Selection Panel Review Summary

Project No: 003
Project Title: Survival and Migratory Patterns of Juvenile Spring and Fall Run Chinook Salmon in Sacramento River and Delta
Principal Investigator: A. Peter Klimley
Amount Requested: $1,746,955
Recommended Amount: $1,746,955

Summary: This project aims to evaluate the effect of natural and anthropogenic changes in flow and related water project operations on the survival and movement patterns of juvenile spring and fall-run Chinook salmon within the Sacramento River and Delta. The applicants believe it would provide resource managers in California with a more comprehensive understanding of the response of juvenile salmon outmigration under a wide variety of flow conditions and Delta water management practices. The two tasks of this research proposal are to establish a network of acoustic receivers capable of monitoring the migratory movements of juvenile fall and spring run Chinook salmon and to apply miniature coded transmitters to members of four groups of Chinook salmon: 1) hatchery spring-run, 2) wild spring-run, 3) hatchery fall-run, and 4) wild fall-run at or near their source points to assess reach specific survival rates in the river.

Assessment: The Selection Panel found that the goals, objectives, and hypotheses were clear and relevant to the PSP, BDCP, and the OCAP Biological Opinions. The proposal had previously been submitted to the Science Program PSP and showed good responsiveness to the initial technical reviews before it was submitted to this PSP, including participation in an independent science review if requested. The project should add to our knowledge of reach-specific survival of salmon smolts, providing information on where predation and mortality occur in the part of the system covered by the study. The Selection Panel felt the proposal made good use of recent technology and the receiver array may be useful to future projects. The Panel would like to see more clarity in the task descriptions.

2010 Final Review Panel – Summary of Review

Proposal # 132

Proposal Title: Survival and Migratory Patterns of Juvenile Spring and Fall Run Chinook Salmon in Sacramento River and Delta

Lead Primary Investigator: Abbott (Peter) Klimley

Applicant Organization: University of California, Davis

Amount Requested: $1,746,955

Panel Findings:

Relevance to Topic Areas: The proposed research is highly relevant to the PSP and to the ongoing issues about Chinook salmon outmigration. The proposal relates directly to Topic 1: Native Fish Biology and Ecology.

Quality of the Proposed Research: The proposed research has the ingredients for generating very useful information on reach-specific survival of juvenile salmon, and detailed information on their passage through the key Delta region. The quality and usefulness of the data from the project depends on many, high-risk steps going perfectly, and thus something or several things will likely not go as planned. Tags may have larger effects on small fish than expected, environmental conditions may not create sufficient contrast for inference of effects, and receivers can malfunction or have low detection rates. Yet, this type of reach-specific survival rates are critical information for better understanding the population dynamics of Chinook.

Main Summary Comments of Reviewers: There are many issues with the proposal, but these can be addressed with additional information and revised sampling methods. These issues should be addressed before the project proceeds. These issues relate primarily to the approach and the specification of methods to be used. The Panel identified the following major issues: 1) confirm the actual availability of tags and receivers to be purchased, 2) examine the optimal number of receivers and their placement, 3) examine the data quality and costs tradeoffs between the number of tags and the number of receivers, 4) examine the tagging and release

design to ensure convincing results are obtained, and 4) detail plans for assessing tag effects on fish of the small size, as this is at the limit before tagging effects become too important. The investigators should also explain in more detail how environmental variables will be incorporated into the analysis of reach-specific survival.

This is a large, complex and expensive proposal that can generate potentially critical information. Therefore, to ensure the project's deliverables can withstand critical review, a revised proposal should: 1) include provisions for setting up a scientific advisory panel, 2) include a section that discusses lessons learned from the prior telemetry study, 3) discuss foreseeable constraints and identify potential pitfalls and contingency plans in case the research does not progress as planned, and 4) plan to mesh this study with Hilborn's study (Proposal 066) should both proposals be funded.

Funding Category: Above Average/Sufficient

Proposal Number:	0132
Proposal Title:	SURVIVAL AND MIGRATORY PATTERNS OF JUVENILE SPRING AND FALL RUN CHINOOK SALMON IN SACRAMENTO RIVER AND DELTA
Proposal Applicant:	University of California, Davis
Amount Requested:	$1,746,955
Primary Investigator:	Abbott (Peter) P., Klimley

FRP primary Reviewer's Evaluation Summary and Rating

Provide a brief explanation of your summary and rating.

Comments:

Purpose	Tag and track juvenile fall and spring run Chinook, both hatchery and wild, from their source points and compute reach-specific survival rates. In addition, tag and track fall and spring hatchery fish at the entrance to the Delta and compute survival rates with the DCC open and closed.
Background/Conceptual Models	The background is well described. Fall run Chinook drive the fishery; winter run are endangered; spring run are threatened. The decline in Fall run caused closure of the ocean fishery in 2008 and 2009. New technology allows for tagging (individually-coded ultrasonic tags) of smaller fish then in the past and the availability of low cost monitors. What was missing or not highlighted was the previous work on this topic. There was much debate over earlier tagging studies of salmon through the Delta, related to the VAMP. How this proposed study would address the issues with the earlier studies was not described.
Approach	Task 1 is management. Task 2 is to add 28 monitors to the existing array of about 300. Locations will include tributaries (Feather River below hatchery, mouths of Deer and Mill Creeks), and mainstem from Battle Creek to the head of the Delta. The authors do not present evidence that they have considered the trade-off between number of receivers and number of tagged fish. Task 3 is the actual tagging and releasing. The authors use earlier work to justify that these new tags will not affect such small fish. They are certainly at the lower limit of the size of fish that can be tagged. Some laboratory work tailored to this situation to determine any tag effects and assess tag performance is warranted. If people think the tag has effects, then

the rest of the entire study loses important credibility. The authors already are using hatchery fish for a significant portion of the releases. It is a little confusing to determine how many fish will be tagged by the authors and when they will be released. At one point, the authors examine the size distribution of released fish and say 200 tags, but then later say, for Fall run, they will tag 150 in an early April release and 150 in a late April release, as part of usual (CNFH) hatchery releases. A table showing the details of the fish tagging for each of the three years would clarify this. Task 4 is about the hatchery Spring run fish, and the authors will tag 200 with an early April release and 200 with a late April release (related to the Feather River Hatchery). Task 5 is the tag and release of the wild fall and spring run fish. They will tag 200 smolts caught at the Mill and Deer Creeks rotary screw traps between Oct and May, and use size and timing to assign them to a run. Fin clips will be taken but it was not clear if the genetic analysis was going to be done or might be done. Task 6 is the Delta study. Hatchery fall (75) and hatchery spring (75) will be released near Sacramento before the DCC closes and the same number just after the DCC closes, and followed within the Delta. Task 6 seemed to be a one-time release, which may not be very informative. Task 7 is the analysis. Mark-recapture modeling applied to the trajectories of individuals with explanatory variables (flow, temperature, turbidity, channel form, riparian cover, and timing of hatchery releases). They will also compute movement rates between monitors. Then Task 7 gets vague. The authors add "analysis of data in relation to site of water projects, diversions, by-passes." Yet, the relationship between survival and movement routes relative to water removals is of major management importance.

Feasibility

The project is doable, although before 1.7 million dollars is invested, the authors need to examine the trade-offs on costs and data quality between more receivers versus more tags. Also, some lab studies should be done to clearly show these tags can be used on small fish. Also, the analysis of the data needs to be better described, especially as it relate to testing of the hypotheses and determining the correlates to the difference in survival rates. The authors cite previous work on tagging but never directly address how their study will not have the same problems as earlier studies. If the study goes perfectly, the results have great potential for being extremely useful. In this type of study, many things can go wrong and even small problems can result in data that is not very useful.

Relevance

	The proposed study is highly relevant, but also has a high probability of something going wrong.
Qualifications	The authors are qualified to do the proposed work.
Summary Comments	The study is very much needed and the authors have presented a good approach. Given the high cost of the study and the likelihood that something will go wrong, perhaps a smaller version (one-year, two releases with Fall run hatchery fish) would be a more prudent approach. Also, before investing in monitors versus tags, the trade-offs should be examined to optimize the system for the long-term. Above average (higher if the authors show the monitor versus tag trade-offs, and do a scaled down version).

Please identify your overall ranking for this proposal:

– Superior
x Above Average
– Sufficient
– Inadequate

FRP Member's Observations Of External Technical Reviewers' Performance On Review Of Proposal:

Along with your written observations, please **rate the collective performance** of the external reviewers of this proposal utilizing the criteria below. Please also provide a **brief summary** in the comment box below.

x Superior
– Good
– Fair
– Poor

Comments:
Excellant reviews.

Select "Update" after you make changes you wish to save.

Proposal Number:	0132
Proposal Title:	SURVIVAL AND MIGRATORY PATTERNS OF JUVENILE SPRING AND FALL RUN CHINOOK SALMON IN SACRAMENTO RIVER AND DELTA
Proposal Applicant:	University of California, Davis
Amount Requested:	$1,746,955
Primary Investigator:	Abbott (Peter) P.. Klimley

FRP secondary Reviewer's Evaluation Summary and Rating

Provide a brief explanation of your summary and rating.

Comments:

	The purpose of this proposal is to augment knowledge of the migratory patterns and success of smaller CVC smolt by the use of minute transmitters.
Purpose	The goal is clearly stated and timely for this full-scale project; however, objectives and hypotheses need clarification. Objectives should focus of needed results: Establish a network of receivers capable of detecting movements of juvenile fishes through the system with high reliability; Tag sufficient numbers of juveniles to generate convincing estimates of reach-specific survival rates; and Conduct experiments to evaluate the efficacy of the DCC to enhance out-migration of juveniles. Hypotheses should also be recast in a testable form to reflect the objectives.
Background/Conceptual Models	The background information is generally adequate, but information on tag burden and effects, correction factors, laboratory experiments, and the field performance evaluations of the actual tag designs and receivers to be used is lacking or contradictory.
Approach	The approach is highly feasible and should accomplish the aims of the proposed study; however, the approach description is inadequate. Many faults were identified by both reviewers under their headings of Approach/Feasibility and should be addressed before funding. Most deal with the lack of details, contradictory or vague information, or no justification of receiver placement, tags settings and detection trade-offs, sample sizes, or statistical power.
Feasibility	The project is feasible if the new high tech JSTATS tools can be obtained in a timely manner and at the cost anticipated in the budget. This issue should be

	resolved before funding to ensure that the schedule can be met with the budget as allocated. The team clearly has the talent and the experience to pull the study off.
Relevance	The proposal is highly relevant to PSP topics related to Native Fish Biology and Ecology and the migration of fishes thru the SF estuary. It is also relevant to other DSP issues including Life Cycle Models and Population Biology of Key Species, Environmental Influences on Key Species, and Assessment and Monitoring. The proposal makes a strong case for relevance.
Qualifications	The team is highly qualified and experienced with telemetry and salmonids in the study area. Several members of the team are currently participating in a similar study on larger smolt in the system.
Summary Comments	There are many problems with the proposal that can be addressed and should be before funding is promised. These problems relate primarily to the approach and the specification of methods to be used. Two excellent reviews address the main points that should be dealt with in revising the proposal. These are at a minimum: 1) the actual availability of tags and receivers to be purchased, 2) the number of receivers and their placement, 3) the number of tags and the number of runs they will be used on to achieve convincing results, 4) details of plans to assess tag effects on fish size and other QA/QC questions.

Please identify your overall ranking for this proposal:

– Superior
x Above Average
– Sufficient
– Inadequate

FRP Member's Observations Of External Technical Reviewers' Performance On Review Of Proposal:

Along with your written observations, please **rate the collective performance** of the external reviewers of this proposal utilizing the criteria below. Please also provide a **brief summary** in the comment box below.

x Superior
– Good
– Fair
– Poor

Comments:
This proposal received the attention of two excellent outside reviewers,

both constructively critical but one more favorable and optimistic than the other. I rate them as superior.

Select "Update" after you make changes you wish to save.

Proposal Number:	0132
Proposal Title:	SURVIVAL AND MIGRATORY PATTERNS OF JUVENILE SPRING AND FALL RUN CHINOOK SALMON IN SACRAMENTO RIVER AND DELTA
Proposal Applicant:	University of California, Davis
Amount Requested:	$1,746,955
Primary Investigator:	Abbott (Peter) P.. Klimley

FRP secondary Reviewer's Evaluation Summary and Rating

Provide a brief explanation of your summary and rating.

Comments:

Purpose	Identification of the problem, questions, critical unknowns - The problem is clearly identified. Chinook salmon runs are severely depleted and major knowledge gaps impede recovery efforts. Project goals and objectives - The goals and objectives are clearly identified. However, the objectives are more along the lines of research tasks than actual scientific objectives. Clearly stated hypothesis - The proposal clearly states three hypotheses. However, like the objectives, these don't really appear to be scientifically driven but more general hypotheses for a conceptual understanding of the salmon populations. Description of relevant studies - The authors included a short but dense description of relevant studies in the Bay-Delta and other systems.
Background/Conceptual Models	Conceptual model - A conceptual model of the influence of management on salmon populations and the study design are presented both in figures and in the narrative. The authors also provide a description of the decline of the salmon runs and the implications. The figures however are difficult to read. Physical setting - The specifics of the physical environment where the study will be conducted are not described in this section, nor is a map included.
Approach	Methods and techniques - In general, the proposed tasks are appropriate for meeting the project objectives. The authors go into great detail describing tagging procedures. The specific methods used in this study are outside of my technical expertise. However, one of the technical reviewers had serious misgivings about several of the technical aspects of the proposed work and he/she gave the approach a ranking of

	"insufficient". The second technical reviewer seemed to have more confidence in the approach but still raised concerns about spacing of receivers and required sample sizes to support statistical tests. Equipment and facilities - The authors clearly describe the equipment to be used in the proposed study along with the related studies that they are involved in. Data collection - Data collection and storage are clearly described. Statistical analysis and quality control - The authors provide details for how the data will be processed and how population data/survival will be investigated. However, it is not clear how or if the collected data will be used to test the research hypotheses. Scheduling - Scheduling is only included in the Task and Budget Summary. Deliverables - The deliverables are clearly described.
	Reasonableness of timeline - A timeline is not provided.
Feasibility	Foreseeable constraints - Constraints are not identified. Contingencies or requirements - Contingencies are not described. Project management coordination - Project management is not clearly outlined. Other comments - The feasibility of this project is argued through the experience and diversity of the research team. Although it is true that the research team has an impressive track record conducting similar studies, foreseeable constraints and contingencies should have been identified. For example, what happens if the smaller tags don't meet performance standards? Permitting also should have been discussed in the proposal.
Relevance	Relevance to this PSP - As correctly identified in the proposal, the proposed work directly addresses the needs state in the PSP, particularly priority topic #1. Relevance to the Delta Science Program - The authors also draw clear connections to how the proposed research addresses the broader needs of the Delta Science Program.
Qualifications	Experience and expertise of participants - The proposal team has extensive experience related to the proposed research and represents a diverse range of fields and institutions. The proposal text could have provided more insights into the experience of the team and their roles. Rather, the reader must dig through the extended attachments to find the relevant information. Further, the resumes were inconsistent and should have been abridged to highlight experience relative to this proposal. Individual roles and responsibilities - The individual roles and responsibilities for each of the project participants should have been made clearer in the body of the proposal. Tasks are associated with

Summary Comments	various participants in the Task and Budget Summary form. Organizational structure - This also should have been clarified. This is a very interesting proposal which very clearly addresses the priorities raised in the PSP along with those of the Delta Science Program overall. The proposal is very well written and easy to follow. The authors make a compelling argument as to why the study is needed and the benefits that will arise from its results. The proposal team has the experience, skills, and diversity to suggest that they will be able to successfully complete the proposed work. The proposal had a few general shortcomings including: 1. One of the technical reviewers had serious concerns regarding the technical approach and the other technical reviewer mentioned several valid questions. 2. The objectives are really tasks and the hypotheses don't appear to be testable. Statistical methods for testing the hypotheses are not provided. 3. This is a very large project requesting substantial financial resources. However, the authors do not discuss foreseeable constraints or contingency plans if the study does not unfold as proposed. Although the researchers probably have the experience and wherewithal to overcome typical research setbacks, they should have included some discussion of potential pitfalls and contingency plans.

Please identify your overall ranking for this proposal:

- Superior
X Above Average
- Sufficient
- Inadequate

FRP Member's Observations Of External Technical Reviewers' Performance On Review Of Proposal:

Along with your written observations, please **rate the collective performance** of the external reviewers of this proposal utilizing the criteria below. Please also provide a **brief summary** in the comment box below.

X Superior
- Good
- Fair
- Poor

Comments:
The two reviews were extremely helpful. Both reviewers provided very thorough reviews and obviously they both had extensive experience in this area. This was particularly helpful for me because I only have a general understanding of fish tracking techniques and technology.

Select "Update" after you make changes you wish to save.

External Review, Form #40, of Proposal #0132: SURVIVAL AND MIGRATORY PATTERNS OF JUVENILE SPRING AND FALL RUN CHINOOK SALMON IN SACRAMENTO RIVER AND DELTA

Proposal Title: SURVIVAL AND MIGRATORY PATTERNS OF JUVENILE SPRING AND FALL RUN CHINOOK SALMON IN SACRAMENTO RIVER AND DELTA

Proposal Number: 0132

Proposal Applicant: University of California, Davis

Project

comments	The proposal does a fair job of explaining the context of the problem and how the proposed project may help address the problem. However, detail is lacking and generalizations are made that hurt the overall quality of the proposal and make it difficult to assess whether it will be able to address the hypotheses. The project appears to be well set-up to achieve the stated objectives, but these are not research objectives, they are merely methods objectives. Section I.B. should present the research objectives. The proposal instead lists methods as objectives (e.g., establish a net work of receivers or tag four groups...). These are not research objectives. Section I.C. lists hypotheses to be tested but these are vague. For example, the first hypothesis states that tagged fish experience significant mortality but the measure of significance is not given here or in the approach for this task. The second hypothesis states that mortality rates will vary. Is this really a worthwhile and testable hypothesis? The final hypothesis states that mortality rates and variability in movement 'patterns' (which is really a second hypothesis and not well-defined) will be higher when gates are open (it should add 'than when DCC gates are closed' for clarity). Again, the level of the difference (significance level) should be included here or at least in the detailed approach.
rating	Sufficient

Background

comments	The background section is fairly well-developed and presented. However, there are problems with the discussion of tag burden and tagging effects. The proposal seems to select a tag burden of 8% as acceptable for the work proposed. This value is then later called into question when the proposal discusses work that has been conducted in the Columbia River basin (on page 11 of the proposal). The proposal cites a paper by Ammann et al. as in prep

	- so it is not available for review. This reference should be eliminated until that work is available. Further, the proposal states that one of the study team (Merz) has implanted JSATS tags into 85 mm smolts, as apparent justification that this has no detrimental effects on the tagged fish (page 6). Just because a tag can be 'successfully' placed inside a fish, does not mean there will be no tagging effect on that fish. Later in the proposal, it states that correction factors will be developed based on tagging effects measured in laboratory experiments (page 15). This is problematic as lab studies may provide insight into relative degrees and types of tagging-related effects, but the results will likely not be directly transferable to field data. Therefore, the basis for the 8% body burden used throughout the proposal is called into question. The proposal also mentions that Lotek will have a 0.30 g tag available prior to the initiation of this study, however the proposal is not clear on whether this smaller tag would be used for some or all of the tasks. If the smaller tag is used and it follows the specifications listed on page 6 of the proposal (0.30 g, 150 dB, and 15 s pulse rate), then the performance of the tag will be much reduced over the JSATS tag that has been used in recent Columbia River studies (0.43 g, 156 dB, 3 to 5 s pulse rate). The source level (dB) and pulse rate relate directly to effective range, with the 156 dB signal having about double the range of the 150 dB signal. If the proposed project uses the 150 dB/15 s PRI tag, the receivers will need to be placed closer together and in areas of slower water than has typically been the case in Columbia River studies mentioned in this proposal. The example of pulse rates and detection distances at the end of the first full paragraph at the top of page 7 should be recalculated based on more realistic ranges with the smaller tag and with the PRI that is proposed for use in this study (15 s...?). The proposal does not explain the receiver spacing or expected range. Further, the availability of the small tags and the Lotek receivers is stated as 'available in early fall of 2010'. This should be confirmed prior to funding, as it is typical for many telemetry vendors to promise a product of certain specifications by a certain date or at a certain price (e.g., 2000 to 2500/receiver) and then not deliver on time or at the same price. This could have major implications for the project schedule and budget, as well as the size of fish which might be able to be tagged. The conceptual model of the study is good, but no basis is given for the sample sizes selected (apart from saying that Perry released about the same number for one small task (DCC on vs DCC off). A power analysis with expected detection probabilities, a range of sample sizes and expected precision levels should be presented to show what the expected error will be for the various tasks.
rating	Sufficient

Approach

comments	It is difficult to tell exactly what will be done to address each specific task. The maps in Figure 4 are not legible. It is unclear why funding was requested for only 22 receivers, when 28 are needed. Does this 28 include any spares in the event receivers are lost or damaged? Will pre-, in-, and post-season testing be performed on each receiver to document effectiveness? There is no real mention of any QA/QC approaches throughout the proposal (for equipment or data processing/analyses). There is no mention of any tag life tests to provide a data set for tag-life corrections. Table 1 on page 11 is a very good table. However, as stated earlier, the proposal selects a tag burden in the 8% range and justifies that, in part, on the statement that Brown et al. (cited as in press - but it has now been published) found a threshold of significant tagging effects over 7.6%, when in fact that threshold in the published paper is somewhere below 6.7% (see Brown et al. 2010, NAJFM 30:499-505). In that study, the survival and growth of juvenile fall Chinook salmon was significantly lower over the 30 d study period for fish in the 80-89 mm size range. Based on this, it is unlikely that there would be no tagging effects on the size of fish the proposal promises to tag (e.g., page 10; 'maybe even 75 mm....'). Further, the proposal cites work by Welch et al. (2008), stating that they tagged fish with an average burden of 9.3%. Just because others have done it - does not justify doing it. The proposal goes on to recap some of the findings from the Columbia Basin tagging effects research (bottom of page 11) - which showed that tag burdens as low as 5% may have detrimental effects on post-release performance. The proposal then states that it will conduct studies of the effect of JSATS implantation. As stated earlier in this review, the proposal is not clear on exactly what these studies will entail, or how they will apply a 'correction factor' to the field data. At the top of page 12, the proposal discusses that the work would only be able to tag the largest 25% of the fall-run juveniles (and this is using the poorly justified 8% burden level). This would clearly not be representative of that population, thus any results from those groups of fish would be of questionable value in terms of absolute indicators of performance. This may however provide some insight into how the largest of these fish may perform. In Task 7, the proposal is overly simplistic in its approach to the management application of the study results (e.g., page 15, 'can be subsequently afforded protection to increase survival'). In general, the proposal leaves the reader with the feeling that it will demonstrate cause and effect relationships, when in reality it is more likely that it will simply demonstrate relationships (even though it is possible they would be spurious). Finally, as previously stated, the description of the lab studies and how results from these may be applied to the field data is very weak.
rating	

	Inadequate

Feasibility

comments	Apart from the problems listed above, the approach appears feasible in terms of the experience and qualifications of the study team. One cause for concern is the reliance on equipment that is not yet available (the Lotek equipment listed on page 6). If Lotek is unable to deliver on these promises prior to the start of the research, suitable replacements would have to found. This may have budget and schedule implications as well, as currently available receivers are substantially more expensive than those proposed for procurement under this proposal.
rating	Sufficient

Relevance To The Delta Science Program

comments	The work proposed, if the study design deficiencies are addressed and the frame of inference is suitable (e.g., to the largest 25% of the fall run), then this work would appear to address priority research needs in the DSP quite well.
rating	Above Average

Qualifications

comments	The track record of the study team appears to qualify them well to succeed in the proposed project if the study design and approach problems are adequately addressed.
rating	Above Average

Overall Evaluation Summary Rating

comments	If the proposed study is modified to address the concerns, primarily around the availability of the equipment specified, the size of the fish to be tagged, the sample sizes, and the frame of inference, then this would appear to be a worthwhile study.
rating	Sufficient

External Review, Form #40, of Proposal #0132: SURVIVAL AND MIGRATORY PATTERNS OF JUVENILE SPRING AND FALL RUN CHINOOK SALMON IN SACRAMENTO RIVER AND DELTA

Proposal Title: SURVIVAL AND MIGRATORY PATTERNS OF JUVENILE SPRING AND FALL RUN CHINOOK SALMON IN SACRAMENTO RIVER AND DELTA

Proposal Number: 0132

Proposal Applicant: University of California, Davis

Project

comments	Goals, objectives, and hypotheses are clearly stated, and this idea is timely and important. The Juvenile Acoustic Telemetry System (JSATS) is the best choice of equipment for conducting a survival study on small juvenile salmonids because of miniaturization of tags and phase-shift key encoding which will reduce data-processing costs and increase detectability. The scope of proposed receiver deployment is justified and necessary to obtain the survival information desired. There is a possibility that the number of receivers requested may not be sufficient to populate survival detection arrays to adequate densities, but information on receive spacing within arrays is not sufficient for me to tell. Also, the authors need to be certain that the number of tagged fish will deliver the precision in survival estimates that they may require. Receiver spacing and sample size requirements are discussed in more detail below. Results should add substantially to the knowledge base because smaller tags can be successfully implanted in a greater proportion of each population without introducing tag effects that could bias behavior, travel time, and survival estimates.
rating	Superior

Background

comments	The conceptual model is clearly stated and sufficient to understand the proposed research. The authors added considerable detail describing the JSATS relative to other acoustic telemetry systems.
rating	Above Average

Approach

comments	The proposed team of scientists appears to be well qualified to conduct the research, and the team draws on multidisciplinary talents from many institutions. Most of the described infrastructure appears to be sufficient to accomplish the proposed research. Management, administration, and resources are clearly defined. The research will deliver valuable products, particularly if the issues raised below are considered and addressed. The plan for dissemination of results seems to be well thought out, and data produced by this effort will lay the groundwork for building larger more comprehensive databases in the future.
rating	Above Average

Feasibility

comments	The approach is fully documented and technically feasible. Studies like this have been conducted on the Columbia River for several years now. I am slightly concerned that proposed sample sizes of tagged fish and the number of requested JSATS receivers may not be sufficient to provide enough precision for reach survival estimates, but I would need more information to be certain. The number of fish tagged and released and detection probabilities for each reach will affect the precision of survival estimates and also the power of statistical tests to detect differences in survival among river reaches. This is a good proposal, and I recommend funding it after careful consideration of the density of receiver deployments at each cross section, and after setting those receiver densities high enough to maximize tag detection probabilities. The authors also might want to consider whether more tags might be needed to obtain desired precision in survival estimates after receiver densities are increased to provide >95% detection probabilities at each array. The reason for this is that you have to add a lot of tags to increase survival precision if array detection probabilities are not high. I recommend that the authors download a sample size program and manual from http://www.cbr.washington.edu/paramest/samplesize/ to help them address these considerations. Conducting study on two groups of fish instead of four would allow the researchers to double sample sizes without increasing the proposed budget. Receiver numbers, spacing, and allocation among arrays: The proposal mentions a decode range of 300 m, but this may be overly optimistic especially in noisy areas with high flow, and I could not find a description of receiver spacing at each sampled cross section. In dam-passage survival studies on the lower Columbia River from 2006 through 2009, JSATS receivers were

deployed ≤152 m apart and ≤76 m from shore at each cross section. With this receiver spacing, tag detection probabilities for arrays covering deep cross sections upstream of Bonneville Dam usually were >95%, but for shallower cross sections downstream of Bonneville Dam, detection probabilities were between 60% and 80%. Flows through these cross sections ranged from 1 to 2 m / s and the pulse repetition rate of tags was 3 pings per second. Reducing the distance between adjacent receivers in two arrays downstream of Bonneville Dam in 2010 from ≤152 m to about 100 m increased tag detection probabilities to 95%. Spacing acoustic receivers 200-300 m apart likely will yield poor tag detectability. Given the relative cost of tags and receivers and how many additional tags have to be added to increase precision, it makes sense to deploy enough receivers at each cross section to maximize detectability before adding tags. I think that populating each array adequately should be the first consideration. Next, the researchers can determine the number of arrays that can be deployed given the number of available receivers and then either propose to add more receivers or to reduce the number of receiver arrays (and river reaches studied) accordingly.

After receiver densities are adequate, consider sample sizes of tagged fish:

I ran two scenarios through the sample size program described above. In the first run, I assumed that the number of released tags ranged from about 150 to 300 (i.e., from the minimum number proposed to double that number). In addition, I assumed that the detection probability at the first array was 0.6, which may be optimistic for JSATS nodes spaced 300 m apart or 150 m from shore. An output figure, which cannot be pasted here, showed the ½ 95% confidence interval (CI) curves as a function of sample size. The ½ 95% CIs on survival estimates would be about 7.37% if samples size was 150 fish and 5.83% if samples size was 300 fish. In short, survival estimates would have to differ by at least 14.7% to detect significant differences between survival rates in two river reaches at n=150 and by about 11.7% if sample sizes were doubled (n=300).

The situation improves considerably if the detection probability of the primary array were increased to 0.95 by deploying receivers at distances of about 100 m from each other and 50 m from shore, especially for areas where the channel is shallow and has extensive sand bars that absorb sound transmissions from tags. Results of sample size modeling show that the ½ 95% CI would be about 5.1 when n=150 and 3.6, when n=300. Under these conditions, researchers will have a better chance of detecting survival differences >10.2% when n=150 or >7.2% when n=300.

Other considerations:

	It may be in the best interest of the researchers to conduct a tag life study to ensure that the tags last as long as specified or assumed. Early failure of the tags can negatively bias the results of a survival study. This portion of the study could possibly be leveraged off of the tag retention, growth, survival, and swimming performance portion of the study, if active tags are implanted in the fish and monitored throughout the life of the tag. You need to know how long each tag keeps transmitting at the expect rate (e.g. 60.12 days), and it would be good to have at least 50 tags in the study. On p. 20-21, it is stated that "A post-processing program has been developed to eliminate false detections from these files. This consists of filtering criteria where detections must match a the list of tags released, the detection date and the release date, requires a minimum of four detections over an interval of 60 seconds, and match the time spacing between the intervals to the known tag pulse rate." With a 15 second ping rate interval, it is not wise to filter assuming that every ping would be detected. In noisy and high flow environments detection of all pings is not very likely. The choice of ping rate is a balance between detectability at survival-detection arrays and tag life. On the lower Columbia River, tag life settings started out at 10 pings / second, but ended up at 3 pings / second to improve detectability for estimating route-specific survival at dams. Experience will provide insight for identifying the optimum pulse repetition interval for the Sacramento River and Delta, but detectability will be important to precision in this study. The tight receiver spacing described above for the Columbia River that provided 95% detection probabilities also was for tags pinging once every 3 seconds. In the proposal, the authors appropriately expressed concern about detection ranges and the ability to detect slow pinging tags.
rating	Above Average

Relevance To The Delta Science Program

comments	The proposal does clearly and directly address priority research Topic 1. I cannot imagine protecting and recovering native fishes without high quality reach survival and travel time information that has inference for the smaller fish in those populations. Small acoustic tags like those proposed are absolutely critical to provide the proper inference for populations dominated by small individuals. This proposal gives a lot of attention to integration, collaboration and multiple disciplines. The information that can be provided by this proposal, even with possible precision deficiencies in survival estimates, is far better than Delta resource managers have had to work with so far. This proposal will allow tagging of runs of salmon that could not

	previously be tagged because of body burden considerations. I am certain that any information on survival and travel times for these runs will be welcome.
rating	Superior

Qualifications

comments	The project team is made up of highly experienced individuals that have demonstrated ability to implement a research study of this scope and technical complexity. Proposed infrastructure and support seems to be adequate. Again, I would like to see the authors revisit issues of acoustic receiver allocation and sample sizes relative to the precision of survival estimates, but these adjustments can be made without jeopardizing the project.
rating	Superior

Overall Evaluation Summary Rating

comments	To summarize, I believe that this proposal is superior and worthy of funding, but the authors should provide more detail describing the acoustic receiver locations, numbers, and densities. The researchers also should carefully consider whether expected precision will allow them to accomplish proposed objectives. Other concerns about filtering data, pulse repetition rates, and tag life (as mentioned earlier) should be addressed.
rating	Superior