Lower Yuba River Juvenile Chinook Salmon Life History And Thermal Bioenergetics Evaluation

Project Information

1. **Proposal Title:**

   Lower Yuba River Juvenile Chinook Salmon Life History And Thermal Bioenergetics Evaluation

2. **Proposal applicants:**

   Ian Drury, California Department of Fish and Game
   John Nelson, California Department of Fish & Game

3. **Corresponding Contact Person:**

   Ian Drury
   California Department of Fish & Game
   The Resources Agency Department of Fish & Game Sacramento Valley-Central Sierra Region
   1701 Nimbus Road Rancho Cordova, CA 95670
   916 452-3132
   idrury@dfg.ca.gov

4. **Project Keywords:**

   Anadromous salmonids
   Fish Health Biology
   Monitoring

5. **Type of project:**

   Monitoring

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:**

   State Agency

9. **Location - GIS coordinates:**

   Latitude: 39.152

   Longitude: -121.582

   Datum:

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

Project location includes the lower Yuba River from its' mouth (confluence with the Feather River in Marysville CA) to Englebright Dam. The project incompasses approximately the lower 24 river miles of the Yuba River.

10. **Location - Ecozone:**

    8.2 Yuba River

11. **Location - County:**

    Nevada, 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:**

    California, 2nd

15. **Location:**

    California State Senate District Number: SD 1

    California Assembly District Number: AD 03

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

    3 years

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

       Yes

       If yes, list the different overhead rates and total requested funds:

State Overhead Rate:	15.0%
Total State Funds:	$ 1,017,626
Federal Overhead Rate:	13.9%
Total Federal Funds:	$ 1,003,410

b) Do you have cost share partners already identified?

No

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)

Paul Ward	**California Department of Fish & Game**	**916-895-5015**	**pward@dfg.ca.gov**
Craig Fleming	**U.S. Fish & Wildlife Service**	**209-946-6400-315**	**cfleming@delta.dfg.ca.gov**
Mike Tucker	**National Marine Fisheries Service**	**916-930-3604**	**Michael.Tucker@noaa.gov**
Dr. Stacy Li	**National Marine Fisheries Service**	**707-575-6082**	**Stacy. Li@noaa.gov**

21. **Comments:**

Environmental Compliance Checklist

Lower Yuba River Juvenile Chinook Salmon Life History And Thermal Bioenergetics Evaluation

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 monitoring study, and not a project as defined in CEQA or NEPA.

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

   CEQA Lead Agency: None
   NEPA Lead Agency (or co-lead:) None
   NEPA Co-Lead Agency (if applicable): None

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: Danitoni Farms - Naumes Inc. - Steve Maxey - (530) 743-2055	Required, Obtained

6. **Comments.**

The proposed project's steelhead trout activities will be permitted under the existing ESA 4d rule for Central Valley steelhead trout, that authorizes potential take of steelhead trout from the Department of Fish and Game research and monitoring activities. The proposed project's spring-run chinook salmon activities will be permitted under the proposed ESA 4d rule for Central Valley salmon. This 4d rule has been proposed and will be finalized by December 31, 2001.

Land Use Checklist

Lower Yuba River Juvenile Chinook Salmon Life History And Thermal Bioenergetics Evaluation

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?**

   Yes

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 and monitoring only.

4. **Comments.**

Conflict of Interest Checklist

Lower Yuba River Juvenile Chinook Salmon Life History And Thermal Bioenergetics Evaluation

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):

Ian Drury, California Department of Fish and Game
John Nelson, California Department of Fish & Game

Subcontractor(s):

Are specific subcontractors identified in this proposal? Yes

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

Alice Rich	A.A. Rich and Associates
None	None
None	None
None	None
None	None

Helped with proposal development:

Are there persons who helped with proposal development?

Yes

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

Ian Drury	**California Department of Fish & Game**

John Nelson **California Department of Fish & Game**

Alice Rich **A.A.Rich and Associates**

Comments:

Budget Summary

Lower Yuba River Juvenile Chinook Salmon Life History And Thermal Bioenergetics Evaluation

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.

Federal Funds

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	Annual Adult Escapement Surveys - Yuba County Water Agency (YCWA)	0	0	0	0	0	0	0	0	0.0	0	0.00
2	Rotary Screw Trap Monitoring	4,368	51,848	7,933	0	1,500	0	25,000	20,000	106281.0	13,670	119951.00
3	Coded-Wire Tragging	0	0	0	0	19,000	42,000	113,500	0	174500.0	24,256	198756.00
4	Water Temperature Monitoring	288	3,419	523	0	500	7,500	0	0	11942.0	1,587	13529.00
5	Fish/Fish Stomach Sampling	0	0	0	0	0	23,000	0	0	23000.0	3,197	26197.00
6	Data Reduction and Data Entery	1,088	12,915	1,976	0	0	10,000	0	0	24891.0	3,185	28076.00
7A	Analysis and Report of Results	0	0	0	0	0	0	0	0	0.0	0	0.00
7B	Analysis and Report of Results	0	0	0	0	0	36,000	0	0	36000.0	5,004	41004.00
8	Meetings	0	0	0	0	0	3,500	0	0	3500.0	486	3986.00
9	Project Management	0	0	0	0	0	0	0	0	0.0	0	0.00
		5744	68182.00	10432.00	0.00	21000.00	122000.00	138500.00	20000.00	380114.00	51385.00	431499.00

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**
1	Annual Adult Escapement Surveys - Yuba County Water Agency - (YCWA)	0	0	0	0	0	0	0	0	0.0	0	0.00
2	Rotary Screw Trap Monitoring	4,368	53,421	8,173	0	1,545	0	0	20,600	83739.0	10,504	94243.00
3	Coded-Wire Tagging	0	0	0	0	19,570	43,260	0	0	62830.0	8,733	71563.00
4	Water Temperature Monitoring	288	3,522	539	0	250	7,500	0	0	11811.0	1,567	13378.00
5	Fish/Fish Stomach Sampling	0	0	0	0	0	24,000	0	0	24000.0	3,336	27336.00
6	Data Reduction and Data Entery	1,088	13,306	2,036	0	0	10,500	0	0	25842.0	3,309	29151.00
7A	Analysis and Report of Results	0	0	0	0	0	0	0	0	0.0	0	0.00
7B	Analysis and Report of Results	0	0	0	0	0	36,500	0	0	36500.0	5,074	41574.00
8	Meetings	0	0	0	0	0	3,900	0	0	3900.0	542	4442.00
9	Project Management	0	0	0	0	0	0	0	0	0.0	0	0.00
		5744	70249.00	10748.00	0.00	21365.00	125660.00	0.00	20600.00	248622.00	33065.00	281687.00

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**
1	Annual Adult Escapement Surveys - Yuba County - (YCWA)	0	0	0	0	0	0	0	0	0.0	0	0.00
2	Rotary Screw TRap Monitoring	4,368	54,993	8,414	0	1,591	0	0	21,218	86216.0	10,815	97031.00
3	Coded-Wire Tagging	0	0	0	0	20,157	44,558	0	0	64715.0	8,995	73710.00
4	Water Temperature Monitoring	288	3,626	555	0	250	7,500	0	0	11931.0	1,581	13512.00
5	Fish/Fish Stomach Sampling	0	0	0	0	0	25,000	0	0	25000.0	3,475	28475.00
6	Data Reduction and Data Entery	1,088	13,698	2,096	0	0	11,000	0	0	26794.0	3,433	30227.00
7A	Analysis and Report of Results	0	0	0	0	0	0	0	0	0.0	0	0.00
7B	Analysis and Report of Results	0	0	0	0	0	37,000	0	0	37000.0	5,143	42143.00
8	Meetings	0	0	0	0	0	4,500	0	0	4500.0	626	5126.00
9	Project Management	0	0	0	0	0	0	0	0	0.0	0	0.00
		5744	72317.00	11065.00	0.00	21998.00	129558.00	0.00	21218.00	256156.00	34068.00	290224.00

Grand Total=1003410.00

Comments.

Budget Justification

Lower Yuba River Juvenile Chinook Salmon Life History And Thermal Bioenergetics Evaluation

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

The only individuals funded by the proposal are Department of Fish and Game Temporary Personnel: 1) Rotary Screw Trap Personnel: (2 people)(8 hours/day)(273 days/year)(3 years) = 13,104 hours. 2) Water Temperature Monitoring Personnel: (2 people)(8 hours/day)(18 days/year)(3 years) = 864 hours. 3) Data entery personnel: (1 person)(4 hours/day)(273 days/year)(3 years) = 3,276 hours. 3) Total hours = 17,244 hours.

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

The only individuals funded by the proposal are Department of Fish and Game Temporary Personnel: Year 1: $11.87 per hour Year 2: $12.23 per hour Year 3: $12.59 per hour

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

All Department of Fish and Game Personnel recieve a benefit rate of 15.3%.

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

Not Applicable.

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

Field Supplies: Year 1 - $21,000 (anesthetic,nets,buckets,water temperature monitoring supplies,coded-wire tags,cutters for tagging machines,etc) Year 2 - $21,365 (all of the above) Year 3 - $21,998 (all of the above) Total = $64,363 The Department of Fish and Game will cover all office, laboratory, and computing supplies and expendables.

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.

Consultant 1) A.A. Rich and Associates. Tasks to be completed for each of the 3 years - (Task 4) Water Temperature Monitoring,(Task 5) Fish/Fish Stomach Sampling,(Task6) Data Reduction and Data Entery for A.A. Rich responsibilities,(Task 7A) Analysis and Report of Results for A.A. Rich responsibilities,(Task 8) Meetings for A.A. Rich responsibilities, (Task 9) Project Management for A.A. Rich responsibilities. Year 1) $80,000 Year 2) $82,400 Year 3) $85,000 Total for A.A Rich and Associates = $247,400 Services 1) Jerry Big Eagle, Inc. Task to be completed for each of the 3 years - The actual tagging of >100,000 juvenile chinook salmon per year. Year 1) $42,000 Year 2) $43,260 Year 3) $44,558 Total for Jerry Big Eagle, Inc. = $129,818 Three year total for services or Consultants = $377,218

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.

1) 1 rotary screw trap = $25,000 2) 3 tagging machines at $28,000 each = $84,000 3) 1 tagging trailer = $25,000 4) 1 generator = $4,500

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.

All project management costs associated with Department of Fish and Game Tasks will be funded by Department of Fish and Game. All project management costs associated with A.A. Rich and Associates Tasks will be funded by A.A. Rich and Associates.

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

Operations and Maintenance (vehicles, tagging trailer, tagging machines, misc.): Year 1) $20,000 Year 2) $20,600 Year 3) $21,218

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.

A Federal overhead rate of 13.9% (indirect costs) was used to determine funds needed for this project. This overhead includes costs associated with general office requirements for managing a Federal contract.

Executive Summary

Lower Yuba River Juvenile Chinook Salmon Life History And Thermal Bioenergetics Evaluation

The proposed project is a monitoring program on the Lower Yuba River, located in Yuba and Nevada Counties. The objectives of the project are to build on our knowledge of the life history, population trends, and thermal requirements of juvenile chinook salmon in the Yuba River, so that improved adaptive management of the river, including fish restoration projects and appropriate in-stream flow regimes, can be achieved. To determine Yuba River juvenile chinook salmon life history, and population trends the following tasks will be undertaken: Task 1: Annual Adult Escapement Surveys; Task 2: Rotary Screw Trap Monitoring; Task 3: Coded-Wire Tagging. To determine the relationship between water temperatures and growth and productivity of juvenile chinook salmon in the Yuba River, the following tasks will be untaken: Task 4: Water Temperature Monitoring; Task 5: Fish Sampling/Stomach Sampling; Task 6: Data Reduction and Data Entery; Task 7: Analysis and Report of Results; Task 8: Meetings; Task 9: General Project Management. The hypotheses being tested are; (1) The size of juvenle chinook salmon at emigration contribute differently to adult escapement, (2) Different water year types (flows) result in different survival rates of chinook salmon, and (3) Water temperatures are stressful to juvenile chinook salmon in the Yuba River. Uncertainties with the proposed project center around the opperation of rotary screw traps, where climatic conditions dictate the success of each sampling year. Operation of the rotary screw trap becomes difficult during exceptionally high or low water flows. However, the Department of Fish and Game has successfully operated rotary screw traps on the Yuba River under flow conditions of up to 29,000 cubic feet per second (cfs). From past experience (1997 flood event) flows that exceed this amount would be expected to last for only a short period. In addition, because of current in-stream flow requirements, flows are not expected to drop to levels in which rotary screw trap operation becomes infeasible. The proposed project addresses four of the CALFED Ecosystem Restoration Program (ERP) Strategic Goals (At-Risk Species, Ecosystem Processes and Biotic Communities, Harvestable Species, and, Habitats) and addresses one of the most important limiting factors identified in the CVPIA list of priorities; water temperature requirements and impacts on chinook salmon in the Bay-Delta. By continuing the documentation of chinook salmon life history, thermal requirements, and population trends under different flow regimes in the Yuba River, we will improve our ability to manage for spring-run chinook salmon as well as fall- and late fall-run chinook salmon and steelhead trout. Knowledge of the life history strategies will allow us to apply adaptive management measures by manipulation of water flows, water transfers, and water temperatures, to improve conditions for all salmonids and specifically for the size of juvenile salmon at outmigration that provides the greatest downstream survival and escapement.

Proposal

California Department of Fish and Game

Lower Yuba River Juvenile Chinook Salmon Life History And Thermal Bioenergetics Evaluation

Ian Drury, California Department of Fish and Game
John Nelson, California Department of Fish & Game

Project Description

The California Department of Fish and Game (DFG) requests funds from CALFED and CVPIA to conduct anadromous fisheries research on the Yuba River. Spring-, fall-, and late fall-run chinook salmon, *Oncorhynchus tshawytscha* , populations exist in the river, but there is a lack of information concerning basic life history, thermal requirements, and population levels. Information generated by the proposed project will help guide fish restoration projects and environmental planning with the goal of improving the anadromous fish populations of the Yuba River.

1) Statement of the Problem

Problem: Yuba River chinook salmon are one of the largest wild populations of chinook salmon in the Central Valley. Yuba River chinook salmon consist of spring-run (SRCS), which are listed as threatened under both the California and Federal Endangered Species acts, as well as the fall- (FRCS) and late fall-run (LFRCS). To protect these anadromous salmonid populations, a number of projects have been implemented, and more are currently being planned. These projects include fish screens, adult exclusion devices or weirs on certain tributaries, and dam removal or new fish ladders at Daguerre Point Dam. However, the effectiveness of these projects on chinook salmon will never be fully realized without a more complete understanding of artificial flow regimes, thermal requirements, and the effects these factors have on both the juvenile and adult life stages of this species.

Annual water transfers and other artificial flows could be adaptively managed in such a way as to benefit both chinook salmon populations and water providers. Yuba River juvenile chinook salmon exhibit the following two principal life history strategies: (1) after a relatively short rearing period the majority of juveniles emigrate out of the system as fry; and, (2) a smaller number remain in the river for more extended rearing before migrating out as smolts. The relative contribution of the two different outmigration strategies to overall adult escapement is not known. This information is essential for adaptive management.

To date, there has been no research conducted on the escapement rates of different juvenile chinook salmon life history strategies in the Yuba River. In 1999, the DFG began a life history study of chinook salmon in the Yuba River. The purpose of that study was to document emigration patterns, size of fish at emigration, and relative abundance. One report with the project's findings for 1999-2000 is currently in review. Data were collected by RST to determine: (1) the timing and duration of emergence and downstream movement; (2) size of downstream migrants (by date); and, (3) if the different races of juvenile chinook salmon can be differentiated by size and time of capture. The completed project, as well as current in-stream flow regulations, indicated the importance of

information concerning the adult escapement rates for each of the two juvenile chinook salmon life history strategies. This information can be gained through the use of coded-wire tagging (CWT) and spawner escapement surveys. Tagging fish over the next several years is needed.

Additionally, high water temperature in the Yuba River may be a limiting factor to chinook salmon. If so, chinook salmon survival and productivity are at risk. Acceptable water temperatures are required for the parr-smolt transformation and juvenile rearing during out-migration (Rich, 2000). The proposed study will address critical information needs, regarding the relationship between water temperatures and growth and productivity of young chinook salmon in the Yuba River. From the results of the proposed study, it will be possible to identify practical site-specific restoration actions, that will improve conditions for young chinook salmon in the Yuba River. In addition, it may be possible to transfer the information on water temperature requirements for young chinook salmon in this watershed to those in other Sacramento-San Joaquin watersheds, when conditions are similar.

Knowledge of optimal, stressful, and lethal water temperatures on young chinook salmon is far from adequate to define safe thermal limits for this species in the Yuba River Watershed or anywhere else in the Sacramento-San Joaquin Bay Delta (Rich, 2000). For example, although it is known that anadromous salmonids proceeding through the parr-smolt transformation are sensitive to high water temperatures (Zaugg and Wagner, 1973; Zaugg et al., 1972), wide ranges of water temperatures have been identified as optimal, stressful, and lethal for young chinook salmon (Figures 1 and 2). Both the difference and overlap in ranges of what is considered to be optimal, stressful, or lethal depends on the type of study undertaken and the biologists interpreting the data. As a result, water temperature requirements for chinook salmon in the wild are often subject to debate, due primarily to: (1) the lack of field-oriented thermal studies; and, (2) misapplication and misinterpretation of thermal methodologies (Rich, 2000, 1997, 1987a,b).

Most thermal studies on chinook salmon are restricted to laboratory experiments on fish fed maximal rations under controlled environmental conditions. Often, it is assumed that the results of a laboratory experiment can be transferred directly to conditions in the wild. This is not a practical or safe approach, from the standpoint of chinook salmon health and survival. As chinook salmon do not respond in the natural environment the same way they do in a laboratory (Brett and Groves, 1979), it is erroneous to conclude that one can transfer the results of laboratory experiments directly to a creek or river. If one errs on the side of conservatism and chooses a very low temperature as being optimal (based on a laboratory study), and undertakes restoration actions to reduce water temperatures, such actions may stunt growth and reduce productivity in the field. By contrast, if one chooses higher water temperatures, again based on the results of laboratory studies where the fish are fed all they can eat, but there is a

limited amount of food in the creek or river, then the salmon would be stressed, thereby reducing growth and productivity and, if extreme enough, this would lead to mortality.

A second problem with determining the water temperature requirements of chinook salmon is one of misapplication and potential misinterpretation of thermal methodologies. For example, it is often assumed that the temperature at which maximum growth rate occurs in the laboratory with juvenile chinook salmon fed maximal rations is also the optimum temperature in the field (Rich, 2000, 1997, 1987a,b). Such a conclusion could not be further from the truth. If a chinook salmon in a laboratory, fed all it can eat, is exposed to increasingly high water temperatures, its metabolism increases and hence, so too does its need for food. As the temperature increases, though, the energy it takes to convert the food into fish flesh increases. Thus, in a laboratory situation, although growth may increase at higher temperatures, the amount of food needed to convert the food to growth also increases (Brett and Groves, 1979). Hence, at higher temperatures, it is very inefficient for the fish to eat. Thus, the primary way physiologists determine optimum water temperatures is to determine the temperature at which maximum food conversion efficiency occurs. These temperatures are rarely equal to the maximum growth rate. Without site-specific thermal bioenergetics studies which are able to integrate thermal data, growth rates, and physiological metabolic data for the fish in question, it is very difficult, if not impossible, to determine both optimal and stressful water temperatures for fishes in the wild.

To adequately evaluate water temperature criteria, one must know the thermal requirements for each life stage of chinook salmon. Of all of the life stage requirements, water temperature is one of the most important, yet commonly the least understood. Temperature can be considered in the following two ways: (1) as a factor affecting the rate of development, metabolism, and growth; or, (2) as a stressful or lethal factor. The two, of course, are inseparable. The criteria for setting safe limits of temperature for fish have been considered by various authors (e.g., Elliott, 1981; Alabaster and Lloyd, 1980; Coutant, 1977). One principle governing the criteria involves setting acceptable limits to the reduction of such vital functions as growth, food conversion efficiency, swimming speed, metabolic scope, and reproductive capacity. To do this, a variety of thermal studies have been conducted, including growth and food conversion efficiency and other bioenergetics studies. One of the objectives of the proposed study will be to determine the relationship between water temperatures and chinook salmon growth and productivity in different areas of the Yuba River. This objective will be achieved by collecting field data during the chinook salmon parr-smolt transformation and rearing life stages. By incorporating water temperature data and data collected from the fish (i.e., weights, age, food consumed) into physiological thermal bioenergetics models (Hanson et al., 1997; Hewett and Johnson, 1992), it will be possible to determine the relationship between daily water temperatures and growth rates and productivity of the young salmon in the

Yuba River. The use of the thermal bioenergetics models will then allow us to determine if, when, and where water temperatures are stressful to the young salmon in the Yuba River. From the results, site-specific restoration actions can be planned to improve conditions for the Yuba River.

In summary, the purpose of this proposed project is to build on our knowledge of the life history, thermal requirements, and population trends of chinook salmon in the Yuba River, so that improved adaptive management of the river, including fish restoration projects and appropriate in-stream flow regimes, can be achieved.

Chinook salmon life history, thermal requirements, and population trends will be documented by:

- Monitoring timing of alevin emergence;
- Determining duration of downstream movement;
- Determination of juvenile salmon size at emigration;
- Determination of thermal requirements of, and thermal stress to, juvenile salmon;
- Measurement of relative abundance;
- Determination of timing and size of juvenile salmon entering the Delta;
- Determine contribution of Yuba River chinook salmon to ocean harvest: and,
- Determine contribution of different juvenile sizes at emigration to spawner escapement

Completion of this proposed project will aid in achieving CALFED Strategic Goal 1: At-Risk Species, Goal 2: Ecosystem Processes and Biotic Communities, Goal 3: Harvestable Species, and Goal 4: Habitats. By continuing the documentation of chinook salmon life history, thermal requirements, and population trends under different flow regimes in the Yuba River, we will improve our ability to manage for spring-run chinook salmon as well as fall- and late fall-run chinook salmon and steelhead trout. Knowledge of the life history strategies will allow us to apply adaptive management measures by manipulation of water flows, water transfers, and water temperatures, to improve conditions for all salmonids and specifically for the size of juvenile salmon at outmigration that provides the greatest downstream survival and escapement.

2) Justification

Conceptual Model: Our goal is to improve conditions for chinook salmon in the Yuba River. Information from the current study has given a general understanding of the ecosystem processes of the Yuba River. Through our evaluation, we have identified areas that need additional research. Areas which need to be identified are: (1) the importance of different juvenile life history strategies (size at emigration) to the overall adult escapement of adult chinook salmon; (2) thermal requirements for juvenile chinook salmon; (3) the effects of

different in-stream flow regimes on juvenile chinook salmon; (4) timing and size of Yuba River chinook salmon emigrating through the Delta; and, (5) contribution of Yuba River chinook salmon to ocean harvest. By using the Adaptive Management Process (Figure 3), the results of the proposed project will: (1) begin to provide the basis for identifying cause-and-effect type restoration actions in the Yuba River; (2) provide much-needed data on the responses of wild chinook salmon to ambient water temperatures; and, (3) serve as a general template for similar field-oriented thermal bioenergetics projects on salmonids for other Bay-Delta systems.

Hypotheses Being Tested: The research areas have lead to the following hypotheses.

1. The size of juvenile chinook salmon at emigration contribute differently to adult escapement.

2. Different water year types (flows) result in different survival rates of chinook salmon.

3. Water temperatures are stressful to juvenile chinook salmon in the Yuba River.

Adaptive Management: The focus of the proposed project is for expanded targeted research and monitoring. CALFED's Comprehensive Monitoring, Assessment, and Research Program (CMARP, 1998) states "Appropriate and timely assessment of monitoring and research data is critical to effective management." Knowledge of life history strategies and thermal requirements of chinook salmon in the Yuba River is lacking. The proposed project will provide needed life history and thermal data to assist with adaptively managing flows and enhancing the populations of chinook salmon in the Yuba River. As our understanding of the Yuba River fisheries and ecosystem improves, resource managers and stakeholders will be able to direct restoration activities designed for the adaptive management of in-stream flows and the enhancement of chinook salmon.

3) Approach

Location and/or Geographic Boundaries of the Project: The project area is the Yuba River downstream of Englebright Dam to its confluence with the Feather River in Marysville, Yuba County. This proposal includes CALFED Ecological Management Unit number 8.2.

Proposed Scope of Work: To determine Yuba River chinook salmon life history, and the relationship between Yuba River chinook salmon and ecosystems outside the Yuba River watershed, the following tasks will be undertaken: Task 1: Annual Adult Escapement Surveys; Task 2: Rotary Screw

Trap Monitoring; and, Task 3: Coded-Wire Tagging. To determine the relationship between water temperatures and growth and productivity of juvenile chinook salmon in the Yuba River, the following tasks will be undertaken: Task 4: Water Temperature Monitoring; Task 5: Fish Sampling/Stomach Sampling; Task 6: Data Reduction and Data Entry; Task 7: Analysis and Report of Results; Task 8: Meetings; and, Task 9: General Project Management.

The DFG will have overall responsibility for the completion of the proposed project. In coordination with the DFG, Dr. Alice Rich (A.A. RICH AND ASSOCIATES) will be responsible for the completion of the thermal bioenergetics (Tasks 4-7B). The DFG and Dr. Rich will work collaboratively on Tasks 8 and 9."

Task 1: Annual Adult Escapement Surveys - The proposed project will utilize annual adult chinook salmon escapement data from surveys conducted by the Yuba County Water Agency (YCWA). Weekly carcass surveys will be conducted during the principal spawning season of early October through late December. The study area is separated into three distinct reaches that include nearly all of the spawning areas used by chinook salmon in the Yuba River. The outcome of these surveys includes an estimate of the returning adult population, and the recovery of all possible coded wire tags. Escapement is used for population trends and as an indicator of attainment of recovery goals for Central Valley chinook salmon.

Task 2: Rotary Screw Trap Monitoring – Monitoring time of alevin emergence, documenting size and condition of juvenile chinook salmon at emigration, measuring relative abundance, and monitoring in-stream rearing and emigration patterns will be determined through placement of thermographs and the operation of a rotary screw trap (RST). Trapping would be continuous through the juvenile chinook salmon outmigration period of October through June. The fish trapping location on the Yuba River will be approximately 6 river miles east of the city of Marysville.

To help determine the timing of alevin emergence, we will monitor chinook salmon fry captured in the RST. The sampling site is essentially downstream of all potential chinook salmon spawning habitat. Alevin emergence will also be recorded by comparing peak spawning activity with daily water temperatures. Determination of peak spawning will be accomplished for each distinct spawning reach through the YCWA adult escapement survey. Temperature will be recorded within each distinct spawning reach using thermographs deployed for the thermal bioenergetics portion of the project. By knowing timing of spawning and daily water temperatures, thermal units can be determined that can be used to access the time of emergence.
Abundance estimates of juvenile chinook salmon will be determined by the operation of the RST and trap efficiency tests. Efficiency tests will be performed as necessary (major fluxions in river flow, changes in mean salmon size at

capture), and will be accomplished by releasing coded-wire tagged experimental salmon 400 yards up-stream of the RST for recapture (the introduction of hatchery stock to the Yuba River's wild population to accomplish trap efficiency tests is undesirable). Fish will be marked with a bismark brown stain solution (Mundie and Taber, 1983), prepared at a concentration of eight grams of bismark brown to 380 litters (L) of water. Fish will be stained in the solution for 45-50 minutes, and held for 24 hours before being released.

Size of juvenile chinook salmon at emigration, and emigration patterns will be determined by the operation of the RST. Conditions permitting (high flow events, and excessive debris), the RST will be operated seven days per week and twenty-four hours per day. Daily fish capture will be recorded. To determine average length, condition factor, and thermal requirements of the juveniles, length and weights of the chinook salmon will be taken. Bi-weekly catch summaries and length frequency graphs will be generated from the catch data. Evaluating this information will help assess the life history strategies of the Yuba River chinook salmon.

An additional benefit of operating the RST is the information on steelhead trout. The Yuba River supports a large population of Central Valley steelhead trout. By operating the RST, steelhead trout data can be collected to estimate relative abundance, document the timing and duration of emergence and downstream movement, size of downstream migrants (by date), and the condition of downstream migrants. With this information resource managers and stakeholders will be able to direct restoration activities designed for the adaptive management of in-stream flows and the enhancement of steelhead trout.

Task 3: Coded-Wire Tagging - Another focus of the proposed project will be the determination of the overall contribution of different juvenile chinook salmon life history strategies to total adult escapement. This will be accomplished by coupling the RST data (length, weight, and condition of juveniles at emigration), along with emigration patterns of juveniles, to a coded-wire tagging program. Juvenile chinook salmon will be coded-wire tagged (CWT) and adipose-fin clipped as they are captured in the RST. Tag codes will be systematically changed every two weeks. Differential tagging will be utilized when fry and smolt life stages are present during the same periods. The goal of the proposed project is to tag 100,000 or more juvenile chinook salmon each year. This amount of tagging effort will insure an appropriate number of tagged adult chinook salmon will be recovered in downstream waters, the ocean, and in the annual adult escapement surveys. However, these are natural stock chinook salmon and attainment of 100,000 tagged is dependent on many variables (i.e. run size, ability to trap successfully, etc). By releasing a large population of tagged chinook salmon, we hope to gain valuable information on the success of different juvenile chinook salmon life history strategies.

The coded-wire tagging program is an integral component in determine the relative contribution of size of juveniles at outmigration (fry vs. smolt) to ultimate adult escapement. The program will also provide important insight into the timing of juvenile chinook salmon presence in the mainstem Sacramento River and Delta, as well as information on the contribution of Yuba River chinook salmon to the ocean harvest. These elements of the proposed project will rely on the annual adult escapement surveys, downstream and ocean tag recovery from other researchers, and by commercial and sport fishing efforts.

Task 4: Water Temperature Monitoring - The time period during which the juvenile outmigration occurs is from October through June. Thermograph sites will be selected in representative habitats of the Yuba River, including the screw trap site. Thermographs ("tidbits", Onset Computer, Massachusetts) will be placed in selected representative habitats. The number and location of each thermograph will be determined by Dr. Rich prior to juvenile outmigration for each year of study. It is anticipated that some of the thermographs will be stolen or vandalized, so duplicate thermographs will be placed in each of the representative habitats.

Task 5: Fish/Fish Stomach Sampling: During operation of the RST, the types of data that will be important for the thermal bioenergetics modeling include salmon weights, lengths, stomach contents, and scales and otoliths (for age determination). To reduce the stress of capture on the salmon, a species particularly susceptible to stress, the fish will be placed in a buffered (sodium bicarbonate to pH 7.0, 75 ppm) anaesthetic (methane trisulphonate, 50 ppm). Previous studies (Rich, 1979, 1983) demonstrated that salmonids exhibited minimal handling stress response when such a mixture was used. Once the fish have been collected, lengths and weights will be recorded and scales obtained for subsequent age determination. The stomach contents of 10-20 of the captured fish per month (depending upon size) will be extracted by gastric lavage, using a small 12-volt bilge pump with a hose connected to a stainless steel turkey baster. This will provide a continuous flow of water to flush stomach contents onto a fine mesh screen (Hawkins and Tipping, 1999). The contents of the stomach will then be weighed and preserved (10% formalin) for identification of food organisms later. To determine the relationship between wet to dry weights of the food contents (needed in the bioenergetics modeling), the stomach contents from an additional 10-20 (depending upon size ranges) salmon per month will be frozen and saved for subsequent analysis. Similarly, 10-20 salmon per month will also be utilized for dry weight determination. These samples will be dried later in a drying oven. As age determination from scales is often inaccurate, otoliths from these fish will be obtained for age determination as a back-up to the scales analysis. After completing the recording of the data and gastric lavage on the salmon, the fish will be returned carefully to the river. Dr. Rich will train the Department's biologists on the gastric lavage procedure. Dr. Rich's firm, A.A. Rich and Associates, will be responsible for analysis of dry

weights, age determination (scale and otolith analysis), and identification of stomach organisms (fish food organisms).

Task 6: Data Reduction and Data Entry -All data from the thermographs will be downloaded using Onset Computer's program, Boxcar. All data (i.e., weights, lengths, water temperature, food organisms) will be entered into either Excel or Sigmaplot, a statistical and graphics program.

Task 7: Analysis and Report of Results – (7A) Data from CWT recoveries downstream in the Sacramento River and Delta, ocean harvest, and the adult escapement surveys will be used to determine timing and distribution of juvenile chinook salmon in downstream waters, contribution of Yuba River salmon to the ocean harvest, affect of water year types on survival rates, and the differential contribution of fry and smolt to adult escapement.
The DFG will provide work products that will consist of Quarterly Summary Reports, Annual Draft and Final Draft Reports, and a Draft and Final Completion Report to CALFED. These work products will include similar products from Dr. Rich for the Bioenergetics element. The Draft and Final Annual Technical Reports and the Daft and Final Completion Reports will describe the full effort, including: Introduction/Background; Scope of Work/Objectives; Methodology for all components; Analysis and Discussion of Results; Conclusions; Recommendations for Restoration Actions; Literature Cited; and, Appendices.

(7B) The data needed for the thermal bioenergetics models will be used in the following three forms: (1) the original database (weights, lengths, age, water temperatures in 10 minute intervals from October through June); (2) thermal bioenergetics-based database which can be used to determine the relationship between water temperatures and growth and productivity of juvenile salmon; and, (3) reduced form of the thermal database (depicting daily minimum, mean, and maximum temperatures). In addition to physiological constants (e.g., respiratory, excretory content), the thermal bioenergetics-based database will consist of water temperatures, as a function of time, and estimates of dry weights of the fish as a function of time, diet (i.e., food consumed, expressed as dry weight). Scales and otoliths of the chinook salmon will be examined under a stereoscope (Leica MS5), with fiber optic light (Leica). In addition, as a back-up procedure, scales will be examined with the use of a microfiche reader/copier (Micron Microcopy 15A). Magnification will be between 10-40X, depending upon the size of the scale or otolith.

Bioenergetics modeling of fish growth is a useful approach for assessing the effects of water temperatures on chinook salmon. A bioenergetics approach is appealing because: (1) growth is an important indicator of population health; and, (2) bioenergetics modeling has an extensive record of previous applications in research and management (Hanson et al., 1997; Ney, 1993; Railsback and Rose, 1999; Beauchamp et al., 1989; Boisclair and Leggett, 1989; Boisclair and Sirois, 1993; Brandt, 1993; Hansen et al., 1993; Hartman and Brandt, 1995;

Labar, 1993; Mason et al., 1995; Rand et al., 1994). Using field data (i.e., water temperatures, salmon weights, food eaten by juvenile salmon), together with the computer bioenergetics models developed by Hewett and Johnson, 1992, and revised by Hanson et al. (1997), it will be possible to determine the relationship between daily water temperatures and growth rate and relative productivity of juvenile chinook salmon in the Yuba river. Such an approach will provide a functional site-specific field-oriented determination of the relationship between growth/food conversion efficiency and water temperatures for juvenile chinook salmon within the Yuba River. These results will then be used to determine if, when and where water temperatures were limiting to young chinook salmon.

Task 8: Meetings - Two annual meetings with DFG are planned. Before any data are collected, there will be an initial meeting with Dr. Rich and the DFG. The purpose of the first meeting will be to review the study plan, objectives, and tasks to be performed and "fine tune" the field methodologies. The second meeting will occur each year after the Draft Report has been completed by Dr. Rich and the DFG has had a chance to review it. At that meeting, Dr. Rich will discuss the results of the studies and provide recommendations for future enhancement activities and studies, if warranted. In addition, this meeting will provide an opportunity for the DFG to ask questions and make recommendations. A similar meeting will be held annually with the Yuba River Technical Work Group.

Task 9: Project Management - The DFG will be responsible for overall project coordination and management. Project management will consist of submitting progress reports, budget tracking and invoicing. The work products will consist of Quarterly Summary Reports, Annual Draft and Final Technical Reports, and a Draft and Final Completion Report (s). The Draft and Final Annual Technical Reports and the Draft and Final Completion Reports will describe the full effort, including: Introduction/Background; Scope of Work/Objectives; Methodology for all components; Results; Analysis and Discussion of Results; Conclusions; Recommendations for Restoration Actions; Literature Cited; and, Appendices.

4) Feasibility: The proposed project is a continuation and expansion of the existing Yuba River Juvenile Chinook Salmon Life History Evaluation, currently in its second and final year. The approaches previously described have proven to be effective methods for the documentation of the life history strategy of chinook salmon. Meeting the tagging goals stated in this proposal should be attainable within the three-year time frame. However, climatic conditions dictate the success of each sampling year. Operation of RST becomes difficult during exceptionally high or low water flows. In the past DFG has successfully operated RST on the Yuba River under flow conditions of up to 29,000 cubic feet per second (cfs). From past experience (1997 flood event) flows that exceed this amount would be expected to last for only a short period. In addition, because of

current in-stream flow requirements, flows are not expected to drop to levels in which RST operation becomes infeasible.

Coded-wire tagging of juvenile chinook salmon during emigration is a new aspect of the project. However, DFG has experience tagging juvenile salmonids, including recent experience with the coded-wire tagging of naturally produced juvenile spring-run chinook salmon on Butte Creek. Depending on tagging load, outside service contracts (Big Eagle & Associates, Inc.) may be necessary for tagging during peak tagging periods.

Completing the proposed CWT project in three years will provide an eight-year evaluation of chinook salmon in the Yuba River (two completed years of juvenile monitoring, three additional years of juvenile monitoring and tagging, and three years of adult tag recovery). Achievements of the evaluation will be a basis for adult spawner population trends, important information on juvenile life history contributions to total adult escapement, information on the timing of juvenile chinook salmon presence in the Yuba River, mainstem Sacramento River and Delta, as well as information on Yuba River chinook salmon contributions to ocean harvest.

The project site has already been established. For the RST, permission to access the site has been granted by Naumes Inc. The site has been used since 1999, the onset of the Yuba River chinook salmon evaluation.

Operation of the RST requires an incidental take permit for Central Valley steelhead trout. The project has a Section 10 incidental steelhead trout take permit issued by the National Marine Fisheries Service (NMFS), which expires in 2002. We will submit applications for a three-year take permit extension for steelhead trout, and any other species or sub-species that require take permits from NMFS or the U.S. Fish and Wildlife Service (USFWS).

5) Data Handling and Storage: Data for the life history portion of the project will be entered into a relational database at least once per week and exported to the Interagency Ecological Program server in Sacramento. Once per week, a backup is made of the database on removable media. The backup is stored at a site remote from the DFG offices. Original field data sheets are kept at the DFG Sacramento field office and photocopies are kept at DFG's Rancho Cordova office.

Data for the thermal bioenergetics portion of the project will be captured and stored in various formats, including the data management program, RBASE, the thermograph program, Boxcar, Sigmaplot for thermograph and other figures, the bioenergetics program, Fish Bioenergetics 3.0 (for bioenergetics modeling), photographs of thermograph and fish sampling sites, and photographs of fish scales from the microfiche reader. A complete bioenergetics database will be provided by Dr. Rich to the DFG at the end of completion of each year of effort.

6) Expected Products/Outcomes: DFG's project manager will prepare and submit quarterly progress reports. Progress reports will be submitted to CALFED by the 10th day of the month following the end of the quarter. Progress reports will include project financial information, progress toward achieving the objectives stated in this proposal, and problems and/or delays encountered in the study. If needed, a description of any modifications to the project contract will be outlined. Annual reports will be prepared, as well as a comprehensive report at the end of the three year project. This final project report will summarize the five years that the study will have spanned. Project staff are participants in the Yuba River Technical Workgroup. Public outreach will be established through local stakeholder meetings.

7) Work Schedule: Please refer to Table 1 to identify the start and completion dates for each of the above listed tasks. All tasks are inseparable components of the proposed project. These tasks are needed for the long-term evaluation of Yuba River chinook salmon.

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

1) ERP, Science Program and CVPIA Priorities: The Restoration Priorities for the 2002 Daft Stage 1 Implementation Plan were developed using the ERP Strategic Goals and important scientific uncertainties identified by the Strategic Plan.

The proposed project will aid CALFED in meeting the following Daft Stage 1 Implementation Plan Restoration Priorities and address the identified scientific uncertainties.

MR-6.) Ensure recovery of at-risk species by developing conceptual understanding and models that cross multiple regions – (Salmonids Studies integrated across the system): This goal places highest priority on salmonid studies that consider the animals' use of widely varying habitats, from the upper rivers through the Delta, into the oceans and back to the rivers. One of the purposes of the proposed project is to gain important insight into the timing of juvenile chinook salmon presence in the mainstem Sacramento River and Delta, as well as information on the contribution of Yuba River chinook salmon to the ocean harvest. By releasing coded wire-tagged salmon utilizing different life history strategies, information may be gathered on interconnections to different habitats, the effects on different life stages in the Delta, and movement throughout the whole system. This proposed project will rely on the downstream and ocean tag recovery from other researchers, and by commercial and sport fishing efforts.

SR-3.) Conduct adaptive management experiments in regard to natural and modified flow regimes to promote ecosystem functions or otherwise support restoration actions – (Effects of managed flow fluctuations): This goal places highest priority on studies that consider effects of flow fluctuations on anadromous fish habitat below dams. Through operation of the RST and by releasing a large number of CWT fish, the proposed project will gain important information on the long term effects of managed flow fluctuations on the different juvenile life history strategies utilized by Yuba River chinook salmon, both within and between sampling years. A comparison of survival of chinook salmon emigrating as fry vs. chinook salmon rearing for longer periods before emigrating as smolt, will give an estimation on the effects of different flow regimes on juvenile survival.

SR-3.) Conduct adaptive management experiments in regard to natural and modified flow regimes to promote ecosystem functions or otherwise support restoration actions – (Instream flow programs): This goal places highest priority on instream flow studies that address the effects of flows and flow regimes on fish populations in the Sacramento Valley. Through operation of the RST and by releasing a large number of CWT fish, the proposed project will gain important information on the long term effects of managed flow regimes on the different juvenile life history strategies utilized by Yuba River chinook salmon, both within and between sampling years. A comparison of survival of chinook salmon emigrating as fry vs. chinook salmon rearing for longer periods before emigrating as smolt, will test current flow recommendations and their effects on spring-, fall-, and late fall-run chinook salmon passage on the Yuba River.

SR-7.) Develop conceptual models to support restoration of river, stream and riparian habitat – (Juvenile life history requirements): This goal places highest priority on the general need to understand juvenile life history requirements of salmonids in the Sacramento River and its tributaries. The proposed project will address juvenile life history strategies and requirements through the continual operation of a RST throughout the project's sampling period, October through June annually. The project will document the following: long term population trends, timing and duration of emergence, timing and duration of downstream movement, size of downstream migrates (by date), as well as an attempt to determine if the different runs of juvenile chinook salmon can be differentiated by size and time of capture.

In addition the proposed project addresses three of five CALFED Ecosystem Restoration Program (ERP) Strategic Goals. Specifically, the proposed project addresses ERP Goals 1, 2 and 4 as follows:

Goal 1 - At -Risk Species: - "Achieve recovery of at-risk native species.... in San Francisco Bay and the watershed above the estuary." By determining what temperatures are stressful and which are not, restorations actions can be

implemented to reduce the thermal stress which, in turn, will improve conditions for the at-risk species, the chinook salmon.

Goal 2 - Ecosystem Processes and Biotic Communities: - "Rehabilitate natural processes in the Bay-Delta system...." By determining what temperatures are stressful and which are not, restorations actions can be implemented to reduce the thermal stress which, in turn, will improve natural conditions in on of the watershed in the Bay-Delta system.

Goal 3 - Harvestable Species: - "Maintain and/or enhance populations of selected species for sustainable commercial and recreational harvest…" By improving conditions for chinook salmon and steelhead trout and ultimately increasing production and escapement which, in turn will provide increased numbers for recreational and commercial harvest.

Goal 4 - Habitats: - "... becomes important to protect and restore large expanses of major habitat types...." By determining what temperatures are stressful and which are not, restorations actions can be implemented to reduce the thermal stress which, in turn, will improve habitat conditions for chinook salmon.

2) Relationship to Other Ecosystem Restoration Projects: The life history portion of the proposed project has its own goals and objectives, however it is related to several past and future projects on the Yuba River. Past projects on the Yuba River include the reconstruction and improvement of the Hallwood-Cordua diversion fish screen located at Daguerre Point Dam, and the placement of a modern fish screen at the Brown's Valley Irrigation diversion. Long term documentation of chinook salmon population trends will help document the success of these past restoration projects.

Future projects on the Yuba River include modifications to fish ladders at Daguerre Point Dam to include fish monitoring devices, if not the total removal of the dam. Also planned are a water temperature control device and a full flow bypass for hydro-electrical facilities located at Englebright Dam. Using previous chinook salmon data for a basis, the proposed project will be able to determine the effects of these future projects.

In addition the thermal bioenergetics portion of the proposed study is part of an ongoing effort by the DFG to determine thermal requirements for chinook salmon in the Sacramento-San Joaquin River system. The proposed study will address critical information needs, regarding the relationship between water temperatures and growth and productivity of chinook salmon in the Yuba River. From the results of the proposed study, it will be possible to identify restoration actions which will improve conditions for young chinook salmon and hence, for the watershed as a whole. In addition, it may be possible to transfer the thermal requirement information for young chinook salmon to those in other Central

Valley rivers, if conditions are similar. It will serve as a general template for similar field-oriented thermal bioenergetics projects for other Bay-Delta systems.

3) Requests for Next-Phase Funding: Not Applicable.

4) Previous Recipients of CALFED Program or CVPIA funding: Not Applicable.

5) System-Wide Ecosystem Benefits: System-wide benefits include the ability to track CWT chinook salmon from the Yuba River and determine their timing at the Delta pumping facilities and contribution to ocean harvest. By releasing coded wire tagged salmon utilizing different life history strategies, information may be gathered on interconnections to different habitats, the effects on different life stages in the Delta, and movement throughout the whole system. As our understanding of the Yuba River fisheries and ecosystem improves, resource managers and stakeholders will be able to direct restoration activities designed for the adaptive management of in-stream flows and the enhancement of juvenile chinook salmon.

In addition the proposed project will provide important field-based data on the thermal requirements of young chinook salmon in a Bay-Delta watershed. As there are few field-oriented thermal studies on chinook salmon, the information resulting from the proposed project can then be used: (1) to identify cause-and-effect type restoration actions within the watershed; (2) to identify what types of habitat provide the best thermal conditions; and, (3) as a general template for further field-oriented thermal bioenergetics research on salmonids in this and other Central Valley rivers.

6) Additional Information for Proposals Containing Land Acquisition: Not Applicable.

Qualifications

The California Department of Fish and Game, Sacramento Valley & Central Sierra Region, will oversee this project. The Regional Manager and Senior Fisheries Staff will provide guidance and support to insure that the project is completed in a timely and professional manner. The direct project manager is Mr. John Nelson, Environmental Specialist IV for the DFG. Mr. Nelson's supervisor is Mr. Rich Dixon, Senior Fisheries Biologist. Mr. Nelson has lead fisheries research and monitoring activities for 22 years with DFG, including the current activities on the Yuba River. Mr. Ian Drury will serve as a secondary project manager as well as direct field sampling lead for the life history portion of the proposed project. Mr. Drury is a Fisheries Biologist with DFG and will not be supported by CALFED or CVPIA funds. The data analyst and field technicians included in this proposal are not yet determined. They will work under Ian Drury's lead.

Dr. Alice Rich (A.A. RICH AND ASSOCIATES) will manage all aspects of the thermal bioenergetics portion of the proposed project. Dr. Rich has over 25 years of technical experience in a wide range of fisheries-related projects. Her professional experience encompasses work as a fisheries consultant, fisheries biologist, fish physiologist, analytical chemist, and university lecturer. She is a recognized expert in fish thermal physiology, as well as other fishery resources needs, and has been called upon as an expert witness on the impacts of water temperature, water quality, water diversions, migration barriers, timber harvest practices, and catch-and release fishing on fishery resources. She has designed and supervised numerous chinook salmon and other salmonid thermal physiology studies in California, Idaho, Nevada, Washington, and Maine and has provided expert witness testimony for the California Department of Fish and Game, Sacramento County, and other agencies on the thermal impacts of altered stream flows on chinook salmon and other salmonids in the Yuba River, American River, Sacramento and San Joaquin Rivers. The results of Dr. Rich's thermal bioenergetics studies which identified thermal requirements for juvenile chinook salmon in the American River are currently used by both state and federal agencies in the Central Valley.

References for Dr. Rich:

Ms. Deborah McKee, California Department of Transportation, 1120 B Street, Sacramento , California 95669, Telephone (916) 653-8566

Dr. Stacy Li, National Marine Fisheries Service, 777 Sonoma Avenue, Room 325, Santa Rosa, California 95404, Telephone (101) 575-6082

Ms. Gail Seymour, California Quality Control Board, North Coast Region, 5550 Skylane Blvd., Suite A, Santa Rosa, California 95403, Telephone (707) 576-2698

References for California Department of Fish and Game Personnel:

Ms Deborah McKee, California Department of Transportation, 1120 B Street, Sacramento , California 95669, Telephone (916) 653-8566

Mr. Paul Ward, California Department of Fish and Game, 2545 Zaneila Way, Suite F, Chico, California 95928, Telephone (530) 895-5015

Mr. Craig Fleming, U.S. Fish and Wildlife Service, North Wilson Way, Stockton, California 95205, Telephone (209) 946-6400

Cost

DFG – Juvenile life history, RST, and fry vs. smolt adult escapement contribution
Cost - $637,492

A. A. Rich and Associates – Bioenergetics
Cost - $247,400

Total - $884,892*

*does not include DFG overhead (13.9% for Federal funds, 15.0% for State funds)

1) Budget: The detailed budget for each year of requested support and budget justification are included in the web forms and do not need to be included here.

2) Cost-Sharing: The proposed project will be provided support from the DFG through the use of vehicles, clerical services, and the funding of Ian Drury, which is not included in overhead.

Local Involvement

The proposed project's plan for public outreach involves many constituents. Our goal is to keep the public informed and keep the support of the local landowners. Permission to access private land has been and will be obtained. Many of the stakeholders concerned with the Yuba River, including CDFG, participate in the Yuba River Technical Work Group (YRTWG). The YRTWG includes Federal, State, and local government agencies, local landowners, environmental groups, and other interest groups. The YRTWG is supportive of the proposed project. The YRTWG is the principle method for keeping the local stakeholders informed.

Compliance with Standard Terms and Conditions

This project will comply with all Standard Terms and Conditions as stated in the 2002 Proposal Solicitation Package.

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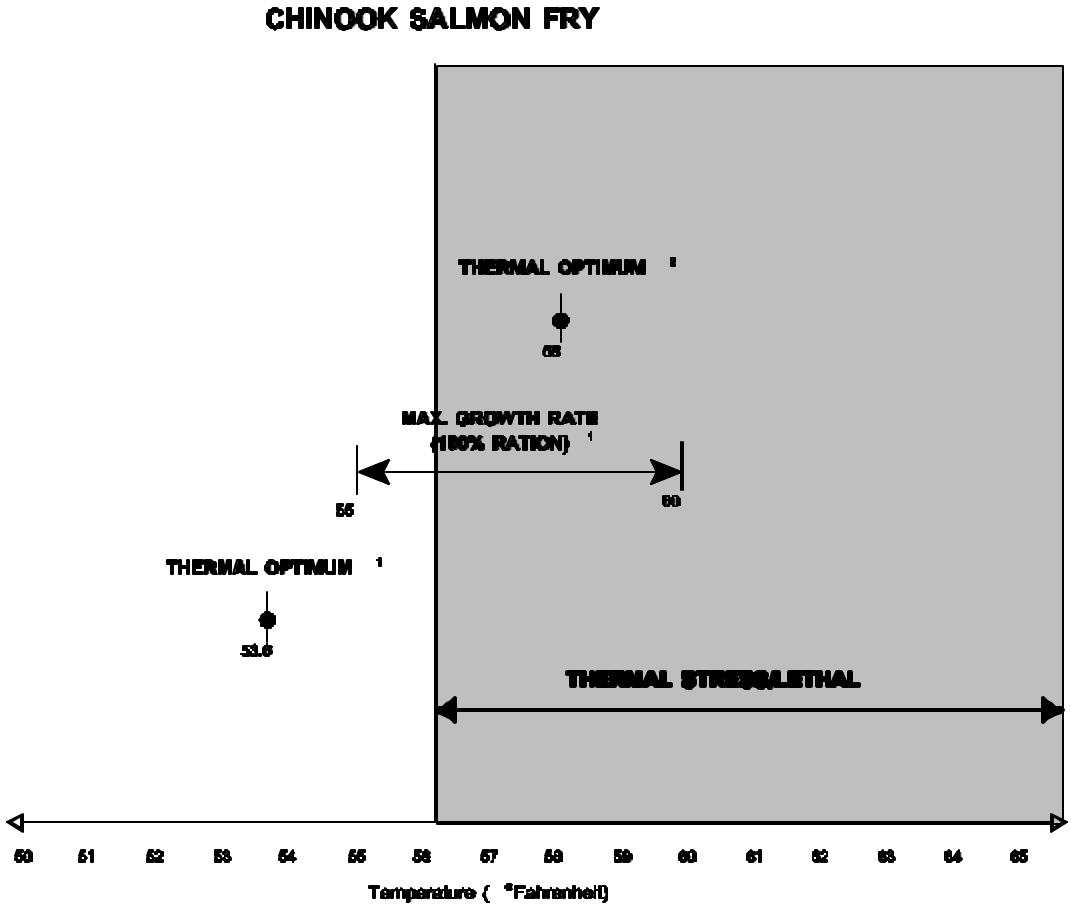

FIGURE 1. Status Summary of Knowledge of Effects of Water Temperature on Chinook Salmon Fry (Source: Rich, 2000)

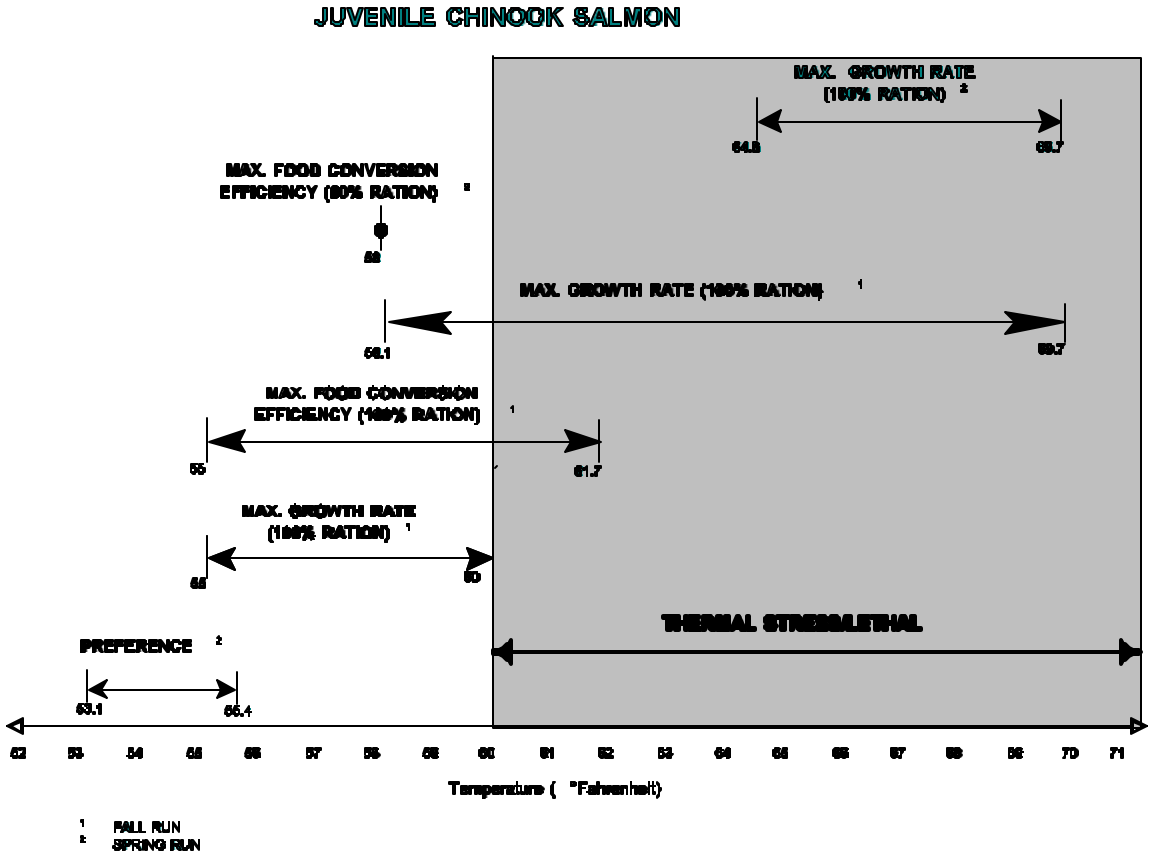

Figure 2. Status Summary of Knowledge of Effects of Water Temperature on Juvenile Chinook Salmon (Source: Rich, 2009)

Table 1. Activity description, starting and ending dates of chinook salmon monitoring on the Yuba River.

#	Task	Start	End	Frequency	Deliverable
1	Annual Adult Escapement Surveys	October	December	Annual	Quarterly Reports Annual Report Final Report
2	Rotary Screw Trap Monitoring	October	June	Annual	Quarterly Reports Annual Report Final Report
3	Coded-Wire Tagging	December	June	Annual	Quarterly Reports Annual Report Final Report
4	Water Temperature Monitoring	October	June	Annual	Quarterly Reports Annual Report Final Report
5	Fish Sampling/Stomach Sampling	October	June	Annual	Quarterly Reports Annual Report Final Report
6	Data Reduction and Data Entry	November	August	Annual	Quarterly Reports Annual Report Final Report
7	Analysis and Report of Results	Throughout Project	Throughout Project	Annual	Quarterly Reports Annual Report Final Report
8	Meetings	October	After Review of Daft Report	Annual	Quarterly Reports Annual Report Final Report
9	Project Management	Throughout Project	Throughout Project	Annual	Quarterly Reports Annual Report Final Report

All tasks are inseparable components of the proposed project. These tasks are needed for the long-term evaluation of Yuba River chinook salmon.