Estimating Juvenile Chinook Salmon Spring And Winter Run Abundance At Chipps Island

submitted to Science Program 2006

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lead investigators:
Brandes, Patricia

Project Information And Executive Summary

Estimating Juvenile Chinook Salmon Spring And Winter Run Abundance At Chipps Island

This is proposal #0084 for the Science Program 2006 solicitation.

Frequently asked questions and answers for this PSP are now available.

The submission deadline for this proposal has passed. Proposals may not be changed.

Instructions

Please complete the Project Information and Executive Summary Form prior to proceeding to the other forms contained on this website and required to be completed as part of your PSP application submittal. Information provided on this form will automatically support subsequent forms to be completed as part of the Science PSP submission process. Information provided on this form will appear in the Contacts and Project Staff, Task and Budget Summary, and Conflict of Interest forms.

Proposal Title: **Estimating Juvenile Chinook Salmon Spring and Winter Run Abundance at Chipps Island**

This field is limited to 255 characters. All proposal titles must be entered in title case. No abbreviations or acronyms will be accepted.

Applicant Information

Applicant Organization Name: **U.S. Fish and Wildlife Service**

Please provide the name of the organization submitting the application as follows: Davis, California University of; Fish and Game, California Department of; California Waterfowl Association, etc.

Applicant Organization Type:
federal agency

eligibility

Below, please provide contact information for the representative of the applicant organization who is authorized to enter into a contractual agreement with the State of California and who has overall responsibility for the operation, management, and reporting requirements of the applicant organization. (This should be the same individual who signs the signature page.)

Salutation: **Ms.**
First Name: **Kim**
Last Name: **Webb**
Street Address: **4001 N. Wilson Way**
City: **Stockton**
State or Province: **CA**
Zip Code or Mailing Code: **95205**
Telephone: **209-946-6400X 311**
E-mail Address: **Kim_Webb@fws.gov**

Below, please provide contact information for the primary point of contact for the implementation of the proposal. This person should be the same individual who is serving as the project Lead Investigator/Project Director.

Salutation: **Ms.**
First Name: **Patricia**
Last Name: **Brandes**
Telephone: **209-946-6400 X 308**
E-mail Address: **Pat_Brandes@fws.gov**

Proposal Information

Total Amount Requested: $483,903

The figure represented above is provided by the total amount requested on your completed Task and Budget Summary Form. The applicant must ensure the amount indicated above is correct and equal to the total amount requested in the budget document uploaded via the Budget and Justification Form for this project.

Select one primary and up to three secondary topic areas that best apply to this proposal:

Trends and Patterns of Populations and System Response to a Changing Environment (Primary)

Environmental Water

Select up to five keywords to describe this project.
− ***agriculture***
− ***agricultural economics***
− ***agricultural engineering***
− ***agronomy***
− ***agro−ecology***
− ***benthic invertebrates***
− ***benthos***
− ***biochemistry***
X ***biological indicators***
− ***birds***
− ***channels and sloughs***
− ***climate change***
− ***conservation or agricultural easements***
− ***conservation program management***
− ***database management***
− ***ecotoxicology***
− ***economics***
− ***engineering***
− ***erosion control***
− ***environmental education***
− ***evapotranspiration***
X ***fish biology***
− delta smelt
X salmon and steelhead
− other species
− otoliths
− tagging
X ***fish management and facilities***
− ***flooded islands***
− ***floodplains and bypasses***
− ***forestry***
X ***genetics***
− ***geochemistry***
− ***geographic information systems (GIS)***
− ***geology***
− ***geomorphology***
− ***groundwater***
− ***human health***
− ***hydrodynamics***
− ***hydrology***
− ***insects***
− ***integrated pest management***
− ***integrated resource planning***
− ***invasive species / non−native species / exotic species***
− ***irrigation systems***
− ***land use laws and regulations***
− ***land use management***
− ***land use planning and policy***
− ***levees***
− ***mammals***
− ***microbiology / bacteriology***
− conceptual
− quantitative
− ***oceanography***
− ***performance measures***
− ***phytoplankton***

− ***plants***
− terrestrial
− aquatic
− wetland
− ***remote sensing / imaging***
− ***reptiles***
− ***reservoirs and lakes***
− ***restoration***
− ***riparian zone***
− ***rivers and streams***
− ***sediment***
− ***soil science***
− ***statistics***
− ***subsidence***
− ***sustainable agriculture***
− ***trophic dynamics and food webs***
− ***water operations (diversions, pumps, intakes, exports, barriers, gates, etc.)***
− ***water quality***
− other
− temperature
− contaminants
− nutrients, organic carbon, and oxygen depleting substances
− salinity
− sediment and turbidity
− ***water supply***
− ***watershed assessment***
− ***watershed management***
− ***wetlands***
− ***zooplankton***

Provide the geographic coordinates that best describe the center point of your project. (Note: If your project has more than one site, provide a center point that best captures the central location.)

Example:	Latitude:	38.575; must be between 30 and 45
	Longitude:	−121.488; must be between −120 and −130

Help for finding a geographic location.

Latitude: **38.04365**
Longitude: **−121.9112847**

Provide the number miles radius from the center point provided above, to demonstrate the radius of the entire project.
1

Provide a description of the physical location of your project. Describe the area using information such as water bodies, river miles and road intersections.

The physical location of our project is in channel just adjacent to Chipps Island in Suisun Bay. It is 18 River miles from the mouth of Suisun Bay.

Successful applicants are responsible for complying with all applicable laws and regulations for their projects, including the National Environmental Policy Action (NEPA) and the California Environmental Quality Act (CEQA). Projects funded through this PSP that tier off the CALFED Programmatic EIS/EIR must incorporate applicable mitigation strategies described in the CALFED Programmatic Record of Decision to avoid or minimize the project's adverse environmental impacts. Applicants are encouraged to review the Programmatic EIS/EIR and incorporate the applicable mitigation strategies from Appendix A of these documents for their projects.

If you anticipate your project will require compliance of this nature (ie applications for permits, other environmental documentation), provide below a list of these items, as well as the status of those applications or processes, if applicable. If you believe your project will not require these regulatory actions, please provide one or two lines of text outlining why your proposed project will not be subject to these processes. Further guidance is available in The Guide to Regulatory Compliance for Implementing CALFED Activities.

The field sampling is already in place to conduct this project and will not require any additional permits.

Is this proposal an application for next phase funding of an ongoing project funded by CALFED Science Program?
X No. **–** Yes.

If yes, identify the ongoing project:

Project Title:
CALFED Contract Management Organization:
Amount Funded:
Date Awarded:
Lead Organization:
Project Number:

Have primary staff and/or subcontractors of the project team (those persons listed on the Contacts and Project Staff form) received funding from CALFED for a project *not* listed above?
– No. **X** Yes.

If yes, list the projects below: (only list up to the five most recent projects)

Project Title: **REview of Four Juvenile Salmon Coded Wire Tag Experiments Conducted in the Delta**
CALFED Contract Management Organization: **CALFED Science Program**
Amount Funded: **83,100.00**
Date Awarded: **9/1/06**
Lead Organization: **U.S. Fish and Wildlife Service**
Project Number: **SCI–06–G06–299**

Project Title:
CALFED Contract Management Organization:
Amount Funded:
Date Awarded:
Lead Organization:
Project Number:

Project Title:
CALFED Contract Management Organization:
Amount Funded:
Date Awarded:
Lead Organization:
Project Number:

Project Title:
CALFED Contract Management Organization:
Amount Funded:
Date Awarded:
Lead Organization:
Project Number:

Project Title:
CALFED Contract Management Organization:
Amount Funded:
Date Awarded:
Lead Organization:
Project Number:

Has the Lead Investigator, the applicant organization, or other primary staff or subcontractors of your project team ever submitted a proposal for this effort or a similar effort to any CALFED PSP?
– No. **X** Yes.

If yes, list the submission below: (only list up to the five most recent projects)

Project Title: **Estimating juvenile winter run abundance and life history characteristic at Chipps Island**
CALFED Program: **CALFED Science**
Date of PSP: **2004**

Project Title:
CALFED Program:

Date of PSP:

Project Title:
CALFED Program:
Date of PSP:

Project Title:
CALFED Program:
Date of PSP:

Project Title:
CALFED Program:
Date of PSP:

Note: Additional information on this or prior applications submitted −− or proposals funded −− may be required of applicants.

List people you feel are qualified to serve as scientific and/or technical reviewers for this proposal and are not associated with your organization or CALFED.

Full Name	Organization	Telephone	E−Mail	Expertise
Sheila Greene	California Department of Water Resources	916−651−9748	sgreene@water.ca.gov	fish biology, salmon and steelhead
Alice Low	California Department of Fish and Game	916−323−9583	alow@dfg.ca.gov	fish biology, salmon and steelhead
Bruce Oppenheim	National Marine Fisheries Service (NOAA)	916−930−3603	bruce.oppenheim@noaa.gov	fish biology, salmon and steelhead
Steve Lindley	National Marine Fisheries Service (NOAA)	831−420−3921	steve.lindley@noaa.gov	modeling, quantitative

Provide additional comments, information, etc. here:

Executive Summary

Provide a brief but complete summary description of the proposed project; its geographic location; project objective; project type, approach to implement the proposal; expected outcomes; and adaptive management approach and relationship to the Science Program goals. The Executive Summary should be a concise, informative, stand−alone description of the proposed project and be no longer than one page in length. Please note, this information will be made public on our website shortly after the closing date of this PSP.

ESTIMATING JUVENILE CHINOOK SALMON SPRING AND WINTER RUN ABUNDANCE AT CHIPPS ISLAND

This project will develop and implement a DNA sampling protocol for juvenile Chinook salmon captured at Chipps Island to estimate the timing, abundance and proportion of spring− and winter−run Chinook salmon leaving the Sacramento−San Joaquin Delta. This 3−year study will estimate the abundance of winter− and spring− run juvenile production leaving the Delta and compare it to other model estimates. This project will also evaluate the feasibility of estimating abundance using DNA sampling, at additional salmon monitoring locations, by first attempting it at Chipps Island.

Fin tissue for DNA analysis will be collected from juvenile Chinook salmon captured in standard trawl sampling conducted at Chipps Island (in the western Delta, near Pittsburg). Trawling at Chipps Island has historically been used to index the abundance of Chinook salmon smolts entering saltwater each year (USFWS, 2003 and Brandes and McLain, 2001). DNA typing will substantially improve distinction of Chinook races, compared to the size−at−date criteria method (Johnson et al., 1992), that is currently in use. A statistically rigorous sampling design will be developed to ensure that results can be expanded accurately to the total population. The priority in the sampling design will be given to estimating the fraction of winter− and spring−run among all Chinook smolts at Chipps Island over a three year period.

Given that expansion of trawl catches are needed to estimate total abundance of winter and spring−run

Chinook salmon leaving the Delta, this project will also thoroughly evaluate trawl efficiency at Chipps Island. Coded wire tag (CWT) recoveries from several past releases (USFWS, 2001, Newman and Rice, 2002 and Rice, 2003) will be reviewed, analyzed and modeled to identify trawl efficiency and apply it to catches of juvenile winter− and spring−run (identified using DNA) to estimate total abundance of these races passing Chipps Island

Estimating the abundance of "true" juvenile winter− and spring−run Chinook salmon leaving the Delta is fundamental to achieving two of the Science Program's priority research topics listed in this CALFED Science Proposal Solicitation: 1) identifying trends and patterns of populations and system response to a changing environment and 2) using discretionary environmental water supplies more effectively for at−risk species.

Abundance estimates based on genetic identification will be considerably more accurate than estimates that are currently based on length−at−date criteria. In addition, a more statistically robust sub−sampling protocol and further assessment of catch efficiency and its application for expansion, will improve our estimates of abundance at Chipps Island such that we can begin to identify relationships between adult escapement, juvenile production and survival, and factors such as water operations in the Delta.

Contacts And Project Staff

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INSTRUCTIONS

Use this form to provide titles, affiliations, qualifications, and descrptions of roles of the primary and secondary project staff. Include any consultants, subcontractors and/or vendors. The Lead Investigator or Project Director, as identified in the Project Information and Executive Summary Form, is required to upload a PDF version of their resume. To complete the qualification field of this form, please provide a bulleted list of relevant project/field experience and any publications/reports that support your participation in the proposed project.

Information provided on this form will automatically support subsequent forms to be completed as part of the Science Program PSP submission process. Please note tht information you enter in this form will appear in the Task and Budget Summary and Conflict of Interest forms.

Information on subcontractor services must be provided even if the specific service provider has not yet been selected. If the specific subcontractor has not been identified or selected, please list TBD (to be determined) in the last name field and the anticipated service type in the title field (example: Fish Biologist).

Please provide this information before continuing to the Tasks and Deliverables Form.

Applicant

U.S. Fish and Wildlife Service
Ms. Kim Webb
4001 N. Wilson Way
Stockton CA 95205
209−946−6400X 311
Kim_Webb@fws.gov

Lead Investigator/Project Director

Salutation: **Ms.**
Last Name: **Brandes**
First Name: **Patricia**
Title: **Fishery Biologist**
Organization: **U.S, Fish and Wildlife Service**
Responsibilities: **Lead coordinator, biological input on study design and catch efficiency and coordination of deliveriables**
Resume:

You have already uploaded a PDF file for this question. Review the file to verify that appears correctly.

Mailing Address: **4001 N. Wilson Way**
City: **Stockton**
State: **CA**
Zip: **95205**
Telephone: **209−946−6400 X 308**
E−Mail: **Pat_Brandes@fws.gov**

All Other Personnel

Salutation: **Dr.**
Last Name: **Banks**
First Name: **Michael**
Title: **Assistant Prof, Director of Cooperative Institute for Marine Resources Studies**
Organization: **Oregon State University**

Position:
subcontractor
Responsibilities: **Genetic identification of samples**
Qualifications:

Michael A. Banks Abbreviated Curriculum Vitae August, 2006

Professional Preparation University of Cape Town, Zoology, BSc, 1981 University of Cape Town, Physics, Chemistry &Biology HED, 1982 Louisiana Tech University, Zoology, MSc, 1988 University of California, Davis, Population Genetics PhD, 1994

Appointments

Director of the Cooperative Institute of Marine Resources Studies 2006 − Assistant Professor, Marine Fisheries Genetics 2001 – Assistant Geneticist, Bodega Marine Laboratory 1996 – 2000 Postdoctoral Fellow, Bodega Marine Laboratory 1994 – 1996 Research Assistant, Univ. of California, Davis 1989 – 1993 Research Assistant, Univ. Of Texas at Austin, MSI 1987 – 1988 Head of Dept. Science &Biology, Ngangelizwe Secondary School 1984 – 1986 Assistant Teacher, Umtata High School, 1983

Selected Publications

Gomez−Uchida, D. and M.A. Banks. 2006. Integrating Temporal and Spatial Scales in Rockfish Population Genetics: Shaping Conservation and Management Goals. In press for: Biology, Assessment and Management of Pacific Rockfishes. 2005 Wakefield symposium. In Press.

Wofford, J.E.B., R.E. Gresswell and M.A. Banks. 2005. Factors influencing within−watershed genetic variation of coastal cutthroat trout. Ecological Applications: 15(2):628−637.

Banks, M.A. 2005. Stock identification for the conservation of threatened or endangered species. In: Stock identification methods Eds: Cadrin, S.X., K.D. Friedland and J.R. Waldman. Elsevier Press. pp609−629.

Miller, J.A., M.A. Banks, D. Gomez−Uchida, and A.L. Shanks. 2005. Population structure in black rockfish (Sebastes melanops): a comparison between otolith microchemistry and DNA microsatellites. Canadian Journal of Fisheries and Aquatic Science. 62:2188−2198.

Banks, M.A., W. Eichert, J.B. Olsen. 2003. Which Genetic Loci have Greater Population Assignment Power? Bioinformatics 19(11):1436−1438.

Banks, M.A. and D.P. Jacobson. 2004. Which Genetic Markers and GSI Methods are More Appropriate For Defining Marine Distribution and Migration of Salmon? North Pacific Anadromous Fish Commission Technical Note 5: 39−42.

Olsen, J.B., Bentzen, P., Banks, M.A., Shaklee, J.B., and Young, S. 2000. Evaluation and application of molecular markers for population assignment in a supportive breeding program for pink salmon. Transaction of the American Fisheries Society. 129:232−242.

Hedgecock D., M.A. Banks, V.K. Rashbrook, C.A. Dean, S.M. Blankenship. 2001. Applications of population genetics to conservation of Chinook salmon diversity in the Central Valley. In: Brown RL, editor. Fish Bulletin 179: Contributions to the biology of Central Valley salmonids. Sacramento (CA): California Department of Fish and Game. p 45−70.

Banks, M.A., V.K. Rashbrook, M.J. Calavetta, C.A. Dean, and D. Hedgecock. 2000. Analysis of microsatellite DNA resolves genetic structure and diversity of chinook salmon in California’s Central Valley. Canadian Journal of Fisheries and Aquatic Sciences 57:915−927.

Banks, M.A. and W. Eichert. 2000. WHICHRUN (version 3.2) a computer program for population assignment of individuals based on multilocus genotype data. Journal of Heredity 91:87−89.

Greig, C.A and M.A. Banks. 1999. Five multiplexed microsatellite loci for rapid response run identification of California’s endangered winter Chinook salmon. Animal Genetics. 30(4):318−320.

Banks, M.A., M. Blouin, B.A. Baldwin, V.K. Rashbrook, H.A. Fitzgerald, S.M. Blankenship, and D. Hedgecock. 1999. Isolation and Inheritance of Novel Microsatellites in Chinook Salmon (Oncorhynchus tshawytscha). Journal of Heredity 90(2):281−288.

Synergistic Activities

Primary initiator of research in population genetics among over-fished rockfish stocks. We developed &published novel rockfish microsatellites, presented findings at 4 national meetings (including 2 invited talks) and published 6 papers in the peer review literature.

Primary initiator of research into the genetic basis of life history diversity in Chinook salmon through investigation of clock genes and a genomic survey of gene expression profiles. We are the first to have isolated clock, BMAL, cry and period from Chinook. Our findings of multiple copies have been presented at international meetings and are currently under peer review.

Primary initiator of research into the assessment of genetic &ecological diversity of Oregon's coastal coho evolutionary significant unit.

Co-PI on an inter-laboratory standardization of coast-wide Chinook salmon genetic data for international harvest management.

Initiator and developer of computer applications for utilizing increased information content of microsatellite data. Programs developed include: WHICHRUN, WHICHLOCI, WHICHPARENTS and SIBLINGS

List relevant project/field experience and publications/reports.

Salutation: **Mr.**
Last Name: **Volkman**
First Name: **Eric**
Title: **Supervisory Fishery Biologist**
Organization: **U.S. Fish and Wildlife Service**
Position:
secondary staff
Responsibilities: **Overseeing field collection and mailing of DNA samples to Oregon State**
Qualifications:

Eric is one of two lead biologists associated with the Interagency Ecological Program's Juvenile Fishes Monitoring Program. He is responsible for overseeing the sampling at Chipps Island as part of that program. He is a supervisory fishery biologist with the U.S. Fish and Wildlife Service.

List relevant project/field experience and publications/reports.

Salutation:
Last Name: **TBA**
First Name: **TBA**
Title: **Statistician/Modeler**
Organization:
Position:
subcontractor
Responsibilities: **Development of sampling design and catch efficiency estimates**
Qualifications:
List relevant project/field experience and publications/reports.

Conflict Of Interest

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Instructions

To assist Science Program staff in managing potential conflicts of interest as part of the review and selection process, we are requesting applicants to provide information on who will directly benefit if your proposal is funded. Please provide the names of individuals who fall in the following categories and are not listed in the Personnel Form:

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

Applicant
Submittor
Lead Investigator/Project Director
Primary Staff
Secondary Staff
Subcontractor

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

Last Name	First Name	Organization	Role
Cramer	Steve	S.P. Cramer and Associates	Helped with 2004 version of proposal

Task And Budget Summary

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Instructions

Use the table below to delineate the tasks needed to carry out your proposal. Tasks in this form should support the narrative description of your project in your proposal document and the informa tion provided in your detailed budget spreadsheet. Each task and subtask must have a number, title, timeline, list of personnel or subcontractors providing services, and associated budget figure.

When creating subtasks, ensure that each activity is counted only once. Please note, the initial task of your table (Task 1) must present all project management/administrative activities supporting your overall proposal.

For proposals involving multiple agencies or organizations (including subcontractors), the table must clearly state the tasks and subtasks performed by each entity.

Task #	Task Title	Start Month	End Month	Personnel Involved	Description	Task Budget
1-5	Project Management	1	36	Brandes, Patricia Volkman, Eric TBA, TBA	Administrative and Management Costs for Budget Tasks 1-5	62,837
1	Design Sampling Plan	1	36	Brandes, Patricia TBA, TBA	Assemble data from other DNA sampling in the Delta and design and update sampling plan to be used at Chipps Island	19,425
2	Collect DNA Samples	2	34	Volkman, Eric	Collect DNA samples and send to Michael Banks at Oregon State University	3,355
3	Analyze DNA samples	6	35	Banks, Michael	Analyze DNA samples provided by USFWS	327,090
4	Estimate trawl efficiency and abundance	12	34	Brandes, Patricia TBA, TBA	Estimate trawl efficiency and apply to catches at Chipps Island to estimate abundance of winter-and spring-run juvenile salmon	36,351
5	Reporting	6	36	Brandes, Patricia Banks, Michael Volkman, Eric TBA, TBA	Report on progress throughout the 3 year period and submit manuscript to peer reviewed journal	34,845

total budget=$483,903

Detailed Budget Upload And Justification

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Using the budget provided via this link as a guide, please complete a budget for your proposal in the software of your choice (e.g. Excel). This document must be in a format and software that can be converted to PDF prior to uploading on the web system.

It is incumbant upon the applicant to fully explain/justify the significant costs represented in the attached budget. This information can be provided either in a text document and uploaded below, or included in your proposal text in a clearly defined budget justification section. If it is not abundantly clear to reviewers what project costs are commensurate with which efforts and benefits, the proposal may receive a poor review and denied funding.

Costs for each task described in the Task and Budget Summary Form and each staff or subcontractor described on the Contacts and Project Staff Form, must be included in your budget. The budget for Task One should represent project management activities, including but not limited to cost verification, environmental compliance, data handling, report preparation, project oversight, and public outreach. The total amount of your budget must equal the total amount represented on your Task and Budget Summary Form and the total budget amount represented on your Project Information and Executive Summary Form.

In a separate text document to be uploaded below, identify any cost share and other matching funds available to support your proposed project. If you identify cost share or matching funds, you must also describe them in the text of your proposal (see explanation of "cost share and other matching funds" in Section Two of the solicitation document).

CBDA may request additional information pertaining to the items, rates and justification of the information presented in your budget. Applications without completed budgets will not be considered for funding.

Uploading The Completed Budget Template

First, convert your completed Budget to a PDF file. Then, use the browse function to locate the PDF version of your document, select the document and click on the upload prompt below.

You have already uploaded this document. View it to verify that it appears as you expect. You may replace it by uploading another document

Uploading The Completed Budget Justification

First, convert your completed Justification text to a PDF file. Then, use the browse function to locate the PDF version of your document, select the document and click on the upload prompt below.

You have already uploaded this document. View it to verify that it appears as you expect. You may replace it by uploading another document

Uploading The Description Of Cost Share/Matching Funds

First, convert your completed Description of Cost Share/Matching Funds text file to a PDF file. Then, use the browse function to locate the PDF version of your document, select the document and click on the upload prompt below.

You have already uploaded this document. View it to verify that it appears as you expect. You may replace it by uploading another document

Schedule Of Deliverables

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Use the table below to delineate the key deliverables and the time necessary to complete them (in months from the date the project's grant agreement is executed). Each Science Program 2006 PSP grant recipient must provide the required minimum deliverables for each project. The required minimum deliverables for each funded proposal are as follows:

- Semi−annual report(s)
- Final Report
- One page project summary for public audience at beginning of project
- One page project summary for public audience upon project completion
- Project closure summary report or copy of draft manuscript
- Presentation at CALFED Science Conference
- Presentations at other events at request of CALFED Science Program staff
- Copy of all published material resulting from the grant

Deliverable	Description	Delivered By: # (In Months From Project Start Date)
One page Project Summary	Description of project for public	1
1st Semi-annual Report	Progress Report 6 months after start of the project	6
1 st Annual Report	Progress Report 12 months after start of the project	12
2nd Semi-annual Report	Progress Report 18 months after start of the project	18
2nd Annual Report	Progress Report 24 months after start of the project	24
3rd Semi-Annual Report	Progress Report 30 months after start of project	32
CALFED Science Conferece presentation	Oral presentation on results to date	13
One page project Summary	Final results of project at end of project for public	36
Draft Manuscript	Draft Manuscript of final results	36
Copy of all published matter results from grant	Copy of published material if applicable	36
Presentations to CALFED Science and Program Staff	Presentation at the request of CALFED Science	36
Presentation to others	Presentation to others doing life-cycle modeling in the Delta	36

If you are unable to provide a Schedule of Deliverables as outlined above, please provide your justification of non−compliance in the text box provided below. The Science Program reserves the right to determine a proposal non−eligible based on an applicants inability to provide the materials requested above.

ESTIMATING JUVENILE CHINOOK SALMON SPRING AND WINTER RUN ABUNDANCE AT CHIPPS ISLAND

I. Project Purpose

Critical Unknown

How many “true” spring- and winter-run Chinook salmon smolts leave the Delta annually?

Project Goals

The goal of this project is to estimate the relative timing and annual abundance of winter- and spring-run Chinook salmon passing Chipps Island for three years (2007-2010) and evaluate the feasibility of using DNA sampling to estimate abundance at additional juvenile salmon monitoring locations.

Objectives

The objectives of this project are:

1.) Design a sampling plan for collecting genetic samples to accurately estimate the composition of juvenile spring- and winter-run Chinook salmon that migrate past Chipps Island in a given year.
2.) Collect DNA samples in each of three years.
3.) Analyze DNA samples to estimate racial proportions.
4.) Estimate abundance of spring- and winter-run Chinook that migrate past Chipps Island in each year of the study.
5.) Obtain peer review and disseminate findings.

Description of relevant studies that document the problem

Four races of Chinook are naturally and artificially produced in the Central Valley (Fisher, 1994). Although the spawning times and locations differ between races, the juveniles are intermixed by the time they reach the Delta.

Since 1993, standardized trawling at Chipps Island in the San Francisco Bay Delta has provided annual abundance estimates of Chinook salmon smolts from the Sacramento and San Joaquin basins (USFWS, 2003, Brandes and McLain, 2001). These estimates are critical for inferring freshwater survival rates, and hence, for relating freshwater survival to water operations, particularly in the Delta (Newman and Rice, 2002, and Newman, 2003). However, these abundance estimates use size-at-date criteria (Johnson et al., 1992) to designate race. In winter-run life-cycle modeling, Cramer et al., (2004) concluded that the difficulty in distinguishing race of juvenile Chinook salmon in the catch at Chipps Island had introduced large errors into abundance estimates presently calculated. In Cramer's analyses the number of winter-run smolts (using the size criteria) passing Chipps Island did not fluctuate in a similar pattern to either the abundance of fry at RBDD or the adult returns from those smolts (Cramer et al., 2004).

DNA sampling of juvenile Chinook salmon taken at the CVP and SWP fish facilities has demonstrated the inaccuracies of the daily "Delta" size-at-date criteria (Johnson et. al., 1992, S. Greene, personal communication) in identifying race. Fin tissue for DNA analysis collected for 7 years from a subset of juveniles sampled at the CVP and SWP fish facilities show that true winter-run juveniles (determined by DNA) composed just 20% to 78% of the juveniles that were designated as winter-run based on length (Figure 1). Thus, while most genetic winter-run were within their designated length range, roughly half the Chinook in that length range were actually of a different race (Figure 2). These results indicate that classifying winter-run Chinook via "Delta" length criteria, at least, has resulted in up to a 5-fold over-estimate in the proportions of winter-run smolts. The size-at-date criteria used at Chipps Island and other salmon monitoring locations uses the Fisher criteria which are slightly different than the "Delta" criteria used exclusively at the Fish Facilities. While these differences between the "Delta" and Fisher criteria are slight, the overall imprecision associated with using either size-at-date criteria would be inferior to DNA sampling to determine race.

Even less is known about the timing and abundance of "true" spring-run in the Delta. Some DNA samples have been taken at the Delta fish facilities, but data is still being summarized (S. Greene, personal communication). The size criteria may be even less accurate for spring-run than it is for winter-run. "True" spring-run have been classified as late-fall and winter run using the size criteria (Figure 3).

Recent work has demonstrated that DNA analysis can distinguish the races accurately. Power gains from employing polymorphic microsatellites have substantially enhanced our ability to distinguish among the runs or life history types in Chinook salmon of the Sacramento River (Banks, 2005). Loci employed in Banks et al., (2000) provided resources for clear distinction of the endangered winter-run but did not hold sufficient statistical power for reliable identification of spring, fall and late-fall runs. Only through employing a number of microsatellites released in the last few years (Greig et. al. 2003; Naish et al., 2003; Williamson et al., 2002), and applying statistical means for resolving which suite of markers provide the best means for discrimination (Banks et al., 2003), have we been able to improve resolution among these more closely related sub-populations. Today statistical power for identification of spring run from Butte, Deer and Mill Creeks is greater than 95% (Banks and Jacobson, 2004).

II. Background and Conceptual Models

Midwater trawl sampling is conducted at Chipps Island throughout the year to meet multiple objectives (Brandes and McLain, 2001, Brandes et al., 2000). Chipps Island is located in the western Delta, near Pittsburg and is just downstream of the confluence of the Sacramento and San Joaquin Rivers. The area sampled near Chipps Island is a relatively constricted area of the western edge of the Delta (3/4 of a mile across the channel) where all naturally produced juvenile salmon in the Central Valley would pass as they migrate to the ocean (Figure 4). Hatchery fish released upstream would also migrate past Chipps Island. Trawling at Chipps Island has historically been used to index the abundance of Chinook smolts entering saltwater each year (Brandes and McLain, 2001).

This project is proposed to improve the accuracy of race composition estimates, and hence abundance estimates, of spring- and winter-run Chinook salmon at Chipps Island by using DNA analysis to partition race instead of length criteria. Some DNA samples to identify winter-run have been taken at Chipps Island in the past (Figure 5), but the sampling methodology has not considered expanding information to estimate abundance. This project will also analyze trawl efficiency at Chipps Island and devise methods to appropriately expand samples to estimate the total abundance of winter- and spring-run passing Chipps Island.

Our focus is on spring and winter run because (1) the statistical power of individual-based assignments of these runs is more established than for the other runs (Banks, 2005), and (2) there is an urgent need for accurate data on winter and spring-run smolt abundance to facilitate life-cycle modeling due to their at-risk status (Cramer et al., 2004, Cramer, personal communication). Once a reliable index of winter- and spring-run abundance is estimated at Chipps Island, it can be compared to adult spawners (and fry estimates at Red Bluff for winter-run) to obtain estimates of survival in the freshwater stage of the lifecycle. Freshwater survival can then be compared to various conditions occurring inland, such as water management activities. The loss of “true” winter-run and spring-run at the State Water and Central Valley Project’s can be compared to the abundance of “true” winter and spring-run leaving the Delta at Chipps Island to assess the relative, direct impact of the SWP and CVP to both at-risk juvenile Chinook runs.

Our conceptual model for this project focuses on the freshwater life-stages of winter- and spring-run juvenile salmon (Figure 6). The conceptual model for spring run would be the same as for winter-run although the only reliable freshwater abundance estimate for spring-run, available at this time, is the number of spawners. The total population of juvenile spring-run cannot be estimated at Red Bluff, as is done for winter-run, since the largest populations of spring-run (Mill, Deer and Butte Creeks) enter the Sacramento River, downstream of Red Bluff (Figure 4). While some presence and absence information is available from rotary screw trapping in each of these creeks, juvenile abundance is not estimated due to the inconsistency of sampling from fluctuations in river flow.

III. Approach and Scope of Work

Fin tissue for DNA analysis will be collected from juvenile Chinook salmon captured in the trawl sampling conducted at Chipps Island per established protocols used for similar sampling at the SWP and CVP fish facilities (Appendix 1). Sample size is limited to 3,000 fish per year by the capacity of Michael Banks’ lab to analyze DNA samples, so a statistically rigorous sampling design will be developed to ensure that results can be expanded accurately to the total population. The priority in the sampling design will be given to estimating the fraction of winter- and spring- run among all Chinook smolts collected at any point in time.

Given that expansion of trawl catches are needed to estimate total abundance of winter and spring run, this project will also estimate trawl efficiency at Chipps Island. Coded wire tag (CWT) recoveries from several past releases (USFWS, 2001, Newman and Rice, 2002, and Newman, 2003) will be reviewed, analyzed and modeled to identify trawl efficiency and apply it to known catches of winter- and spring-run (determined by DNA) to estimate total abundance of each race passing Chipps Island.

It would be possible to fund only the DNA sampling design or trawl efficiency aspects of this study, but it wouldn't be prudent to fund collection and analyses of DNA samples without designing an appropriate study plan. If only relative migration timing information of winter and spring-run at Chipps Island was selected for funding, the trawl efficiency aspect of the study could be deferred, but by doing so, it would limit our ability to estimate population abundances and compare results to population estimates earlier in the freshwater stage of the life-cycle.

The work plan that follows corresponds to the objectives above.

Objective 1: Design a sampling plan for collecting genetic samples

Task 1.1: Assemble data from previous DNA analyses
We will use data from past DNA sampling in the Delta and SWP and CVP Fish Facilities to guide the formulation of an appropriate sampling design (e.g., Figure 2, Figure 3 and Figure 5). These preliminary data identify the capture date and length of juveniles corresponding to genetic winter- and spring-run. Further review of these data will be used to summarize within-year and between-year variability in anticipated distributions of length, passage date, and relative abundance of spring- and winter-run Chinook salmon at Chipps Island.

Task 1.2: Design a sampling plan to allocate 3000 samples (one sample = 1 fish) per year
The genetic sampling program will target juvenile spring- and winter-run Chinook salmon, and will be designed to obtain both a representative sample as well as high levels of statistical confidence in estimating racial proportions during key passage periods. To accomplish this, we will collect 3000 samples per year – the maximum number of DNA samples that can be processed annually at the Marine Fisheries Genetics Laboratory based at the Hatfield Marine Science Center, Oregon State University. The collection of samples will be stratified by date and fish length, and sample sizes will be determined to achieve the desired balance between temporal coverage and statistical confidence given anticipated distributions of length, passage date, and relative abundance.

Task 1.3: Update sample size and goals each year based on new data
We will modify the sampling design each year as necessary to incorporate the new data obtained during the previous sampling season.

Objective 2: Collect DNA Samples

Task 2.1: Collect 3000 DNA samples annually from juvenile salmon collected in sampling at Chipps Island

Sampling at Chipps Island is conducted between 3 and 7 days a week all year. This sampling is funded through other, ongoing, cooperative programs (Interagency Ecological Program for the San Francisco Bay {IEP}, and the Central Valley Project Improvement Act – b2 monitoring). No funds are being requested for field sampling and collection of DNA from juvenile salmon at Chipps Island. Tissue samples for DNA analysis will be collected through the above mentioned sampling plan using standard techniques applied at the SWP and CVP Fish Facilities (Appendix 1).

Task 2.2: Send DNA samples to Michael Banks

Samples will be stored and sent to Michael Banks at Oregon State University every six months.

Objective 3: Analyze DNA samples and estimate racial proportions

Task 3.1: Complete DNA analysis and statistical analysis to estimate racial proportions

Michael Banks, from Oregon State University, will be overseeing the genetic analyses of this project. For the present proposal we will apply data from 12 microsatellite loci for up to 3000 genetic samples collected at Chipps Island during each year of the study (three years). Simulations indicate that these loci provide assignment success of at least 90% across all Chinook races at a stringency of 2 (actually 91.6% correct assignment with a variance of 4.6% {Banks et al. unpublished data}).

Power gains from employing polymorphic microsatellites have substantially enhanced our ability to distinguish among the runs or life history types in Chinook salmon of the Sacramento River (Banks, 2005). Loci employed in Banks et al (2000) provided resources for clear distinction of the endangered winter-run but did not hold sufficient statistical power for reliable identification of spring, fall and late-fall runs. Today statistical power for identification of spring run from Butte, Deer and Mill Creeks is greater than 95% (Banks and Jacobson, 2004). Banks and Jacobson (2004) describe assignment success for top ranking loci at greater than 99%, but this value is attained with assignment stringency of 0 and is overly optimistic. An assignment stringency of 0, just allocates a fish to their most likely population irrespective of how likely this fish may also be assigned to a second population. Thus, for example, 98.9% of spring from Deer and Mill are assigned appropriately, but 1.3% of fish from other runs are also assigned to spring at this stringency of 0. Given that the other runs may exceed spring by 500 fold or more, this can result in a substantial assignment error. Selecting a stringency of 2 designates those fish with assignments that exceed the second most likely population, by 100 times or more. Borderline fish with genotypes that are marginally assigned to more than one population and comprise the bulk of misassignments would not be assigned to any population with this higher stringency. Using a stringency of 2, accurate assignments for Deer and Mill Creek spring run chinook populations is 93%, but importantly, miss-assignment reduces to 0.14%. For further information on this topic, see page 612 in Banks (2005).

Objective 4: Estimate abundance of spring-and winter-run Chinook juveniles

Task 4.1: Estimate catch efficiency of trawl sampling

Estimates of catch efficiency of trawl samples at Chipps Island are required to expand observed catches into estimates of total abundance. Absolute abundance at Chipps Island, by race (using the size criteria) is presently estimated by using the survival of marked fish to Chipps Island to estimate trawl efficiency. Survival to Chipps Island is based on differential recoveries in the ocean fishery, of CWT groups released upstream and near Chipps Island. The trawl efficiency is the number recovered in the trawl divided by the number estimated to be available for capture for each release group. The number available for capture is the number released times the estimated survival rate to Chipps Island. Several estimates of trawl efficiency are averaged to obtain an annual trawl estimate which is then applied to catches through-out the year. These methods are explained in further detail in USFWS, 2003. A comprehensive list of all of the CWT groups used to estimate trawl efficiency is available in USFWS, 2001. We propose to improve upon existing methods for estimating catch efficiencies by using statistical and modeling expertise to determine the best way to estimate trawl efficiency and associated confidence limits and apply them to catches of “true” juvenile winter- and spring-run Chinook salmon.

Task 4.2: Estimate abundance of spring- and winter-run Chinook juveniles at Chipps Island

Catch efficiency estimates will then be used to estimate total abundance of spring- and winter-run Chinook passing Chipps Island in each of the three project years. Abundance estimates and their standard errors will be computed at various times scales (e.g., annual, monthly, and where possible, weekly estimates). We will also determine if past DNA samples collected at Chipps Island can be used to estimate winter or spring run abundance in previous years.

Objective 5: Disseminate Findings

Task 5.1: Complete annual reports

We will submit semi-annual and annual progress reports to CALFED. Semi-annual reports will be submitted by March 1 of 2008, 2009 and 2010. Annual progress reports will be submitted by August 31 of 2008, 2009 and 2010. We will also submit a 1 page project summary for a public audience at the beginning and upon completion of the project.

Task 5.2: Present findings

We propose to present at least one oral presentation at the CALFED Science Conference. We will share data and results with other researchers conducting winter and spring run life-cycle modeling such as National Marine Fisheries Service’s JPE, Lou Botsford, Steve Lindley,Wim Kimmerer and Steve Cramer. We will also share our sampling design process with the Winter Run Genetics Project Work Team for potential use at other sampling locations (e.g. Fish Facilities).

Task 5.3: Submit findings to Peer-Refereed Journals(s)

We propose to submit at least one manuscript for publication in a peer-reviewed journal as we near completion of the three-year project.

Task 5.4: Evaluate using this technology to estimate abundance of winter- and spring-run juveniles at other monitoring locations such as Sacramento and Knights Landing.
This evaluation will be included in our final report on whether the methods we employ would be applicable to other salmon monitoring locations.

IV. Feasibility

The project and timelines are feasible. Sampling is already in place to estimate freshwater abundance of Chinook, but the races of juveniles surviving fresh-water are not accurately estimated. The proposed study would substantially improve estimates of freshwater production and survival of both juvenile spring and winter-run Chinook salmon by employing superior techniques to distinguish race. Michael Banks has the expertise to differentiate juvenile winter- and spring-run Chinook salmon using polymorphic microsatellites and is available to oversee the work. Funding is proposed for September 1, 2007 through August 31, 2010. We propose to start designing the sub-sampling project September 1, 2007. The DNA sampling could start as early as October of 2007 and would continue through June of 2010. The last few months would be used to get results of the last DNA samples and write the manuscript for the peer-reviewed journal article.

The US Fish and Wildlife Service has had funding and Endangered Species sampling permits to conduct standardized trawl surveys at Chipps Island throughout the year since 1995. Funding and permitting are anticipated to continue indefinitely. Some fin clipping of winter run sized juvenile salmon has been done at Chipps Island in the past (up to 2001) and we are confident that NOAA would approve reinstating the clipping for this project.

The USFWS Regional Office – Portland has determined that proposals that are selected by CALFED Science for funding that have established collaborators/partners would follow procedures for contracting by publishing a letter of intent to fund the particular entities contained within the proposal. Outside parties at that time can protest the selection.

V. Relevance to Science Program Priorities

Estimating the abundance of “true” juvenile winter and spring-run Chinook salmon leaving the Delta is fundamental to achieving two of the Science Program’s priority research topics listed in this CALFED Science Proposal Solicitation: 1) identifying trends and patterns of populations and system response to a changing environment and 2) using discretionary environmental water supplies more effectively for at-risk species.

During the proposed three years that abundance estimates are made, trends in the populations can be identified and comparisons can be made across years with unique environmental conditions. By observing environmental water conditions (i.e., Delta inflow and outflow, water temperature, water quality, etc.) during the years of the proposed study (2007-2010) we will be able to develop a better understanding of how water conditions affect juvenile winter- and spring-run Chinook production and survival. This knowledge will also begin to shed light on how previous water conditions may have impacted salmon populations in the past. Incorporating more accurate abundance estimates into life-cycle models will verify whether these models have correctly portrayed the magnitude of all the combined parameters affecting freshwater survival

In addition, more accurate abundance estimates would result in better use of existing environmental water supplies as the timing and relative abundance data of these races are used in determining if, and when, CVP and SWP exports need to be curtailed in the Delta. Estimation of fresh-water production of juvenile Chinook, particularly for each race, is at the very hub of our ability to discern how water operations and management actions influence freshwater production. This need is articulated in the document entitled: The Use of the Environmental Water Account for the Protection of Anadromous Salmonids in the Sacramento/San Joaquin Delta in 2002-2003 (Brandes et al., 2003). Having more accurate winter and spring run abundance estimates at Chipps Island would also help determine the relative proportion of these at-risk salmon races affected by direct entrainment at the Central Valley and State Water Project Facilities. Finally the abundance information would provide verification for winter and spring run life-cycle models that link population abundance and survival to Delta inflow, exports, E/I ratio, water temperature, status of Delta Cross Channel gates, salinity and turbidity. Before we can evaluate how best to use water resources to protect juvenile winter and spring run in the Delta we need to be able to more accurately identify and enumerate them.

Without better assessment of the timing and abundance by race leaving the Delta we cannot correctly apply any of the past winter-and spring-run data. The data gathered from this proposal would provide a means for better understanding of race proportions in the Delta and will allow us to re-examine historical sampling data in a more meaningful way and determine if past assumptions need to be modified about the timing and relative abundance of various race of juvenile salmon in the Delta.

Abundance estimates based on genetic identification will be considerably more accurate than estimates that are currently based on length-at-date criteria. In addition, a more statistically robust sub-sampling protocol and further assessment of catch efficiency and its application for catch expansion, will improve our estimates of abundance at Chipps Island such that we can begin to identify relationships between adult escapement, juvenile production and survival, and factors such as water operations in the Delta.

In the longer term, additional abundance estimates at Sacramento would provide information on the timing of Delta entry for these races. If abundance at both Sacramento and Chipps Island was obtained, estimates of survival through the Delta could be made for known winter- and spring-run juvenile salmon. This project will evaluate the feasibility of estimating abundance using DNA sampling at additional locations by first attempting it at Chipps Island.

VI. Qualifications

Pat Brandes, Fishery Biologist with USFWS will act as lead coordinator for this project. She has coordinated or been involved with several large interdisciplinary, juvenile salmon projects (Vernalis Adaptive Management Program, Historical IEP Salmon and Real-time programs, Delta Cross Channel experiments and new ultrasonic mark and recapture experiments in the Delta) and various project work teams during her 20 year tenure at the Stockton office. Specifically, Ms.

Brandes will assist the statistician and modeler on the biological aspects of the sub-sampling and Chipps Island expansion aspects of the project and assure that the project deliverables are completed as proposed in this document. The documents will be co-written by all participants in the study.

The statistician and modeler for this project has yet to be determined. We have budgeted for an outside contractor to do this work, but Dr. Ken Newman, will be joining the USFWS Stockton Office in September of 2006 and he is highly qualified to work on the statistical and design aspects of this project. If an outside contractor is selected for this aspect of the project we will get CALFED Science approval of our selection.

Dr. Newman has previously been a professor of statistics at the University of St. Andrews in Scotland and at University of Idaho. He has been a consultant analyzing salmon data in the Central Valley and Delta for over 10 years.

Eric Volkman, a Supervisory Fish Biologist also with the Stockton Office will lead the field aspects of the project by coordinating the collection and mailing of DNA samples to Michael Banks. Eric is responsible for implementation of the IEP Delta Juvenile Fishes Monitoring Program, which includes the sampling at Chipps Island.

Michael Banks, from Oregon State University, will be overseeing the genetics analyses of this project. Dr. Banks was selected as our subcontractor because he has been doing similar work for several years, with samples from the SWP and CVP Fish Facilities for the California Department of the Water Resources and his procedures are clear, established and documented. An added benefit of using Michael Banks for this work is that Oregon State is a member agency of the Cooperative Ecological Studies Unit (CESU). As a member agency ourselves, we can contract with the University at lower overhead rates. This agreement enables the FWS to work collaboratively with Oregon State at reduced overhead rates (from 41.5% to 17.5%).

The majority of funds requested in this proposal will go to the Marine Fisheries Genetics Laboratory (Oregon State University) for analyzing the DNA samples. The trawling at Chipps Island is a large expense, but it is already funded through other sources. The sampling design, catch efficiency and reporting aspects of this study are smaller in scope than analyzing 9000 DNA samples over the course of the 3 year sampling period.

VII. Acknowledgements

We would like to acknowledge Steve Cramer and others from S.P. Cramer and Associates for assisting in a previous version of this proposal.

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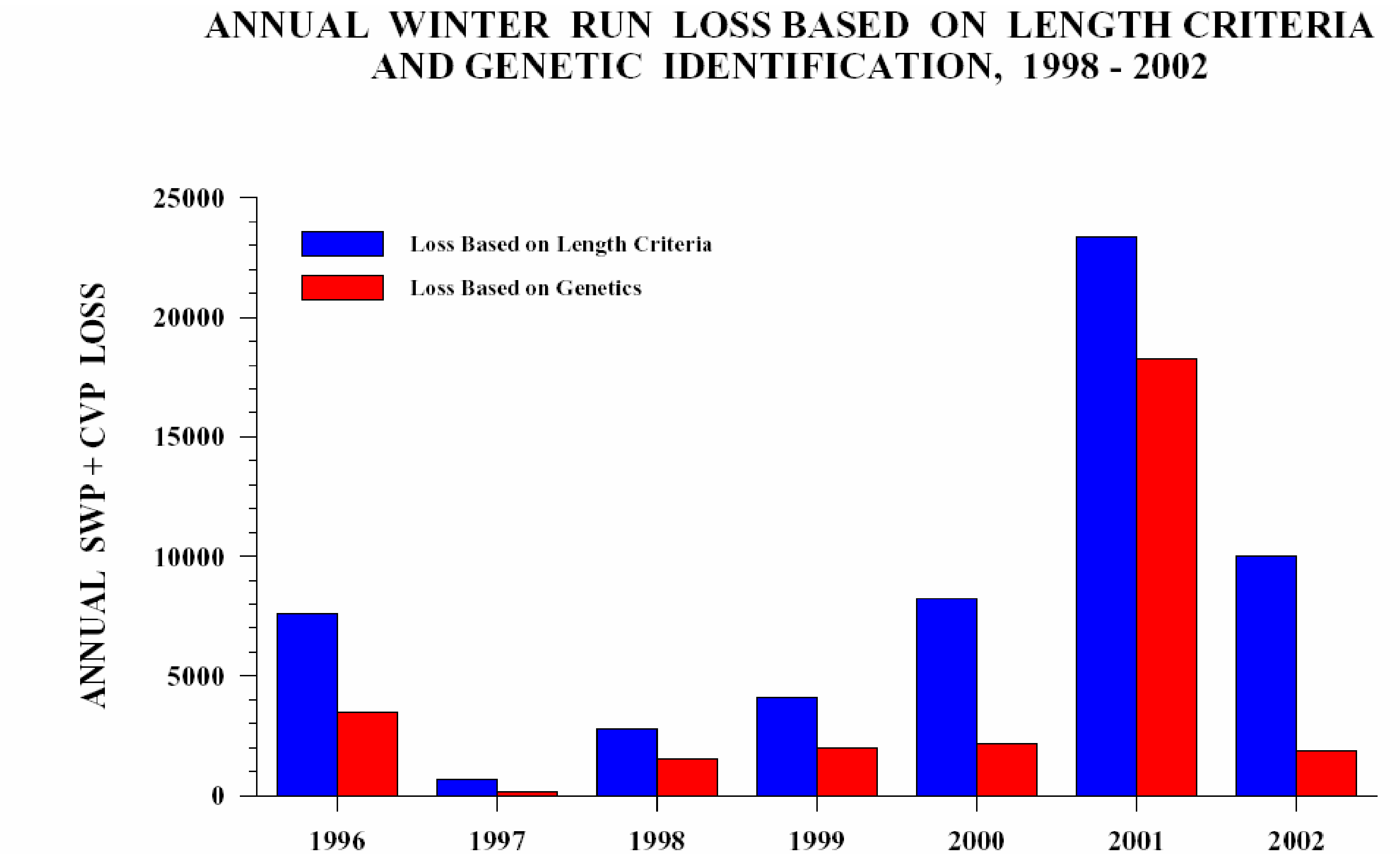


.Figure 1. Mortality at the Delta exports, also called loss, calculated based on length criteria and gentic information. (Shelia Greene DWR, personal communication).

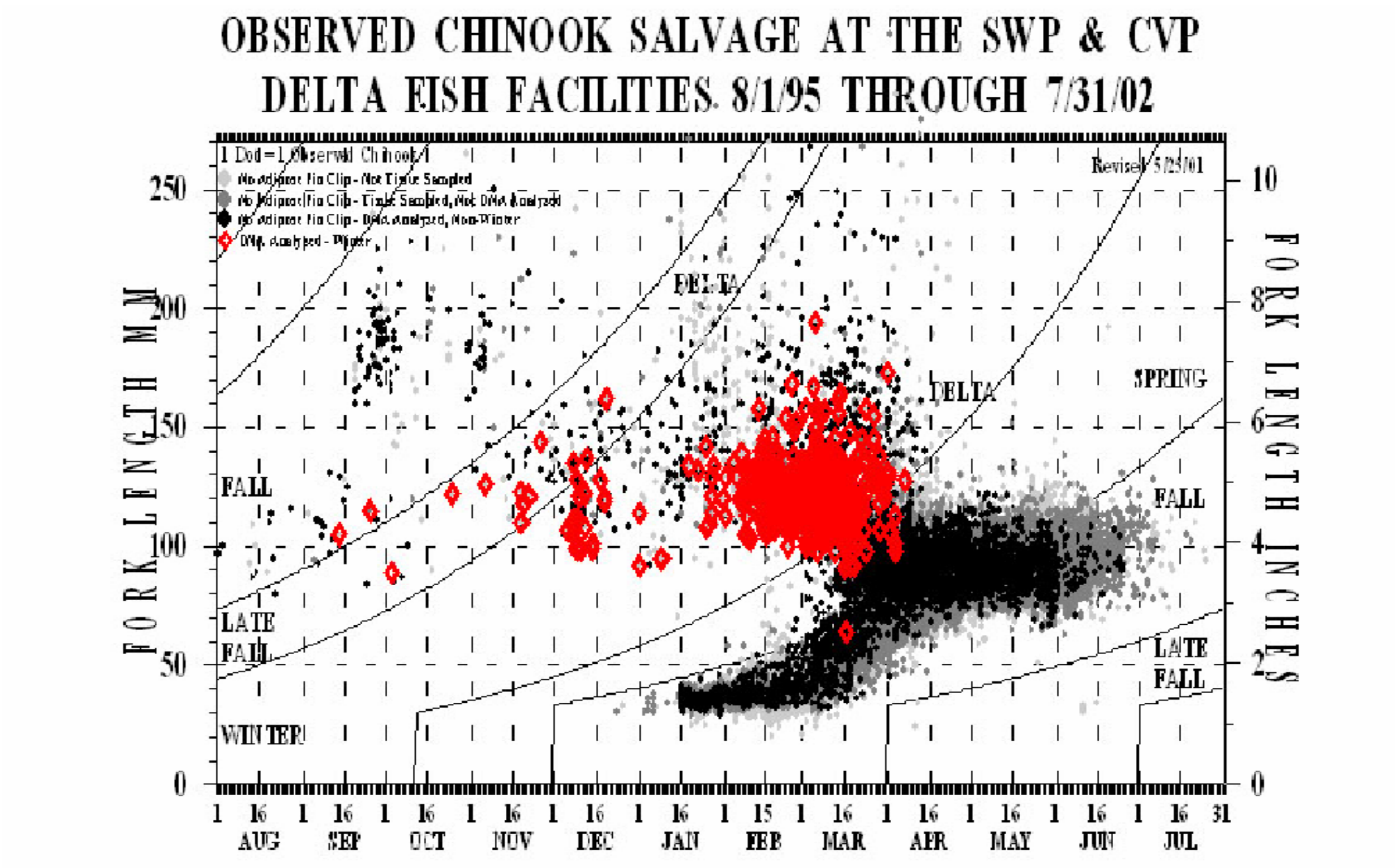


Figure 2. Genetic winter run (red dots) at the State Water and Central Valley Projects and the “Delta” size criteria of races. (S. Greene, personal communication).

OBSERVED CHINOOK SALVAGE AT THE SWP DELTA FISH FACILITIES 8/1/02 THROUGH 7/31/03

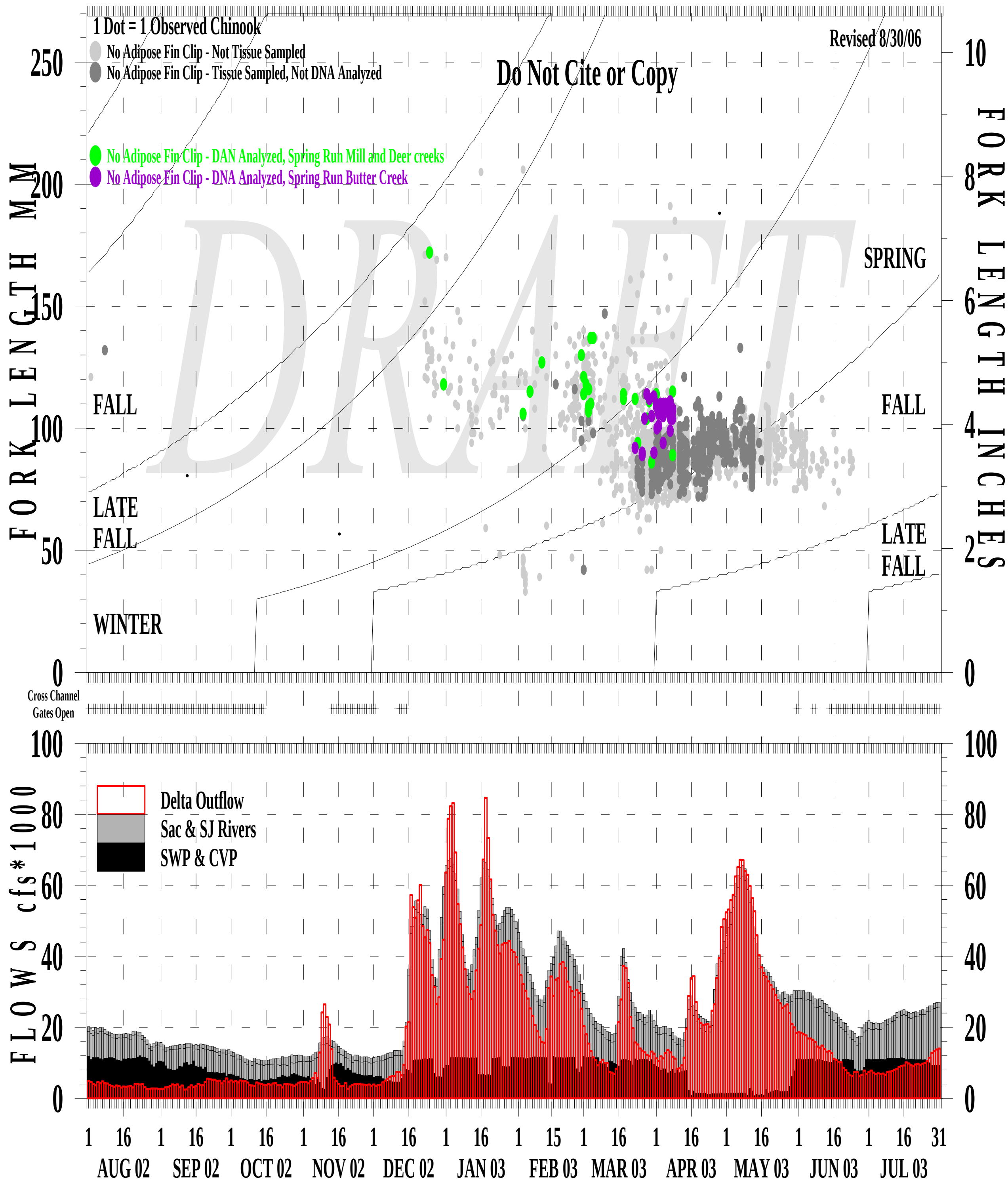


Figure 3: Genetic spring run at the SWP Fish Facility between 8/1/02 and 7/31/03. Graph provided for this PSP by S. Greene, DWR. It is intended for use only in this PSP.

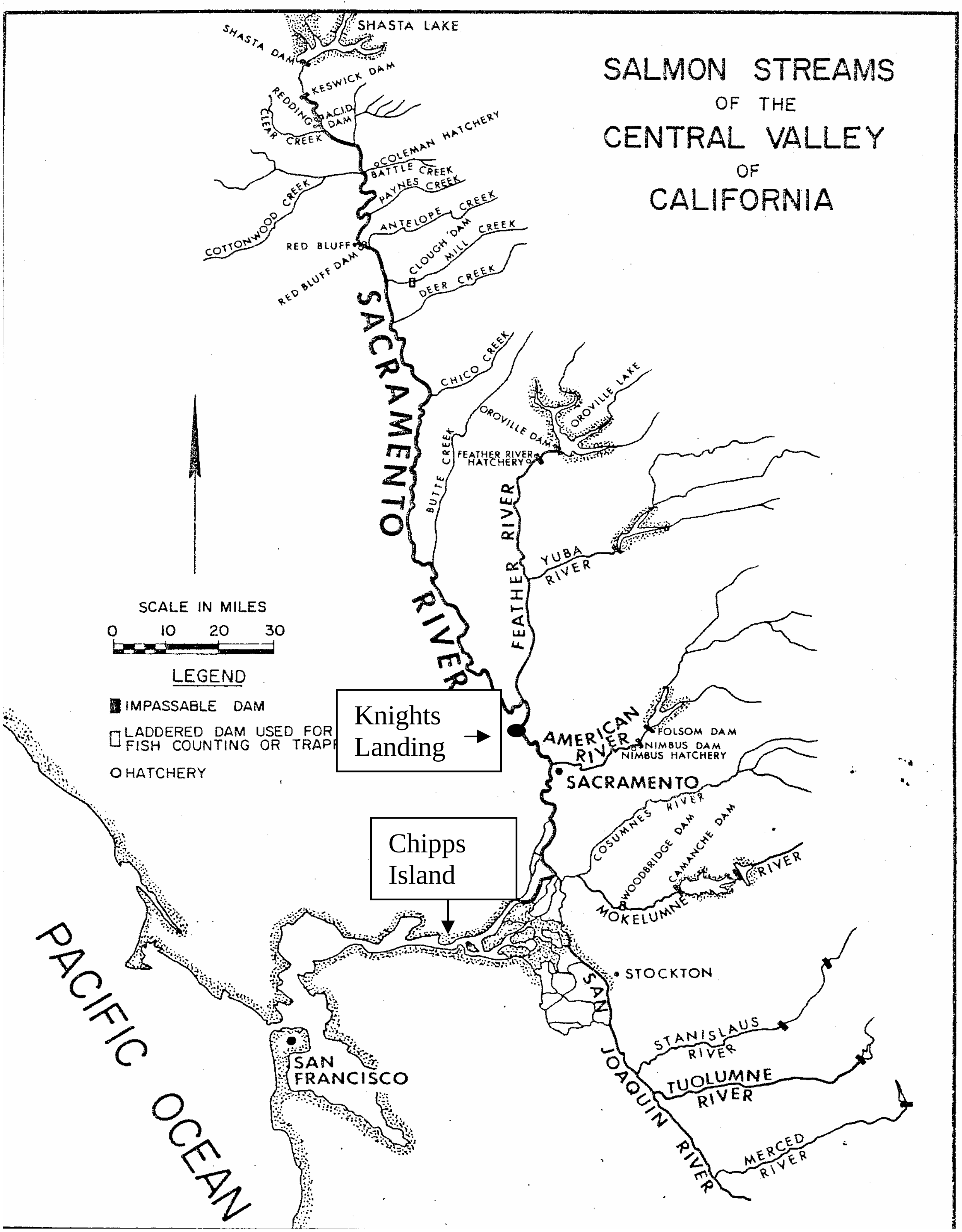
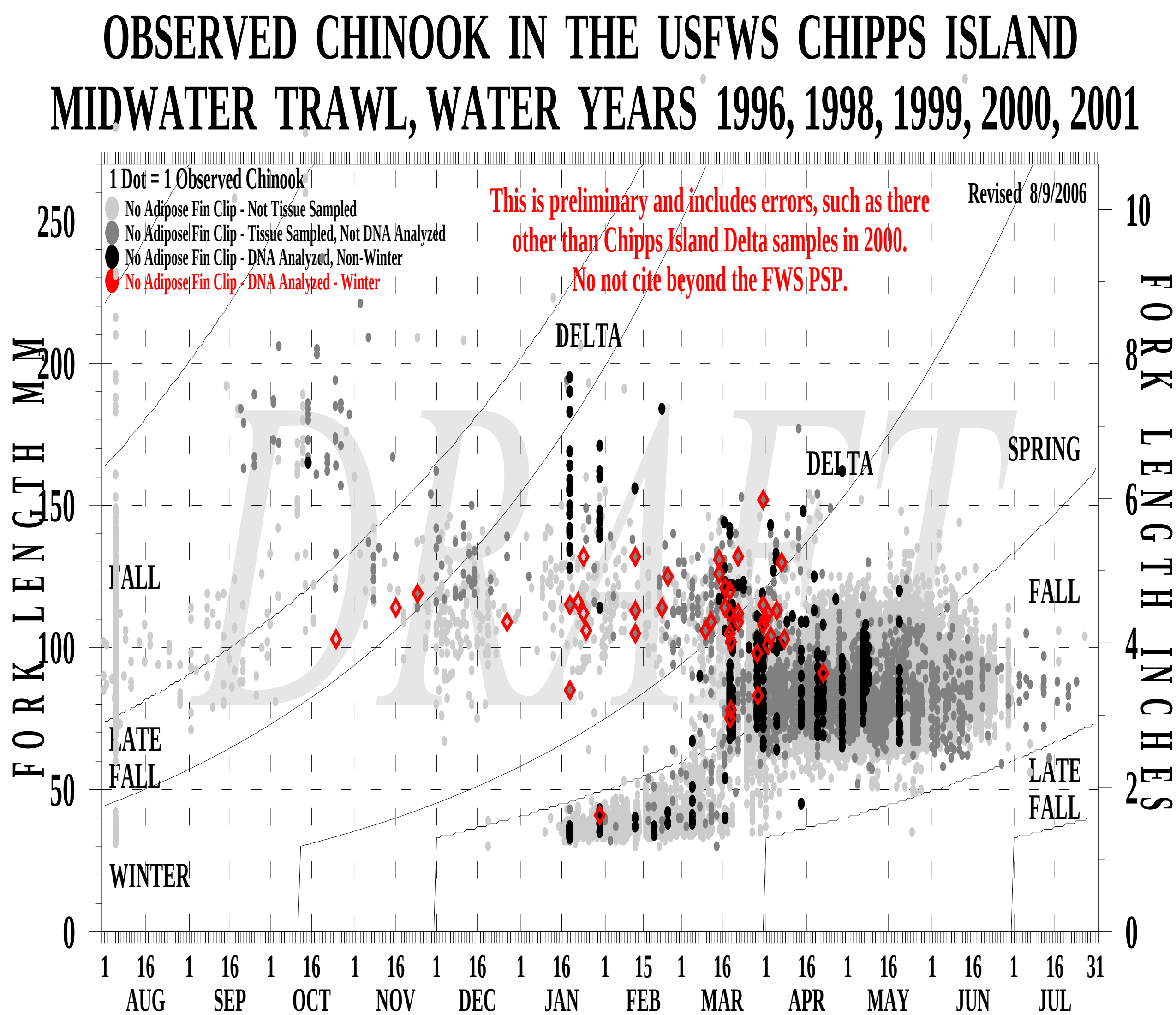


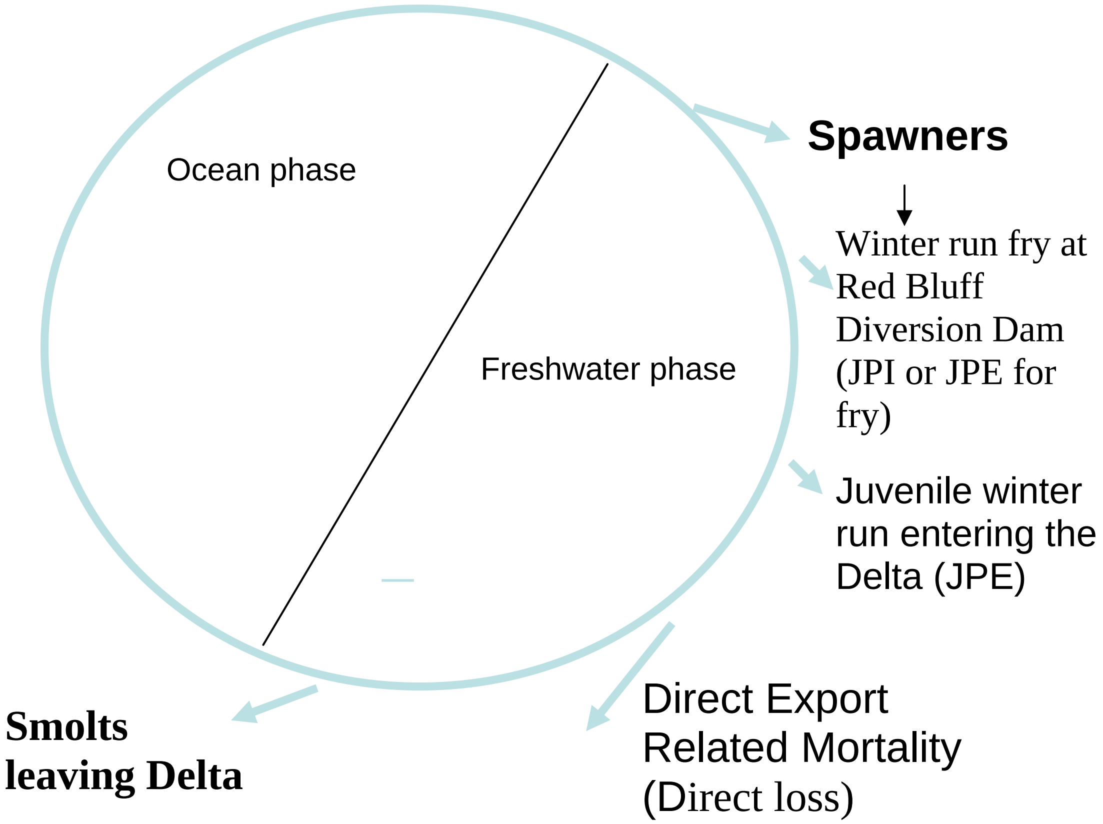
Figure 4: Salmon streams of the Central Valley with salmon hatcheries, and impassable and laddered dams.

Figure 5: Genetic winter run at Chipps Island In 1996, 1998, 1999, 2000 and 2001. (S. Greene, personal communication)



Preliminary, Subject to Revision
Sheila Greene, DWR 8/9/2006

Figure 6: Conceptual model for estimating true juvenile winter run abundance at Chipps Island



Appendix 1:

DRAFT - Genetics (DNA) Tissue Collection Procedure - Chinook Salmon

State Water Project and Central Valley Project Salvage Facilities

Sampling Procedures – 2004-2005 * Detailed

***** sample all Chinook Salmon with adipose fins *****

***** do not sample special study Chinook Salmon *****

***** handle fish carefully, they should stay alive ******

1. **Clean scissors and rinse before each fish is sampled**. To clean the scissors before each fish, **agitate the scissors in argentyne and rinse in delta water**. This will prevent infection due to the tissue clip. The delta water rinse minimizes cross sample tissue contamination and argentyne contamination. If the scissors are getting rusty replace them.
2. **Wet the sampler's hand with delta water before handling the live Chinook.** A wet hand protects the fish's slime layer, reducing infections.
3. **Pick up the salmon and hold the Chinook's tail between the thumb and forefinger.** (Anesthetize the fish as needed for less stressful handling—MS222 has been used in the past.)
4. **Using scissors, clip a small piece of caudal fin tissue.** (best size is **2x4mm** least is 1x1 mm of tissue from either the top or bottom caudal lobe) **See diagram below …. This should not kill the fish.**
5. **Place the snipped tissue from the individual fish in its own pre-labeled vial. Please use vials in numerical order.** Each fish sampled will have one vial. The vials contain a special storage buffer (10 mM Tris-HCL, pH 8.0, 25 mM EDTA, 100 mM NaCl and water)
6. **Verify that the fish length datum and the vial number match on the DNA data sheet.** When time allows, match the length data on the DNA sheet **and the salvage sheet, they should be the same.**
7. **Clean and rinse the scissors to prepare for the next fish. Repeat steps 1-5 for each fish.**
8. **Allow the fish to recover completely in a holding tank.**
9. **Freeze vials with tissue samples, upright as-soon-as-possible.** A divided plastic box is provided in the freezer for upright freezing. Please return the empty cardboard vial storage boxes. The empty boxes and completed data sheets can be placed in the freezer with the samples.
10. **Verify that all necessary information has been recorded and data matches salvage data.**
    - **a.** Collection date and time
    - **b.** Fork length in mm's
    - **c.** Sample ID is the same as the vial ID
    - **d.** Check the ad-clipped yes vs. no column (if a clipped fish is sampled by mistake, keep it and mark the sheet as a clipped fish)
    - **e.** For the SWP be sure which building (new vs. old) is on the form.
    - **f.** Note anything unusual or interesting about the fish or sampling on the lower part of the form. Some examples would be; dye marked fish are showing up, handling is causing death, took 2 hours to process this many samples.

For questions or concerns regarding fin tissue sampling contact:

Jennifer Navicky (DFG - Central Valley Salmonid Tissue Archive) 916-227-6844 or Cathy Reiner (DWR - Ecological Studies Branch) 916-227-1375

SUMMARY OF QUALIFICATIONS

Name: Patricia Little Brandes

Address: U.S. Fish and Wildlife Service
4001 N. Wilson Way
Stockton, CA 95205

Position: Fishery Biologist, Stockton
Fish and Wildlife Office

Education: B.S. Fisheries
Michigan State University, Lansing, MI – 1982

Employment: U.S. Fish and Wildlife Service, 1981 to Present

Jordan River National Fish Hatchery, Elmira, MI
Fishery Biologist Trainee – March, 1981 – Dec. 1981

Senecaville National Fish Hatchery, Senecaville, Ohio
Fishery Biologist – April, 1982 – May, 1983

Stockton Fish and Wildlife Office, Stockton, CA
Fishery Biologist – August, 1983 to Present

Responsibilities:

Responsible for designing field studies, analyzing data and reporting on the survival of juvenile chinook salmon in the Sacramento-San Joaquin Delta.

Professional Organizations:

Member of the American Fisheries Society

Articles

Brandes, P.L. 1996. Results of 1996 coded-wire tag smolt survival experiments in the San Joaquin River Delta. Interagency Ecological Program Newlsetter. 9(4):13-16

Brandes, P.L., and Pierce, M.M. 1998. 1997 salmon smolt survival studies in the South Delta. Interagency Ecological Program Newsletter. 11(1):29-38.

Brandes PL, McLain JS. 2001. Juvenile Chinook salmon abundance, distribution, and survival in the Sacramento-San Joaquin Estuary. In: Brown RL, editor. Contributions to the Biology of Central Valley Salmonids. Fish Bulletin 179. Volume 2. Sacramento (CA): California Department of Fish and Game. p 39-136.

Brandes, P., Perry, K., Chappell, E., McLain, J., Greene, S., Sitts, R., McEwan, D., and Chotkowski, M., Interagency Ecological Program. 2000. Delta Salmon Project Work Team Delta Juvenile Salmon Monitoring Program Review Stockton, CA

Kjelson, M.A., Brandes, P.L. 1989. The use of smolt survival estimates to quantify the effects of habitat changes on salmonid stocks in the Sacramento-San Joaquin River, California, p. 100-115. In C.D. Levings, L.B. Holtby, and M.A. Henderson [ed.] Proceedings of the National Workshop on the effects of habitat alteration on salmonid stocks. Can. Spec. Publ. Fish. Aquatic. Sci. 105.

Kjelson, M, Greene, S., and Brandes, P.L. 1989. A model for estimating mortality and survival of fall-run chinook salmon smolts in the Sacramento River Delta between Sacramento and Chipps Island. U.S. Fish and Wildlife Service, Stockton, CA. 50pp.

Budget For DNA Proposal

Year 1

BUDGET FOR TASK ONE	Number of Hours	Hourly Salary	Fringe	Wages and Benfits	Other Costs (admintistative, management, supplies, etc)	Travel	Shipping	USFWS Overhead	Total Cost, Year 1
Assemble data (Brandes)	60	$44.52	0.28	$3,419.00	$1,869.00	$ -	$ -	$898.96	$6,187
Design Sampling Plan (Brandes)	10	$44.52	0.28	$569.86	$310.00	$ -	$ -	$149.60	$1,029
Design Sampling Plan (Statistician)	112	$34.00	0.554	$5,917.63	$6,066.00	$ -	$ -	$719.04	$12,703
Total	182			$9,906.49	$8,245.00				**$19,919**

BUDGET FOR TASK TWO	Number of Hours	Hourly Salary	Fringe	Wages and Benfits	Other Costs (admintistative, management, supplies, etc)	Travel	Shipping	USFWS Overhead	Total Cost, Year 1
Collect DNA Samples at Chipps (Volkman)		$0.00	0	$0.00	$0.00	0	$0.00	$0.00	$0
Send DNA samples to Michael Banks	10	$28.57	0.28	$366.00	$514.00	0	$500.00	$234.60	$1,615
Total	10			$366.00	$514.00		$500.00		**$1,615**

Year 1

BUDGET FOR TASK THREE	Number of Hours	Hourly Salary	Fringe	Wages and Benfits	Other Costs (admintistative, management, supplies, etc)	Travel	Shipping	USFWS Overhead	Total Cost, Year 1
See detailed Genetics Budget Attached									**$105,894**

BUDGET FOR TASK FOUR	Number of Hours	Hourly Salary	Fringe	Wages and Benfits	Other Costs (admintistative, management, supplies, etc)	Travel	Shipping	USFWS Overhead	Total Cost, Year 1
Estimate Trawl efficiency(Brandes)	40	$44.52	0.28	$2,778.00	$742.00	$0.00	$0.00	$598.40	$4,118
Estimate Trawl efficiency(Statistician)	180	$34.00	0.554	$9,510.48	$9,750.00	$0.00	$0.00	$1,155.60	$20,416
Estimate Abundance (Brandes)	20	$44.52	0.28	$1,139.71	$620.00	$0.00	$0.00	$299.20	$2,059
Estimate Abundance (Statistician)	132	$34.00	0.554	$6,974.35	$7,150.00	$0.00	$0.00	$847.44	$14,972
Total	372			$20,402.54	$18,262.00				**$41,565**

BUDGET FOR TASK FIVE	Number of Hours	Hourly Salary	Fringe	Wages and Benfits	Other Costs (admintistative, management, supplies, etc)	Travel	Shipping	USFWS Overhead	Total Cost, Year 1
Annual Report (Statistician)	40	$34.00	0.554	$2,113.44	$2,167.00	$ -	$ -	$256.80	$4,537
Present Findings (Brandes)	50	$44.52	0.28	$2,849.28	$1,551.00	$ -	$ -	$748.00	$5,148
Peer reviewed publication (Brandes)	0	$0.00			$0.00				$0
Total	60	$0.00		$4,962.72	$3,718.00				**$9,686**

Year 1 Total $ 178,678

Year 2

BUDGET FOR TASK ONE	Number of Hours	Hourly Salary	Fringe	Wages and Benfits	Other Costs (admintistative, management, supplies, etc)	Travel	Shipping	USFWS Overhead	Total Cost, Year 2
Assemble data (Brandes)	10	$ 46.75	0.28	$598.40	$295.00	$ -	$ -	$151.81	$1,045
Design Sampling Plan (Brandes)	10	$ 46.75	0.28	$598.40	$295.00	$ -	$ -	$151.81	$1,045
Design Sampling Plan (Statistician)	34	$ 35.70	0.554	$1,886.25	$1,934.00	$ -	$ -	$229.20	$4,049
Total	54	$129.20		$3,083.05	$2,524.00				**$6,140**

BUDGET FOR TASK TWO	Number of Hours	Hourly Salary	Fringe	Wages and Benfits	Other Costs (admintistative, management, supplies, etc)	Travel	Shipping	USFWS Overhead	Total Cost, Year 2
Collect DNA Samples at Chipps (Volkman)									$0
Send DNA samples to Michael Banks	10	$29.52	0.28	$378.00	$515.00	$0.00	$500.00	$236.81	$1,630
Total	10			$378.00	$515.00		$500.00		**$1,630**

BUDGET FOR TASK THREE	Number of Hours	Hourly Salary	Fringe	Wages and Benfits	Other Costs (admintistative, management, supplies, etc)	Travel	Shipping	USFWS Overhead	Total Cost, Year 2
See detailed Genetics Budget Attached									**$108,988**

BUDGET FOR TASK FOUR	Number of Hours	Hourly Salary	Fringe	Wages and Benfits	Other Costs (admintistative, management, supplies, etc)	Travel	Shipping	USFWS Overhead	Total Cost, Year 2
Estimate Trawl efficiency(Brandes)	10	$46.75	0.28	$598.40	$295.00	$ -	$ -	$151.81	$1,045
Estimate Trawl efficiency(Statistician)	44	$35.70	0.554	$2,441.00	$2,487.00	0	0	$295.68	$5,224
Estimate Abundance (Brandes)	20	$46.75	0	$1,196.00	$590.00			$303.62	$2,090
Estimate Abundance (Statistician)	22	$35.70	0.554	$1,221.00	$1,244.00	0	0	$147.90	$2,613
Total	96			$5,456.40	$4,616.00				**$10,971**

BUDGET FOR TASK FIVE	Number of Hours	Hourly Salary	Fringe	Wages and Benfits	Other Costs (admintistative, management, supplies, etc)	Travel	Shipping	USFWS Overhead	Total Cost, Year 2
Annual Report (Statistician)	40	$ 35.70	0.554	$2,219.11	$2,275.00	$ -	$ -	$269.64	$4,764
Present Findings (Brandes)	50	$ 46.75	0.28	$2,992.00	$2,572.00	$ -	$ -	$945.88	$6,510
Peer reviewed publication (Brandes)	0	$ -			$0.00				$0
Total	90			$5,211.11	$4,847.00				**$11,274**

Year 2 Total **$139,003**

Year 3

BUDGET FOR TASK ONE	Number of Hours	Hourly Salary	Fringe	Wages and Benfits	Other Costs (admintistative, management,	Travel	Shipping	USFWS Overhead	Total Cost, Year 3
Assemble data (Brandes)	10	$49.07	0.28	$628.10	$345.00			$165.41	$1,139
Design Sampling Plan (Brandes)	10	$49.07	0.28	$628.10	$345.00			$165.41	$1,139
Design Sampling Plan (Statistician)	39	$37.49	0.554	$2,272.12	$2,330.00			$276.12	$4,878
Total	59			$3,528.31	$3,020.00				**$7,155**

BUDGET FOR TASK TWO	Number of Hours	Hourly Salary	Fringe	Wages and Benfits	Other Costs (admintistative, management,	Travel	Shipping	USFWS Overhead	Total Cost, Year 3
Collect DNA Samples at Chipps (Volkman)									$0
Send DNA samples to Michael Banks	10	30.48	0.28	$389.00	$584.00	$0.00	$500.00	$250.41	$1,723
Total	10			$389.00	$584.00		$500.00		**$1,723**

Year 3

BUDGET FOR TASK THREE	Number of Hours	Hourly Salary	Fringe	Wages and Benfits	Other Costs (admintistative, management,	Travel	Shipping	USFWS Overhead	Total Cost, Year 3
See detailed Genetics Budget Attached									**$112,208**

BUDGET FOR TASK FOUR	Number of Hours	Hourly Salary	Fringe	Wages and Benfits	Other Costs (admintistative, management,	Travel	Shipping	USFWS Overhead	Total Cost, Year 3
Estimate Trawl efficiency(Brandes)	10	$49.07	0.28	$628.10	$345.00			$165.41	$1,139
Estimate Trawl efficiency(Statistician)	44	37.49	0.554	$2,563.00	$2,629.00	$0.00	$0.00	$311.52	$5,504
Estimate Abundance (Brandes)	20	49.07	0.28	$1,256.00	$690.00	$0.00	$0.00	$330.82	$2,277
Estimate Abundance (Statistician)	22	37.49	0.554	$1,282.00	$1,315.00	$0.00	$0.00	$155.82	$2,753
Total	96			$ 5,729	$ 4,979.00				**$11,672**

BUDGET FOR TASK FIVE	Number of Hours	Hourly Salary	Fringe	Wages and Benfits	Other Costs (admintistative, management,	Travel	Shipping	USFWS Overhead	Total Cost, Year 3
Annual Report (Statistician)	40	$ 37.49	0.554	$2,330.38	$2,390.00			$283.20	$5,004
Present Findings (Brandes)	50	$ 49.07	0.28	$3,140.48	$1,725.00			$827.05	$5,693
Peer reviewed publication (Brandes)	200	$ 49.07	0.28	$12,561.92	$6,898.00			$3,307.88	$22,768
Total	290			$18,032.78	$11,013.00				**$33,464**

Year 3 Total	**$166,222**
Total Requested	**$483,903**

SALARIES & WAGES 2007-1008 Position, Name	Hourley rates	Monthly Salary	OPE %	FTE	MM	Totals
Assistan Professor (Michael Banks)	57.42	$9,187	0.41	1	1	$ 9,187
						$ -
						$ -
Faculty Research Associate(TBD)	23.20	$ 3,712	0.48	0.75	12	$ 33,408
						$ -
						$ -
						$ -
A. TOTAL SALARIES & WAGES						$ 42,595
B. FRINGE BENEFITS						$ 19,803
C. EXPENDABLE SUPPLIES & EQUIPMENT - under $5,000 per unit						$ 22,000
TRAVEL			Instate:			
Domestic			Outstate:	1000		$ 1,000
International						
		Trip 1:				
		Trip 2:				$ -
D. TOTAL TRAVEL						$ 1,000
E. PUBLICATION COSTS						
OTHER COSTS (subcontracts, consultants, computer time, etc.)						
1. Communications						
2. Publications	wage/hr		weeks	Hrs		
Subcontract-indirect rate charged on first $25,000						
F. TOTAL OTHER COSTS						$ -
G. Subtotal DIRECT COSTS subject to indirect rate (sum items A-F)						$ 85,398
INDIRECT COSTS						
ON-campus Cost at	0.175	% (multiply G x rate)				$ 14,945
OFF-campus Cost at	0.065	% (multiply G x rate)				$ 5,551
H. TOTAL INDIRECT COST						$ 20,496
I. GRADUATE STUDENT TUITION						$ -
K. GRAND TOTAL REQUESTED (sum items G to J)						$ 105,894

SALARIES & WAGES 2008-2009 Position, Name	Hourley rates	Monthly Salary	OPE %	FTE	MM	Totals
Assistan Professor (Michael Banks)	59.71	$9,554	0.41	1	1	$ 9,554
						$ -
						$ -
Faculty Research Associate(TBD)	24.13	$ 3,861	0.48	0.75	12	$ 34,745
						$ -
						$ -
						$ -
A. TOTAL SALARIES & WAGES						$ 44,299
B. FRINGE BENEFITS						$ 20,595
C. EXPENDABLE SUPPLIES & EQUIPMENT - under $5,000 per unit						$ 22,000
TRAVEL			Instate:			
Domestic			Outstate:	1000		$ 1,000
International						
			Trip 1:			
			Trip 2:			$ -
D. TOTAL TRAVEL						$ 1,000
E. PUBLICATION COSTS						
OTHER COSTS (subcontracts, consultants, computer time, etc.)						
1. Communications						
2. Publications	wage/hr		weeks	Hrs		
Subcontract-indirect rate charged on first $25,000						
F. TOTAL OTHER COSTS						$ -
G. Subtotal DIRECT COSTS subject to indirect rate (sum items A-F)						$ 87,894
INDIRECT COSTS						
ON-campus Cost at	0.175	% (multiply G x rate)				$ 15,381
OFF-campus Cost at	0.065	% (multiply G x rate)				$ 5,713
H. TOTAL INDIRECT COST						$ 21,094
I. GRADUATE STUDENT TUITION						$ -
K. GRAND TOTAL REQUESTED (sum items G to J)						$ 108,988

SALARIES & WAGES 2009-2010 Position, Name	Hourley rates	Monthly Salary	OPE %	FTE	MM	Totals
Assistan Professor (Michael Banks)	62.10	$9,936	0.41	1	1	$ 9,936
						$ -
						$ -
Faculty Research Associate(TBD)	25.09	$ 4,015	0.48	0.75	12	$ 36,135
						$ -
						$ -
						$ -
A. TOTAL SALARIES & WAGES						$ 46,071
B. FRINGE BENEFITS						$ 21,419
C. EXPENDABLE SUPPLIES & EQUIPMENT - under $5,000 per unit						$ 22,000
TRAVEL			Instate:			
Domestic			Outstate:	1000		$ 1,000
International						
		Trip 1:				
		Trip 2:				$ -
D. TOTAL TRAVEL						$ 1,000
E. PUBLICATION COSTS						
OTHER COSTS (subcontracts, consultants, computer time, etc.)						
1. Communications						
2. Publications	wage/hr		weeks	Hrs		
Subcontract-indirect rate charged on first $25,000						
F. TOTAL OTHER COSTS						$ -
G. Subtotal DIRECT COSTS subject to indirect rate (sum items A-F)						$ 90,490
INDIRECT COSTS						
ON-campus Cost at	0.175 % (multiply G x rate)					$ 15,836
OFF-campus Cost at	0.065 % (multiply G x rate)					$ 5,882
H. TOTAL INDIRECT COST						$ 21,718
I. GRADUATE STUDENT TUITION						$ -
K. GRAND TOTAL REQUESTED (sum items G to J)						$ 112,208

Budget Justification -

The US Fish and Wildlife Service has had funding and Endangered Species sampling permits to conduct trawl surveys at Chipps Island throughout the year since 1995. Funding and permitting are anticipated to continue indefinitely. Taking DNA samples from juvenile salmon caught at this location is cost effective since the sampling is already funded by other entities (Interagency Ecological Program and CVPIA – b2 monitoring). Michael Banks and his lab regularly analyze DNA to differentiate juvenile winter- and spring-run Chinook salmon using polymorphic microsatellites, thus there is no expenses associated with research or training. In addition, Oregon State is a member of the Cooperative Ecological Studies Unit as we are, thus overhead rates will be reduced from 41.5% to 17.5% - a significant cost savings to CALFED Science.

Cost Share/Matching Funds

The 3 to 7 day a week sampling at Chipps Island costs roughly $500,000 annually. This is paid for through the Interagency Ecological Program ($314,893), Department of Water Resources ($39,090) and the USFWS CVPIA-b2 monitoring budget ($148,554). These estimates are based on costs for the 2007-2008 budget projections for these projects and individual budgets can be supplied if necessary. Over the course of this proposal's three year budget, this in-kind sampling would cost roughly 1.5 million dollars.

Signature

The applicant for this proposal must submit this form by printing it, signing below, and faxing it to +1 877-408-9310. Send exactly one form per transmission.

Failure to sign and submit this form will result in the application not being considered for funding. The individual submitting this proposal will receive e-mail confirmation as soon as this signature page has been processed.

The individual signing below declares that:

- all representations in this proposal are truthful;
- the individual signing the form is authorized to submit the application on behalf of the applicant (if applicant is an entity or organization);
- the applicant has read and understood the conflict of interest and confidentiality discussion under the Confidentiality and Conflict of Interest Section in the main body of the PSP and waives any and all rights to privacy and confidentiality of the proposal on behalf of the applicant, to the extent provided in this PSP; and
- the applicant has read and understood all attachments of this PSP.

Proposal Title: Estimating Juvenile Chinook Salmon Spring and Winter Run Abundance at Chipps Island

Proposal Number: 2006.01-0084

Applicant Organization: U.S. Fish and Wildlife Service

Applicant Contact: Ms. Kim Webb

Applicant Signature Kim Webb **Date** 8/31/06

STATE OF CALIFORNIA -- THE RESOURCES AGENCY

ARNOLD SCHWARZENEGGER, *Governor*

DEPARTMENT OF WATER RESOURCES
DIVISION OF ENVIRONMENTAL SERVICES
3251 S STREET
SACRAMENTO, CA 958167017

August 30, 2006

Ms. Patricia Brandes
Sacramento-San Joaquin Estuary
Fishery Resource Office
U.S. Fish and Wildlife Service
4001 North Wilson Way
Stockton, California 95205

Proposal for Estimating Juvenile Chinook Spring and Winter-run Abundance at Chipps Island for the CALFED Science Program Proposal Solicitation Process

Dear Ms. Brandes:

I reviewed your proposal titled Estimating Juvenile Chinook Spring and Winter-run Abundance at Chipps Island (August 2006) for the CALFED Science Program for consideration in the current proposal solicitation process.

Estimating the abundance of juvenile spring- and winter-run Chinook salmon migrating from the Delta to the ocean, using state-of-the-art genetic tools, will be fundamental in achieving the Science Program's stated purpose of identifying trends and patterns of populations and system response to a changing environment. This information would assist in using existing environmental water supplies more effectively to protect at-risk salmon runs, as well as help determine the relative importance of direct entrainment at the Delta facilities. The abundance information would also provide verification for winter and spring run life-cycle models that link population abundance and survival to water project operations in the Delta.

I therefore support the funding of this proposal in the current solicitation process, as it will provide timely information for improved management and protection of these listed runs.

Sincerely,

Sheila Greene

Sheila Greene
Staff Environmental Scientist
Division of Environmental Services

August 30, 2006

Ms. Patricia Brandes
U.S. Fish and Wildlife Service
Stockton Fishery Resources Office
4001 N. Wilson Way
Stockton, California 95205

Dear Ms. Brandes:

This letter is in regard to your recent application to the CALFED Science Program's 2006 focused Proposal Solicitation Package (PSP). I have reviewed and provided comments on your proposal, entitled *Estimating Juvenile Chinook Spring and Winter run Abundance at Chipps Island* (draft August 2006) for this year's PSP. The proposal seeks to fill in some of the long standing data gaps in the Delta by using the latest DNA sampling techniques to estimate emigration rates.

NOAA's National Marine Fisheries Service (NMFS) wishes to support this type of work as it not only meets the Science Program's stated purpose of identifying population level responses to environmental changes, but is vital to validating the various models used to estimate juvenile abundance. These models determining the incidental take limits at the Delta pumping plants and the population level benefits of such programs as the CALFED environmental water account (EWA).

NMFS has for several years recommended the use of DNA identification in the Delta in order to distinguish similar in appearance races of juvenile Chinook salmon (NMFS 2004 biological opinion on Operations, Criteria and Plan [OCAP] for the Central Valley Project and State Water Project). It has only been recently that the use of this method to distinguish spring-run Chinook salmon has become expedient and economically possible. The proposal also meets the recommendations of previous EWA Science Panel reviews and the CALFED OCAP Science Panel Review to reduce areas of uncertainty in the current juvenile production estimates. The proposal will provide useful information for any one of the new salmon life-cycle models currently being funded by CALFED's 2004 Science PSP (e.g., Botsford's Central Valley Chinook Model) or by NMFS (Newman and Lindley 2006).

I would therefore support this proposal for funding during the current year as it will provide necessary information to assess the survival and recovery of listed salmon species in the Central Valley.

Sincerely,

Michael E. Aceituno
Supervisor, Sacramento Area Office

cc: Copy to file – ARN ?
NMFS-PRD, Long Beach, CA

Reference: Newman, Ken and Steve Lindley. 2006. *Accounting for Demographic and Environmental Stochasticity, Observation Error, and Parameter Uncertainty in Fish Populations Dynamics Models*. North American Journal of Fisheries Management 26:685-701.

August 30, 2006

Ms. Patricia Brandes
Sacramento-San Joaquin Estuary Fishery Resource Office
U.S. Fish and Wildlife Service
4001 N. Wilson Way
Stockton, CA 95205

Dear Ms. Brandes:

Subject: Proposal for Estimating Juvenile Chinook Spring and Winter-run Abundance at Chipps Island

I have reviewed your proposal titled Estimating Juvenile Chinook Spring and Winter-run Abundance at Chipps Island (August 2006). I understand that the proposal will be submitted to the CALFED Science Program for consideration in the current proposal solicitation process.

Estimating the abundance of juvenile spring- and winter-run Chinook salmon migrating from the Delta to the ocean, using state-of-the-art genetic tools, will be important in achieving the Science Program's stated purpose of identifying trends and patterns of populations and system response to a changing environment. This information would assist in using existing environmental water supplies more effectively to protect at-risk salmon runs, as well as help determine the relative importance of direct entrainment at the Delta facilities. The abundance information would also provide verification for winter and spring run life-cycle models that link population abundance and survival to water project operations in the Delta.

I therefore support the funding of this proposal in the current solicitation process, as it will provide timely information for improved management and protection of these listed runs.

Sincerely,

Alice F. Low
Senior Fishery Biologist
Central Valley Salmon Program
Fisheries Branch