Selection Panel Review Summary

Proposal No.: 030
Proposal Title: Using Fin Ray Geochemistry to Assess White Sturgeon Life History Movements: Establishing reach specific markers in Sacramento-San Joaquin River Fish
Principal Investigator: Zac Jackson
Amount Requested: $268,258
Recommended Amount: $268,258

Summary: This proposal examines isotope ratios and annuli in fin rays of sturgeon captured in the wild and from fish reared in cages in different parts of the freshwater environment. From these data the project team hopes to determine where the fish were spawned, the hydrological conditions that led to spawning, and the survival and the times the fish spent in different parts of the watershed and estuary.

Assessment: The Selection Panel found this to be a well written proposal with a careful plan for field tests and analysis presented at a relatively low cost that could provide useful information about white sturgeon. While it was noted that the work might not fulfill the stated goals, any new information would be valuable as so little is currently known. The Panel recognized a direct management link in terms of flows. Overall, there were concerns about design flaws and uncertainty of the outcome.

2010 Final Review Panel – Summary of Review

Proposal # 135

Proposal Title: Using Fin Ray Geochemistry to Assess White Sturgeon Life History Movements: Establishing Reach Specific Markers in Sacramento-San Joaquin River Fish

Lead Primary Investigator: Zac Jackson

Applicant Organization: U.S. Fish and Wildlife Service

Amount Requested: $287,256

Panel Findings:

Relevance to Topic Areas: The Panel agreed that the proposal addresses key aspects of sturgeon habitat quantification in the Delta and is highly relevant to the PSP.

Quality of the Proposed Research: The Panel was in agreement that the ideas behind this approach were excellent and the information useful for both basic and management purposes. The Panel liked the fact that isotopic ratios would provide a longer term picture of habitat use of sturgeon, but had questions about various aspects of the methodology. The proposal would have benefitted from less space devoted to justification and trying to make this project relevant, and more space used to provide details about the methods and analyses. Both the Panel and one external reviewer agreed that there were serious problems with the isotopic methodology as described and agreed that the probability that the stated goals would be obtained was low. Other issues with the project involved whether accurate ages and assignment of habitat use could be obtained if there was resorption or hollowing out of fin rays, and whether lake sturgeon are an appropriate surrogate for aging validation. Finally, the Panel agreed that back-tracking spawning success via aging had an uncertain outcome and perhaps length-frequency histograms from historical data could be useful to ascertain whether spawning success was periodic. Preliminary data for these aspects of the proposal would have affected the Panel's rating of this proposal.

Main Summary Comments of Reviewers: Both referees were highly qualified to evaluate this proposal and identified some of the same methodological issues. Nonetheless they had diametrically opposed ratings - superior versus inadequate, which basically reflected their confidence in the abilities of the PI's to complete the project.

Funding Category: Sufficient. The Panel suggested that this project should best be viewed as a high-risk, pilot-level study. The project costs were not high and the topic is of great relevance.

Proposal Number:	0135
Proposal Title:	Using Fin Ray Geochemistry to Assess White Sturgeon Life History Movements: Establishing reach specific markers in Sacramento-San Joaquin River Fish
Proposal Applicant:	US Fish and Wildlife Service
Amount Requested:	$287,256
Primary Investigator:	Zac J. Jackson, U.S. Fish and Wildlife Service

FRP primary Reviewer's Evaluation Summary and Rating

Provide a brief explanation of your summary and rating.

Comments:

Purpose	**The proposal lists a series of goals related to establishing fin ray geochemical markers and hypothesizes that they that could be used to evaluate patterns of habitat use by white sturgeon in the central valley system. One of the investigators has already been involved with some fin ray geochemistry of green sturgeon in the Klamath.**
Background/Conceptual Models	**The background was adequate although more detail concerning life history of sturgeon and whether they show fidelity to specific river systems when they spawn or wander among systems along the coast would have been useful to reviewers.**
Approach	**Although acoustic tagging studies seem to be a more practical approach to investigating habitat use and migration patterns of white sturgeon in a system with an extensive array of receivers, the PIs points out some of the potential limitations of using tagging studies to assess long-term habitat specific use patterns within estuarine systems. Microchemistry has the potential to determine habitat use patterns over longer timeframes, hence the interest in expanding their toolbox to include fin ray geochemistry. Fin ray geochemistry comes with limitations as well and the big questions to be addressed include the typical issues for microchemistry, namely sensitivity and methods validation. That is what this proposal is about, hence it carries some significant risks.**

Feasibility	One of the external reviewers questioned the ability to determine more than fundamental ingress and egress information based upon fin ray geochemistry and also thinks that could be compromised in some cases by the fact that fin rays are living tissue that can be compromised by metabolic processes. At least one published study suggests that ageing based upon fin rays may be a real issue: (Vaughn L. Paragamian, and Raymond C. P. Beamesderfer. (2003) Growth Estimates from Tagged White Sturgeon Suggest That Ages from Fin Rays Underestimate True Age in the Kootenai River, USA and Canada. Transactions of the American Fisheries Society 132:5, 895-903). It also opens the door for obscuring true patterns of migrations. The mesocosm experiments might also be challenging and details are lacking on feeding and placement of cages and how issues like river flow rate might affect this part of the project.
Relevance	The topic and proposed research is highly relevant to Delta science and should be readily integrated into resources decision because of the connection to and involvement of some of the PIs in management.
Qualifications	The team is highly qualified and invested in the research and potential outcomes of this research.
Summary Comments	The PIs need to deal with the potential limitations addressed in the reviews. Ongoing tagged studies should provide some insights for the SFBD system and obtaining fin rays from tagged fish might provide an avenue to determine the risks of using fin ray geochemistry to establish life history information based upon chemical signatures.

Please identify your overall ranking for this proposal:

– Superior
– Above Average
X 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.

– Superior
X Good
– Fair
– Poor

Comments:
External reviews were at the opposite end of the spectrum on their ratings. The low rating by the second external reviewer focused difficulties of using Sr:Ca ratios with unlimited unknown end-members and unknown mixing rates to estimate how sturgeon use the system. They may be able to associate individuals to river systems but within the freshwater reaches the habitat specific signatures are likely to be obscured. It also is not clear how the caging studies will be able to help define them because of limitations of the chemistry and slow growth rates of sturgeon without a clear plan to feed and keep them "happy" and healthy in a cage.

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

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Proposal Applicant:	US Fish and Wildlife Service
Amount Requested:	$287,256
Primary Investigator:	Zac J. Jackson, U.S. Fish and Wildlife Service

FRP secondary Reviewer's Evaluation Summary and Rating

Provide a brief explanation of your summary and rating.

Comments:

Purpose	**This proposal will examine various aspects of demography and movements in white sturgeon via isotopic ratios and field experiments.**
Background/Conceptual Models	**Very good**
Approach	**Hobbs has had success in publishing studies using this methodology, and generally the methodology was very good from a conceptual point of view. However, it was lacking in detail in some crucial aspects which led me to rate it lower than I would have liked, based on the ideas alone.** **How will cages be suspended and held in place, how will fish feed? Some preliminary data would have been helpful here. What if fish start resorbing tissue due to starvation?** **There is no methodology presented for the water sampling for isotope analysis.** **The statement ” This approach will minimize any bias that could result from independent sample collections” makes no sense from a statistical point of view -- bias is incurred when samples aren’t independent.** **The authors repeatedly state that are using validated methods but the methods have been validated for lake sturgeon -- a different species found in a different habitat with greater seasonality than delta sturgeon. This means that they are much more likely to produce annual growth checks. Finally, without validation, how will spawning checks or other non-annual checks be**

separated from annuli. It is exactly this lack of validation that led to overexploitation in some of the rockfish fisheries.

I think that it is unlikely that spawning success will be deducible from strong age classes and then correlated with historical environmental factors. In fact a good way to check on this using existing data would be to look for humps in the length frequency distribution data collected from historic samples. If there isn't evidence of age – class phenomena in the length data then it is unlikely that you'll detect it in back calculated ages which are usually + 1–2 years. In a long lived, difficult to age species like a sturgeon that migrates from brackish to freshwater you will probably have lots of false checks.

Just an FYI, both green and white sturgeon make an annual foraging migration into northern San Francisco Bay when the herring spawn.

I found Fig 2 to be very poorly explained, at the very least arrows could have been placed at the fw and sw values for the three wild fish. Also are these ratios unaffected by diet or toxicants or other factors that vary in the natural environment? If so wouldn't signatures from hatchery raised fish fed on a prepared diet possibly be different from wild fish?

In a previous paper on delta smelt (Freshwater and Marine Sciences 2005)Hobbs was unable to determine the natal habitat of young smelt in the Delta because of river mixing. What has changed?

In some species, older individuals have erosion of the interior portions of their fin rays , which obscures early growth history and yields invalid ages. Once again, some preliminary data would have helped here.

In figure 3 the authors present an isotope map but there are no variances associated with these measurements are they invariant or is this the result of a single sampling event? I noticed that there were no variances for water isotope ratios in the Hobbs et al. 2010 paper either. Maybe these values never vary but it would be nice to have some data to show that rather than just make a crucial assumption.

I really don't see how the isotopic ratio analysis will be able to distinguish movements from spawning. Just because a fish goes to a spawning area doesn't mean that it spawns. In addition, some of the streams have

	similar signatures e.g. Putah Creek and Consumnes River. Also I didn't see signatures of Knights landing which is a major spawning ground Discussion of the statistics that will be used to evaluate many aspects of the project are lacking.
Feasibility	Because of the potential problems outlined in the Approach section of this review I believe that the feasibility of the project is low.
Relevance	Highly relavent to the PSP.
Qualifications	The PI's qualifications are good.
Summary Comments	I would rate this proposal as above average based on ideas but between sufficient and inadequate based on the lack of detail in the approach. Perhaps some seed money can be provided so that they can answer some of the criticisms posed in these evaluations.

Please identify your overall ranking for this proposal:

– Superior
– Above Average
X 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.

– Superior
X Good
– Fair
– Poor

Comments:
Both referees has a variety of comments but had diametrically opposed ratings – superior versus inadequate. both reviewers also are very familiar with the techniques being used in the proposal. I read the proposal carefully and agreed more with the opinion of the more critical reviewer. I really liked some of the ideas behind this proposal but thought that there were too many holes in the methodology.

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

Proposal Number:	0135
Proposal Title:	Using Fin Ray Geochemistry to Assess White Sturgeon Life History Movements: Establishing reach specific markers in Sacramento-San Joaquin River Fish
Proposal Applicant:	US Fish and Wildlife Service
Amount Requested:	$287,256
Primary Investigator:	Zac J. Jackson, U.S. Fish and Wildlife Service

FRP secondary Reviewer's Evaluation Summary and Rating

Provide a brief explanation of your summary and rating.

Comments:

Purpose	**Geochemical analysis of fin rays (strontium) of white sturgeon to determine movement patterns.**
Background/Conceptual Models	**The background is well described. There have been recent declines in white sturgeon, which used to support a recreational fishery. The decline may be due skipping of spawning in dry years. The advantages of fin-ray geochemistry techniques over traditional tagging approaches are clear. The initial goals laid out by the authors in the executive summary, and repeated in the Relevance section, were not useful, as they were much too general. Later on in the Purpose section, the authors stated objectives, although they are still too general. There is also a list of questions in the expected results section. Finally, in the Objectives section, objectives are stated that more in line with the proposed project. The authors seemed to have some difficulty is defining exactly what they will produce.**
Approach	**The approach is divided into three tasks. The first task is a 12-week mesocosm experiment. Two sturgeon in each of three cages are put at 12 distinct locations and at 6 weeks, 3 of the 6 individuals are located to the next location downstream, and fish at the downstream are put back in the beginning. Some of the fish are also PIT tagged, although I am not sure why. This is an interesting, but complicated, experimental design. The authors provide no details on how the results will be analyzed. How will the signatures be used to identify the different locations? Task 2 involves collecting field samples. Task 3 is estimating size-at-age to assign individuals to year-classes, and the analysis of geochemistry of the fin rays for**

	migration pathways. This is the weakest aspect of the proposal. It was not obvious how many fish would be analyzed. More importantly, the authors provide no information on how they will derive movement patterns from times series of strontium values (i.e., use the mesocosm results to identify locations in the time series measured on field fish), and how they will actually relate the derived patterns to freshwater flow. In fact, the authors present an example time series in Figure 2, but do not interpret it.
Feasibility	This has a high probability of not working; however the requested funds are low, so maybe worth the risk.
Relevance	This is one of the few proposals that spent too much space on listing objectives, goals, and questions to be addressed. The authors present multiple lists of objectives and goals, most too generally stated. They also list BDCP, DOSS, and DRERIP. The real issue is whether they can generate information from the experiments and analysis that is relevant; I am skeptical.
Qualifications	The authors are qualified to do the work but I think they would benefit from input and help from others who done this type of study and from statisticians.
Summary Comments	This is a good idea in a weak proposal. The authors spent much too time on general questions (not answerable by the proposal) and trying to make their work sound relevant, and much too little time on detailing the methods. I will add that the requested budget is very modest ($278K), and so perhaps this should be viewed as pilot study rather than a proposal that will address many questions. However, the authors stated these lofty goals. Sufficient (higher if the authors decide on a few, testable hypotheses, and can provide information that demonstrates they can make the measurements and do the analyses to test the hypotheses).

Please identify your overall ranking for this proposal:

– Superior
– Above Average
x 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.

– Superior
X Good
– Fair
– Poor

Comments:
One review was not helpful, while the other review was excellent.

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

Proposal Title: Using Fin Ray Geochemistry to Assess White Sturgeon Life History Movements: Establishing reach specific markers in Sacramento-San Joaquin River Fish

Proposal Number: 0135

Proposal Applicant: US Fish and Wildlife Service

Project

comments	An ambitious series of goals were listed from very general ones - "improve ecosystem quality and reduce the mismatch between ecology and management, and address uncertainties in basic life history, behavior and population structure; to ones that required substantial sophistication in design elements and modeling: "develop models to determine flow requirements and assess outcomes of water management alternatives, model white sturgeon population responses to water management and habitat restoration, and address questions about migratory histories and behavior, responses to environmental variation, importance of various habitat types, and associated management implications." I found strong justification for the last series of goals related to water flow, migration, and reproduction but found these were not in fact addressed in the proposal, which focused more narrowly on developing hard part geochemical tracers. In this way, this study seems to be a pilot study to develop methodology.
rating	Sufficient

Background

comments	The proposal is centered on idea that flow and fishing pressures are curtailing population growth of Sacramento-San Joaquin white sturgeon. Substantial literature supports this view, which is reviewed in the proposal. Life table modeling could have provided more formal framework to assess and rank a priori how affected vital rates due to either of these stressors (see Levin and Stunz 2005).
rating	Sufficient

Approach

comments	Despite broad goals presented as background, a more tenable series of objectives are laid out in Approach and Scope of Work section - using fin ray chemistry (IF it works) to define juvenile rearing areas, frequency of spawning, age at first spawning, and (although less feasible and stated in ambiguous manner) examine inter-annual variability of fw flow on life history of harvested fish. Unfortunately little to no thought is given to sampling or experimental design. Figure 3 presents an isotope map, which gives watershed values for Sr isotopes and then elemental ratios along mixing gradients from fresh to

	saltwater regions of the system. The issue is that there are numerous potential endmembers and unknown mixing rates - I see know way to use mixing functions to determine based upon Sr isotopes and Sr/Ca alone to determine how sturgeons are using this system even in a coarse way. This issue is further confirmed by the results for green sturgeon (Figure 2) - how are we to interpret these results given likely mixing of end members (here defined by Sr isotopes). These are old fish and should have repeatedly spawned, but there is no cyclic evidence for this. Further, the 38 year old shows no evidence of juvenile egress. I was surprised that results like these are presented here and not discussed in the proposal. The idea of transferring fish among cages was interesting and could have potentially been a strong element of the proposal but no experimental design was pursued. As presented, this is an overly complex design with no statistical basis for analysis - why so many sites? why merely shift sturgeon one cage down? What are expected results? There is a literature on these types of studies that show that caging is difficult (what will fish feed on, will they grow, will the hard part grow) as well as analysis (when were fish transferred, will some mark on the hard part show this transfer, how will repeated measures be dealt with statistically). Similarly, investigations looking at fishery-captured fin rays show little evidence of careful consideration of bias in terms of effects of selectivity, and cumulative mortality on estimates of growth and year-class strength.
rating	Inadequate

Feasibility

comments	Because there are serious design flaws, this study is not feasible in its current form. Further, there are serious issues remaining with using fin rays, which are essentially living bone- a large central canal erodes early growth and remodeling of Ca and Sr is likely. I would highlight that while several scientists have attempted to use fin rays of sturgeons (Arai, Venoitt) these have not been successful in applications other than to track egress (Allen et al. 09). I think fin ray geochemistry will require substantial R&D before any application.
rating	Inadequate

Relevance To The Delta Science Program

comments	This proposal addresses important questions related to white sturgeon conservation. It would be important to evaluate possible nursery areas and migration patterns that other methods cannot resolve through tracer approaches such as that proposed here. That said, in the moderate term, it seems likely that given

	current infrastructure and feasibility of biotelemetry in the Delta ecosystem, principal advances on most questions posed in this proposal will come from biotelemetry. The PIs may wish to consider linking their work to telemetry work in the future.
rating	Sufficient

Qualifications

comments	Hobbs is clearly an expert in hard part geochemistry, developing novel approaches using strontium isotopes in the Delta watershed. The project lacked expertise in population modeling and statistics that would have otherwise made this a stronger proposal.
rating	Above Average

Overall Evaluation Summary Rating

comments	The proposal suffers from poor design of field experiments and collections. Juvenile egress patterns seemed to be most feasible part of the proposal, but substantially greater emphasis will be needed in developing this approach, perhaps initially on a smaller scale before I believe this approach warrant application.
rating	Inadequate

Proposal Title: Using Fin Ray Geochemistry to Assess White Sturgeon Life History Movements: Establishing reach specific markers in Sacramento-San Joaquin River Fish

Proposal Number: 0135

Proposal Applicant: US Fish and Wildlife Service

Project

comments	The project proposes to use stable isotope and trace element analyses of pectoral fin rays of white sturgeon to estimate movement and habitat use in Sacramento/San Joaquin River System. These methods are normally applied to otoliths, which require lethal sampling, and only a handful of individuals have employed these tracers in structures such as scales or fins pines that can be sampled non-lethally. I think the goals and objectives of the project are nicely stated and will be achievable given the analytical experience of the assembled team. The project has a nice mix of do-able analytical approaches applied to a novel system to answer specific conservation-oriented questions. That seems to me a wise investment likely to generate real and meaningful results in the proposed time frame. Answering the question of whether skipped spawning occurs seems to me to be particularly pressing, given the historically low population numbers. The addition of water sampling is a commendable aspect of this project, given that too many otolith/fin spine geochemistry studies make inferences about habitat use without any groundtruthing of spatial variation in dissolved elemental and isotopic signatures. This project stands out for its comprehensive understanding of the necessary groundtruthing that must take place in order to make more confident estimates of movement among specific habitats.
rating	Superior

Background

comments	The background is completely sufficient to understand the proposed work. I found no fault with it.
rating	Superior

Approach

comments	There was a lack of some detail in the proposed methodologies, which is understandable given the page limitations. One of the team members (Hobbs) has accumulated a fine body of published work using similar analytical techniques in other species, so I have no doubt that they have the technical expertise required to complete the work successfully. I was a little less clear about how exactly the resulting data were to be integrated into models relating population dynamics with freshwater inflow variability.

	I'm not sure they will acquire enough samples to have reasonable estimates of variation in movement patterns over multiple year classes (both wet and dry). Regardless of this, insight into variable movement patterns will be of enough value on its own without the explicit connection to freshwater inflow to merit the funding of this project. I have a couple suggestions for the PIs that may aid them in achieving their goals: 1.) Include additional trace elements in your analyses. Assays of Sr/Ca will be done on a single collector ICP-MS, and the addition of extra analytes can be done at no extra cost. They may find barium to be quite helpful in teasing out movements across mesohaline habitats, as have a few other authors (McCulloch et al., Elsdon et al.) working in estuaries. 2.) For the caging experiments, consider immersing the experimental fish in some kind of calcium dye (Alizarin, calcein) before they are deployed. That way, after the experiment ends the commencement of the deployment can be clearly identified in the structure subsequently. This would be of great help in targeting pre and post experimental periods for ablation. 3.) Consider the statistics you will use to compare signatures before and after transfer for the caged fish. The current design has two fish in each of three cages. But for transfer, three fish will be moved from each location. This will necessitate "breaking up" one of the cages, meaning that Cage cannot be used as a unit of replication subsequently. You might consider different caging configurations to avoid this.
rating	Above Average

Feasibility

comments	Yes, the approach is definitely feasible. The team is qualified to carry out the work and has appropriate prior experience to succeed.
rating	Superior

Relevance To The Delta Science Program

comments	From what I understand of the Delta Science Program, this proposal fits well with the priority topics. It is definitely interdisciplinary (geochemistry to fish ecology, habitat use and river flows) and collaborative. The targeted species is clearly of great management importance.
rating	Superior

Qualifications

comments	My personal expertise is in the field of otolith chemistry, so I am mostly familiar with the work of Hobbs. His track record is solid and well respected. I have no doubt that he will be of critical importance in achieving the goals laid out in the proposal. I am less familiar with the other co-PIs, but based on their supplied CVs it appears as if they have appropriate expertise in fish ecology, modelling, and a familiarity with the region.
rating	Superior

Overall Evaluation Summary Rating

comments	I was very impressed with this proposal and thought the authors did a good job laying out a careful plan for collections, field experiments and analyses that will help them make reliable estimates of habitat use variability in this species of great conservation concern. I wholeheartedly support its funding and would be eager to see their fesults. The proposed work would dovetail nicely with the burgeoning field of chemical analyses of calcified hard parts to estimate migratory patterns of diadromous species both in the US and worldwide (salmon, barramundi, shad, etc.). I suspect their results will be of interest to investigators in other regions.
rating	Superior