I. EXECUTIVE SUMMARY

A. Project Title and Applicant Name

Monitoring adult and juvenile spring and winter chinook salmon in Battle Creek, California.

U.S. Fish and Wildlife Service, Northern Central Valley Fish and Wildlife Office
10950 Tyler Road, Red Bluff, California 96080
Phone: (916)527-3043, FAX: (916)529-0292, E-mail: JIM_SMITH@MAIL.FWS.GOV
Principle investigator - Steve Croci

B. Project Description and Primary Biological/Ecological Objectives

The goal of this project is to obtain life history information on spring and winter chinook salmon in Battle Creek. This information will assess the suitability of the current habitat and provide an evaluation tool for restoration activities. The following objectives will be determined separately for both spring and winter chinook salmon in Battle Creek:

1. number of adults returning;
2. timing of adult migration;
3. age, size and sex of returning adults;
4. timing of spawning;
5. timing of fry emergence;
6. growth rate of juvenile salmon;
7. timing of juvenile emigration;
8. size of emigrating salmon;
9. collect tissue samples from adult and juvenile chinook salmon for genetic analysis, and;
10. potential limiting factors effecting survival at various life stages.

C. Approach/Tasks/Schedule

Activity description, starting and ending date of winter and spring chinook salmon monitoring on Battle Creek beginning in January 1998 and continuing yearly thereafter.

Activity	Start Date	End Date
Coleman NFH barrier dam fish counts	Late - February	Early - July
Snorkel surveys	Early - May	Early - November
Juvenile monitoring	Start of January	End of December

D. Justification for Project and Funding by CALFED

Spring chinook salmon are considered a candidate species by the State of California and winter chinook salmon are federally and state listed as endangered and both are identified as priority species by the CALFED Bay/Delta Program. This proposal will serve to monitor instream aquatic and shaded riverine aquatic habits which were identified by CALFED as priority habitats. Restoration efforts are being conducted on Battle Creek for spring chinook salmon. The Central Valley Project Improvement Act - Anadromous Fish Restoration Plan and Winter Chinook Salmon Recovery Team recommended exploring the potential of developing a winter chinook salmon population in Battle Creek. Current restoration efforts on Battle Creek allow spring run

the opportunity to access what is believed to be suitable habitat, however, conditions for winter chinook salmon are questionable.

This proposal is designed to obtain life history information on spring and winter chinook salmon in Battle Creek. This effort is being pursued to: 1) preserve a remanent population of spring chinook salmon; 2) assess the winter chinook salmon propagation program; 3) assess the feasibility of developing a winter chinook salmon a population in Battle Creek; and, 4) evaluate the effectiveness of ongoing restoration actions. The information collected in this study will help in: 1) characterizing existing populations; 2) determining the quality and quantity of available habitat; and, 3) identifying possible habitat limitations affecting salmon populations.

E. Budget Costs and Third Party Impacts

Annual project costs in 1998 will be $422,777 and expected to be the same for following years. This project should be funded for a minimum of three years, however, this project is envisioned to be multi-year and should continue as long as the data is needed by managers and researchers working on restoration projects in Battle Creek. There are expected to be no third party impacts.

F. Applicants Qualifications

The U.S. Fish and Wildlife Service's Northern Central Valley Fish and Wildlife Office has been conducting surveys on Battle Creek to obtain adult life history information on spring and winter chinook salmon since 1995. Limited juvenile sampling has also be conducted during this time period. The Northern Central Valley Fish and Wildlife Service has been extensively involved with monitoring chinook salmon in the Northern Sacramento River since 1978. The Service has a strong interest in Battle Creek as it has been operating the Coleman National Fish Hatchery located in the Battle Creek watershed since 1942.

G. Monitoring and Data Evaluation

Quarterly reports will be developed describing recent findings. Annual reports will describe life history information for a particular brood year. Compiled data will be reviewed by peers (California Department of Fish and Game, Interagency Ecological Program, National Marine Fisheries Service, and other Service offices) in order to make the best decisions to enhance Battle Creek.

H. Local Support/Coordination with Other Programs/Compatibility with CALFED Objectives

The objective of monitoring, assessing and reporting on priority species, habitat and stressors of concern will be met by this proposal. Aspects of this proposal will address recommendations by the Winter Chinook Salmon Recovery Team and the Anadromous Fish Restoration Plan to assess the feasibility of developing a winter chinook salmon run in Battle Creek. Conducting these monitoring activities will assist in the evaluation of the winter chinook salmon propagation program being conducted at Coleman National Fish Hatchery located on Battle Creek. Methodologies used are recommended by Comprehensive Assessment and Monitoring Program. Additionally, California Department of Water Resources is proposing to improve passage and reduce entrainment at Pacific Gas and Electric barriers in Battle Creek and this proposal would be a means to assess the effectiveness of those improvements.

II. TITLE PAGE

A. Title of Project

Monitoring adult and juvenile spring and winter chinook salmon in Battle Creek, California.

B. Name of Applicant

U.S. Fish and Wildlife Service, Northern Central Valley Fish and Wildlife Office
10950 Tyler Road, Red Bluff, California 96080
Phone: (916)527-3043, FAX: (916)529-0292, E-mail: JIM_SMITH@MAIL.FWS.GOV
Principle Investigator - Steve Croci

C. Type of Organization and Tax Status

Federal Government, tax exempt

D. Tax Identification Number

E. Technical/Financial Contact

Rich Johnson

F. Participants/Collaborators in Implementation

none

G. RFP Project Group Type

Group type 3 - Other services

III. PROJECT DESCRIPTION

A. Project Description and Approach

The goal of this project is to obtain life history information on spring and winter chinook salmon in Battle Creek. This information will assist in assessing the suitability of the current habitat and provide an evaluation tool for restoration activities. The following objectives will be determined separately for both spring and winter chinook salmon in Battle Creek:

1. number of adults returning;
2. timing of adult migration;
3. age, size and sex of returning adults;
4. timing of spawning;
5. timing of fry emergence;
6. growth rate of juvenile salmon;
7. timing of juvenile emigration;
8. size of emigrating salmon;
9. collect tissue samples from adult and juvenile chinook salmon for genetic analysis, and;
10. potential limiting factors effecting survival at various life stages.

Number of adults returning

The number of adults returning to Battle Creek will be determined by counting adult salmon that ascend the Coleman NFH's barrier dam fish ladder and counting salmon redds. Passage at the Coleman NFH barrier dam will be conducted from early - March through early - July. All other times of the year, the barrier prevents fish passage and is used to divert salmon into Coleman NFH for propagation purposes. Most passage will be video recorded and the tapes will then be reviewed to count salmon that had passed. Some fish ascending the ladder will be trapped to obtain biological information. The number of fish trapped and then passed above the barrier or relocated will be used in escapement estimates. Estimates will be derived by expanding the total number of salmon counted by the percentage of time that passage was observed.

Five times a week from May through October, snorkel surveys will be conducted on Battle Creek to count chinook salmon redds. A salmon per redd ratio above the Coleman NFH barrier dam will be determined based on estimates from barrier dam counts and spawning ground surveys. The number of salmon returning to Battle Creek which do not pass the barrier dam will be estimated by multiplying the number of redds observed below by the salmon per redd ratio above. The estimate below the barrier dam will likely only occur for winter chinook salmon since difficulties exist in distinguishing spring and fall chinook salmon redds due to lack of temporal isolation. A more thorough explanation of the methodology for adult escapements estimation in Battle Creek can be found in "Escapement of hatchery-origin winter chinook salmon (*Oncorhynchus tshawytscha*) to the Sacramento River, California in 1995, with notes on spring chinook salmon in Battle Creek" (USFWS 1996).

Timing of adult migration

Timing and peak adult migration periods for spring and winter chinook salmon will be determined

by observing fish passage at the Coleman NFH barrier dam. The estimated number of spring and winter chinook salmon ascending the barrier dam will be plotted weekly for the time period that passage was observed. This will be accomplished by both video monitoring and trapping.

Age, size and sex of returning adults

Carcasses will be collected during spawning ground surveys to determine age, size and sex of returning adults. Carcasses will be measured (fork length in mm), sexed, checked for marks and expression of sex products. Scales will be collected for ageing. Additionally, the Service will trap adults at the Coleman NFH barrier dam. Length measurements and tissue samples will be collected from salmon that are trapped. A length frequency distribution will be plotted, and age-at-length will be determined by scale reading. Tissue samples will be submitted for genetic analysis to assist in discriminating the various runs.

Timing of spawning

Snorkel surveys will be conducted daily on Battle Creek (excluding weekends and holidays) to locate spring and winter chinook salmon holding and spawning locations beginning in May and continuing through October. The total numbers and location of salmon observed will be recorded. Redds will be marked with flagging or some other visible marker to avoid counting twice. Timing and peak spawning will be determined by redd counts. Aerial surveys will also be conducted from May through October to identify/verify chinook salmon redds and spawning areas.

Timing of fry emergence and growth rate

Fry emergence will be determined by comparing peak spawning with water temperature. By knowing timing and peak of spawning, daily temperature units can be use to determine emergence. As a part of this proposal, temperature recorders will be deployed where redds were observed. These areas will then be sampled by electro-fishing, beach seine or snorkeling to capture or observe fry. These areas will be sampled twice a week until juveniles have emigrated. Growth rates and condition factors will be determined from length and weight measurements of captured juveniles. Temperature recorders will be deployed by CDFG at various locations along Battle Creek and will also be used to obtain daily temperature units.

Timing and length frequency of emigrating juveniles

A 5-foot diameter rotary screw trap will be fished daily at a location just upstream of the Coleman NFH barrier dam. A location above the barrier dam should eliminate capturing steelhead, and fall and late-fall chinook salmon juveniles released from Coleman NFH. Trapping will occur year round. Captured fish will be identified to species, enumerated, and measured (fork length in mm). A length frequency distribution will be determined as well as a fry to yearling emigration ratio. The timing and peak emigration of fry and yearlings will also be determined.

Tissue collection for genetic analysis

Tissue samples will be collected from adult carcasses during stream surveys, live adults from trapping operations and from juveniles collected by rotary screw-trap, electro-fishing and beach seining for genetic analysis. A hole punch will be used to obtain 3 small pieces of tissue (primarily fin) from adult salmon. Samples will be stored in a small vial containing tris - glycine buffer.

Juveniles will be sampled by clipping a small (<1 mm^2) of the caudal fin. The sample will also be preserved in a vial containing tris - glycine buffer and archived at the Northern Central Valley Fish and Wildlife Office (NCVFWO). Collection of tissue samples from 400 juvenile will be spread throughout the entire year. Sampling will be proportional to the number of juveniles collected at the rotary screw trap. Tissue samples from both adult and juveniles will be forwarded to the University of California's Bodega Marine Laboratory and CDFG (Sacramento) tissue archive for eventual genetic analysis. A sample will also be archived at the NCVFWO, Red Bluff, California. These samples will be used in a continuing projects to discriminate between runs of chinook salmon.

B. Location and/or geographic boundaries of project

Battle Creek is located in northern Tehama and southern Shasta counties, California, and drains the volcanic slopes of Lassen Peak into the Sacramento River (river mile 272) from the east. The creek is fed by many springs. Battle Creek has been identified as a creek with high restoration potential because of its relatively high natural and consistent flow of cold water.

C. Expected Benefits

The primary stressors to the aquatic habit in Battle Creek include changes to the natural hydrograph, migration barriers, and entrainment, all which effect winter and spring chinook salmon. Hydroelectric power generation, agriculture and aquaculture are a few of the anthropomorphic activities in Battle Creek have effected the environment. Expected benefits for completing the work in this proposal include: 1) preserving a remanent population of spring chinook salmon; 2) assessing the effectiveness of the winter chinook salmon propagation program; 3) assessing the feasibility of developing a winter chinook salmon a population in Battle Creek, and; 4) evaluating the effectiveness of ongoing restoration actions. Restoration actions currently underway include increasing flows below Eagle Canyon and Coleman Diversion dams, opening up the Coleman National Fish Hatchery barrier dam for a longer duration of time, and investigating the feasibility of screening and improving passage at Pacific Gas and Electric diversion dams.

D. Background and Biological/Technical Justification

Background

The Service estimated escapement of winter and spring chinook returning to Battle Creek in 1995 and 1996, and collected most data to make estimates in 1997. Estimates were based on counts at the Coleman National Fish Hatchery (NFH) barrier dam and stream surveys. In 1995 an estimated 84 hatchery-origin winter chinook salmon and 66 spring chinook salmon returned to Battle Creek (USFWS 1996). In 1996, 228 hatchery-origin and 34 spring chinook salmon returned (Croci and Hamelberg 1997 a & b). Current management attempts to restricts the available habitat for winter and spring chinook salmon below Coleman Diversion Dam on the south fork and Eagle Canyon on the north fork. Restricting the salmon in what is believed to be suitable habitat is an effort to confine the adults to assist in pairing (i.e. finding mates; Elliott

1995), prevent entrainment of the resultant juveniles into water diversions and provide more control over flow management. However, salmon are likely able to pass these barriers during high flows.

Limited effort has been afforded to determine if spring and winter chinook salmon are successfully reproducing in Battle Creek. In 1995, potential rearing habitat was sampled by beach seine on 4 occasions, however, no juvenile salmon were observed. No effort was made to sample for spring chinook salmon. In 1996, while conducting adult snorkel surveys for winter chinook salmon in mid-May through mid-October, juvenile salmon were observed. During September through mid-October juvenile salmon were captured using beach seine, electro-fishing and angling in areas from Coleman Diversion and Eagle Canyon dams downstream to creek mile 4. Captured juvenile salmon ($N = 86$) ranged in size from 60 to 158 mm. Genetic samples were collected from all salmon. The specific run of these juveniles is unknown as adults of all four runs were known to inhabit the surveyed area, including the area above the Coleman NFH barrier dam.

Very limited effort has been afforded to understanding the life history of winter and spring chinook salmon in Battle Creek. With a better knowledge of the life history, factors potentially limiting production may be identified. Specific restoration activities that will aid in restoring the system to its potential can be pursued and evaluated once these limiting factors are known.

Justification

Spring chinook salmon are considered a candidate species by the State of California and winter chinook salmon are federally and state listed as endangered. Currently restoration efforts are being conducted on Battle Creek for spring chinook salmon, and, the Central Valley Project Improvement Act - Anadromous Fish Restoration Plan and the Winter Chinook Salmon Recovery Team recommended exploring the potential of developing a winter chinook salmon population in Battle Creek. Current restoration efforts on Battle Creek allow spring run the opportunity to access what is believed to be suitable habitat, however, conditions for winter chinook salmon are questionable.

Conducting items in this proposal will provide information on life history characteristics and the suitable of the available habitat in Battle Creek for winter and spring chinook salmon. Surveys will also identify limiting factors and assess the effectiveness of restoration actions. The benefits to this project include maintaining a an remanet population of spring chinook salmon, assessing the effectiveness of the winter chinook salmon propagation program, and assessing the feasibility of developing a winter chinook salmon population in Battle Creek.

E. Proposed Scope of Work

Work will begin in January 1998 and should be considered to be a multi-year project. This project should continue as long as the data is needed by managers working on restoration actions in Battle Creek. The project has three main tasks: Coleman National Fish Hatchery barrier dam monitoring, snorkel surveys and juvenile monitoring (Table 1). Updates on accomplished work will be provided quarterly. Each February an annual report will be disseminated that summarizes the previous years activity and suggests recommendations.

Table 1.—Activity description, starting and ending date of winter and spring chinook salmon monitoring on Battle Creek beginning in January 1998 and continuing yearly thereafter.

Activity	Start Date	End Date
Coleman NFH barrier dam fish counts	Late - February	Early - July
Snorkel surveys	Early - May	Early - November
Juvenile monitoring	Start of January	End of December

F. Monitoring and Data Evaluation

This proposal is designed to be a monitoring program to assist in determining life history strategies, identifying limiting factors and evaluating restoration actions in Battle Creek. Proposed restoration actions such as determining alternatives to screening and ladder at Pacific Gas and Electric diversions are developing proposals to be funded through CALFED. Monitoring for adult and juvenile salmon will be consistent with those outlined in the Comprehensive Assessment and Monitoring Program (CAMP) guidelines. Proposed monitoring will complement the evaluation of the winter chinook salmon propagation program being conducted at the Service's Coleman National Fish Hatchery.

G. Implementability

The Service has the required collecting permits for sampling aquatic species and permission from several landowners to access Battle Creek. The proposed project may be effected by extreme hydrologic/climatic conditions but various techniques employed will allow objectives to be met.

References

Croci, S.J. and S. Hamelberg. 1997a. Evaluation of the Sacramento River winter chinook salmon (*Oncorhynchus tshawytscha*) propagation program in 1996. USFWS Report. U.S. Fish and Wildlife Service, Northern Central Fish and Wildlife Office, Red Bluff, CA.

Croci, S.J., and S. Hamelberg. 1997b. *Draft* Escapement of spring chinook salmon (*Oncorhynchus tshawytscha)* to Battle Creek, California in 1996. USFWS Report. U.S. Fish and Wildlife Service, Northern Central Valley Fish and Wildlife Office, Red Bluff CA.

Elliott, Richard L., Regional Manager, California Department of Fish and Game. [Letter to Mr. R.J. Sandhofner, Pacific Gas and Electric Company]. 1995 April 20.

USFWS. 1996. Escapement of hatchery-origin winter chinook salmon (*Oncorhynchus tshawytscha*) to the Sacramento River, California in 1995, with notes on Spring chinook salmon in Battle Creek. USFWS Report. Northern Central Valley Fish and Wildlife Office. Red Bluff, CA.

IV. COSTS AND SCHEDULE TO IMPLEMENT PROPOSED PROJECT

A. Budgeted Costs

Annual project costs in 1998 will be $422,777 and expected to be the same for following years. This project should be funded for a minimum of three years, however, this project is envisioned to be multi-year and should continue as long as the data is needed by managers and researchers working on restoration projects in Battle Creek. Funding could be potentially shared with Anadromous Fish Restoration Plan and CAMP programs, if and when the fund become available.

B. Scheduled Milestones

See Table 1.

C. Third Party Impacts

There are expected to be no third party impacts.

Table 2.—Proposed budget to complete identified tasks associated with monitoring adult and juvenile spring and winter chinook salmon in Battle Creek, California.

Task	Direct Labor Hours	Direct Salaries and Benefits	Vehicle	Materials	Miscellaneous	Overhead Labor	Total Costs
Coleman NFH barrier dam counts	2316	$72,375	$1,800		$2,000	$14,473	$90,648
Snorkel surveys	2964	$92,625	$4,800		$2,000	$18,891	$118,316
Juvenile Monitoring	5052	$157,875	$4,800	$15,000	$2,000	$34,138	$213,813
						Total Cost 1999	$422,777

V. APPLICANT QUALIFICATIONS

The U.S. Fish and Wildlife Service's Red Bluff Fish and Wildlife Office has been conducting surveys on Battle Creek to obtain adult life history information on spring and winter chinook salmon since 1995. Limited juvenile sampling has also be conducted during this time period. The Red Bluff Fish and Wildlife Service has been extensively involved with monitoring chinook salmon in the Northern Sacramento River since 1978. The Service has a strong interest in Battle Creek as it has operated the Coleman National Fish Hatchery located in the Battle Creek watershed since 1942.

VI. COMPLIANCE WITH STANDARD TERMS AND CONDITIONS

Appropriate documents and signatures regarding Submittal/Compliance of Standard Terms and Conditions will be provided prior to signing final contracts, as indicated in Table D-1 matrix of Standard Clauses/Proposal Request for a public agency proposing a Group 3 (Services) application type.