Selection Panel Review Summary

Proposal No.: 25
Proposal Title: Health of Threatened Fish: Role of Contaminants, Disease, and Nutrition
Principle Investigator: Swee Teh
Amount Requested: $953,448.00
Recommended Amount : $953,448.00

Summary: This is a two-year study to determine the biological effects of contaminants, pathogens/diseases, and nutritional status in three pelagic fishes (striped bass, threadfin shad, and Sacramento splittail) and the sedentary tule perch to determine the site specificity of biological effects in the three species with migratory behavior. The suite of fish represents benthic (splittail) and pelagic environments (threadfin shad), and a top consumer (striped bass). The study targets both geographic and temporal distribution, juvenile to adult stages of the four species will be collected from sites in Cache Slough, Suisun Marsh, and San Joaquin River. These habitats were selected because Cache Slough and Suisun Marsh have high primary productivity that support nursery rearing and spawning of these species as well as other fishes, while the San Joaquin River has less productive habitats due, in part, to contaminant loading and decreased plankton production. Based on the habitat features, potential gradients of the stressors and fish nutritional status may be found in the candidate sites chosen for this study.

Assessment: The proposed research is highly relevant, well thought out, and has highly qualified researchers. They will conduct research on four species (2 native and 2 non-native) in three regions. The research addresses an area of great uncertainty and of high importance in terms of effects on fish health (contaminants vs. nutritional status), and tackles evaluating the effects of multiple stressors.

The applicants responded well to previous comments from the Delta Science Program PSP. For example, they have added a statistical modeler to the team. However, there are still many shortcomings associated with the proposal. The Selection Panel had concerns that the hypotheses are very general statements that are very difficult to test (or are untestable), the sampling may not be sufficient statistically to distinguish among three major factors (contaminants, disease and nutritional status), the proposal lacks a description of how the sampling sites differ, the statistical tests may not have enough power to evaluate the incremental and cumulative importance of each of the main environmental factors on the various health response indicators, and the references cited were dated and overlooked the Project Teams own recent contributions. The proposed study could use a laboratory component to test these hypotheses multiple stressors. The project may be overly ambitious considering the number of analyses to be performed and the number of fish to be sampled.

2010 Final Review Panel – Summary of Review

Proposal # 136

Proposal Title: Developing a Baseline Health Status for Threatened Fish in the San Francisco Estuary: An Ecological Approach of Evaluating the Effects of Contaminants, Disease, and Fish Nutrition

Lead Primary Investigator: Swee Joo Teh

Applicant Organization: University of California, Davis

Amount Requested: $1,173,593

Panel Findings:

Relevance to Topic Areas: This proposal is intriguing, and the research is directly relevant to Topic 1 (Native Fish Biology and Ecology).

Quality of the Proposed Research: The proposal was well-organized, well-written, and robust. This is a good idea that could provide useful baseline information against which future changes in fish health can be evaluated. A strong team of well-qualified investigators includes an aquatic toxicologist, a pathologist, and a statistician. However, the proposal lacked a conceptual model to link the components of the study. Moreover, the panel and an external reviewer were concerned about several study-design problems, including the following three. First, the reasons for collecting samples in Cache Slough and Suisun Marsh were not presented, or why 4 sites would be located in Cache Slough (without identifying/describing specific candidate sites) and 6 sites would be located in Suisun Marsh (also without identifying/describing specific candidate sites). Second, it appears that approximately 7,000 fish (divided among four species) will be collected. Assuming approximately 2,500 of those fish will be processed for the large array of fish-health indices, the project might be overly ambitious for the available resources. Third, because the investigators plan to discriminate among three major factors (contaminants, disease, and nutritional status, each of which probably has several to many components), it is not clear how only 10 sample sites will be sufficient to achieve that statistical goal. In fact, the investigators did not even demonstrate

that any differences in contaminants, disease, or nutritional status exist among the sites, thus raising the question of whether any discrimination will be possible even if differences in fish health exist.

Main Summary Comments of Reviewers: This topic is highly relevant because it relates to potential causes of the recent pelagic organism decline. The project appears to be feasible, but assurance needs to be provided that the large number of fish being processed is manageable or the number will be scaled-back to a reasonable amount of fish. Additionally, more information is needed to assure that adequate gradients of contaminants, disease, and/or nutritional status exist among the sampling sites. Finally, the potentially fatal flaw of having only 10 sites to discriminate among a potentially very large number of factors was evident. The panel speculated that it is possible, that differences might be found among sites without any unequivocal conclusions about causation being drawn.

Funding Category: Above Average/Sufficient

Proposal Number:	0136
Proposal Title:	Developing A Baseline Health Status For Threatened Fish In The San Francisco Estuary: An Ecological Approach Of Evaluating The Effects Of Contaminants, Disease, And Fish Nutrition
Proposal Applicant:	Davis, California University of
Amount Requested:	$1,173,593
Primary Investigator:	Swee Joo Teh

FRP primary Reviewer's Evaluation Summary and Rating

Provide a brief explanation of your summary and rating.

Comments:

Purpose	Lacking baseline information on the health status of important endemic fish, this research proposes to create a baseline of information on fish health and its relationship to various identified stressors (physical, chemical, and biological) in the Delta region. This is an important step in identifying the causal relationships of the POD.
Background/Conceptual Models	The proposal provides a detailed and well organized literature review (both peer-reviewed and gray) of the status of biological, physical, and chemical factors that might affect disease. It identifies the most likely pathogens and diseases as well as causal relationships specific to the potential sampling areas and the Delta region.
Approach	The approach to conducting the research is well thought out and provides five hypotheses that piggy-back upon existing research, are testable, and should provide the team with answers to their questions. The only weakness that I found was a lack of detail into some of the statistical analysis; that is, why nonparametric analysis and curve fitting are the most appropriate models.
Feasibility	The laboratories are already dedicated to research and analysis of fish disease and pathology, as well as being well equipped to conduct field research, preservation, transportation and other logistical needs.
Relevance	This is an important project to developing an understanding of the causal agents in the POD. The relationship between susceptibility to disease and various recurring stressors will be a critical

	management and restoration concern.
Qualifications	The research team is clearly outstanding with a combined 100 years or more of research experience in the Delta region. Several members of the team are internationally acknowledged as leaders in the biology and ecology of fish, as well as the pathology/diseases of fish.
Summary Comments	I am particularly intrigued and excited about the idea of applying essentially epidemiological techniques (field-based disease research) to examining one of the critical questions linked to the POD.

Please identify your overall ranking for this proposal:

X Superior
– 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.

– Superior
X Good
– Fair
– Poor

Comments:
Only one review was provided. The reviewer also felt this was an above average/superior proposal. His only concern was in the lack of detail on some of the histopathological techniques. I will have to accept his concern since I have little working knowledge of those areas.

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

Proposal Number:	0136
Proposal Title:	Developing A Baseline Health Status For Threatened Fish In The San Francisco Estuary: An Ecological Approach Of Evaluating The Effects Of Contaminants, Disease, And Fish Nutrition
Proposal Applicant:	Davis, California University of
Amount Requested:	$1,173,593
Primary Investigator:	Swee Joo Teh

FRP secondary Reviewer's Evaluation Summary and Rating

Provide a brief explanation of your summary and rating.

Comments:

Purpose	**A specific purpose was not identified. A goal was identified in the first sentence of the second paragraph in the Project Description and Purpose section, but then 5 specific goals were listed in the next paragraph. I found that confusing, and I believe it would have been more appropriate to instead refer to those 5 specific goals as objectives.** **The 5 hypotheses listed at the end of the Project Description and Purpose section were not stated as clearly testable hypotheses; instead, they appeared to be beliefs and/or ideas the researchers would like to investigate.**
Background/Conceptual Models	**The authors presented a large amount of information demonstrating or speculating that stressors in the San Francisco Estuary (SFE) can individually and in concert affect fish health and, thus, fish populations. They especially emphasized the potential interplay among fish nutrition, pathogens, and contaminants. Although the authors stated that the contribution of a specific stressor can be difficult to quantify when a suite of stressors affects a population, they provided a strong argument that adequate background data about fish health are lacking in the SFE. Given the numerous stressors that have been in the SFE for decades and are still present or increasing, the current background probably does not represent a true baseline condition. However, the current condition can still be a valuable reference condition to judge whether future conditions represent a trend of change to improvement or decline.**

Approach

The conceptual model was succinctly stated, simply reiterating the linkages that were discussed earlier in the Background section. After many pages of perhaps too much discussion of the effects of contaminants, diseases, and nutritional status on fish, that brevity was refreshing.

Although it makes sense that pollutants should increase the susceptibility of fish to pathogens (and vice versa), perhaps it should be noted that not all pathogen–pollutant interactions are synergistic; in fact, some can appear to be antagonistic (e.g., Morris et al. 2006).

A wide enough range of histopathology indices, biochemical markers, and pathogen analyses will be conducted, that a useful baseline condition might be established for the sampled sites. However, the 10 sampling sites apparently will only be distributed among two areas within the SFE – Cache Slough (4 sites) and Suisun Marsh (6 sites). No details are presented about those 10 sites, perhaps because exact locations might vary depending on presence of the endangered delta smelt at a given sampling time. Furthermore, nothing is presented to indicate that gradients of environmental conditions will exist across these sites (e.g., types and/or concentrations of pollutants, types and densities of pathogens, types and densities of food). Statistical methods appropriate for identifying differences and/or gradients among sites were proposed, but those won't be helpful if conditions don't vary enough among the sites.

Feasibility

Because it appears that no new methods will have to be developed for this project, the proposed fish collection, processing, and analyses appear to be feasible. The large number of fish to be processed and analyzed might be probative for completing all the proposed work, but that is difficult to judge because the authors did not address that question in their relatively brief Feasibility section.

My major concern is the feasibility of addressing the stated goal of evaluating the impacts of contaminants and disease, and the underlying role of nutrition, on fish health. The sample size of 10 sites located in only two areas of the SFE leads me to suspect that unequivocal conclusions will not be possible, given the wide variety of potential contaminants, diseases, and nutritional statuses.

Relevance

This topic is highly relevant because it relates to potential causes of the recent pelagic organism decline.

Qualifications	**The researchers appear to be well-qualified to conduct the study and appear to have adequate facilities.**
Summary Comments	**A baseline study of biomarkers of contaminants, diseases, and nutritional status of fish in the SFE will provide very useful information against which results of future monitoring can be compared. However, given that fish will be sampled from only two general areas of the SFE and the associated gradients of contaminants, diseases, and nutritional status have not been identified or even speculated in the proposal, it is difficult to evaluate whether the product will be worth the relatively high price tag of $1.2 million.** **In general, the writing was very understandable. However, I do not believe the proposal hit the mark because (1) the purpose, goals, and objectives were not sharp and to the point (although I could infer that the topic is very important) and (2) too much time was spent discussing the literature about effects of contaminants, diseases, and nutritional status on fish, when more specifics about the study design (especially the sampling areas) would have been more helpful.**

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:
The reviewer provided an excellent, detailed critique of the Approach section. However, I wonder whether the reviewer is so enamored by the biomarker approach that potential problems with the overall interpretability of the results (based on a potentially limited gradient of conditions among a relatively small number of sample sites) might have not been recognized. Perhaps my different perspective on this proposal is due to a major disciplinary difference between the external reviewer and me.

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

Proposal Number:	0136
Proposal Title:	Developing A Baseline Health Status For Threatened Fish In The San Francisco Estuary: An Ecological Approach Of Evaluating The Effects Of Contaminants, Disease, And Fish Nutrition
Proposal Applicant:	Davis, California University of
Amount Requested:	$1,173,593
Primary Investigator:	Swee Joo Teh

FRP secondary Reviewer's Evaluation Summary and Rating

Provide a brief explanation of your summary and rating.

Comments:

Purpose	**The proposal is very well organized and clearly written with an overarching research goal of evaluating the impacts of two stressors (contaminants and disease) as well as fish nutrition on fish health in the San Francisco Estuary. Three fish species, including two POD (striped bass and threadfin shad), one endemic (Sacramento splittail) and one control (tule perch), will be the focus organisms of the study. The PIs articulate 5 specific goals and 5 hypotheses and make a compelling rationale for the study and the need to fill the gap in knowledge that the research will provide within the context of the Delta-Bay pelagic organism decline. The research theme is intriguing and innovative and will likely result in new insights with regard to fish health that will substantially support management and restoration efforts and overall scientific evaluation of fish status.**
Background/Conceptual Models	**The proposal includes an effective explanation of the relationships among the various factors that affect fish health and the role of disease in interpreting cumulative health impacts on fish, including the risk of pathogens associated with invasive species. A thorough description of various nutritional indicators is also provided and their use as biomarkers. The PIs make several statements that they label as concepts, but that are really re-statements of hypotheses. Therefore, the proposal lacks a conceptual model that places their ideas in a broader research/science context and that illustrates the linkages among the various components of the research.**
Approach	

	The study plan includes a collection phase for fish and environmental measurements and then subsequent evaluation of fish condition, including exposure to contaminants, presence of disease/pathogens, and nutritional assays. The procedures and justification for each step are well-detailed in the proposal and conclude with a informative section on final data integration and analysis (statistical). Overall, it is a thorough description.
Feasibility	Given the details of the field sampling and especially follow-up laboratory procedures on evaluation of fish condition, the project seems highly feasible.
Relevance	The project is highly relevant to issues related to POD in the San Francisco Estuary particularly to priority research topic 1 (Native Fish Biology and Ecology) and potentially to topic 2 (Food wEbs of Key Delta Species and Relationship to Water quality and other Drivers).
Qualifications	Lead PI Teh has expertise in toxicology and pathology, including background in biomarker studies and experience with CALFED projects. Other investigators contribute expertise in veterinary medicine and fish health, conservation and ecology of fishes, infectious diseases and quantitative analyses. Therefore, the research team is very well qualified to conduct the research.
Summary Comments	The proposal is well-written and makes a convincing case for the need for the research that will provide a thorough evaluation of fish health and nutritional status in the context of likely, major stressors. The results will also very likely contribute novel and useful information to management and restoration efforts. Unfortunately, the proposal lacks a robust conceptual framework that would link the research to a broader scientific perspective both within the Delta-Bay environment and elsewhere.

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 external reviewer made a valuable evaluation of the proposal.

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

Proposal Title: Developing A Baseline Health Status For Threatened Fish In The San Francisco Estuary: An Ecological Approach Of Evaluating The Effects Of Contaminants, Disease, And Fish Nutrition

Proposal Number: 0136

Proposal Applicant: Davis, California University of

Description of connection to review or why the reviewer declined this review:
The only way I am connected to this proposal is through an ongoing rersearch collaboration with Dr. Swee Teh. Basically this involves a subcontract we (Oak Ridge Natl. Lab) has with Dr. Teh to perform histopathological analysis on fish tissue. Please let me know if this is a conflict of interest relative to me performing this review.

Project

comments	This study is relatively innovative and unique among field-based fish health investigations in that it seeks to establish potential causal relationships between different environmental stressors and a suite of fish health responses. By taking such an approach to evaluating fish health, the relative importance of incremental an cumulative impacts of different environmental stressors can be evaluate for at risk fish populations. Such integrative studies can serve as the basis of effective environmental regulatory and management decisions particularly when multiple environmental factors and stressors are involved. Such studies are critical for establishing baseline conditions upon which to evaluate effects of progressive environmental degredation in aquatic ecosystems and for developing and applying a demonstation project and a "ground truthing" conceptual model approach by which effects of multiple environmental stressors can be assessed for other at risk aquatic organisms in other aquatic ecosystems.
rating	Superior

Background

comments	This section provides a good overview of the present state of knowledge concerning interactions of some major environmental stressors such as pathogens, contaminants, and nutrition on various aspects of fish health. Documentation is also provided that several fish species in the SFE are experiencing varying degrees of stress as evidenced by the variety of studies conducted to date. This background section, however, does not provide comprehensive or definitive evidence that the 4 study species have been and are currently undergoing rapid declines in abundance or that some level of reproductive dysfunction is occurring in these species. This section should spend less effort, for example, on discussions of the general nature of fish diseases,etc. and provide more evidence which specifically indicates that the 4 study species are in serious decline and over what time periods these declines have occurred. It is

	mentioned, however,in the project description about the general decline in abundance of pelagic organisms but the background section should be more specific as to what fish species are most at risk and the relative rate of decline (ie., mainly in last few years, steady decrease over several decades,etc.) Even though the problem related to nutrient pollution is mentioned on pg. 5, no information is presented relative to the potential role of low dissolved oxygen (DO) and fish stress. This is a major environmental issue in the near-shore coastal zones of the Gulf of Mexico and in many estuarine systems on the east coast. If high nutrients and related eutrophication processes are an issue in the SFE, then DO as a possible major stressor on fish health should be considered as one of the major environ. factors investigated in this study. Even though reproduction is mentioned in passing in this section, it should probably be elevated to a higher importance in this study as a major potential mechanism to help explain declining fish populations. Measurement of reproductive-related responses are discussed in the Approach section relative to EDCs and such parameters should also be discussed in the Background section because of their importance in evaluating potential causes and mechanisms of fish population declines.
rating	Above Average

Approach

comments	Overall, the approach or experimental design for meeting the objectives of this project appears adequate and appropriate. This approach has several excellent design features while some other components of the experimental design could have benefited from better and more detailed explanations, clarifications, etc. The crowning jewel of the sampling design is the primary objective of relating or linking a variety of environmental physicochemical factors to the various fish health indicators in order that possible causal relationships can be established between environmental stressors and fish health responses. Another excellent design feature of this design is that it incorporates an impressive and comprehensive suite and array of fish health responses to be measured including those indicative of exposure to environmental stressors (biomarkers), integrative indicators of lesions and pathology (histopathology), presence of pathogens and disease, and a suite of nutrition and condition indicators. An additional excellent design feature includes the sampling of 4 species of fish that represent different feeding types, tropic levels,and home range characteristics along with collections along a spatial gradient of sample sites at two main sample locations. Several aspects of the experimental design, however, are not adequately explained or addressed and these are listed below in no particular order of importance. Areas related to description of the approach which could have improved this section are (1) it would have been helpful to provide a map of

the two main sampling areas showing locations of specific sample sites along spatial gradients, (2) a better explanation of how the tule perch will serve as a control (in addition to just having a high site fidelity- - what would be, for example the quantitative criteria for using tule perch as a control compared to the other 3 species?), (3)are both the 2 main study areas characterized by the same types of and relative magnitude of environmental stressors such as temp, pathogens, and contaminants? Is the fact that one area is primarily freshwater and the other brackish have an influence on interpretation of fish health results? Should the study design also include a 3rd primary sampling area that would serve as more of a reference or control system for evaluating fish health? Are the upper sample sites in the two main sample areas representative of "upstream controls" and the lower sites along the spatial gradient representative of increased exposure to stressors such as temp, contaminants, etc? Are there spatial gradients in physicochemical factors at the 2 main sample locations?, (4)even though pg. 12 lists several physicochemical factors that will be measured at each site there is no mentioned of how contaminants will be measured. Will contaminants be measured in both water and sediment? Will the main physicochemical factors measured at each site be monitored using continuously recording devices such as YSI or Hydrolab instruments and data analyzed as integrated or time averaged values based on continuous recording at a site?(5) top of pg. 11 and reference to pathogens/disease as the "ultimate health indicator" -- could be overstating importance of this particular indicator. Wouldn't endpoints such as indicators of reproductive competence be more of the "ultimate health indicators" because such responses have more ecological significance relative to population fitness, declines, etc? (6) it just seems to me in calculating the total number of fish to be collected and analyzed in one year (over 4 months) that this may be overly ambitious for this project. For example, if I understand the sampling scheme correctly, each year 40-50 individuals of each of 4 species will be collected each month for 4 months at each of 10 sites. According to my calculations and assuming 45 individuals collected per site for each collection episode, in one year that's 10 sites x 4 sampling periods x 45 individuals x 4 species = over 7,000 individual fish to be collected, and assuming 15 individuals are processed for the fish heath measurements, then that's almost 2,500 total individuals to be processed and measured for all the extensive array of fish health indicators. According to my experience such an ambitious sampling regime may be unrealistic and I would suggest doing a power analysis to determine the statistically "optimum" number of individuals for each species to be sampled at each site each month (we have found that 8-10 individuals of each species at each sampling period is adequate for statistical purposes for most fish health responses). Also consider reducing number of sites in the Suisun marsh from 6 to 4 and sample 2-3 months instead of 4 to make this sample design more realistic. (7) as to

	the primary method of sampling=trawling, such collection methods are extremely damaging to fish and some may not survive the trawling process such as threadfin shad which are very sensitive. Also, are striped bass commonly caught in trawls- - I suspect so for juveniles but not for larger SB. (8) suggest eliminating measurement of stress proteins—such measures are not specific to environmental factors and are highly variable. The question is "so what" if differential patters in SPs are found between sites, etc., what would this mean in terms of evaluating fish health? (9) for the proximate analysis which are excellent indicators of nutritional status and fit well within the overall objectives of this experimental design, how many individuals of each species from each site will be analyzed- - I assume on the same individuals for which other health indicators are measured, (10) as to the statistical procedures, even though several statistical procedures are mentioned for integrating data and for analyzing relationships between environmental factors and various aspects of fish health, it is unclear how such statistical tests will be able to quantitatively evaluate the incremental and cumulative importance of each of the main environmental factors (i.e., contaminants, disease, nutrition, etc) on the various health response indicators including integrated health responses which can be determined using discriminant analysis procedures. The multivariate and functional analysis tests, including discriminant analysis and the AOOD method can provide approaches for integrating fish health information among species and sample sites but there should be a better detailed description of how such approaches will be used, for example, to evaluate the incremental and cumulative effects of each major environmental factor on the fish health profile as related to hypotheses 1 and 5 on pg. 2 and 3. Such analysis are important because environmental regulatory and management practices can be prioritized based on the relative importance of the various environmental stressors in affecting fish health. **As to the other instructions and questions relative to evaluation of the Approach section (1) yes, it is clear who will be performing the management and administrative tasks of the project, (2) yes, adequate resources appear to be available to accomplish the objectives, (3) the question related to products of value likely from the project are not addressed in this section but appear to be addressed in the feasibility and Relevance to the Delta Science Program sections, (4) the question related to a plan for dissemination of information and contributions to larger data management systems is also not addressed in this section.**
rating	**Above Average**

Feasibility

comments	I would rate this study as highly feasible based primarily on (1) the diversity and expertise of the investigators, (2) the availability of the necessary infrastructure and scientific instrumentation to measure the wide suite of fish health indicators, (3) the long-term experience that most of the primary investigators have in conducting complex lab and field studies, and(4)the knowledge and understanding that some of the PIs have related to the ecology of the SFE ecosystem. Even though this is an ambitious and challenging project, I would rate its likelihood of success as high because, for no other reason, any scientific progress and contribution at all in the understanding of the cumulative effects of environmetnal stressors on the health status of at risk fish populations will certainly advance the state of knowledge in this area. The scale of the project is certainly consistent with the project objectives and very feasible given the expertise and experience of the authors.
rating	Superior

Relevance To The Delta Science Program

comments	This study directly addresses two of the main priority research areas which are (1) native fish biology and ecology, and (2)food webs of key delta species and their relationships to water quality and other drivers. Because of the nature of the objectives and the experimental design, this project also includes various aspects of integration, synthesis, use of existing info, collaborations, and multiple disciplines. The type of information generated from this study will be extremely useful to resource managers including environmental regulators because studies are lacking that address both the incremental and cumulative effects of multiple environmental stressors on the health, fitness, and success of at risk fish populations. Given the limited financial and manpower resources of most agencies, information generated from this project should allow resource managers to prioritize environmental regulatory and management effors to focus first, for example, on those environmental stressors that contribute most to the health and declines of important fishery populations.
rating	Superior

Qualifications

comments	The investigators involved with this project certainly have the necessary qualifications, experience, and expertise to effectively and efficiently conduct this project and also to generate information and results that will be valuable in assisting resource managers in implementing and conducting effective fishery management strategies for the SFE. The project

	has all the necessary infrastructure including physical facilities, scientific instrumentation, field collecting gear, etc. to accomplish the goals of this project. Also see the Feasibility section that addresses the qualifications of the investigators and availability of the necessary infrastructure.
rating	Superior

Overall Evaluation Summary Rating

comments	Overall I am rating this project midway between Superior and Above Average. The main reason that I am not ranking this proposal as Superior is because some components of the Approach or experimental design could have benefited from better detailed explanations, clarifications, etc. However, this should not be an obsticle to funding of this proposal because some of the limitations of the experimental design can be easily rectified. THIS PROPOSAL SHOULD BE FUNDED primarily because of its unique and innovative objectives which are to assess the incremental and cumulative effects of various environmental stressor on the health and fitness of at risk fish populations in the SFE. If funded this project could benefit from an outside scientific advisor particularly someone who has extensive experience with these types of challenging studies. If appropriate, I would like to be involved in an advisory capacity because this is such an important, challenging, interesting project.
rating	Above Average

Proposal Title: Developing A Baseline Health Status For Threatened Fish In The San Francisco Estuary: An Ecological Approach Of Evaluating The Effects Of Contaminants, Disease, And Fish Nutrition

Proposal Number: 0136

Proposal Applicant: Davis, California University of

Project

comments	The define fish health using the following biological criteria: 1) condition factor and organo-somatic index, 2) biomarkers, 3) pathogens/diseases, and 4) fish nutritional status. They shall cover 1) Native fish biology and ecology, and 2) food webs of key delta species and their relationships to water quality and other drivers. Goals: 1) evaluate temporal and spatial trends in the different measurements of biological effects, and to determine if these trends are related to gradients of physicochemical parameters. 2) determine if exposures to contaminants (biomarker responses) and pathogens/diseases affect the nutritional status of fish, or vice versa. 3) assess if changes in key physicochemical stressors such as salinity and temperature affect the nutritional status of fish. 4) characterize the general fish health. 5) Archive the general health status of the target species as baseline information and determine potential correlation to the habitat health. My Evaluation: This is an excellent, well-thought-out proposal with important questions, and an excellent approach. The investigators are well qualified to do this study. I strongly recommend funding this proposal.
rating	Superior

Background

comments	This is one of the better conceptual models I have reviewed and it clearly outlines all aspects of the study. I feel well informed after reading this portion of the proposal.
rating	Superior

Approach

comments	The rational for choosing the species in this study is well thought out and supported. They further demonstrate that the investigators have experience working with these species. (Species involved: Sacromento Splittail, Stiped bass, threadfin shad). By choosing species that inhabit different trophic levels it provides an excellent approach. Further, by mixing game and

	non-game species it provides valuable information that I think is very important.
rating	Superior

Feasibility

comments	The authors have convinced me in their study that their approach is both feasible and realistic. The authors have the technical knowledge and background, and their resources are sufficient to undertake a study of this kind. The study is complex and large, but orchestrated in a manner that is very doable.
rating	Superior

Relevance To The Delta Science Program

comments	Because they are addressing stressors that are currently reoccuring in the Delta, it is very clear that this has direct relevance to the Delta Science Program. However, I would add that this study is extremely valuable and has implications far beyond the Delta. Their findings will be important to investigators and resource managers involved in similar systems the world-wide. Therefore, I believe this makes this study even more valuable to the DSP. I absolutely love this study design and the overall goals.
rating	Superior

Qualifications

comments	There is no doubt in the investigator qualifications, as I previously mentioned. The publication records of all investigators are obvious in reviewing their CVs. Further, they have strong grant records. Their insitutional support is extensive and I have no doubt that the investigators are competent in all aspects of this study.
rating	Superior

Overall Evaluation Summary Rating

comments	Excellent. After reviewing numerous proposals for various state and federal agencies over the past several years, this was overall the best laid-out. After dragging through this proposal, I find it to be one of the most well-written I can recall. I STRONGLY encourage the program to fully fund this proposal because the potential findings are extremely important and the authors have convinced me that they are capable.
rating	Superior