Feasibility of Geographic Specific Selective Fisheries for Central Valley Origin Chinook Salmon

Project Information

1. **Proposal Title:**

   Feasibility of Geographic Specific Selective Fisheries for Central Valley Origin Chinook Salmon

2. **Proposal applicants:**

   Randy Bailey, Bailey Environmental
   Ted Bjornn, Idaho Cooperative Fish and Wildlife Research Unit
   Christine Moffitt, University of Idaho

3. **Corresponding Contact Person:**

   Randy Bailey
   Bailey Environmental
   3050 Meadow Creek Road Lincoln, CA 95648
   916 645-1235
   rebailey

4. **Project Keywords:**

   Anadromous salmonids
   At-risk species, fish
   Hatchery Management

5. **Type of project:**

   Research

6. **Does the project involve land acquisition, either in fee or through a conservation easement?**

   No

7. **Topic Area**:

   At-Risk Species Assessments

8. **Type of applicant:**

   Private for profit

9. **Location - GIS coordinates:**

   Latitude: 37.846

   Longitude: 122.418

   Datum:

Describe project location using information such as water bodies, river miles, road intersections, landmarks, and size in acres.

Project area includes all areas of Central Valley with chinook salmon distribution, San Francisco Bay, and coastal California adjacent to chinook salmon distribution.

10. **Location - Ecozone:**

    Code 15: Landscape

11. **Location - County:**

    Alameda, Butte, Calaveras, Colusa, Contra Costa, El Dorado, Glenn, Lassen, Marin, Mendocino, Merced, Monterey, Napa, Nevada, Placer, Plumas, Sacramento, San Francisco, San Joaquin, San Mateo, Santa Cruz, Shasta, Sierra, Solano, Sonoma, Stanislaus, Sutter, Tehama, Tuolumne, Yuba

12. **Location - City:**

    Does your project fall within a city jurisdiction?

    No

13. **Location - Tribal Lands:**

    Does your project fall on or adjacent to tribal lands?

    No

14. **Location - Congressional District:**

    4

15. **Location:**

    California State Senate District Number: 1

    California Assembly District Number: 4

16. **How many years of funding are you requesting?**

    1

17. **Requested Funds:**
    a) Are your overhead rates different depending on whether funds are state or federal?

       No

       If no, list single overhead rate and total requested funds:

       Single Overhead Rate: 5

       Total Requested Funds: 62,835

b) Do you have cost share partners already identified?

Yes

If yes, list partners and amount contributed by each:

USGS Idaho Cooperative Fish and Wildlife Research Unit 3,400

c) Do you have potential cost share partners?

No

d) Are you specifically seeking non-federal cost share funds through this solicitation?

No

If the total non-federal cost share funds requested above does not match the total state funds requested in 17a, please explain the difference:

18. **Is this proposal for next-phase funding of an ongoing project funded by CALFED?**

No

Have you previously received funding from CALFED for other projects not listed above?

No

19. **Is this proposal for next-phase funding of an ongoing project funded by CVPIA?**

No

Have you previously received funding from CVPIA for other projects not listed above?

No

20. **Is this proposal for next-phase funding of an ongoing project funded by an entity other than CALFED or CVPIA?**

No

Please list suggested reviewers for your proposal. (optional)

21. **Comments:**

Environmental Compliance Checklist

Feasibility of Geographic Specific Selective Fisheries for Central Valley Origin Chinook Salmon

1. **CEQA or NEPA Compliance**
   a) Will this project require compliance with CEQA?

      No
   b) Will this project require compliance with NEPA?

      No
   c) If neither CEQA or NEPA compliance is required, please explain why compliance is not required for the actions in this proposal.

      This is a research project on salmon imprinting. It requires no environmeal disturbance. It is a feasibility report only.

2. **If the project will require CEQA and/or NEPA compliance, identify the lead agency(ies).** *If not applicable, put "None".*

   CEQA Lead Agency:
   NEPA Lead Agency (or co-lead:)
   NEPA Co-Lead Agency (if applicable):

3. **Please check which type of CEQA/NEPA documentation is anticipated.**

   CEQA
   -Categorical Exemption
   -Negative Declaration or Mitigated Negative Declaration
   -EIR
   Xnone

   NEPA
   -Categorical Exclusion
   -Environmental Assessment/FONSI
   -EIS
   Xnone

   If you anticipate relying on either the Categorical Exemption or Categorical Exclusion for this project, please specifically identify the exemption and/or exclusion that you believe covers this project.

4. **CEQA/NEPA Process**
   a) Is the CEQA/NEPA process complete?

      Not Applicable

   b) If the CEQA/NEPA document has been completed, please list document name(s):

5. **Environmental Permitting and Approvals** (*If a permit is not required, leave both Required? and Obtained? check boxes blank.*)

LOCAL PERMITS AND APPROVALS

Conditional use permit

Variance

Subdivision Map Act

Grading Permit

General Plan Amendment

Specific Plan Approval

Rezone

Williamson Act Contract Cancellation

Other

STATE PERMITS AND APPROVALS

Scientific Collecting Permit

CESA Compliance: 2081

CESA Compliance: NCCP

1601/03

CWA 401 certification

Coastal Development Permit

Reclamation Board Approval

Notification of DPC or BCDC

Other

FEDERAL PERMITS AND APPROVALS

ESA Compliance Section 7 Consultation

ESA Compliance Section 10 Permit

Rivers and Harbors Act

CWA 404

Other

PERMISSION TO ACCESS PROPERTY

Permission to access city, county or other local agency land.
Agency Name:

Permission to access state land.
Agency Name:

Permission to access federal land.
Agency Name:

Permission to access private land.
Landowner Name:

6. **Comments.**

Land Use Checklist

Feasibility of Geographic Specific Selective Fisheries for Central Valley Origin Chinook Salmon

1. **Does the project involve land acquisition, either in fee or through a conservation easement?**

   No

2. **Will the applicant require access across public or private property that the applicant does not own to accomplish the activities in the proposal?**

   No

3. **Do the actions in the proposal involve physical changes in the land use?**

   No

   If you answered no to #3, explain what type of actions are involved in the proposal (i.e., research only, planning only).

   research only, no land disturbance.

4. **Comments.**

Conflict of Interest Checklist

Feasibility of Geographic Specific Selective Fisheries for Central Valley Origin Chinook Salmon

Please list below the full names and organizations of all individuals in the following categories:

- Applicants 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.
- Subcontractors listed in the proposal who will perform some tasks listed in the proposal and will benefit financially if the proposal is funded.
- Individuals not listed in the proposal who helped with proposal development, for example by reviewing drafts, or by providing critical suggestions or ideas contained within the proposal.

The information provided on this form will be used to select appropriate and unbiased reviewers for your proposal.

Applicant(s):

Randy Bailey, Bailey Environmental
Ted Bjornn, Idaho Cooperative Fish and Wildlife Research Unit
Christine Moffitt, University of Idaho

Subcontractor(s):

Are specific subcontractors identified in this proposal? Yes

If yes, please list the name(s) and organization(s):

Dr. Christine Moffitt University of Idaho

Helped with proposal development:

Are there persons who helped with proposal development?

No

Comments:

Budget Summary

Feasibility of Geographic Specific Selective Fisheries for Central Valley Origin Chinook Salmon

Please provide a detailed budget for each year of requested funds, indicating on the form whether the indirect costs are based on the Federal overhead rate, State overhead rate, or are independent of fund source.

Independent of Fund Source

Year 1												
Task No.	**Task Description**	**Direct Labor Hours**	**Salary *(per year)***	**Benefits *(per year)***	**Travel**	**Supplies & Expendables**	**Services or Consultants**	**Equipment**	**Other Direct Costs**	**Total Direct Costs**	**Indirect Costs**	**Total Cost**
1	Conduct Literature Review, Review Case Studies, Write Feasibility Report				4000		56075			60075.0	2760	62835.00
		0	0.00	0.00	4000.00	0.00	56075.00	0.00	0.00	60075.00	2760.00	62835.00

Year 2												
Task No.	**Task Description**	**Direct Labor Hours**	**Salary *(per year)***	**Benefits *(per year)***	**Travel**	**Supplies & Expendables**	**Services or Consultants**	**Equipment**	**Other Direct Costs**	**Total Direct Costs**	**Indirect Costs**	**Total Cost**
		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Year 3												
Task No.	**Task Description**	**Direct Labor Hours**	**Salary *(per year)***	**Benefits *(per year)***	**Travel**	**Supplies & Expendables**	**Services or Consultants**	**Equipment**	**Other Direct Costs**	**Total Direct Costs**	**Indirect Costs**	**Total Cost**
		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Grand Total=62835.00

Comments.
All budget costs are estimated as consulting contracts for Bailey Environmental and the University of Idaho. All benefits are included in the hourly rates quoted in the budget justification form. University of Idaho's overhead rate is 25% for the $3,900 contract for Christine Moffitt and Pam Porter for a total of $4,875.00 to the University of Idaho. Randy Bailey's hourly rate includes all benefits.

Budget Justification

Feasibility of Geographic Specific Selective Fisheries for Central Valley Origin Chinook Salmon

Direct Labor Hours. Provide estimated hours proposed for each individual.

0

Salary. Provide estimated rate of compensation proposed for each individual.

0

Benefits. Provide the overall benefit rate applicable to each category of employee proposed in the project.

0

Travel. Provide purpose and estimate costs for all non-local travel.

Travel includes three trips (Alaska in late fall or winter, Moscow, Idaho, and Portland-Olympia) to discuss the science of the project, review case studies similar to the project concept, and to acquire documention of previous case studies which are not published in the literature, but do exist in a variety of agency memos, technical memoranda, and gray literature that is not available online. Estimated cost is $4,000.00

Supplies & Expendables. Indicate separately the amounts proposed for office, laboratory, computing, and field supplies.

$0.00

Services or Consultants. Identify the specific tasks for which these services would be used. Estimate amount of time required and the hourly or daily rate.

Contract with the University of Idaho to provide initial literature review and report scoping and draft report review. Estimated 60 hours - Christine Moffitt - Univesity of Idaho - University Rate $45.00/hr Estimated 80 hours - Pam Porter - University of Idaho - $15.00/hour Estimated 60 hours - Ted Bjornn - Idaho Cooperative Fish and Wildlife Research Unit - No charge University of Idaho Overhead Rate is 25% Estimated 440 hours for Randy Bailey @ $100.00/hour to review the applicable literature, meet with the various agency staffs that have completed undocumented and unpublished case studies, write and revise the feasibility report.

Equipment. Identify non-expendable personal property having a useful life of more than one (1) year and an acquisition cost of more than $5,000 per unit. If fabrication of equipment is proposed, list parts and materials required for each, and show costs separately from the other items.

$0.00

Project Management. Describe the specific costs associated with insuring accomplishment of a specific project, such as inspection of work in progress, validation of costs, report preparation, giving presentatons, reponse to project specific questions and necessary costs directly associated with specific project oversight.

72 Hours - Randy Bailey at $100.00 per hour.

Other Direct Costs. Provide any other direct costs not already covered.

$0.00

Indirect Costs. Explain what is encompassed in the overhead rate (indirect costs). Overhead should include costs associated with general office requirements such as rent, phones, furniture, general office staff, etc., generally distributed by a predetermined percentage (or surcharge) of specific costs.

Overhead rate of 5% includes fax, phone, report printing costs, general computer costs. Note that the overhead rate is only 5% which is considerably less than major consulting firms or university researchers.

Executive Summary

Feasibility of Geographic Specific Selective Fisheries for Central Valley Origin Chinook Salmon

This research project will document the appropriate literature and case studies applicable to geographic specific imprinting for chinook salmon. This technique has been used in other locations to create new selective fisheries and direct returning adults to specific locations for harvest. In the Central Valley, this technique could be used as a hatchery management tool to eliminate/reduce the current problem of excess spawning escapements to Central Valley streams. This feasibility report will document the existing science and case studies and make recommendations regarding the applicability of using this technique in California. If this technique were to be adopted in California, it would be multi-regional in scope and address both CALFED and CVPIA goals with respect to species at risk, harvestable species, and restoration of anadromous salmonids.

Proposal

Bailey Environmental

Feasibility of Geographic Specific Selective Fisheries for Central Valley Origin Chinook Salmon

Randy Bailey, Bailey Environmental
Ted Bjornn, Idaho Cooperative Fish and Wildlife Research Unit
Christine Moffitt, University of Idaho

Feasibility of Geographic Specific Selective Fisheries for Chinook Salmon of Central Valley Origin

A. Project Description: Project Goals and Scope of Work

1. Problem - This project is designed to address a potential solution to the problem of excess chinook salmon escapement to Central Valley hatchery facilities and adjacent streams. Recent reductions in ocean exploitation rates, by the Pacific Fisheries Management Council (Council) to provide additional protection for listed chinook species, coupled with favorable ocean conditions has resulted in excessive spawning escapements to several Central Valley streams. These excessive escapements have resulted in degraded water quality, superimposition of redds, increased juvenile competition with wild stocks, increased straying of hatchery origin fish to adjacent watersheds, and in some cases embarrassing public relations problems for resource agencies. Commercial fishing interests are deeply concerned about the excess escapements because the hatchery origin fish are required as mitigation for water project impacts, but these same mitigation fish are now not available to the commercial and marine recreational fishermen. This project is intended to review the applicable and appropriate literature regarding Pacific salmon imprinting, review the case studies in other states where geographically specific imprinting and selective fisheries have been implemented, identify the specific management concerns that have surfaced as a result of these fisheries, and make recommendations to CALFED and the resource management agencies on whether geographically specific imprinting and associated selective fisheries have the potential to eliminate/reduce the excess spawning escapement currently occurring in Central Valley streams. The goal is to produce a scientifically defensible feasibility report that makes recommendations on establishing geographically specific selective fisheries in California as a management technique designed to maximize the use of hatchery origin fish, while at the same time reducing the multiple biological impacts to inland areas and naturally spawning chinook salmon stocks. If the science and other agencies' experience with this management technique prove feasible in California, then this project could form the foundation for an entirely new approach to hatchery and fisheries management for Central Valley chinook salmon stocks.

Geographically specific imprinting has been used to create new fisheries in Alaska for chinook salmon on the Kenai Peninsula and near Juneau and for pink and chum salmon in Prince William Sound (Dave Watsjold, U.S. Fish and Wildlife Service, Anchorage and formerly sport fish biologist with the Alaska Department of Fish and Game, pers. comm.). The State of Washington has experimented with similar concepts, but the results are not published in the readily available literature (Dr. Lee Blankenship, Washington Department of Fish and Wildlife and Guy Thornburgh, Northwest Marine Technology, pers. comms.). Dr. Ted Bjornn, Idaho Cooperative Fish and Wildlife Research Unit has conducted a number of geographically specific imprinting studies as an adjunct to other larger studies, but the results of these specific studies have not been published. Attempts over the last four months to obtain what written documentation

exists (according to Watsjold, this information is scattered through a wide range of Federal Aid reports, technical memoranda, and interoffice memoranda) for Alaska's decade long experiences has been unsuccessful.

2. **Justification -** Ocean salmon management has undergone major changes in the past decade, primarily in response to species listings under the Endangered Species Act, these changes have exacerbated spawning escapement problems in inland areas. The current situation cannot continue and what is needed is a new approach to hatchery and fisheries management for Central Valley hatchery origin chinook salmon stocks. The current problems facing chinook salmon management are a consequence of the anthropogenic changes in the quantity and quality of habitats available to chinook salmon as the Central Valley began to develop in the later half of the 19th century. As the population of California increased, the focus of land management became the development of the natural resources in the Central Valley to support the needs of a burgeoning population and interstate commerce. Control and use of water resources was the critical element of this resource management, first for agricultural development and later to support California's rapidly growing urban-industrial development. Water resource development involved draining floodplains and channelizing rivers, and, to ensure reliable water for agricultural and urban use in the 6-month dry season, the construction of hundreds of impoundments.

As a result, access to many upstream areas was blocked by dams and diversions built for a variety of purposes. Estimated habitat losses are approximately 1,000 stream miles out of an original 1,300 miles of salmon distribution in the Central Valley. Stream habitat quality was degraded by mining practices; unscreened water diversions to support ranching and farming operations, delivery of drinking water to cities and towns, and production of hydropower; logging and grazing practices which removed riparian vegetation along stream courses; and water storage reservoirs which changed the natural hydrograph, altered the water temperature regime downstream of the reservoir, reduced the volume of water flowing down the stream during critical times of the year, and changed the stream's sediment transport and substrate characteristics.

At the same time these practices were occurring in upstream areas, major changes were made to downstream areas as well. These alterations included development of major flood control structures, including a massive system of dikes and levees which further restricted access to traditional floodplain feeding, rearing, and migratory habitats. In the Sacramento-San Joaquin River Delta (Delta), the inland estuary-marsh system was converted to a series of islands encircled by levees, resulting in the creation of a maze of channels. Increases in ship traffic into San Francisco Bay and Estuary also started the onslaught of unintentional introductions of non-native aquatic species which immediately began to displace the native flora and fauna. Humans also intentionally introduced a number of species which have had a negative impact on chinook salmon in the system.

All of these changes to the aquatic system are well documented. Historical public policy and a lack of understanding of the cumulative effects these actions would have on salmon populations resulted in conditions that caused Central Valley salmon stocks to

decline dramatically. Recognizing that loss of habitat and other factors have adverse impacts on salmon stocks; efforts were made, based on the "biological wisdom" of the time, to mitigate for the effects of some of these changes, primarily the effects of major water supply reservoirs. Up to and including the 1960's, the primary mitigation strategy pursued was based on the premise that losses of wild runs and races of chinook salmon in the Central Valley could be offset by building artificial production facilities. As a result, major production facilities were built on Battle Creek (Coleman National Fish Hatchery), Feather River (Feather River Fish Hatchery), American River (Nimbus Fish Hatchery), Mokelumne River (Mokelumne River Fish Installation), Merced River (Merced River Fish Facility), Sacramento River below Keswick Dam (Livingston Stone National Fish Hatchery). Facilities at other locations and streams which have been abandoned or subsumed by the current facilities.

Since the 1960's, hatchery production in mitigation for the impacts of major water development facilities has been up to 35 million juvenile chinook salmon per year. Based on the assumption that this production was adequate to mitigate for habitat loss and other anthropogenic impacts, fisheries managers permitted harvest rates for chinook salmon from the Central Valley approaching 75%, with fall run chinook from the San Joaquin sometimes exceeding 80%. Although inland harvest was not systematically assessed, inland managers began to notice declines in the number of naturally-spawning fish (the term naturally spawning is used in California to describe a fish spawning in a stream, whether the fish is wild or of hatchery origin), and fishing was closed in the San Joaquin River and its tributaries. In response to these observations, there has recently been renewed interest in the effects of a variety of anthropogenic factors on the status of wild stocks (naturally spawning fish not of hatchery origin). The status of the both hatchery and wild stocks has been difficult to determine with any precision because (1) good spawning escapement estimates have not been available; (2) some hatcheries have adopted a practice of closing the entry fish ladder once the needed eggs have been secured, thus forcing hatchery-origin fish into the adjacent river; (3) the inability to differentiate hatchery origin from wild fish; and (4) the intense focus on juvenile salmon survival in the Delta and the impacts of the two major water diversion pumping plants has resulted in minimal study of ocean-related factors affecting the status of stocks.

The success of the artificial propagation program, coupled with the public policy decisions regarding harvest levels, hatchery management practices, and the importance of a balanced approach to understanding salmon ecology and management needs all contributed to a classic case of the "Law of Unintended Consequences." Artificial production facilities were built to mitigate for the impacts of lost and deteriorated salmon habitats in the Central Valley. The goal was to maintain the same number of returning adults, after the impacts, as occurred prior to impacts. The hatcheries constructed did not, however, have capacity to assimilate the large numbers of adult salmon associated with years of high escapement. Allowing surplus hatchery-origin adults to enter the hatchery and be destroyed was publically viewed as a "waste" of the resource, leaving managers with only two options:

a. Allow excess hatchery-origin escapement to spawn naturally in the river adjacent

to the hatchery, or

b. Reduce hatchery-origin escapement by allowing high harvest rates in the ocean.

In general, managers attempted to limit the spawning escapement to the hatcheries by supporting high exploitation rates in the various fisheries, but periods of high escapement continued to result in episodes of hatchery-origin fish being excluded from the hatchery and allowed to spawn naturally. The effect of these management strategies, combined with an inability to distinguish hatchery-origin from wild fish and an inadequate spawning escapement monitoring program, was that the status of wild stocks was difficult to assess. This same situation occurred in the Pacific Northwest and has been well documented by Jim Lichatowich (1999).

Between 1977 and 1989 several events occurred which further masked the problems facing wild stocks of chinook salmon remaining in Central Valley streams. Resource agencies continued the practice of separating spawning escapements into "naturally spawning" and those which returned to the hatcheries, without distinguishing between hatchery-origin and wild stocks. During this same time period, major problems had developed with spawning escapements of fall run chinook in the Klamath River basin. Severe declines in escapement resulted in time and area closures in the vicinity of the Klamath River mouth, with a resultant shift in fishing pressure and increased catch south along the California coast. This shift, combined with high exploitation rates based on hatchery production, placed even greater pressure on wild stocks in the Central Valley. In the midst of this time period was the occurrence of 1982-83 El Nino event, which for a variety of reasons resulted in lower chinook salmon production. As a general rule, overall fishing pressure increased along the California coast during this same time. Resource managers were also faced with inadequate or incomplete escapement estimates and creel census data from inland areas for fall run chinook. Agency biologists working on the Sacramento River in the Redding area also documented a steep decline in the spawning escapement of winter run chinook. This decline was hypothesized to have occurred because of water project operations at Red Bluff Diversion Dam (RBDD) and Central Valley Project (CVP) and State Water Project (SWP) south Delta pumping plants, poor juvenile survival conditions in the Delta, and harvest rates. As a result of the documented decline, winter run chinook were listed as a threatened species in 1989. As a result of the winter run listing and other concerns regarding the status of Klamath River fall run chinook stocks and coastwide coho stocks, fishing seasons have generally been shortened and the spring starting dates moved into May to minimize conflict with winter run spawning runs. In short:

a. Fishing seasons in the Klamath River area were being restricted to protect fall run chinook stocks;
b. Fishing effort along the coast was generally increasing;
c. There was a general shift in the distribution of that fishing pressure south towards San Francisco;
d. Salmon hatchery practices still focused on production and not conservation genetics or the impacts of hatchery releases on wild stocks; and
e. Exploitation rates in the mixed stock fishery remained high.

All of these factors, and several others, were being studied and evaluated somewhat independently. As a result, we either failed to understand the connections between these factors or did not see the comprehensive picture with respect to salmon ecology and management in the Central Valley.

The problems associated with this management regime were exacerbated by the 1987-1992 drought and the subsequent 1993 El Nino event which reduced nearshore upwelling, increased water temperatures, and decreased general marine productivity. The six-year drought generated significant contradictions for salmon managers. Although, inland habitat areas were greatly reduced in quantity and quality because of low stream flows, water management needs, and higher than normal water temperatures, harvests in 1987 and 1988 were at record levels, with high spring flows in 1983 and again in 1986 receiving credit for the production of large salmon cohorts. With the drought came an increased emphasis on water management issues and their impacts on salmon smolt survival. There is no doubt that instream conditions in tributaries to the Central Valley were bad. During the drought and immediately afterward, chinook salmon stocks appeared to decline dramatically, not only in California, but along the entire West Coast. As a result, all West Coast salmon stocks were eventually proposed for listing under the Endangered Species Act (Lichatowich 1999).

In response to the concerns, fishing seasons and area closures were further restricted. Continuing concerns about Klamath River basin stocks, coho stocks, and deepening concerns regarding winter run and spring run chinook from the Central Valley drove these further restrictions. The only bright spot, from a fisherman's point of view, was 1995 when chinook catch in California was approximately 1.08 million fish, the second highest catch since 1970. Most people attributed this success to increased restrictions on water management activities, high spring flows in 1993, and improved Delta survival. The impacts on wild stocks were still continuing to be masked by the high allowable exploitation rates and the 'naturally spawning" policy. Salmon research continued to focus on within-Delta survival and water project operations.

Beginning in the spring of 1995, the Central Valley experienced a number of consecutive wet winters which corresponded with good ocean conditions to set the stage for a general chinook salmon rebound. As Table 1 shows, since 1995 there has been a major shift in the management allocations of fall run chinook salmon stocks originating from the Central Valley. Commercial catch is down an average of 135,000 fish per year when compared to the pre-1995 time period. Recreational catch, not including the incomplete in-river time series, is up and average of 50% in the last six years. Mean total spawning escapement (defined here as all jacks and adults (naturally spawning and hatchery returns) is up approximately 67% in the last six years. Of the seven highest total spawning escapements in the Central Valley since 1970, six have occurred in the six year period from 1995-2000, with 1985 being the lone exception. The Council's conservation objective for the Sacramento River Basin is 122,000 to 180,000 adults returning to the system. The 1970-1994 average is about the middle of the conservation objective range. However, since 1995, the conservation objective range has been exceeded by an average of 64%, with the 2000 adult escapement exceeding the maximum objective by 138%.

Even the minimum adult escapement, in the Sacramento River Basin, has exceeded the maximum conservation objective by 32%.

Table 1 - Selected catch and spawning escapement summary parameters for fall run chinook salmon from California's Central Valley, 1970-2000.

	Pre - 1995		1995 - 2000	
PARAMETER [1]	**Mean**	**Range**	**Mean**	**Range**
Commercial Catch	551,142	163,400 (1992) to 1,317,200 (1988)	415,780	227,300 (1998) to 679,300 (1995)
Years	1971-1994			
Recreational Catch [2]	131,321	63,800 (1983) to 200,000 (1972)	196,680	87,900 (1999) to 397,200 (1995)
Years	(1971-1994)			
Total Mean Annual Catch	682,463		612,460	
Total Sacramento River Basin Adult Spawning Escapement	156,444	83,800 (1992) to 235,000 (1985, 1986)	295,850	237,500 (1998) to 428,200 (2000)
Years	(1970-1994)		(1995 - 2000)	
Total Central Valley Spawning Escapement	211,932	110,400 (1992) to 361,000 (1985)	353,417	292,200 (1995) to 494,100 (2000)
Years	(1970-1994)		(1995 - 2000)	

[1] Sources for this data include: Pacific Fishery Management Council (1984, 1987, 2001)

[2] Recreational catch does not include harvest not reported in the port sampling program. Inland harvest only has sporadic creel census programs over the period of record. Historically, catch was thought to equal about 10% of ocean harvest. Some recent figures place the inland harvest as high as 80,000 fish.

The data strongly suggest that management actions by the Council have resulted in a dramatic shift in catch allocations of fall run chinook stocks among user groups and spawning escapements. These management actions are intended to provide additional protection for weak stocks (e.g., Klamath River stocks and spring and winter run from the Central Valley, coho in general), while at the same time providing for the various fisheries and meeting spawning escapement objectives in the Central Valley. However, this shift has created additional problems in the commercial fishing industry and for resource managers at inland artificial production facilities. Over the past several years, the commercial fishing industry has suffered decreases in prices and catches, while excessive spawning escapements have shown up in the various tributary streams with

hatchery facilities, with the general exception of facilities in the San Joaquin River Basin. Salmon research is still focused on within-Delta survival and south Delta water operations, while the status of wild fall run chinook salmon stocks in the Central Valley remains uncertain.

Salmon managers are therefore faced with a management scenario with a number of internal and external conflicts including:

a. Wild stocks are either listed (spring and winter chinook) or their status (fall and late fall chinook) is uncertain;

b. The Council has implemented a variety of fishery management actions designed to reduce the impacts on weak stocks, with a resultant shift in allocations among user groups and spawning escapement;

c. Fall chinook spawning escapement for the Sacramento River Basin has exceeded the escapement objectives by 50,000 to 250,000 fish/yr. in the last six years ;

d. Excess (excess to hatchery egg requirements) fall chinook salmon are appearing in three (Battle Creek, Feather River, American River) tributary streams and possibly straying to other non-natal streams because of the current juvenile downstream trucking policy. These excess spawning escapements have resulted in embarrassing public relations problems for resource agencies, as well as dissolved oxygen depletion problems in Battle Creek in some years, and an unknown impact on wild stocks forced to compete with hatchery origin fish in the Central Valley;

e. The federal and state government, along with a variety of stakeholders are spending billions of dollars to provide fish screens to increase juvenile salmon survival in inland areas, restore habitats and stream flows, and build expensive fish screening and handling facilities at the two major south Delta pumping plants. All of these actions are designed to produce more fish;

f. The anadromous fish hatchery facilities in the Central Valley were constructed as mitigation for the impacts of various water projects being built;

g. The Council continues to pursue a mixed stock fishery management strategy for Pacific salmon along the coast of California;

h. Some resource professionals and stakeholders are questioning the impacts of continued large escapements of adult salmon into smaller tributary streams on wild stock genetics, straying rates, and the continued high allowable exploitation rates which are still geared to hatchery production;

i. Some members of the water community, which pay the costs of operating the various hatchery programs, are questioning why we need more fish to return to already crowded streams and have suggested that a potential solution could be to reduce juvenile production at the facilities to bring adult escapement in line with hatchery needs;

j. Some resource professionals and stakeholders are fearful that the current situation will result in a reduction in the mitigation requirements for individual facilities, thus allowing some water projects to not meet their original mitigation requirements for chinook salmon; and

k. Commercial fisherman are unable to capture excess adult fall run chinook produced because of the success of the Sacramento River Basin hatcheries, with a resultant direct loss of income and indirect losses to the coastal economies.

As a result of the continued ocean mixed-stock fishery, harvest rates on some wild stocks remain high, but have been lowered to a point where we are now under-exploiting hatchery-origin fall chinook stocks. At the same time, commercial and recreational fishing interests are seeking ways of enhancing harvest. However, there is a continued need to protect weak stocks. Adding to this problem is the CALFED-CVPIA program to restore spawning habitat and access to spawning habitat throughout the Central Valley, with the objective of further increasing production and escapement. While some see the solution as decreasing hatchery production, others do not want the mitigation requirements for these facilities reduced. Finally, the long-term research focus on factors affecting the survival of juvenile chinook salmon, and a paucity of data on the interaction between hatchery-origin adults and wild stocks, makes it difficult to develop effective management strategies for these stocks.

Creating geographic specific harvest areas is a variation of time and area closures or openings management scheme. This management option has been used in a variety of ways by a number of resource managers along the Pacific Coast of North America. One variation of the time and area concept is to allow harvest in a "terminal" area (e.g., right around the mouth or in the estuary of a particular stream) so that fishing can target a specific stock or species. This variation can be used to "adjust" both catch and/or spawning escapement to a particular watershed.

A second terminal area harvest scheme is based on having fish come to a particular geographic location where they are not co-mingled with other stocks or species and suitable spawning areas are not available. The objective of the fishery is to harvest every available fish. This technique has been used extremely successfully in Alaska for pink salmon, where juveniles are imprinted to a specific geographic location [usually in connection with a freshwater source (e.g., a waterfall along the beach)], and the adults return to this specific location where the harvest objective is to catch every fish. Alaska has also used a variation of this approach with chinook salmon at the Homer Spit in Southcentral Alaska. On the south side of the town of Homer is a sand spit which arcs out into Kachemak Bay. The spit is narrow and contains a road, a few buildings, and some small port facilities. The Alaska Department of Fish and Game initiated a chinook salmon sport fishery right on the beach of the spit by imprinting juvenile chinook salmon with a chemical called morpholine, releasing these juveniles into salt water adjacent to the spit, and then enticing adults to return to the beach by dripping morpholine into the water adjacent to the spit at the right time several years later. Using this technique, managers were able to supply an extremely popular and national award winning chinook salmon fishery by geographically separating the harvest location from traditional migratory pathways and spawning locations or streams. The management objective is to catch every returning adult chinook. This program has been in operation for over 10 years and evaluation of the program revealed that proper timing of juvenile release results

in the adults returning to the desired location without the chemical imprinting or drip off the spit (Dave Watsjold, U.S. Fish and Wildlife Service, Anchorage, AK, pers. comm.).

A third Alaskan example of this same technique is a new chinook salmon fishery near Juneau. In this situation, juvenile chinook salmon are held in an area in net pens, again in association with a freshwater source, and then released. The release location is not along a known chinook migratory pathway or in close proximity to wild chinook spawning locations. Based on knowledge gained from the Homer Spit fishery, juveniles are not imprinted with chemicals, but volitionally return to the specific geographic location. Again, the management objective is to catch every fish (Dave Watsjold, U.S. Fish and Wildlife Service, Anchorage, AK, pers. comm.). Similar geographic only imprinting behavior has been noted for both chinook salmon and steelhead trout in the Snake River system (Dr. Ted Bjornn, U.S.G.S., Biological Resources Division, Idaho Cooperative Fish and Wildlife Unit, pers. comm.)

The elegance of this technique is that managers can target specific stocks (e.g., hatchery origin fish) for harvest at rates too high, in mixed stock fisheries, to protect weak or listed stocks; decrease the fishing related shaker mortality, since all fish in an area are subject to harvest; and create these "all harvest" fisheries in geographic locations which eliminate or greatly minimize spatial-temporal overlap with other stocks/species. Also, selection of release sites and timing of release must be carefully evaluated to assess potential straying of adults.

CALFED's ecosystem restoration objectives present a double edged sword for selective fisheries. Ecosystem restoration includes a variety of actions that are outlined in the Ecosystem Restoration Program (ERP). Some of these actions would affect ecosystem structure and function, nutrient dynamics, and presumably races of salmon and steelhead spawning naturally in restored streams. Under the current situation and salmon management regime off California, exploitation rates on listed stocks have been reduced though a variety of management techniques. These actions have resulted in improving brood year replacement ratios for listed stocks which is consistent with ERP objectives. However, the increase in spawning escapements, particularly to streams with hatchery facilities on them, is a good news-bad news situation. For example, increased spawning escapements have resulted in increased nutrient deposition, in the form of dead salmon carcasses, in tributary streams, thus meeting an ecosystem restoration need. At the same time, increased spawning escapements have increased the number of fish spawning naturally in the stream, thus meeting one of the goals of the anadromous fish doubling program of CVPIA. However, a large percentage of these fish spawning "naturally" in the streams are of hatchery origin and therefore continue to put pressure on any remaining wild fish, thus increasing the potential for wild fall run chinook salmon to go extinct without humans being able to detect the extinction. This situation fails to meet the ERP objectives.

There is no doubt that increased spawning escapements have increased the pressure to restore streams and complete projects which improve spawning migration; improve spawning, hatching, and emergence success; and protect the juveniles emigrating to the ocean. In addition, supplemental habitats are bing created, water quality issues are

being addressed, and nutrient dynamics and survival of juvenile salmon across the estuary are being researched. All of these actions are designed to improve the quality of inland areas and thus increase the chances for survival of smolts headed to the ocean. On the other side of the coin, decreasing the exploitation rates on listed stocks have resulted in excessive escapement to inland hatchery streams and thus reduced the recreational and commercial catch of chinook salmon, with a resulting impact on coastal economies. In short, the current situation is having both positive and negative impacts on CALFED's ERP objectives.

It is technically possible to design a salmon management regime, using selective imprinting and fishing techniques, which will allow CALFED's ERP objectives to be more fully met, while reducing the number and degree of those not being met. However, it will take a comprehensive program to outline the changes, research, and public education necessary to affect the needed changes. This project is the first step in defining the scientific basis for potentially implementing a new salmon management scenario for Central Valley chinook salmon stocks that fully utilizes hatchery origin fish, while protecting wild stocks.

3. **Approach -** The approach to completing this feasibility report is relatively straightforward. The initial literature search and review will be conducted by Mr. Bailey and Ms. Porter. Mr. Bailey has an extensive personal library of anadromous salmonid literature, while Ms. Porter is a research assistant to Dr. Bjornn at the University of Idaho and has extensive experience at conducting literature searches, including a number of topics related specifically to this project for Dr. Bjornn. Mr. Bailey will then confer with Drs. Moffitt and Bjornn to discuss the specific topics to be included in the feasibility report. Mr. Bailey will then travel to Alaska (preferably in the late fall or winter) to meet with Alaska Department of Fish and Game personnel who have extensive experience with geographic specific imprinting and selective fisheries and to collect Alaska's documentation of their experiences (the documentation is scattered throughout a variety of much larger study reports, technical memoranda, and interoffice memoranda). Mr. Bailey would also travel to Portland, OR and Olympia, WA to discuss the experiences of these states with the topic. Mr. Bailey would then draft a report which summarizes the appropriate scientific literature on imprinting, more formally document the existing cases studies, and develop recommendations on whether there is a sufficient scientific basis to implement a demonstration project in California. Mr. Bailey would have this draft reviewed by Drs. Moffitt and Bjornn prior to a draft final report being submitted to CALFED. After CALFED review, Mr. Bailey would revise the report and submit a final to CALFED. All project management activities would be completed by Mr. Bailey.

4. **Feasibility -** This project is fully feasible to complete in the time frame suggested under the work schedule. Since this project is the development of a feasibility report and appropriate literature review, there are no known obstacles to completing it successfully.

5. **Performance Measures -** The expected performance measure for this project is well

documented and scientifically defensible feasibility report on the potential for geographically specific imprinting of chinook salmon to provide selective fisheries.

6. **Data Handling and Storage -** The "data" for this project will be copies of documents used in the literature review and summaries of the personal interviews documenting the various case studies. A bibliography of the literature reviewed will be included in the final report, copies of unpublished documentation will be made available to CALFED for duplication (at CALFED's expense), and the report and personal interview documentation will be available to CALFED in electronic format.

7. **Expected Products/Outcomes -** The expected product would be the final feasibility report. In addition, Mr. Bailey anticipates presenting the results at a minimum of one scientific meeting or workshop. One other outcome that, depending on the recommendations, could occur is the future development of a demonstration project to test the geographically specific imprinting concept and associated selective chinook salmon fishery in California.

8. **Work Schedule -** Applicant anticipates that this project will take approximately eight months from start to finish. Given the assumption that contract award would occur in March 2002 and that it would take approximately six months to receive a final contract. A proposed schedule follows:

    Month 1: Travel to Idaho and confer with Moffitt and Bjornn; complete initial literature review; document Idaho case studies with Bjornn.
    Month 2: Travel to Alaska, Oregon, Washington to document case studies, acquire agency gray literature; continue literature review
    Month 3-4: Write initial draft of report, review by Drs. Moffitt and Bjornn, revise draft and submit to CALFED for peer review.
    Month 5-6: CALFED review.
    Month 7: Revise report and submit final to CALFED.
    Month 8: Present results to CALFED workshop or scientific meeting.

B. Applicability to CALFED ERP and Science Program Goals and Implementation Plan and CVPIA Priorities

1. **ERP, Science Program and CVPIA Priorities:** This project has the potential to affect all of the Regions identified in the Draft Stage I Plan. Specifically, this project is intended to result in steps which would facilitate the recovery of at risk anadromous salmonids. The most obvious benefit would be to naturally spawning chinook salmon stocks, with some lesser known benefit to steelhead trout. This project specifically addresses restoration priorityMR-6 for salmonids. This project could potentially address all life history stages of chinook salmon and steelhead trout. In addition, this project address issues presented in Ecosystem Restoration Program Strategic Goal 1: At-Risk Species, Goal 2: Ecosystem Processes and Biotic Communities, and Goal 3: Harvestable

Species. This project also addresses the Science Program priorities of improving the management of at-risk species, advancing the scientific basis of regulatory activities, addressing societal issues related to restoration, and to a lesser degree the project is landscape in scale. From a CVPIA perspective, this project address the objectives of the Anadromous Fish Restoration Program and the Habitat Restoration Program.

The feasibility report from this project will address all of the priorities outlined above by addressing the problems currently associated with hatchery and harvest management practices for chinook salmon. Removing the excess spawning escapement of fall run chinook salmon has multiple benefits for the entire Central Valley. First, the report would form a scientific foundation to change hatchery and harvest management practices to reduce straying caused by ill-advised downstream trucking of juveniles; reducing the genetic impacts of straying on wild and naturally spawning populations; improving water quality in streams with hatchery facilities; reducing competition between naturally spawning adults; reducing competition between wild stock juveniles and juveniles from naturally spawning, hatchery origin fish; reducing the impacts of large spawning escapements on other juvenile salmonids (steelhead) and non-salmonid native species; reducing the potential for redd superimposition; allowing continued full production of chinook salmon mitigation requirements; providing fishermen with biologically appropriate access to hatchery origin fish; and providing new commercial and recreational fishing opportunities to Central Valley, San Francisco Bay, and Coastal California areas.

2. **Relationship to Other Ecosystem Restoration Projects** - If the feasibility report documents that a change to geographically specific imprinting and selective fisheries are possible, then all of the ecosystem restoration programs, which are designed to produce more fish, can proceed without the undue influence of excessive spawning escapements to Central Valley streams. However, the scientific basis for such a program must be firmly established first, and this project is specifically designed to establish that base.

3. **Requests for Next-Phase Funding** - Not applicable to this proposal.

4. **Previous Recipients of CALFED Program or CVPIA Funding** - Although the applicant (Bailey Environmental) has not directly received CALFED Program or CVPIA Funding previously, Bailey Environmental recently completed three reports as a subcontractor to Northwest Marine Technology under the "Mass Marking Demonstration Project" funded by the Bureau of Reclamation. In addition, CALFED provided additional funding under the same contract to expand the modeling effort by the University of Idaho through subcontract to Bailey Environmental. The reports resulting from this previous effort are in the literature cited section of this proposal as: Bailey and Monroe (2000), Hicks (2001), Hicks and Newman (2001), Newman et al. (2000), and Bailey and Monroe (2001). All reports are completed and have been submitted to CALFED.

5. **System-Wide Ecosystem Benefits -** Completion of this project most likely (based on the applicant's personal knowledge of the existing case studies) will lead to development of a new hatchery and fisheries management regime for Central Valley chinook salmon stocks. Implementation of geographically specific imprinting of a portion of the current hatchery production and subsequent associated selective fisheries could eliminate the current problem of excess spawning escapement to Central Valley streams. Removal of the physical, biological, and water quality impacts associated with excess escapement will have positive effects on naturally spawning chinook salmon stocks, reduce conflicts between listed salmon species and fishing stakeholders, and yet provide full and appropriate utilization of hatchery origin fish being raised as mitigation for past projects.

6. **Additional Information for Proposals Containing Land Acquisitions**: Not applicable.

C. **Qualifications:** Applicant has assembled a highly qualified and respected team to complete this project. Project cooperators include: Dr. Christine Moffitt, University of Idaho, who specializes in fish health and hatchery management; Dr. Ted Bjornn, USGS Idaho Cooperative Fish and Wildlife Research Unit, who specializes in anadromous salmonid management, ecology, and migratory behavior; Mr. Randy Bailey, Principal, Bailey Environmental, who specializes in anadromous salmonid ecology and fisheries management issues. A brief biographical sketch of each principal is presented below:

Dr. Christine Moffitt is a fisheries professor at the University of Idaho specializing in fish health and hatchery management issues. Chris has published extensively on anadromous salmonid issues and has been actively involved in salmonid management and hatchery management and evaluation issues in the Columbia River Basin for over 20 years. She was an editor of the American Fisheries Society's book entitled *"Common Strategies of Anadromous and Catadromous Fishes"* which examined the science behind migratory behaviors of anadromous and catadromous fishes. A listing of her publications is available at the University of Idaho's College of Forestry, Range, and Wildlife web site. She is the spouse of Dr. Bjornn. Chris' responsibilities for this project will be to assist with the literature review, help develop the topics to be covered in the feasibility report, and review of the draft report prior to submission to CALFED.

Dr. Ted Bjornn is with the USGS's Idaho Cooperative Fish and Wildlife Research Unit located at the University of Idaho. Ted has spent over three decades conducting research on anadromous salmonids in the Columbia River and Snake River basins. He is an internationally recognized expert on anadromous salmonid management, ecology, biology, and behavior. He is widely recognized as one of the pre-eminent authorities on chinook salmon migratory behavior. Ted has published extensively on salmonids; including co-authoring chapters on "Salmonid distribution and Life Histories" and "Habitat Requirements of Salmonids in Streams" in the American Fisheries Society's book entitled "*Influences of Forest and Rangeland Management on Salmonid Fishes and Their Habitats"*. He is currently writing a book on Snake River salmon. A listing of his

publications is also available at the University of Idaho's College of Forestry, Range, and Wildlife web site. Ted's responsibilities for this project include assisting with the literature review, helping develop the topics to be covered in the feasibility report, providing documentation on his heretofore unpublished case studies of geographically specific imprinting, and review of the draft report prior to submission to CALFED.

Mr. Randy Bailey will be the principal author, researcher, and complete all project management functions for this project. Mr. Bailey has been actively involved in management and ecological issues related to anadromous salmonids for nearly 30 years. Randy was a forest fishery biologist for the USDA Forest Service in Eastern Oregon and focused on forest management impacts and habitat restoration on chinook salmon and steelhead. He then served as the Forest Service's Regional Fisheries Program Manager for the California Region, which included technical oversite of all anadromous fish habitat improvement projects on national forests in California. In addition, he also served on a number of watershed level restoration programs on the Trinity and Klamath rivers and was the Region's representative to the Pacific Fisheries Management Council on issues affecting national forest management. Randy served as Chief, Fisheries Division, U.S. Fish and Wildlife Service, Alaska Region, for nine years where he was involved in numerous research and management studies on anadromous salmonids. He also has personal knowledge and experience with Alaska's geographically specific imprinting and associated selective fisheries. For the past eight years, Randy has been involved in a variety of issues related directly to CALFED and salmon management in the Central Valley. His most recent publications on salmon management and restoration, completed for CALFED, are included in the literature cited section of this proposal.

D. Cost

1. Budget: See Budget Forms

2. Cost-Sharing: Dr. Ted Bjornn, USGS Idaho Cooperative Fish and Wildlife Research Unit has agreed to provide consultation and advice on the project as well as agreeing to review the draft report before submittal to CALFED. Dr. Bjornn anticipates donating 60 hours of his time to this effort.

E. Local Involvement: Not applicable to this proposal.

F. Compliance with Standard Terms and Conditions: Applicant agrees to comply with the Terms and Conditions for State Funds found in Attachment D of the PSP with the following exception. Applicant intends to subcontract to the University of Idaho for specific services. However, under the provisions of standard terms and conditions number 5, which deals with subcontracts, the language states ..."Unless the subcontract was submitted to the CALFED Program with the proposal, Grantee must obtain at least 3 competitive bids for all subcontracted work; or comply with the provisions of

Government Code section 4525 et seq. As applicable; or obtain the State of NFWF's approval for non-compliance with these requirements." Applicant believes this condition is unreasonable since an entity (University of Idaho) cannot agree in a subcontract to support all of the as yet unknown contractual clauses in a final contract between Grantee and CALFED. Attachment D specifically states that additional clauses will be required, but does not specifically set forth theses clauses. Therefore, applicant's proposal cannot logically submit a proposed subcontract, given the fact that all contractual requirements are not known at this time. CALFED and applicant should reach a reasonable accommodation on this small ($4,875.00) subcontract.

Applicant agrees to comply with the Federal contracting requirements set forth in Attachment E of the PSP.

G. Literature Cited:

Bailey, R.E. and J. Monroe. 2001. Selective fishing for California's Central Valley chinook salmon stocks: need, objectives, options, and issues. Technical report prepared under contract via Northwest Marine Technology for CALFED. CALFED Bay/Delta Program, Sacramento, California.

Bailey, R. E., and J. Monroe. 2000. An assessment of the contribution rates of CWT-tagged groups of juvenile salmonids from California's Central Valley to the adult population. Report prepared by Bailey Environmental for Northwest Marine Technology under contract from Calfed Bay Delta Program, Sacramento.

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Hicks, A., and K. Newman. 2001. CFM Sim: constant fractional marking program. User manual, Version 1.0 for Windows.

Lichatowich, J. 1999. Salmon without rivers: A history of the Pacific Salmon crisis. Island Press, Washington, D.C.

Newman, K., R. E. Bailey, and J. Monroe. 2000. Development of a marking and tagging program for juvenile chinook salmon reared in California's Central Valley fish production facilities. Report prepared by Bailey Environmental for Northwest Marine Technology under contract from Calfed Bay Delta Program, Sacramento.

Pacific Fishery Management Council. 1984. Review of 1983 ocean salmon fisheries and status of stocks and management goals for the 1984 salmon season off the coasts of California,

Oregon, and Washington. Pacific Fishery Management Council, Portland, Oregon.

Pacific Fishery Management Council. 1987. Review of 1986 ocean salmon fisheries. Pacific Fishery Management Council, Portland, Oregon.

Pacific Fishery Management Council. 2001. Review of 2000 ocean salmon fisheries. Pacific Fishery Management Council, Portland, Oregon.