

99F105

4.5 PSP Cover Sheet (Attach to the front of each proposal)

Biological Assessment of Green Sturgeon in the
 Sacramento-San Joaquin Watershed

Proposal Title: _____

Applicant Name: Joseph J. Cech, Jr

Mailing Address: Wildlife, Fish, & Conservation Biology, University of
California, Davis, CA

Telephone: (530) 752-3103

Fax: (530) 752-4154 95616

Email: jjcech@ucdavis.edu

Amount of funding requested: \$ 159,000/205,013 for 1 years

Indicate the Topic for which you are applying (check only one box).

- Fish Passage/Fish Screens
- Habitat Restoration
- Local Watershed Stewardship
- Water Quality
- Introduced Species
- Fish Management/Hatchery
- Environmental Education

Does the proposal address a specified Focused Action? yes X no

What county or counties is the project located in? Sutter, Yolo

Indicate the geographic area of your proposal (check only one box):

- Sacramento River Mainstem
- Sacramento Trib: _____
- San Joaquin River Mainstem
- San Joaquin Trib: _____
- Delta: (incl. Feather River)
- East Side Trib: _____
- Suisun Marsh and Bay
- North Bay/South Bay: _____
- Landscape (entire Bay-Delta watershed)
- Other: _____

Indicate the primary species which the proposal addresses (check all that apply):

- San Joaquin and East-side Delta tributaries fall-run chinook salmon
- Winter-run chinook salmon
- Late-fall run chinook salmon
- Delta smelt
- Splittail
- Green sturgeon
- Migratory birds
- Other: _____
- Spring-run chinook salmon
- Fall-run chinook salmon
- Longfin smelt
- Steelhead trout
- Striped bass
- All chinook species
- All anadromous salmonids

Specify the ERP strategic objective and target (s) that the project addresses. Include page numbers from ~~January 1999~~ ^{February} version of ERP Volume I and II:
Vol. 1, pp. 205-206; Vol. 2, pp. 88-90, 99-100, 188-189, 293-295, 297-298.

Indicate the type of applicant (check only one box):

- | | |
|--|---|
| <input type="checkbox"/> State agency | <input type="checkbox"/> Federal agency |
| <input type="checkbox"/> Public/Non-profit joint venture | <input type="checkbox"/> Non-profit |
| <input type="checkbox"/> Local government/district | <input type="checkbox"/> Private party |
| <input checked="" type="checkbox"/> University | <input type="checkbox"/> Other: _____ |

Indicate the type of project (check only one box):

- | | |
|--|---|
| <input type="checkbox"/> Planning | <input type="checkbox"/> Implementation |
| <input type="checkbox"/> Monitoring | <input type="checkbox"/> Education |
| <input checked="" type="checkbox"/> Research | |

By signing below, the applicant declares the following:

- 1.) The truthfulness of all representations in their proposal;
- 2.) The individual signing the form is entitled to submit the application on behalf of the applicant (if the applicant is an entity or organization); and
- 3.) The person submitting the application has read and understood the conflict of interest and confidentiality discussion in the PSP (Section 2.4) and waives any and all rights to privacy and confidentiality of the proposal on behalf of the applicant, to the extent as provided in the Section.

Joseph J. Cech, Jr.

Printed name of applicant

Joseph J. Cech Jr.

Signature of applicant



smdowdy@ucdavis.edu
OFFICE OF THE VICE CHANCELLOR FOR RESEARCH
(530) 752-2075
FAX: (530) 752-5432

410 Mrak Hall, One Shields Avenue
DAVIS, CALIFORNIA 95616-8671

April 14, 1999

CALFED Bay-Delta Program Office
1416 Ninth Street, Suite 1155
Sacramento, CA 95814

Proposal Title: "Biological Assessment of Green Sturgeon in the
Sacramento-San Joaquin Watershed"
Principal Investigator – Joseph J. Cech, Jr.

Dear Colleague:

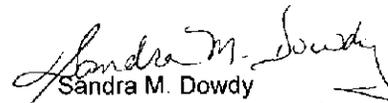
It is a pleasure to present for your consideration the referenced proposal.

It is our understanding that for purposes of determining applicant category, The Regents will be classified as "State" thereby resulting awards will only include the terms identified in Attachment D of the 1999 Proposal Solicitation Package as "Terms and Conditions for State (CALFED) Funds" and "Standard Clauses-Interagency Agreements".

The University takes exception to clauses pertaining to Substitution, Rights in Data and Indemnification as detailed in Attachment D. On behalf of The Regents of the University of California, we hereby reserve the right to negotiate said clauses as detailed in the Proposal Solicitation Package should this proposal result in a subsequent award.

Please call on the principal investigator for scientific information. Administrative questions may be direct to me or to Petrina Ho by telephone, facsimile or electronic mail at the numbers specified above. We request that correspondence pertaining to this proposal and a subsequent award be sent to the Office of Research and to the principal investigator.

Sincerely,


Sandra M. Dowdy
Contracts & Grants Analyst

Enclosures

Proposal to:

Name CALFED Bay-Delta Program Office
Address 1416 Ninth St., Suite 1155
Sacramento, CA 95814

Submitting Organization:

THE REGENTS OF THE UNIVERSITY OF CALIFORNIA
UNIVERSITY OF CALIFORNIA
ONE SHIELDS AVENUE
DAVIS, CALIFORNIA 95616

Title of Proposed Research: Biological Assessment of Green Sturgeon in the Sacramento-San Joaquin Watershed

Total Amount Requested:

\$159,000 / \$205,013

Proposed Duration:

One Year

Desired Starting Date:

2-1-00

Principal Investigator/

Co-Investigator(s):

Joseph J. Cech, Jr.

Department:

Wildlife, Fish, & Cons. Biology (530) 752-3103

Phone Number:

Serge I. Doroshov, Animal Sci. (530) 752-7603; Gary P. Moberg, Animal Sci., (530) 752-0233; Bernard P. May, Animal Sci. (530) 754-8123; Raymond G. Schaffter, Cal Fish & Game (209) 948-7081; David W. Kohlhorst, Cal Fish & Game (209) 948-7080

Checks Made Payable to:

The Regents of the University of California

Send Checks to:

CASHIER'S OFFICE
UNIVERSITY OF CALIFORNIA
ONE SHIELDS AVENUE
DAVIS, CA 95616

Send Award Notice to:

OFFICE OF RESEARCH
UNIVERSITY OF CALIFORNIA
ONE SHIELDS AVENUE
DAVIS, CA 95616
(530) 752-2075

Approvals:

Joseph J. Cech, Jr. 4-9-99
Principal Investigator Date Co-Investigator Date

[Signature] 4-9-99
Co-Investigator Date Department Chair Date

Dean, College/School Date

Sandra M. Dowdy
Official Signing for Organization Sandra M. Dowdy
Contracts and Grants Analyst

PD:/kirkman.fcm/proposal

Title Page

Title of Project: BIOLOGICAL ASSESSMENT OF GREEN STURGEON IN THE SACRAMENTO-SAN JOAQUIN WATERSHED

Primary Contact (Principal Investigator):

Joseph J. Cech, Jr., Professor, Department of Wildlife, Fish, and Conservation Biology, University of California, Davis, CA 95616, Phone: (530) 752-3103, FAX (530) 752-4154, jjcech@ucdavis.edu

Co-Principal Investigators:

Serge I. Doroshov, Professor, Department of Animal Science, University of California, Davis, CA 95616, Phone: (530) 752-7603, sidoroshov@ucdavis.edu

Gary P. Moberg, Professor, Director, Aquaculture and Fisheries Program, and Associate Dean for Animal Biology, College of Agricultural and Environmental Sciences, Department of Animal Science, University of California, Davis, CA 95616, Phone: (530) 752-0233, (530) 752-1253, gpmoberg@ucdavis.edu

Bernard P. May, Associate Research Biologist, Department of Animal Science, University of California, Davis, CA 95616, Phone: (530) 754-8123, bpmay@ucdavis.edu

Raymond G. Schaffter, Fishery Biologist, California Department of Fish and Game, Bay Delta and Special Water Projects Division, 4001 N. Wilson Way, Stockton CA 95205, Phone: (209) 948-7081, FAX (209) 946-6355, rschaffi@delta.dfg.ca.gov

David M. Kohlhorst, Senior Fishery Biologist, California Department of Fish and Game, Bay Delta and Special Water Projects Division, 4001 N. Wilson Way, Stockton CA 95205, Phone: (209) 948-7080, FAX (209) 946-6355, dkohlhor@delta.dfg.ca.gov

Type of Organization and Tax Status:

UC Davis is a State-assisted public research and educational institution. California Department of Fish and Game is a Constitutionally mandated agency of the State of California. (Non-Profit, exempt under status 501(c)(3) of the IRS code of 1954 under Type of organization and Tax Status)

Tax Identification Number: 94-603-6494 (UC Davis)

Participants and Collaborators in Implementation:

US Fish and Wildlife Service
Yurok Tribes

Executive Summary

A. Project Title and Applicant Name: **BIOLOGICAL ASSESSMENT OF GREEN STURGEON IN THE SACRAMENTO-SAN JOAQUIN WATERSHED;** Joseph J. Cech, Jr.

B. Project Description and Primary Biological/Ecological Objectives: The green sturgeon (GS, *Acipenser medirostris*) is a CALFED Priority Group I species, and the proposed work will focus on the biological characteristics of this species and its habitats towards their eventual restoration. Our coordinated UC Davis-CDFG team will address key areas of scientific uncertainty about GS to minimize harm to this species and its population(s) in the lower Sacramento-San Joaquin watershed. In the first two phases (years) of a multi-phase investigation, we will determine baseline information regarding this species' biological requirements in the Sacramento-San Joaquin watershed, and the feasibility of GS culture for further research and potential mitigational considerations. The project has five objectives: 1. determine juvenile GS' food and oxygen requirements at different environmental temperatures, temperature tolerance limits and behavioral tendencies, and swimming performance; 2. determine GS' requirements for gonadal development, spawning, and the successful rearing of larvae and juveniles; 3. determine potential environmental stressors' effects on GS' reproductive functioning and well being; 4. determine the genetic stock structure of naturally spawning GS from the Sacramento-San Joaquin river system; and 5. determine GS spawning site suitability in the Feather River and provide GS adults, sub-adults, larvae, and eggs from the Sacramento system to UC Davis scientists conducting the studies outlined in the first four objectives. These projects will provide valuable information to decision-makers regarding environmental resource management options to restore Bay-Delta ecological health and water quality.

C. Approach/Tasks/Schedule: We will determine the physiological/behavioral responses and limits, reproductive/early life history requirements, stress responses, genetic makeup, and spawning locations/requirements of GS in the lower Sacramento-San Joaquin watershed. We will capture juvenile GS from Feather and Sacramento Rivers (including cooperative arrangements with Curt Brown, USFWS). Sturgeon egg and larval sampling will be conducted with simultaneous temperature, depth, flow velocity and substrate composition measurements during the late winter and spring of 1999 and 2000. Sturgeon eggs will be either maintained alive or preserved and transported to UC Davis researchers. During the fall of 1999, modifications will be made to procedures of a scheduled sturgeon tagging study so that adult and sub-adult green sturgeon captured during this tagging can be held alive until they can be transported to the UC Davis Aquatic Center. During juvenile longline sampling in the west delta during August and November of 1999 and 2000, all GS juveniles will be made available for UC Davis scientists for live pickup at various delta marinas. With USFWS and tribal (Yurok) cooperation, we will capture a few brood fish for captive spawning from the Klamath basin (where spawning GS are more likely captured) to characterize early development and provide more fish for the proposed studies. At UC Davis (Phase 1, currently funded), we are determining GS' temperature tolerance limits and behavioral tendencies, swimming performance limits, developmental progress of gonadal tissues and germ cells, rhythms of circulating hormones and gonadal responses to stressors (including culture conditions), molecular markers to differentiate white sturgeon (WS) and GS and their relative proportion spawning in the Sacramento-San Joaquin drainage, and GS genetic polymorphisms.

During Phase 2 (here proposed), we will continue spawning location/requirements studies, determine temperature's influence on food and oxygen consumption rates, optimum artificial spawning techniques, and degree of reproductive isolation of Sacramento-San Joaquin GS from Klamath River and Rogue River (Oregon) populations. Plans for subsequent phases will depend upon results from the first two phases.

D. Justification for Project and Funding by CALFED: CALFED funding is proposed because of the critical need for species-specific information on GS in the natural environment and in laboratory and culture conditions. Published information on the life history and environmental requirements of this native species is almost entirely lacking. Because this species is rare and only lightly harvested in California, there is little justification for funding from normal sport or commercial fisheries research funding sources. Without determining the GS' vulnerability to temperature stress and flow characteristics, spawning and early rearing requirements, responses to stressful environments, and population identity, we cannot justify flow and other recommendations for maintenance and preservation of this species.

E. Budget Costs and Third Party Impacts: Requested CALFED funding is \$159,000 - 205,013 for Feb., 2000 - Jan., 2001. This amount includes funds for salaries and benefits of personnel (students' support; and partial support of a staff research associate, and associate research biologist), student fee remissions, equipment, supplies/expenses, operation of vehicles and vessels, and overhead (@10 - 46%, except for student fee remissions and equipment costs). "Leveraged" support (\$48,276) will be provided by UC Davis (5% of investigators' salaries and benefits while working on the GS project), and an estimated \$30,000 of support by using CDFG personnel and vessels conducting white sturgeon (WS) research funded by Federal Sport Fisheries Restoration Funds and matching state funds for obtaining GS, and by using State Water Project facilities and personnel to collect juveniles at the Byron fish screens. Eventual enhanced sport and native Californian fisheries and more flexible water management strategies should benefit third parties.

F. Applicant Qualifications: Drs. Joseph J. Cech, Jr., Serge I. Doroshov, Gary P. Moberg, and Bernard P. May are well-known, UC Davis fish (including sturgeon) biologists; and Raymond G. Schaffter and David Kohlhorst are well-known CDFG Bay-Delta sturgeon authorities.

G. Monitoring and Data Evaluation: Data collection and evaluation will follow established procedures. In addition to quarterly, annual and final reports, results will be presented at interagency workgroup meetings, workshops, and professional scientific meetings, and published in peer-reviewed journals. Feather River temperature data will be entered on the CDFG web page within 30 days of data collection.

H. Local Support/Coordination with Other Programs/Compatibility with CALFED Objectives: Most of the infrastructure/equipment required for this project is already available at UC Davis and CDFG Bay Delta and Special Water Projects Division. Assistance from USFWS (Paul Zedonis, Jay Glase) and the Yurok Tribal Fisheries biologists (Troy Fletcher, Rose Bond, Desma Williams, Dave Hillemeier) has been arranged. Increased knowledge of this priority (tier one) species will potentially assist several CALFED projects.

PROJECT DESCRIPTION

PROJECT DESCRIPTION

Proposed Scope of Work:

1. Objectives: The project has five objectives that combine agency and university biological expertise and link laboratory and field approaches: 1. determine juvenile green sturgeon's (GS) food and oxygen requirements at different environmental temperatures, temperature tolerance limits and behavioral tendencies, and swimming performance; 2. determine GS' requirements for gonadal development, spawning, embryo development, and the successful rearing of larvae and juveniles; 3. determine potential environmental stressors' effects on GS' reproductive functioning and well being; 4. determine the genetic stock structure of naturally spawning GS from the Sacramento-San Joaquin river system; and 5. determine GS spawning site suitability and environmental requirements for specific life stages in the Feather River and provide GS adults, sub-adults, larvae and eggs tissue, and live specimens from the Sacramento system to UC Davis scientists conducting the studies outlined in the first four objectives. Information gained from these assessments will be valuable to decision-makers regarding environmental resource management options to restore ecological health and improve water management for beneficial uses of the Bay-Delta system.

Phase 1 tasks that have already been funded (CALFED fund #: DWR Agreement No. B81738) are: Task 1, GS Temperature Tolerance Limits and Behavioral Tendencies and Swimming Performance; Task 2, Reproductive Characteristics of Wild GS; Task 3, Assessment of Stress and its Impact on Reproduction; Task 4, Development of Molecular Markers for GS vs. WS Larval Identification and for GS Population Characterization; and Task 5, Determination of Sturgeon Spawning Habitats and Their Environmental Conditions.

2. Approach and Methods: Animal Sampling and Holding: Juvenile and subadult/adult GS will be collected primarily from the Feather and Sacramento Rivers using appropriate methods and gear (specific methods outlined in Task 5, below) and held at UC Davis. Fish will be transported to the UC Davis Aquatic Center in oxygenated plastic bags (juveniles) or tanks (subadults/adults) with river water that will be kept cool. Immediately upon arrival, fish will be transferred to 1-4-m diameter, fiberglass tanks with aeration and a continuous flow of unchlorinated, air-equilibrated well water. Tank temperatures will approximate river temperatures at the time of capture (except for specific experimental protocols, see below), and GS will be offered fish pellets *ad libitum* (except for specific experimental protocols, see below).

Task 1. Food Consumption Rate, Growth Rate, and Respiratory Metabolism Measurements: Juvenile GS, either from river and Delta collections or from captive breeding experiments (see below) will be used to assess temperature's effects on three critical functions: food consumption, growth, and metabolism. Food consumption rate and growth rate studies will be conducted simultaneously on juvenile GS in replicate tanks at three temperature treatments: 11, 15, and 19°C (Myrick and Cech 1996). Fish will be situated in groups of 30 in five, replicate 110-L round fiberglass tanks (with continuous water and air flows) per temperature treatment. Fish will be fed Biodiet fish pellets twice daily, and uneaten pellets will be siphoned (and counted) twice daily to calculate food consumption rates (in g food/tank/day, with appropriate statistical comparisons between groups). Fish will be weighed and measured at the start and end of the 30-d experiment to determine growth rates, using appropriate statistical comparisons. Specific growth rate will be

determined (Busacker et al. 1990) for comparisons with literature values on juvenile WS (Cech et al. 1984, Crocker and Cech 1996). Respiratory metabolic (oxygen consumption) rate measurements will be conducted on ten (post-food consumption and growth rates experiment) fish from each of the three temperature treatment groups (11, 15, 19°C) in closed respirometers following the methods of Cech (1990). If GS show significant activity in respirometers, experiments will be videotaped to quantify activity (Crocker and Cech 1997) and oxygen (convertible to energy units) costs of activity will be estimated (with appropriate statistics).

Task 2. Captive Breeding, Culture, and Characterization of Early Developmental Stages: GS captive breeding will provide critical material for our assessments, in addition to culture techniques that may be needed for artificial reproduction of this rare species. We will collect 2-3 female and 3-5 male broodfish from the Sacramento and Klamath systems (gill nets or angling) and transport them by truck (with special oxygenated tank) to UC Davis. Broodfish will be held in 4-m diameter outdoor tanks with continuous water flows. Spawning and hatchery techniques will generally follow standard WS procedures (Conte et al. 1988, Van Eenennaam et al. 1996, Moberg and Doroshov 1996). Larvae and juveniles will be raised, at low density in smaller flow-through tanks, on the artificial (Biodiet) and/or natural (brine shrimp nauplii and tubifex) diets. Young GS survival, growth, feeding, and health will be maintained, and water quality will be monitored. We expect success, because Asian GS have large yolky eggs, and large and robust larvae at the onset of exogenous feeding (Artyukhin and Andronov, 1990), in contrast with lake and Atlantic sturgeon that possess more technically challenging larvae. We will incubate fertilized GS eggs in temperature-controlled (four levels: range 8-20°C) flow-through tanks or hatching jars and determine the effects of temperature on development rates, mortalities, and abnormalities using photomicrography and appropriate analysis (Wang et al. 1985, Dettlaff et al. 1993). Larval length and weight measurements will yield temperature effects data on larval growth. Photomicrographs of embryos and larvae will be scanned, processed (Adobe Photoshop software) and compared with those of WS. Dettlaff et al. (1993) noted that different sturgeon species are distinguished by the egg size and pigmentation patterns and that differences in morphology become prominent in larval stages (see also Wang et al. 1985).

Task 3. Responses to Stressors: GS' responses to stressors will be determined in developing larvae and potential broodstock. Larvae will be exposed to net dipping and movement to new holding tanks to determine the ontogeny of the stress response of developing GS. Mature fish responses will be determined via brief air exposures in a dip net (simulating culture procedures) and ACTH₁₋₂₄ administrations (via a vascular cannula) to determine the maximum and temporal characteristics of the GS' interrenal response. At this time and during subsequent studies, we will monitor the effect of the interrenal response on gonadal steroid secretion. These data will be used to establish appropriate culture conditions (e.g., tank size, stocking densities, handling practices, water temperature), should GS captive breeding/mitigative stocking be needed.

Task 4. Delta GS Stock Identification: The degree of reproductive isolation of Sacramento-San Joaquin GS from Klamath River and Rogue River (Oregon) populations will be determined using the microsatellites and AFLP DNA techniques developed in Phase I studies. Klamath River collections (coordinated with USFWS (Paul Zedonis, Jay Glase) and the Yurok Tribal Fisheries biologists (Troy Fletcher, Rose Bond, Desma Williams, Dave Hillemeier) and Rogue River

Sacramento-San Joaquin GS. Genotypic data will be collected from 20-40 individuals in each population and analyzed with genetic software to determine allele frequencies, Hardy-Weinberg equilibrium, average heterozygosities, and genetic similarities. In addition the baseline genotyping of these breeding populations will permit an assessment of contributions of these populations to the fishery in the mouth of the Columbia River.

Task 5. Determination of Sturgeon Spawning Habitats and Their Environmental Conditions: GS sampling and spawning habitat characterization will continue using the equipment and techniques that proved most successful during Phase 1 efforts. Eggs and larvae will be collected (March through June) twice weekly from artificial substrates in the Feather River for later DNA analysis (microsatellite and AFLPs) or growout at UC Davis to determine species (WS or GS). Preserved embryo samples will be aged to back-calculate time of spawning using temperature-modified WS development times (Wang et al. 1985, Beer 1981) until species-specific information is developed from our captive breeding and culture studies. Twice weekly, larval nets (Kohlhorst 1976) will be fished, and larvae will be either preserved or maintained alive for transport to UC Davis. Time of spawning will be estimated by WS larval development times (Beer 1981). Throughout the spawning seasons, flows/velocities will be monitored hourly by CDWR and CDFG, and hourly temperatures will be recorded (submersible data loggers) at several locations. GS from collection efforts at San Pablo Bay, the west Delta, and the John Skinner Fish Facility of the State Water Project will be retained for later transport to UC Davis.

Task 6. Project Management: Develop a Biological Monitoring/Research Plan (BMP) incorporating a Quality Assurance Project Plan (QAPP) and submit to CALFED for review and approval, and provide quarterly fiscal and programmatic reports to CALFED, based on the federal fiscal year, utilizing the reporting format and specifics required reporting information provided by CALFED.

3. Proposed Scope of Work: In this document, we describe the second phase of a coordinated, CDFG-UC Davis two-phase biological assessment of GS in the Sacramento-San Joaquin watershed. Phase 1 is currently being conducted during the first project year, and phase 2 will be conducted during the following project year. The Project Description and Approach (above) identifies the six tasks to be completed in Phase 2. Tasks' deliverables and costs (@ 10% overhead / 46% overhead) are: 1. temperature effects on juvenile GS food consumption, growth, and metabolism (\$30,438 / \$38,937); 2. captive breeding, culture, and characterization of GS' early developmental stages (\$48,369 / \$62,737); 3. GS' responses to stressors (\$30,438 / \$38,937); 4. genetic characterization of Sacramento-San Joaquin GS stock (\$48,471 / \$57,698); 5. identification of suitable river conditions for GS' spawning and larval rearing (already funded by CALFED); and 6. project management (\$1,284 / \$1,705). Total for Phase 2: (\$159,000 / \$205,013). The linked components of this study are not easily separated, because the individual tasks rely on deliverables from the others.

Location of Project: Project location is primarily in the Feather and Sacramento River systems, with additional work in San Pablo Bay, the John Skinner Fish Facility, and at UC Davis.

ECOLOGICAL/BIOLOGICAL BENEFITS

Ecological/Biological Objectives: The GS is a CALFED priority (Priority Group I) species, and the proposed assessments will focus on the biological characteristics of this species and its habitats towards their eventual restoration. The project has five objectives that combine agency and university biological expertise and link laboratory and field approaches: 1. determine juvenile green sturgeon's (GS) food and oxygen requirements at different environmental temperatures; 2. determine temperature-related requirements for GS embryo and larval growth and development; 3. determine potential environmental stressors' effects on GS' reproductive functioning and well being; 4. determine the degree of reproductive isolation between Sacramento-San Joaquin Watershed GS and those from the Klamath and Rogue Watersheds; and 5. determine GS spawning site suitability and environmental requirements for specific life stages in the Feather River, and provide GS adults, sub-adults, larvae and eggs tissue, and live specimens from the Sacramento system to UC Davis scientists conducting the studies outlined in the first four objectives.

Volume 1 of the ERPP, February 1999, Vision for Green Sturgeon (pp. 203) states that "green sturgeon rear in the Sacramento-San Joaquin estuary and spawn in the Sacramento and San Joaquin Rivers and their major tributaries." Knowledge of the age and body size-related gonadal development will benefit GS' stock management by providing data on the reproductive potential of the population. Characterization of environmental requirements for spawning, and for embryo and larval development will provide baseline information for the optimal use and potential improvement of spawning and nursery habitat.

The ERPP Vol. 1 also states that GS "may leave the Bay-Delta and move along the coast to as far as Alaska," and states that "populations of green sturgeon are found in many of the larger rivers from California north to British Columbia." Little is known about the reproductive isolation and genetic differentiation of Delta GS relative to GS in the Klamath and Rogue Rivers. GS are taken in the fishery in the lower Columbia River where no reproduction occurs. Genetic characterization of Sacramento-San Joaquin Watershed GS will help decide whether the Columbia River fish are Sacramento-San Joaquin GS, in the future.

Volume 1 of the ERPP, February 1999, Vision for Green Sturgeon (pp. 203-204) states that "habitat requirements for green sturgeon are poorly known" and that "green sturgeon would benefit from restoring spawning and rearing habitat." Before we can restore spawning habitat, we must first understand GS spawning habitat characteristics. We aim to provide the first information on GS spawning habitat requirements and on the status of sturgeon spawning in the Feather River. Temperature sensors located above and below the Thermalito outfall will provide hourly temperature information during winter and spring periods that can be compared with hourly flow information currently available and begin to document temperature effects due to Thermalito afterbay operations in the lower Feather River. Assessments regarding GS' status, biological requirements (including temperature-related effects) in the Sacramento-San Joaquin watershed, and the feasibility of GS culture for future mitigational considerations may suggest how existing flow regulation facilities (Oroville Dam, Thermalito Diversion Dam, water elevation and residence time in Thermalito afterbay) may be best employed to provide optimal flow and temperature conditions for sturgeon spawning. Collected information will significantly aid decision-makers in developing environmental resource management options to restore ecological health and improve water management for beneficial uses of the Bay-Delta system.

environmental resource management options to restore ecological health and improve water management for beneficial uses of the Bay-Delta system.

Background and Justification: Basic GS life history information is critical to this unique native species' protection. Environmental requirements data are quantitatively linked via bioenergetic models (Jobling 1994) that allow predictions of physiological shortcomings (e.g., reduced growth, reproduction, and survival) associated with environmental stresses (measured by tolerance limits and hormonal responses) that lead to populational declines (Wedemeyer et al. 1990). American GS are known to spawn in the Sacramento and Klamath Rivers (Moyle et al., 1994) and the adults are present in the lower reaches of the Columbia and Fraser Rivers (Houston, 1988) but the spawning grounds, timing of spawning migrations, and developmental biology of this species are unknown. Similarly, no information exists on the GS' reproductive characteristics, such as gonadal development, age and body size at sexual maturity, fecundity, and egg size. Artyukhin and Andronov (1990) described spawning runs of the Asian GS (considered the same species *A. medirostris* Ayres or, as subspecies *A. medirostris mikadoi* Hilgendorf) in the Tummin River (Sakhalin Island) and succeeded in the artificial spawning of two females. However, they provided no detailed descriptions of early GS development.

Stress negatively impacts the health, growth and reproductive success of fish. Volume 1 of the ERPP, February 1999, Vision for Green Sturgeon (p. 204) states that "Reducing stressors is a component of restoring white and green sturgeon populations." Before we can reduce stressors and their effects, we must understand the GS' stress response (e.g., to temperature changes, low water quality). These responses have never been studied and we have no knowledge regarding which natural or culture conditions are best for GS. Decreased water quality (e.g., elevated water temperatures, water pollutants) may decrease the physiological ability of developing GS larvae to cope with stress. These same stressors can reduce the reproductive success of adult GS, resulting in decreased numbers of fertile eggs and young, and, in some cases, may account for unexplained failure of populations to reproduce normally. However, studies to test this hypothesis are not possible until a fundamental understanding of the GS' stress response is developed.

Regarding identification of GS populations, the two primary advantages of AFLPs include the ability to randomly screen a large proportion of the genome and repeatability, thus scanning far more of the genome per unit of effort and cost than any other molecular genetic approach currently available. Our coordinated approach will significantly assist in GS restoration, a specific ERPP objective (Vol. 1, February 1999, Green Sturgeon, pp. 203-206; Vol. 2, February 1999, Sacramento-San Joaquin Delta Ecological Management Zone Vision, pp. 82; Vol. 2, February 1999, Suisun Marsh/North San Francisco Bay Ecological Management Zone Vision, pp. 137; Vol. 2, February 1999, Sacramento River Ecological Management Zone Vision, White Sturgeon and Green Sturgeon, pp. 174-175; Vol. 2, February 1999, Feather River-Sutter Basin Ecological Management Zone, Green Sturgeon, p. 290).

Linkages

This proposed Phase 2 work will link with ongoing Phase 1 GS tasks, and with other native fish and habitat-related work in the Delta and Feather River ecosystems. The ERPP (Vol. 2, February 1999, Sacramento River Ecological Management Zone Vision, White Sturgeon and Green

Sturgeon, pp. 174-175) states that the vision for both GS and WS is "to maintain and restore population distribution and abundance to historical levels." Combined GS Phase 1 and Phase 2 work will complement previous and ongoing studies at UC Davis, CDFG, and elsewhere on WS biological requirements, genetic stock identification, habitat requirements, and responses to stressors (e.g., see Selected Publications, under Applicant Qualifications, below). The ERPP (Vol. 2, p. 174) mentions the success of "the Department of Fish and Game's white sturgeon management program," in terms of the sport fishery harvest which has increased to "nearly 70% of the average commercial catch from 1875 to 1899, about 374,000 pounds," after an early, unregulated fishery "nearly wiped out the populations in a short period of time." Further, the involvement of CDFG field biologists and their Bay-Delta fish sampling (e.g., Real-Time Monitoring during spring months, San Francisco Bay-Outflow Study during the March-December period, and the year-around interval sampling at the John Skinner Fish Facility at the State Water Project) provides additional links to ongoing Bay-Delta fish distribution and abundance studies.

System-Wide Ecosystem Benefits

Because the GS is a native, anadromous sturgeon, it is a conspicuous component of our Sacramento-San Joaquin Watershed's natural heritage and aquatic ecosystem. As such, a biological assessment of the species is key to a better understanding of its environmental requirements (including needs for spawning, and rearing of the young), stress response mechanisms, stock identification, and spawning habitat conditions. The ERPP (Vol. 2, Sacramento-San Joaquin Delta Ecological Management Zone, p. 82) states that, "The vision for green sturgeon is to achieve recovery of this California species of special concern and to restore population distribution and abundance to historical levels. Restoration of this species (will) contribute to overall species richness and diversity and reduce conflict between the need for protection for these species and other beneficial uses of water in the Bay-Delta." Possible modifications of Sacramento-San Joaquin Watershed instream flows, thermal regimes, and structures (e.g., diversions) based on GS data developed in this project will likely benefit the restoration of other native, co-evolved species (e.g., WS, chinook salmon, steelhead, splittail). Further, water releases to restore GS spawning and rearing habitats would also benefit water-dependent riparian zones, seasonally flooded areas, and their resident animals and plants, including those of special concern.

Compatibility with Non-Ecosystem Objectives

Vol. 1 of the ERPP (p. 203) states that one of the major factors "that limit sturgeon populations in the Bay-Delta are adequate streamflows for attracting adults to spawning areas in rivers and transporting young to nursery areas." If habitat-related, GS restoration efforts include increasing fresh water flows (e.g., during the spawning and rearing periods), downstream water quality (i.e., for drinking water) should also improve. In addition, development of GS captive breeding and stress physiology information will provide both test animals and laboratory techniques for water quality-related toxicological assessments, in the future.

TECHNICAL FEASIBILITY AND TIMING

Our proposed approaches for collecting the biological and ecological information necessary for GS recovery will provide the most quantitative information on this species' life history requirements and stock identification in the shortest time period, for the least cost. Alternative approaches (e.g.,

The methods and analyses described in this proposal have been rigorously scrutinized for applicability to these GS assessments. These methods have been proven on other fish species (WS, steelhead, splittail) at UC Davis and CDFG facilities. There is always a risk in initiating assessments (including those involving feeding, growth, reproduction, measurements of stress, and location of spawning and rearing sites) on "new" species. However, the facilities and experience of the UC Davis and CDFG investigators minimize this risk. Even though the funding for Phase 1 has just been received at the UC Davis campus (April, 1999), our preliminary efforts with GS capture, transport, and holding have been very successful. CDFG's San Francisco Bay Outflow Study samples have yielded fourteen GS, which have all been successfully transported to UC Davis. Through a lengthy trial period of offering different natural and prepared dietary items, all of the GS have survived, and have either maintained or gained body weight.

The Fish Ecophysiology Laboratory (Dr. Cech) has the necessary apparatuses (respirometers) and instruments (dissolved gas analyzers, video equipment), to successfully provide the Task 1 deliverables (along with the UC Davis Aquaculture and Fisheries Program Facility's tanks and unchlorinated water). The Fish Reproduction Laboratory (Dr. Doroshov) has the necessary temperature-controlled flow-through tanks and hatching jars for egg and larval rearing, and photomicrography equipment for quantification of developmental rates and processes. The Fish Endocrinology Laboratory (Dr. Moberg) has the radioimmunoassay and chromatography equipment necessary to assay GS hormone concentrations. The Genomic Variation Laboratory (Dr. May) has acrylamide gel and other equipment (including a fluorimager) to conduct the molecular genetic studies. CDFG Bay-Delta Laboratory (R. Schaffler and D. Kohlhorst) has the necessary sampling and monitoring equipment for the GS field studies. All necessary collecting permits (CDFG- Scientific Collecting Permits #801001-02, #801039-04) and cooperative arrangements (USFWS, Yurok Tribe) are currently in place. Animal care and use protocols (UC Davis Protocols #8311 and #8380) have also been approved by the UC Davis Animal Care and Use Committee which regularly monitors all animal facilities and experiments.

The technical feasibility of GS' captive breeding is greatly enhanced by our experience in breeding white sturgeon (Van Eenennaam et al. 1996) and knowledge of the endocrine and environmental control of sturgeon reproduction (Moberg and Doroshov, 1996). The risk factors are associated with the capture of broodfish in a proper stage of gonadal maturity and potential effects of transportation stress on reproductive performance. Potential effects of these factors will be minimized by using an improved-design transport tank and, potentially, GS spawning at the capture site so that fertilized eggs, instead of broodfish, are transported. Finally, the UC Davis Statistical Laboratory provides pre- and post-experimental statistical consulting and data analysis services. Timing of the proposed work is critical because of the high priority status of GS (Priority Group I) work, and the linkage of Phase 1 and Phase 2 activities. The proposed Phase 2 start date is immediately after the completion of Phase 1.

MONITORING AND DATA COLLECTION METHODOLOGY

Biological/Ecological Objectives

Task 1. Determine juvenile GS food and oxygen requirements at different environmental temperatures.

Task 2. Determine temperature-related requirements for GS embryo and larval growth and development.

Task 3. Determine potential environmental stressors' effects on GS' reproductive functioning and well being.

Task 4. Determine the degree of reproductive isolation between Sacramento-San Joaquin Watershed GS and those from the Klamath and Rogue Watersheds.

Task 5. Determine GS spawning site suitability and environmental requirements for specific life stages in the Feather River, and provide GS adults, sub-adults, larvae and eggs tissue, and live specimens from the Sacramento system to UC Davis scientists conducting the studies outlined in the first four objectives.

Monitoring Parameters and Data Collection Approach

The specific monitoring and data collection approaches for Tasks 1 through 5 are summarized in Table 1, including biological assessment questions to be evaluated, monitoring parameters, data collection and evaluation approaches, and data priorities. Data from the CDFG field efforts with the Feather River fish, temperature, and flow sampling activities (Task 5) will be compared with data from other GS-relevant monitoring programs (e.g., Real-Time Monitoring during spring months, San Francisco Bay-Outflow Study during the March-December period, and the year-around interval sampling at the John Skinner Fish Facility at the State Water Project) to facilitate the adaptive management process of the CALFED program.

Data Evaluation Approach

The specific data evaluation approaches, including sampling protocols, data syntheses and analyses, and quality assurance procedures, for Tasks 1 through 5 are summarized in Table 2. On-going project results will be presented in quarterly reports, and a final CALFED report will be prepared at the conclusion of the project. Peer review of project results will be a two-step process. The first step will use local and regional colleagues' comments for CALFED final reports. The second step will involve blind reviews of project-derived manuscripts submitted to professional journals.

Wide dissemination of project data and findings will result from presentations at local, regional, and national workshops and meetings, submission of CALFED quarterly and final reports, submission of IEP Newsletter articles, and submission of manuscripts to peer-reviewed professional journals.

LOCAL INVOLVEMENT

The Yolo and Sutter Counties Planning Departments and Boards of Supervisors have been notified of our intention to conduct the proposed assessment. Copies of these letters are attached.

The proposed project has the support of USFWS (Paul Zedonis, Jay Glase) and Yurok Tribal Fisheries biologists (Troy Fletcher, Rose Bond, Desma Williams, Dave Hillemeier). UC Davis biologists met with these groups on 1/21/99 in Weaverville.

Third Party Impacts:

Positive potential third party impacts resulting from this project include enhanced sport and native

Californian fisheries resulting from improved fish populations. California sturgeon farmers may benefit from new data and technology resulting from the proposed GS captive breeding and rearing, environmental requirements, and stress minimization efforts. Also, California water consumers may benefit through restoration of a native, CALFED priority species, obviating its potential listing as a threatened or endangered species and restricting future water management options. California water consumers may also benefit indirectly through improved water quality resulting from potential project-derived changes in Sacramento Watershed flow regimes. Potential negative third party impacts may include reductions of exotic gamefish populations because of altered flow and temperature conditions. Also, potential listing (e.g., as a threatened or endangered species) of the GS may impact WS management because of incidental take of GS during WS fishing.

COST

a. Total Budget

Total Phase 2 funding requested from CALFED is \$159,000 - 205,013. This amount (Tables 3, 4) includes funds for salaries and benefits of personnel (partial support of three graduate students, four undergraduate assistants, staff research associate, CDFG biologist, and associate research scientist), student fee remissions, equipment, supplies/expenses, travel, and overhead (@10% [State] or 46% [Federal] of non-student fee remissions and non-equipment costs for UC Davis). The 46% Federal overhead rate is negotiated by the UC Regents in consultation with Federal granting agencies. The graduate student research assistants and undergraduate student assistants will assist in all aspects of the field and laboratory work, and the other staff will conduct the assessments and supervise/train the student assistants. Investigator B.P. May will require two months salary/benefits support. Student fee remissions are required in all UC Davis grants and contracts incorporating graduate student research assistants. Equipment needs include a thermocycler (polymerase chain reaction instrument to amplify regions of interest, such as microsatellite DNA, @\$5,000) for Phase 2. Miscellaneous and other direct costs include supplies, expenses, and travel expenditures. Supplies and expenses include physiological measurements supplies, water and feed costs, egg and larval aquaculture systems supplies, histological supplies, film and developing supplies, steroid analyses supplies, molecular biology supplies, chemicals and reagents, and field sampling supplies. Travel costs are for truck/car rental and mileage for round trips to the Delta, Feather River, Sacramento River, Klamath River (with hotel and per diem costs) and to workshops/meetings to present/discuss results and implementation. "Leveraged" support (\$48,276 for Phase 2) is calculated from the 5% time commitment (salaries + benefits) of the faculty investigators for the project and the approximate \$30,000 in kind support by using CDFG personnel and vessels conducting white sturgeon (WS) research funded by Federal Sport Fisheries Restoration Funds and matching state funds for obtaining GS, and by using State Water Project facilities and personnel to collect juveniles at the Byron fish screens (Table 4).

Phase 2 Schedule:

February-April: (Initiation of CALFED Phase 2 funding) Initiate metabolism experiments; begin collection of gonadal samples (field trips to Delta); begin adult stress response experiments; and, begin collecting genotypic data for population samples for molecular methods developed in Phase 2; begin Feather River temperature and flow data collection, and sampling for GS eggs and larvae;

and prepare first CALFED quarterly report.

May-June: Initiate food consumption and growth experiments; continue metabolism experiments; capture of broodfish, gonad sample processing, hatchery spawning, and experimental observations on early development; continue stress response measurements on adult GS and start measurements on larval GS; continue collecting genotypic data; continued collection of Feather River temperature and flow data and sampling for GS eggs and larvae; and prepare second CALFED quarterly report.

July-September: Continue metabolism experiments; analyze food consumption, growth data; continue rearing of larvae and juveniles with observations on growth, development, and survival; continue measurements of adult and larval GS stress responses; analyze population genetic data; analyze Feather River flow, temperature, and GS distribution data; and prepare third CALFED quarterly report.

October-January: Analyze GS metabolism experiment data; analyze GS embryo and larval development data; analyze GS adult and larval stress response data; complete analyses of GS reproductive isolation data; complete analyses of Feather River field data; and prepare CALFED final (includes fourth quarter activities) report.

COST-SHARING

See Table 4.

APPLICANT QUALIFICATIONS

JOSEPH J. CECH, JR.

EDUCATION

B.S. U. Wisconsin, Madison, 1966 (Zoology); M.A., 1970 & Ph.D., U. Texas, Austin, 1973
(Zoology)

CURRENT POSITION

Professor of Fisheries Biology, UC Davis

TWO SELECTED PUBLICATIONS

1. . Crocker, C.E. and J.J. Cech, Jr. 1997. Effects of environmental hypoxia on oxygen consumption rate and swimming activity in juvenile white sturgeon, *Acipenser transmontanus*, in relation to temperature and life intervals. *Env. Biol. Fish.* 50:383-389. 2. Crocker, C.E. and J.J. Cech, Jr. 1998. Effects of hypercapnia on blood-gas and acid-base status in the white sturgeon, *Acipenser transmontanus*. *J. Comp. Physiol. B* 168:50-60.

SERGE I. DOROSHOV

EDUCATION

B.S. & M.S. (Zoology): U. Moscow, Russia, 1959; Ph.D. (Biology): Institute of Oceanology, Academy of Science, Russia, 1967.

CURRENT POSITION

Professor, Dept. Animal Science, UC Davis.

TWO SELECTED PUBLICATIONS

1. Chapman, F.A., J.P. Van Eenennaam, and S.I. Doroshov. 1996. The reproductive condition of white sturgeon, *Acipenser transmontanus*, in San Francisco Bay, California. Fish. Bull. 94:628-634.
2. Doroshov, S.I., G.P. Moberg and J.P. Van Eenennaam. 1997. Observations on the reproductive cycle of cultured white sturgeon, *Acipenser transmontanus*. Env. Biol. Fish. 48:265-278.

BERNARD (BERNIE) PAUL MAY

EDUCATION

B.S. 1973 (Molecular Biology) & M.S. U. Washington, 1975 (Fisheries); Ph.D. Pennsylvania State U. 1980 (Genetics).

CURRENT POSITIONS

Associate Research Biologist IV and Director, Genomic Variation Laboratory, Dept. Animal Science, UC Davis (75%); 1988-Present Senior Research Associate and Director, CLEEG, Department of Natural Resources, Cornell U. (25%).

TWO SELECTED PUBLICATIONS

1. May, B., C.C. Krueger, and H.L. Kincaid. 1997. Genetic variation at microsatellite loci in sturgeon: primer sequence homology in *Acipenser* and *Scaphirhynchus*. Can. J. Fish. Aquat. Sci. 54: 1542-1547.
2. May, B. 1998. Starch gel electrophoresis of allozymes. In: Molecular Genetic Analysis of Populations: A Practical Approach. 2nd Ed. A.R. Hoelzel, ed. Oxford Univ. Press.

GARY P. MOBERG

EDUCATION

B.A. Monmouth College, 1963 (Biology); M.S. U. Illinois, 1965 (Physiology); Ph.D. U. Illinois (Physiology); Postdoctoral Fellow, UC San Francisco 1970 (Neuroendocrinology)

CURRENT POSITIONS

Professor of Animal Science and Professor of Animal Physiology/Neurobiology, Physiology, and Behavior, UC Davis; Director of Aquaculture and Fisheries Program, UC Davis; Associate Dean for Animal Biology, College of Agricultural and Environmental Science, UC Davis.

TWO SELECTED PUBLICATIONS

1. Pavlick, Raymond J. Jr. and Gary P. Moberg. 1997. The effect of chronic testosterone administration on sturgeon gonadotropins in juvenile and pre-vitellogenic white sturgeon (*Acipenser transmontanus*). Gen.Comp. Endocr. 105:218-227.
2. Faulkner, Iwalani N. and Gary P. Moberg. 1997. Effects of short term management stress on the ability of GnRH α to induce gonadotropin secretion in male white sturgeon, *Acipenser transmontanus*. Aquaculture. 159:159-168.

RAYMOND G. SCHAFFTER

EDUCATION

B.S. U. Florida, Gainesville, 1965 (Zoology); M.S. U. Florida, Gainesville, 1968 (Botany).

CURRENT POSITION

Biologist, California Dept. Fish and Game.

TWO SELECTED PUBLICATIONS

1. Schaffter, R. G. 1997. White sturgeon spawning migrations and location of spawning habitat in the Sacramento River. Calif. Fish Game 83:1-20.
2. Schaffter, R. G. 1997. Growth of white catfish in California's Sacramento-San Joaquin Delta. Calif. Fish Game 84:57-67.

DAVID W. KOHLHORST

EDUCATION

B.S. U. Wyoming, Laramie, 1966 (Wildlife Conservation and Biology), M.A. UC Davis, 1970 (Zoology)

CURRENT POSITION

Senior Biologist (Specialist), California Dept. Fish and Game.

TWO SELECTED PUBLICATIONS

1. Kohlhorst, D.W., L.W. Miller, and J.J. Orsi. 1980. Age and growth of white sturgeon collected in the Sacramento-San Joaquin Estuary, California, 1965-1970 and 1973-1976. *Calif. Fish Game* 66:83-95. 2. Kohlhorst, D.W., L.W. Botsford, J.S. Brennan, and G.M. Cailliet. 1991. Aspects of the structure and dynamics of an exploited central California population of white sturgeon (*Acipenser transmontanus*). Pages 277-292 in: P. Willott, editor. *Acipenser: First International Symp. on the Sturgeon*. CEMAGREF, Bordeaux, France.

Compliance with Standard Terms and Conditions:

The University of California, Davis, and the California Department of Fish and Game are public organizations of the State of California. Both organizations comply with the standard terms and conditions of non-discrimination and non-collusion. There are no conflicts of interest.

Table 1. Summary of Monitoring Parameters and Data Collection Approach.

Hypothesis / Question to be Evaluated	Monitoring Parameter(s) and Data Collection Approach	Data Evaluation Approach	Comments / Data Priority
Task 1 - Juvenile GS Food Consumption, Growth, and Respiratory Metabolism			
What are the temperature effects on GS growth, food, and oxygen consumption rates?	growth rates, food consumption rates, oxygen consumption rates	Regression analysis, analysis of variance, comparison between treatments and with data on other sturgeon species	Bioenergetic variables reveal how GS allocate food energy to body maintenance and growth at different temperatures
Task 2 - GS Captive Breeding, Culture, and Characterization of Early Developmental Stages			
What are the effects of temperature on the growth and development of GS embryos and larvae?	spawning success, fecundity, embryo and larval development rates, larval survival and growth	Comparison between temperature treatments and with WS data; photomicrography and regression analysis	Data will reveal optimal temperature conditions for larval and juvenile growth and development
Task 3 - GS Responses to Stressors			
What are larval and adult GS' stress responses to temperature and simulated handling?	interrenal and gonadal steroid concentrations (adults & larvae); growth and body composition (larvae)	Regression analysis, analysis of variance, comparison between treatments and with data on other sturgeon species	Hormone concentrations will indicate stress responses and gonadal steroids will suggest effect of stress on reproduction; body weight and composition will indicate stress on the larvae
Task 4 - Sacramento-San Joaquin Delta GS Stock Identification			
What is the degree of reproductive isolation between Delta, Klamath Basin, and Rogue River GS populations?	microsatellites and amplified fragment length polymorphisms (AFLP)	Codominant microsatellite and AFLP band presence / absence data will be analyzed for genetic differences	Results will determine degree of reproductive isolation of Delta GS from Oregon
Task 5 - Determination of Sturgeon Spawning Habitats and Environmental Conditions			
What areas of the Feather River are used for GS spawning? What temperature and flow conditions are necessary for GS spawning?	Egg sampling by artificial substrate and larval sampling by larval nets.	Evaluation of temperature and flow conditions at time of spawning	Need temperature-development timing and species determination, probably by microsatellite or AFLP approach.

Table 2. Summary of Data Evaluation Approach. Page 1 of 2

Task #	Experiment Title	Samples						Data Synthesis and Analysis	Personnel	Ref's.
		Type	Number	Frequency	Handling / Preservation / Storage	Analytical Techniques	Quality Assurance			
1	30-d juvenile GS food consumption	number of pellets fed, number of recovered pellets	(15 each) 5 measurements per treatment X 3 temperature treatments	twice daily	amounts recorded on paper and on electronic media	ANOVA	regular calibration of analytical balances; replication of experiments; hard copies of all data sheets	consumption rates in (g food/tank/day) calculated from total number of pellets fed - recovered pellets	3	Myrick and Cech 1996
1	30-d juvenile GS growth	initial and final weights, standard length, fork length, total length	(450 each) 30 fish per tank X 5 tanks per treatment X 3 temperature treatments	twice (day 0, day 30)	weights and lengths recorded on paper and on electronic media	ANOVA, regression analysis	regular calibration of analytical balances; replication of experiments; hard copies of all data sheets	specific growth rates calculated from weight data; length-weight relationships determined from length and weight data	3 to 6	Braucker et al. 1990.
1	juvenile GS respiratory metabolism	initial and final oxygen contents, fish weight, SL, FL, TL	(30 each) 10 fish per treatment X 3 temperature treatments	once	initial and final oxygen contents recorded on paper and electronic media	ANOVA	replication of experiments; calibration of balances and dissolved gas meters with NIST-traceable standards; 2 hard copies of all completed data sheets.	oxygen consumption rates calculated from oxygen content data and normalized for fish size (mass)	2	Cech 1990
2	temperature effects on GS embryo and larval development	photomicrographs, fixed specimens	(15 each), 10 developmental stages, 4 temperature treatments	daily	photomicrographs digitized and stored on electronic media; samples preserved in buffered formalin-ethanol	ANOVA; regression analysis; measurements using Adobe Photoshop	replication of experiments; calibration of instruments with NIST-traceable standards; 2 hard copies of all completed data sheets.	embryo development (including abnormalities and mortality) will be monitored; larval measurements and weights will yield temperature effects on larval growth	2	Wang et al. 1985; Detlaff et al. 1993
3	GS responses to stressors	interrenal and gonadal steroid hormone concentrations	larvae: 20/treatment x 10 time periods; adults: 8/treatment group x 3 treatments	larvae once each; adults 4 times (0, 1, 4, and 24 hrs)	hormone concentrations will be recorded on paper and electronic media	Radioimmunoassays	replication of experiments; calibration of instruments with NIST-traceable standards; 2 hard copies of all completed data sheets.	larvae: weights and body composition; hormone concentrations; adults: hormone concentrations.	3	Faulkner and Moberg 1997, Moberg 1995
4	GS Stock identification	microsatellite and AFLP DNA techniques	40 individuals from each population	once	gel images and genotypic data recorded on paper and electronic media	Genetic data analysis programs	replication of experiments; calibration of instruments with NIST-traceable standards; 2 hard copies of all completed data sheets.	H-W equilibria, heterozygosity, allele frequencies, and genetic similarities	2	May et al. 1997; Vos et al. 1995

Table 2. Summary of Data Evaluation Approach. Page 2 of 2

Task #	Experiment Title	Samples						Data Synthesis and Analysis	Personnel	Refs.
		Type	Number	Frequency	Handling / Preservation / Storage	Analytical Techniques	Quality Assurance			
5	CR spawning habitat and environmental conditions	Eggs and larvae	Variable	Twice weekly	Live (cooled) or preserved with methods compatible with later DNA analysis	Appropriate statistical methods	calibration of instruments; replication of experiments; tampon development - temperature times used as surrogate unless specific species information developed)		Schaffter 1978, Schaffter 1997, Wang et al. 1985, Beer 1981.	
5	CR spawning habitat and environmental conditions	River stage and temperature	2x/day	Hourly	Recorded in digital format	Appropriate statistical methods	Flow gauges and temperature sensors calibrated against NIST-traceable reference instruments		Schaffter 1997	
		River flows, temperature relationships with date and location								

Table 3a. Cost Breakdown of Funding Requested from the CALFED Program.

Task	Direct Labor Hours	Direct Salary and Benefits	Service Contracts	Material and Acquisition Costs	Miscellaneous and other Direct Costs		Overhead and Indirect Costs		Total Cost	
					Supplies and Expenses	Student Fee Remission	State @ 10%	Federal @ 46%	State	Federal
Task 1	1056	15609	0	0	8000	4468	2361	10860	30438	38937
Task 2	2112	30560	0	0	9350	4468	3991	18359	48369	62737
Task 3	1056	15609	0	0	8000	4468	2361	10860	30438	38937
Task 4	1408	32919	0	5000	6600	0	3952	18179	48471	62698
Task 5	Already Funded by CALFED during 1998-1999 (DWR Agreement No. B81738)									
Project Management Task	79	1168	0	0	0	0	117	537	1284	1705
Total	5711	95865	0	5000	31950	13404	12781	58795	159000	205013

Table 3b. Quarterly Cost Breakdown of Funding Requested from the CALFED Program.

Task	Quarterly Budget Oct-Dec 99		Quarterly Budget Jan-Mar 00		Quarterly Budget Apr-Jun 00		Quarterly Budget Jul-Sep 00		Quarterly Budget Oct-Dec 00		Total Budget	
	State	Federal	State	Federal	State	Federal	State	Federal	State	Federal	State	Federal
Task 1	6088	7787	6088	7787	6088	7787	6088	7787	6088	7787	30438	38937
Task 2	9674	12547	9674	12547	9674	12547	9674	12547	9674	12547	48369	62737
Task 3	6088	7787	6088	7787	6088	7787	6088	7787	6088	7787	30438	38937
Task 4	9694	12540	9694	12540	9694	12540	9694	12540	9694	12540	48471	62698
Task 5	Already funded by CALFED (DWR Agreement No. B81738)											
Project Management Task	256.8	341	256.8	341	256.8	341	256.8	341	256.8	341	1284	1705
Total	30800	40003	30800	40003	30800	40003	30800	40003	30800	40003	159000	205013

Table 4. Total (including "Leveraged") Funding for the Project.

Source of Funding	Amount
University of California, Davis (matching funds)	18276
California Department of Fish & Game (in kind)	30000
CALFED (requested)	159,000 / 205,013
Total	207,276 / 253,289

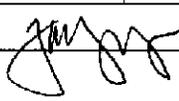
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**APPLICATION FOR
FEDERAL ASSISTANCE**

OMB Approval No. 0348-0043

2. DATE SUBMITTED 4-16-99		Applicant Identifier	
3. DATE RECEIVED BY STATE		State Application Identifier	
4. DATE RECEIVED BY FEDERAL AGENCY		Federal Identifier	
TYPE OF SUBMISSION: Application <input type="checkbox"/> Construction <input type="checkbox"/> Preapplication <input checked="" type="checkbox"/> Non-Construction <input type="checkbox"/> Construction <input type="checkbox"/> Non-Construction			
APPLICANT INFORMATION			
Legal Name: Joseph J. Cech, Jr.		Organizational Unit: University of California, Davis	
Address (give city, county, State, and zip code): Dept. Wildlife, Fish, and Conservation Biology University of California, Davis Davis, Yolo County, CA 95616		Name and telephone number of person to be contacted on matters involving this application (give area code): Joseph J. Cech, Jr. (530) 752-3103 jjcech@ucdavis.edu	
EMPLOYER IDENTIFICATION NUMBER (EIN): 94-6036494		7. TYPE OF APPLICANT: (enter appropriate letter in box) A. State H. Independent School Dist. <input checked="" type="checkbox"/> B. County I. State Controlled Institution of Higher Learning C. Municipal J. Private University D. Township K. Indian Tribe E. Interstate L. Individual F. Internunicipal M. Profit Organization G. Special District N. Other (Specify) _____	
TYPE OF APPLICATION: <input checked="" type="checkbox"/> New <input type="checkbox"/> Continuation <input type="checkbox"/> Revision Revision, enter appropriate letter(s) in box(es) <input type="checkbox"/> <input type="checkbox"/> A. Increase Award B. Decrease Award C. Increase Duration D. Decrease Duration Other (specify): _____		9. NAME OF FEDERAL AGENCY: U.S. Bureau of Reclamation	
8. CATALOG OF FEDERAL DOMESTIC ASSISTANCE NUMBER: TITLE: _____		11. DESCRIPTIVE TITLE OF APPLICANT'S PROJECT: Biological Assessment of Green Sturgeon in the Sacramento-San Joaquin Watershed	
2. AREAS AFFECTED BY PROJECT (Cities, Counties, States, etc.): Sutter County, California, USA			
3. PROPOSED PROJECT		14. CONGRESSIONAL DISTRICTS OF:	
Start Date 2-1-00	Ending Date 1-31-01	a. Applicant Congressional District #3	
5. ESTIMATED FUNDING:		b. Project Congretional District #3	
Federal \$ 205,013	Applicant \$	16. IS APPLICATION SUBJECT TO REVIEW BY STATE EXECUTIVE ORDER 12372 PROCESS?	
State \$	Local \$	a. YES. THIS PREAPPLICATION/APPLICATION WAS MADE AVAILABLE TO THE STATE EXECUTIVE ORDER 12372 PROCESS FOR REVIEW ON: DATE _____	
Other \$	Program Income \$	b. No. <input type="checkbox"/> PROGRAM IS NOT COVERED BY E. O. 12372 <input type="checkbox"/> OR PROGRAM HAS NOT BEEN SELECTED BY STATE FOR REVIEW	
TOTAL \$ 205,013	17. IS THE APPLICANT DELINQUENT ON ANY FEDERAL DEBT? <input type="checkbox"/> Yes If "Yes," attach an explanation. <input checked="" type="checkbox"/> No		
8. TO THE BEST OF MY KNOWLEDGE AND BELIEF, ALL DATA IN THIS APPLICATION/PREAPPLICATION ARE TRUE AND CORRECT, THE DOCUMENT HAS BEEN DULY AUTHORIZED BY THE GOVERNING BODY OF THE APPLICANT AND THE APPLICANT WILL COMPLY WITH THE ATTACHED ASSURANCES IF THE ASSISTANCE IS AWARDED. Fay Yee			
Type Name of Authorized Representative		b. Title Contracts & Grants Analyst	c. Telephone Number (530) 752-2075
Signature of Authorized Representative 		e. Date Signed 4/16/99	

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Standard Form 424 (Rev. 7-97)
Prescribed by OMB Circular A-102

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I-020449

U.S. Department of the Interior

Certifications Regarding Debarment, Suspension and
Other Responsibility Matters, Drug-Free Workplace
Requirements and Lobbying

Persons signing this form should refer to the regulations referenced below for complete instructions:

Certification Regarding Debarment, Suspension, and Other Responsibility Matters - Primary Covered Transactions - The prospective primary participant further agrees by submitting this proposal that it will include the clause titled, "Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion - Lower Tier Covered Transaction," provided by the department or agency entering into this covered transaction, without modification, in all lower tier covered transactions and in all solicitations for lower tier covered transactions. See below for language to be used; use this form for certification and sign; or use Department of the Interior Form 1954 (DI-1954). (See Appendix A of Subpart D of 43 CFR Part 12.)

Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion - Lower Tier Covered Transactions - (See Appendix B of Subpart D of 43 CFR Part 12.)

Certification Regarding Drug-Free Workplace Requirements - Alternate I. (Grantees Other Than Individuals) and Alternate II. (Grantees Who are Individuals) - (See Appendix C of Subpart D of 43 CFR Part 12)

Signature on this form provides for compliance with certification requirements under 43 CFR Parts 12 and 18. The certifications shall be treated as a material representation of fact upon which reliance will be placed when the Department of the Interior determines to award the covered transaction, grant, cooperative agreement or loan.

PART A: Certification Regarding Debarment, Suspension, and Other Responsibility Matters - Primary Covered Transactions

CHECK ___ IF THIS CERTIFICATION IS FOR A PRIMARY COVERED TRANSACTION AND IS APPLICABLE.

- (1) The prospective primary participant certifies to the best of its knowledge and belief, that it and its principals:
 - (a) Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency;
 - (b) Have not within a three-year period preceding this proposal been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State or local) transaction or contract under a public transaction; violation of Federal or State antitrust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property;
 - (c) Are not presently indicted for or otherwise criminally or civilly charged by a governmental entity (Federal, State or local) with commission of any of the offenses enumerated in paragraph (1)(b) of this certification; and
 - (d) Have not within a three-year period preceding this application/proposal had one or more public transactions (Federal, State or local) terminated for cause or default.
- (2) Where the prospective primary participant is unable to certify to any of the statements in this certification, such prospective participant shall attach an explanation to this proposal.

PART B: Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion - Lower Tier Covered Transactions

CHECK ___ IF THIS CERTIFICATION IS FOR A LOWER TIER COVERED TRANSACTION AND IS APPLICABLE

- (1) The prospective lower tier participant certifies, by submission of this proposal, that neither it nor its principals is presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from participation in this transaction by any Federal department or agency.
- (2) Where the prospective lower tier participant is unable to certify to any of the statements in this certification, such prospective participant shall attach an explanation to this proposal.

DI-2010
March 1995
This form supersedes DI 1953, DI 1954,
DI 1955, DI 1956 and DI 1963!

PART C: Certification Regarding Drug-Free Workplace Requirements

CHECK IF THIS CERTIFICATION IS FOR AN APPLICANT WHO IS NOT AN INDIVIDUAL.

Alternate I. (Grantees Other Than Individuals)

A. The grantee certifies that it will or continue to provide a drug-free workplace by

- (a) Publishing a statement notifying employees that the unlawful manufacture, distribution, dispensing, possession, or use of a controlled substance is prohibited in the grantee's workplace and specifying the actions that will be taken against employees for violation of such prohibition;
- (b) Establishing an ongoing drug-free awareness program to inform employees about--
 - (1) The dangers of drug abuse in the workplace;
 - (2) The grantee's policy of maintaining a drug-free workplace;
 - (3) Any available drug counseling, rehabilitation, and employee assistance programs; and
 - (4) The penalties that may be imposed upon employees for drug abuse violations occurring in the workplace;
- (c) Making it a requirement that each employee to be engaged in the performance of the grant be given a copy of the statement required by paragraph (a);
- (d) Notifying the employee in the statement required by paragraph (a) that, as a condition of employment under the grant, the employee will --
 - (1) Abide by the terms of the statement; and
 - (2) Notify the employer in writing of his or her conviction for a violation of a criminal drug statute occurring in the workplace no later than five calendar days after such conviction;
- (e) Notifying the agency in writing, within ten calendar days after receiving notice under subparagraph (d)(2) from an employee or otherwise receiving actual notice of such conviction. Employers of convicted employees must provide notice, including position title, to every grant officer on whose grant activity the convicted employee was working, unless the Federal agency has designated a central point for the receipt of such notices. Notice shall include the identification numbers(s) of each affected grant;
- (f) Taking one of the following actions, within 30 calendar days of receiving notice under subparagraph (d)(2), with respect to any employee who is so convicted --
 - (1) Taking appropriate personnel action against such an employee, up to and including termination, consistent with the requirements of the Rehabilitation Act of 1973, as amended; or
 - (2) Requiring such employee to participate satisfactorily in a drug abuse assistance or rehabilitation program approved for such purposes by a Federal, State, or local health, law enforcement, or other appropriate agency;
- (g) Making a good faith effort to continue to maintain a drug-free workplace through implementation of paragraphs (a) (b), (c), (d), (e) and (f).

B. The grantee may insert in the space provided below the site(s) for the performance of work done in connection with the specific grant:

Place of Performance (Street address, city, county, state, zip code)

Department of Wildlife, Fish, & Conservation Biology, University of
California, One Shields Ave., Davis, CA 95616

Check if there are workplaces on file that are not identified here.

PART D: Certification Regarding Drug-Free Workplace Requirements

CHECK IF THIS CERTIFICATION IS FOR AN APPLICANT WHO IS AN INDIVIDUAL.

Alternate II. (Grantees Who Are Individuals)

- (a) The grantee certifies that, as a condition of the grant, he or she will not engage in the unlawful manufacture, distribution, dispensing, possession, or use of a controlled substance in conducting any activity with the grant;
- (b) If convicted of a criminal drug offense resulting from a violation occurring during the conduct of any grant activity, he or she will report the conviction, in writing, within 10 calendar days of the conviction, to the grant officer or other designee, unless the Federal agency designates a central point for the receipt of such notices. When notice is made to such a central point, it shall include the identification number(s) of each affected grant

**PART E: Certification Regarding Lobbying
Certification for Contracts, Grants, Loans, and Cooperative Agreements**

*CHECK IF CERTIFICATION IS FOR THE AWARD OF ANY OF THE FOLLOWING AND
THE AMOUNT EXCEEDS \$100,000: A FEDERAL GRANT OR COOPERATIVE AGREEMENT;
SUBCONTRACT, OR SUBGRANT UNDER THE GRANT OR COOPERATIVE AGREEMENT.*

*CHECK IF CERTIFICATION IS FOR THE AWARD OF A FEDERAL
LOAN EXCEEDING THE AMOUNT OF \$150,000, OR A SUBGRANT OR
SUBCONTRACT EXCEEDING \$100,000, UNDER THE LOAN.*

The undersigned certifies, to the best of his or her knowledge and belief, that:

- (1) No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of an agency, a Member of Congress, and officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.
- (2) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.
- (3) The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers (including subcontracts, subgrants, and contracts under grants, loans, and cooperative agreements) and that all subrecipients shall certify accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by Section 1352, title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than \$10,000 and not more than \$100,000 for each such failure.

As the authorized certifying official, I hereby certify that the above specified certifications are true.


SIGNATURE OF AUTHORIZED CERTIFYING OFFICIAL

Fay Yee
Contracts & Grants Analyst

TYPED NAME AND TITLE

DATE

4/16/99

ASSURANCES - NON-CONSTRUCTION PROGRAMS

Public reporting burden for this collection of information is estimated to average 15 minutes per response, including time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding the burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to the Office of Management and Budget, Paperwork Reduction Project (0348-0040), Washington, DC 20503.

PLEASE DO NOT RETURN YOUR COMPLETED FORM TO THE OFFICE OF MANAGEMENT AND BUDGET. SEND IT TO THE ADDRESS PROVIDED BY THE SPONSORING AGENCY.

NOTE: Certain of these assurances may not be applicable to your project or program. If you have questions, please contact the awarding agency. Further, certain Federal awarding agencies may require applicants to certify to additional assurances. If such is the case, you will be notified.

As the duly authorized representative of the applicant, I certify that the applicant:

1. Has the legal authority to apply for Federal assistance and the institutional, managerial and financial capability (including funds sufficient to pay the non-Federal share of project cost) to ensure proper planning, management and completion of the project described in this application.
2. Will give the awarding agency, the Comptroller General of the United States and, if appropriate, the State, through any authorized representative, access to and the right to examine all records, books, papers, or documents related to the award; and will establish a proper accounting system in accordance with generally accepted accounting standards or agency directives.
3. Will establish safeguards to prohibit employees from using their positions for a purpose that constitutes or presents the appearance of personal or organizational conflict of interest, or personal gain.
4. Will initiate and complete the work within the applicable time frame after receipt of approval of the awarding agency.
5. Will comply with the Intergovernmental Personnel Act of 1970 (42 U.S.C. §§4728-4763) relating to prescribed standards for merit systems for programs funded under one of the 19 statutes or regulations specified in Appendix A of OPM's Standards for a Merit System of Personnel Administration (5 C.F.R. 900, Subpart F).
6. Will comply with all Federal statutes relating to nondiscrimination. These include but are not limited to: (a) Title VI of the Civil Rights Act of 1964 (P.L. 88-352) which prohibits discrimination on the basis of race, color or national origin; (b) Title IX of the Education Amendments of 1972, as amended (20 U.S.C. §§1681-1683, and 1685-1686), which prohibits discrimination on the basis of sex; (c) Section 504 of the Rehabilitation Act of 1973, as amended (29 U.S.C. §794), which prohibits discrimination on the basis of handicaps; (d) the Age Discrimination Act of 1975, as amended (42 U.S.C. §§6101-6107), which prohibits discrimination on the basis of age; (e) the Drug Abuse Office and Treatment Act of 1972 (P.L. 92-255), as amended, relating to nondiscrimination on the basis of drug abuse; (f) the Comprehensive Alcohol Abuse and Alcoholism Prevention, Treatment and Rehabilitation Act of 1970 (P.L. 91-616), as amended, relating to nondiscrimination on the basis of alcohol abuse or alcoholism; (g) §§523 and 527 of the Public Health Service Act of 1912 (42 U.S.C. §§290 dd-3 and 290 ee 3), as amended, relating to confidentiality of alcohol and drug abuse patient records; (h) Title VIII of the Civil Rights Act of 1968 (42 U.S.C. §3601 et seq.), as amended, relating to nondiscrimination in the sale, rental or financing of housing; (i) any other nondiscrimination provisions in the specific statute(s) under which application for Federal assistance is being made; and, (j) the requirements of any other nondiscrimination statute(s) which may apply to the application.
7. Will comply, or has already complied, with the requirements of Titles II and III of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (P.L. 91-646) which provide for fair and equitable treatment of persons displaced or whose property is acquired as a result of Federal or federally-assisted programs. These requirements apply to all interests in real property acquired for project purposes regardless of Federal participation in purchases.
8. Will comply, as applicable, with provisions of the Hatch Act (5 U.S.C. §§1501-1508 and 7324-7328) which limit the political activities of employees whose principal employment activities are funded in whole or in part with Federal funds.

9. Will comply, as applicable, with the provisions of the Davis-Bacon Act (40 U.S.C. §§276a to 276a-7), the Copeland Act (40 U.S.C. §276c and 18 U.S.C. §874), and the Contract Work Hours and Safety Standards Act (40 U.S.C. §§327-333), regarding labor standards for federally-assisted construction subagreements.
10. Will comply, if applicable, with flood insurance purchase requirements of Section 102(a) of the Flood Disaster Protection Act of 1973 (P.L. 93-234) which requires recipients in a special flood hazard area to participate in the program and to purchase flood insurance if the total cost of insurable construction and acquisition is \$10,000 or more.
11. Will comply with environmental standards which may be prescribed pursuant to the following: (a) institution of environmental quality control measures under the National Environmental Policy Act of 1969 (P.L. 91-190) and Executive Order (EO) 11514; (b) notification of violating facilities pursuant to EO 11738; (c) protection of wetlands pursuant to EO 11990; (d) evaluation of flood hazards in floodplains in accordance with EO 11988; (e) assurance of project consistency with the approved State management program developed under the Coastal Zone Management Act of 1972 (16 U.S.C. §§1451 et seq.); (f) conformity of Federal actions to State (Clean Air) Implementation Plans under Section 176(c) of the Clean Air Act of 1955, as amended (42 U.S.C. §§7401 et seq.); (g) protection of underground sources of drinking water under the Safe Drinking Water Act of 1974, as amended (P.L. 93-523); and, (h) protection of endangered species under the Endangered Species Act of 1973, as amended (P.L. 93-205).
12. Will comply with the Wild and Scenic Rivers Act of 1968 (16 U.S.C. §§1271 et seq.) related to protecting components or potential components of the national wild and scenic rivers system.
13. Will assist the awarding agency in assuring compliance with Section 106 of the National Historic Preservation Act of 1966, as amended (16 U.S.C. §470), EO 11593 (identification and protection of historic properties), and the Archaeological and Historic Preservation Act of 1974 (16 U.S.C. §§469a-1 et seq.).
14. Will comply with P.L. 93-348 regarding the protection of human subjects involved in research, development, and related activities supported by this award of assistance.
15. Will comply with the Laboratory Animal Welfare Act of 1966 (P.L. 89-544, as amended, 7 U.S.C. §§2131 et seq.) pertaining to the care, handling, and treatment of warm blooded animals held for research, teaching, or other activities supported by this award of assistance.
16. Will comply with the Lead-Based Paint Poisoning Prevention Act (42 U.S.C. §§4801 et seq.) which prohibits the use of lead-based paint in construction or rehabilitation of residence structures.
17. Will cause to be performed the required financial and compliance audits in accordance with the Single Audit Act Amendments of 1996 and OMB Circular No. A-133, "Audits of States, Local Governments, and Non-Profit Organizations."
18. Will comply with all applicable requirements of all other Federal laws, executive orders, regulations, and policies governing this program.

SIGNATURE OF AUTHORIZED CERTIFYING OFFICIAL 	TITLE Fay Yee Contracts & Grants Analyst
APPLICANT ORGANIZATION THE REGENTS OF THE UNIVERSITY OF CALIFORNIA	DATE SUBMITTED 4/16/99

Standard Form 424B (Rev. 7-97) Bac

BUDGET INFORMATION - Non-Construction Programs

SECTION A - BUDGET SUMMARY							
Grant Program Function or Activity (a)	Catalog of Federal Domestic Assistance Number (b)	Estimated Unobligated Funds			New or Revised Budget		
		Federal (c)	Non-Federal (d)	Federal (e)	Non-Federal (f)	Total (g)	
1. Task 1 UCD Fish Physiology		\$	\$	\$38,937	\$	\$38,937	
2. Task 2 UCD Fish Reproduction				62,737	0	62,737	
3. UCD Fish Endocrinology				38,937	0	38,937	
4a. Task 4 UCD Fish Genetics				57,698	0	57,698	
4b. Task 5 CDFG Bay Delta-Sturgeon				0	0	0	
4c. Task 6 Project Management				1,705	0	1,705	
5. Totals		\$0	\$0	\$200,014	\$0	\$200,014	
SECTION B - BUDGET CATEGORIES							
6. Object Class Categories	GRANT PROGRAM, FUNCTION OR ACTIVITY						Total (5)
	(1)	(2)	(3)	(4a)	(4b)	(4c)	
a. Personnel	\$15,024	\$27,694	\$15,024	\$25,867	\$0	\$1,148	\$84,757
b. Fringe Benefits	585	2,866	585	7,052	0	20	11,108
c. Travel	2,000	1,350	2,000	600	0	0	5,950
d. Equipment	0	0	0	5,000	0	0	5,000
e. Supplies	6,000	8,000	6,000	6,000	0	0	26,000
f. Contractual	0	0	0	0	0	0	0
g. Construction	0	0	0	0	0	0	0
h. Other	4,468	4,468	4,468	0	0	0	13,404
i. Total Direct Charges (sum of 6a-6h)	28,077	44,378	28,077	44,519	0	1,168	146,219
j. Indirect Charges	10,860	18,359	10,860	18,179	0	537	58,795
k. TOTALS (sum of 6i and 6j)	\$38,937	\$62,737	\$38,937	\$62,698	\$0	\$1,705	\$205,014
7. Program Income	\$0	\$0			\$0	\$	\$

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SECTION C. NON-FEDERAL RESOURCES					
(a) Grant Program	(b) Applicant	(c) State	(d) Other Sources	(e) TOTALS	
8. Task 1: UCD Fish Physiology	\$6,092	\$0	\$0	\$6,092	\$6,092
9. Task 2: UCD Fish Reproduction	6,092		0	6,092	6,092
10. Task 3: UCD Fish Endocrinology	6,092	0	0	6,092	6,092
11a. Task 4: UCD Fish Genetics	0				
11b. Task 5: CDFG Bay-Delta Sturgeon		30,000			
11c. Task 6: Project Management					
12. TOTAL (sum of lines 8 - 11)	\$16,276	\$30,000	\$0	\$48,276	\$48,276
SECTION D. FORECASTED CASH NEEDS					
13. Federal	Total for 1st Year	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
	\$206,014	\$51,254	\$51,254	\$51,254	\$51,254
14. Non-Federal	\$48,276	\$12,069	\$12,069	\$12,069	\$12,069
15. TOTAL (sum of lines 13 and 14)	253,290	63,323	63,323	63,323	63,323
SECTION E. BUDGET ESTIMATES OF FEDERAL FUNDS NEEDED FOR BALANCE OF THE PROJECT					
(a) Grant Program	FUTURE FUNDING PERIODS (Years)				
	(b) First	(c) Second	(d) Third	(e) Fourth	
16	\$	\$	\$	\$	
17					
18					
19					
20. TOTAL (sum of lines 16-19)	\$0	\$	\$	\$	
SECTION F. OTHER BUDGET INFORMATION					
21. Direct Charges: \$146,219	22. Indirect Charges: \$56,795				
23. Remarks:					

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COLLEGE OF AGRICULTURAL AND
ENVIRONMENTAL SCIENCES
AGRICULTURAL EXPERIMENT STATION
COOPERATIVE EXTENSION

DEPARTMENT OF WILDLIFE, FISH AND CONSERVATION BIOLOGY
ONE SHIELDS AVENUE
DAVIS, CALIFORNIA 95616-8751
FAX (530) 752-4154

April 14, 1999

Yolo County Board of Supervisors
625 Court
Woodland, CA 95695-3448

Dear Sir or Madam,

This letter to inform you that I have submitted a proposal entitled "Biological Assessment of Green Sturgeon in the Sacramento-San Joaquin Watershed" to the CALFED Ecosystem Restoration Program. Part of the work described in the proposal will be conducted at the University of California, Davis, in Yolo County.

Sincerely,

A handwritten signature in black ink that reads "Joseph J. Cech, Jr.".

Joseph J. Cech, Jr.
Professor

cc: CALFED Bay/Delta Program

UNIVERSITY OF CALIFORNIA, DAVIS

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COLLEGE OF AGRICULTURAL AND
ENVIRONMENTAL SCIENCES
AGRICULTURAL EXPERIMENT STATION
COOPERATIVE EXTENSION

DEPARTMENT OF WILDLIFE, FISH AND CONSERVATION BIOLOGY
ONE SHIELDS AVENUE
DAVIS, CALIFORNIA 95616-8751
FAX (530) 752-4154

April 14, 1999

Yolo County Planning Department
292 W. Beamer
Woodland, CA 95695

Dear Sir or Madam,

This letter to inform you that I have submitted a proposal entitled "Biological Assessment of Green Sturgeon in the Sacramento-San Joaquin Watershed" to the CALFED Ecosystem Restoration Program. Part of the work described in the proposal will be conducted at the University of California, Davis, in Yolo County.

Sincerely,

A handwritten signature in cursive script that reads "Joseph J. Cech, Jr.".

Joseph J. Cech, Jr.
Professor

cc: CALFED Bay/Delta Program

UNIVERSITY OF CALIFORNIA, DAVIS

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FAX (530) 752-4154

April 14, 1999

Sutter County Board of Supervisors
1160 Civic Center Blvd.
Yuba City, CA 95993-3007

Dear Sir or Madam,

This letter to inform you that I have submitted a proposal entitled "Biological Assessment of Green Sturgeon in the Sacramento-San Joaquin Watershed" to the CALFED Ecosystem Restoration Program. Part of the work described in the proposal will be conducted in Sutter County.

Sincerely,

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April 14, 1999

Sutter County Planning Department
1201 Civic Center Blvd.
Yuba City, CA 95993-3007

Dear Sir or Madam,

This letter to inform you that I have submitted a proposal entitled "Biological Assessment of Green Sturgeon in the Sacramento-San Joaquin Watershed" to the CALFED Ecosystem Restoration Program. Part of the work described in the proposal will be conducted in Sutter County.

Sincerely,

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cc: CALFED Bay/Delta Program