CALFED 2000). The proposed research also directly address topic 1 of the 2009 PSP; How do native migratory fishes navigate through the San Francisco estuary? What factors affect their migratory behavior? What are the management implications? And What are the physiological tolerances and adaptive traits of native fish species that determine their resilience to existing and emerging stressors? This research will address these questions with the most important species in the system, the delta smelt.

This research is also relevant and extremely important for understanding the mechanisms associated with the Pelagic Organism Decline and is a key data need for the 2009 IEP study plan. My previous research on the delta smelt was funded through the CALFED Fellowship Program, and the IEP POD study. This work is also relevant and crucial for the Bay Delta Conservation Plan, the OCAP Biological Opinion, and a key data need from the Blue Ribbon Task Force, Delta Vision Plan.

7. *Expected quantitative result (project summary):*

Expected results must be consistent with those identified in Appendix E. If project occurs at more than one site, summarize the results for the project as a whole. Report measurements in the units listed in Appendix E.

Information from this study will identify the critical habitats for delta smelt and longfin smelt and aid in the recovery of these endangered species.

8. Other products and results:

List and describe any other outcomes and results not described above.

9. Qualifications

James Hobbs, Ph.D., Assistant Research Scientist in the Department of Wildlife, Fish and Conservation Biology and an associate with the Interdisciplinary Center for Inductively Coupled Plasma Mass Spectrometry at UC Davis. Dr. Hobbs received his B.S. degree in Marine Biology from Sonoma State University, completed his PhD. in Ecology from the University of California, Davis and was a Sea Grant-CALFED Post-Doctoral Fellow at the University of California, Berkeley. His research focuses on development of otolith

microstructure and microchemistry techniques to understand the population biology and ecology of commercially important and threatened species. Dr. Hobbs has published several articles in peer review literature regarding the application of laser ablation inductively coupled plasma mass spectrometry. He has received grants from the U.S. Forest Service to determine natal stream origins and migration history of Chinook and Coho salmon in the Klamath River; Army Corp of Engineers-Bonneville Power District to determine migration history and estuarine residency of spring Chinook salmon; Sonoma County Water Agency to determine estuarine residency in steelhead trout; Interagency Ecological Program to determine ocean residency in the threatened longfin smelt and natal origin of the endangered delta smelt

10. Literature Cited

Barnett-Johnson, R., T.E. Pearson., F.C. Ramos., C.B. Grimes. and R.B. MacFarlane. 2008. Tracking natal origins of salmon using isotopes, otoliths, and landscape geology. Limnology and Oceanography. 53(4)1633-1642.

Bennett, W. A. , J.A. Hobbs, and S.J. Teh. 2008. Interplay of Environmental Forcing and Growth-Selective Mortality in the Poor Year-Class Success of Delta Smelt in 2005. Final Report to POD. http://www.science.calwater.ca.gov.

Feyrer, F., M, Nobriga and T, Sommer,. 2007. Multidecadal trends for three declining fish species: habitat patterns and mechanisms in the San Francisco Estuary, California, USA . Canadian Journal of Fisheries and Aquatic Sciences Volume: 64(4), 723-734.
Hobbs, J.A., W. A. Bennett, N Ikemiyagi, E Brown. Looking Back to Go Forward: The application of otolith growth and micro-chemistry to determine spatial-temporal variability in recruitment success for delta smelt. *Submitted to San Francisco Estuary and Watershed Science. Jan 2009.*
Hobbs, J.A., W. A. Bennett., J.E. Burton., and B. Baskerville-Bridges. 2007. Modification of the biological intercept model to account for ontogenetic effects in laboratory-reared delta smelt (*Hypomesus transpacificus*). Fishery Bulletin. 105:30-28.

Hobbs, J.A., Q. Yin, J. Burton-Hobbs, and W.A. Bennett. 2005. Retrospective determination of natal habitats for an estuarine fish with otolith strontium isotope ratios. Journal of Freshwater and Marine Research. 56: 655-660
Kennedy, B.P., Klaue, A., Blum, J.D., Folt, C.L., K. H. Nislow. (2002) Reconstructing the lives of fish using Sr isotopes in otoliths. Canadian Journal of Fisheries and Aquatic Sciences 59, 925-929

Kimmerer, W. J., 2008. Losses of Sacramento River Chinook salmon and delta smelt to entrainment. San Francisco Estuary and Watershed Science.
Kraus, R.T., Secor, D.H., 2005. Connectivity in estuarine white perch populations of Chesapeake Bay: evidence from historical fisheries data.
Estuarine, Coastal and Shelf Science 64, 108-118.

Secor, D.H., 1999. Specifying divergent migrations in the concept of stock: the contingent hypothesis. Fisheries Research 43.

Sommer, T., C. Armor, R. Baxter, R. Breuer, L. Brown, M. Chotkowski, S. Culberson, F. Feyrer, M. Gingras, B. Herbold, W. Kimmerer, A. Mueller-Solger, M. Nobriga, and K. Souza. The collapse of pelagic fishes in the upper San Francisco Estuary el colapso de los peces pelagicos en la cabecera del estuario San Francisco. 2007. Fisheries 32(6): 270-277.
Swanson, C., Reid, T., Young P.S. and J. J Cech. 2000. Comparative environmental tolerances of threatened delta smelt (Hypomesus transpacificus) and introduced wakasagi (H. nipponensis) in an altered California estuary. Oecologia 123(3), 384-390

Section 7: Project Budget

1. Detailed Project Budget

Instructions for Completing Total Project Budget

Each proposal must contain a detailed line item budget broken down into three categories: Personal Services, Operating Expense and Administrative Overhead. Additionally the budget must identify the amount being requested from DFG, the amount being provided by the applicant and the total cost for each line item. The amount requested from each source must be divisible by the listed unit cost. The total project budget must contain all project costs.

- Projects approved for funding will be required to submit invoices matching this budget format. Add or delete line items where not applicable.
- It is recommended you calculate, create and save your budget in *Microsoft Excel®* or similar spreadsheet program, as doing so will avoid costly and unfortunate budget errors; then export your budget to *Microsoft Word® or* compatible word processing program with the rest of your written proposal. If the proposal is funded, the information can be sent electronically to DFG staff without reformatting it. A fill and print budget template is provided in the ERP Proposal Application Form.
- It is recommended that the budget be in whole dollar amounts.

Personal Services Costs
All employee costs are required to complete the proposed project.

- List each personnel classification, their total hours, hourly pay rate, and the calculated total. **The calculated total must equal the line item calculation, including both the cost-share and requested amounts. (Do not include staff benefits in the hourly pay rate.)**
- A "Staff Benefit(s)" amount must be listed and calculated.
- Do not list subcontracts in this section. Subcontracts are listed as Operating Expenses.
- Do not list workers' compensation insurance in this section. Workers' compensation insurance is listed as an Operating Expense.

Operating Expenses
Include all materials, contractual services, equipment, and incidental costs.

Contractual Services are those necessary for the implementation of the proposal for which the applicant will subcontract. These services are undertaken by a provider external to the applicant's organization.

- List each subcontractor on a separate line. Provide names of subcontractor(s) if known.

Other Operating Expenses: Expenses related to the operation of the proposal.
- Provide as much cost detail as possible and practical. Use unit costs when applicable (per lb., per day, cubic yard, linear foot, etc.).
- Purchase of equipment with DFG funds is not normally allowed. See *Part II, #2 Project Budget*, for equipment definitions and restrictions.

Travel
Expenses must be consistent with state guidelines for reimbursed travel expenses. Per diem and mileage rates may not exceed State of California standards. State guidelines can be found at www.dpa.ca.gov/personnel-policies/travel/hr-staff.htm.

Streambed Alteration Permitting Fees
Fish and Game Code, Section 1600 et seq. authorizes the Department to recover the total costs it incurs to administer and enforce its Lake and Streambed Alteration Program by charging applicant fees for Lake and Streambed Alteration Agreements. The actual fees charged will depend on the total cost of the project. Before calculating the fee, be sure to read the definition of a project per the Lake and Streambed Alteration Program. The definitions, instructions and forms are available on the Lake and Streambed Alteration Agreements website at www.dfg.ca.gov/habcon/1600/forms.html.

Standard Agreement	
If project costs is:	**Permit fee will be:**
less than $5,000	$200
$5,000 to less than $10,000	$250
$10,000 to less than $25,000	$500
$25,000 to less than $100,000	$750
$100,000 to less than $200,000	$1,100
$200,000 to less than $350,000	$1,500
$350,000 to less than $500,000	$2,250
$500,000 or more	$4,000

Administrative Overhead
Administrative overhead should be applied only to projected administrative costs that cannot be recovered in other budget categories.

- Administrative overhead in excess of 10% must be justified on a separate attachment.

Budget			
The Role of Life History Variability on the Population Resiliency of Delta Smelt and Longfin Smelt			
			Totals
PERSONAL SERVICES			
Staff Level 3yr total	**Number of Hours**	**Hourly Rate**	
Hobbs Assistant Research Scientist	2880	$34.06	$98,100
SRA 1	2880	$19.76	$56,898
Subtotal			$154,998
Staff Benefits @ 35 %			$54,249
TOTAL PERSONAL SERVICES			
OPERATING EXPENSES			
Description			
Subcontractor Costs			
Materials			
Microscope Rental			$750
Printing and Duplicating			
Office Supplies			
General Expense ICPMS			$25,500
Travel and Per Diem			$7,500
Training			
Add/delete line items above for work to be performed by the contractor			
Total Operating Expenses			$242,997
EQUIPMENT			$0
SUBTOTAL			
OVERHEAD @ % (Less Equipment)			$60,749
GRAND TOTAL			**$303,747**

2. Budget Justification

UC milage reimbersement rate $0.50/mi.
UC Per Diem (breakfast $10, lunch $15, Dinner $20)

Task 1

Salary

Salary for J.Hobbs for 6mo. $5,450/mo(100%) + 35% fringe and 2 undergraduate lab technicians @680/mo (50%) + Jr Specialist II 6mo./yr @$3,161/mo (100%) +35% fringe.

Travel to local meetings and IEP workshops, to Tracy Fish Facilities, SWP, CVP, to field sites for sample collection w

1 Scientific Meetings(American Fisheries Society, Estuarine Research Federation)
2 Local Travel.

Supplies

service fees for laser ablation ICPMS @ the Interdisciplinary Center for ICPMS-UCD

supplies include microscope rentals, slides, otoliths prep materials

Conferences

AFS National		Cal-Neva		
Flight/car	$400	100		$500
Reg	$400	200		$600
Lodging	$400	400		$800
Per Diem	$300	300		$600
				$2,500

Total **$3,000**

Cost/Rat	**Hours**	**Total**
$106/hr	142	**$4,000**

Microsco	$250/yr	1yr	$250
Oto-prep	$3,600		$1,000
Office materials			$2,500
			$3,750

3. **Administrative Overhead**

For DFG use only	
Proposal No.	Region

(Pages A13-A18)

Section 1: Summary Information

1. **Project title:**	
2. **Applicant name:**	
3. **Contact person:**	
4. **Address:**	
5. **City, State, Zip:**	
6. **Telephone #:**	
7. **Fax #:**	
8. **Email address:**	
9. **Agency Type:**	Federal Agency ☐ State Agency ☐ Local Agency ☐ Nonprofit Organization ☐ University (CSU/UC) ☐ Native American Indian Tribe ☐
10. **Certified nonprofit organization:**	Yes ☐ No ☐
11. **New grantee:**	Yes ☐ No ☐
12. **Amount requested:**	
13. **Total project cost:**	
14. **Topic Area(s):**	
15. **ERP Project type:**	
16 **Ecosystem Element:**	
17. **Water Quality Constituent:**	
18. **At-Risk species benefited:**	

19. Project objectives:	
20. Time frame:	

Section 2: Location Information

1. Township, Range, Section: and the 7.5 USGS Quad map name.	
2. Latitude, Longitude (in decimal degrees, Geographic, NAD83):	
3. Location description:	
4. County(ies):	
5. Directions:	
6. Ecological Management Region:	
7. Ecological Management Zone(s):	
8. Ecological Management Unit(s):	
9. Watershed Plan(s):	
10. Project area:	
11. Land use statement:	
12. Project area ownership:	% Private_____ % State_____ % Federal_____ *Enter ownership percentages by type of ownership.*
13. Project area with landowners support of proposal:	

Section 3: Landowners, Access and Permits

1. Landowners Granting Access for Project: (Please attach provisional access agreement[s])	
2. Owner Interest:	
3. Permits:	
4. Lead CEQA agency:	
5. Required mitigation:	Yes ☐ No ☐

Section 4: Project Objectives Outline

1. **List task information:**

2. **Additional objectives:**

3. **Source(s) of above information:**

Section 5: Conflict of Interest

To assist ERP staff in managing potential conflicts of interest as part of the review and selection process, we are requesting applicants to provide information on who will directly benefit if your proposal is funded. Please provide the names of individuals who fall in the following categories:

- Persons listed in the proposal, who wrote the proposal, will be performing the tasks listed in the proposal, or who will benefit financially if the proposal is funded; and/or
- Subcontractors listed in the proposal, who will perform tasks listed in the proposal, or will benefit financially if the proposal is funded.

Primary Contact for Proposal:
Primary Investigator:
Co-Primary Investigator:
Supporting Staff:
Subcontractor:

Provide the list of names and organizations of all individuals not listed in the proposal who helped with proposal development along with any comments.

Last Name	First Name	Organization	Role

Section 6: Project Tasks and Results Outline

1. Detailed Project Description

2. Background and Conceptual Models

3. Approach and Scope of Work

4. Deliverables

5. Feasibility

6. Relevance to the CALFED ERP

7. Expected quantitative results (project summary):

8. Other products and results:

9. Qualifications

10. Literature Cited

Section 7: Project Budget

1. **Detailed Project Budget** *(Excel spreadsheets can be used)*

Budget			
Project Title			
			Totals
PERSONAL SERVICES			
Staff Level	**Number of Hours**	**Hourly Rate**	
Subtotal			
Staff Benefits @ %			
TOTAL PERSONAL SERVICES			
OPERATING EXPENSES			
Description			
Subcontractor Costs			
Materials			
Photographic Supplies			
Printing and Duplicating			
Office Supplies			
General Expense			
Travel and Per Diem			
Training			
Add/delete line items above for work to be performed by the contractor			
Total Operating Expenses			
EQUIPMENT			
SUBTOTAL			
OVERHEAD @ % (Less Equipment)			
GRAND TOTAL			

2. **Budget justification:**

3. **Administrative overhead:**

Proposal to:

California Department of Fish and Game
WaterBranch 830 "S" Street
Sacramento, CA 95811

Submitting Organization:

The Regents of the University of California
Office of Research, Sponsored Programs
1850 Research Park Drive, Suite 300
University of California
Davis, California 95618

Title of Proposed Research:

"The Role of Life History Variability on the Population Resiliency of Delta Smelt and Longfin Smelt"

Total Amount Requested:

$303,747

Principal Investigator:	**Department:**	**Phone Number:**
Dr. James Hobbs	Wildlife & Fisheries Biology	707-480-0188

Checks Made Payable to:

The Regents of the University of California

Send Checks to:

Cashier's Office
University of California Davis
PO BOX 989062
West Sacramento, California 95798-9062

Send Award Notice to:

Office of Research
Sponsored Programs
1850 Research Park Drive
University of California
Davis, California 95618
(530) 754-7700 / FAX (530) 754-8229
vcresearch@ucdavis.edu

Approval:

Courtney M. Blair 2/25/2011

Official Signing for Organization Date

Courtney Blair
Contracts and Grants Analyst, Sponsored Programs