Proposal to Coded-Wire Tag Wild Juvenile Chinook to Determine Contribution of Fry, Parr and Smolt Emigrants to Adult Recruitment from the San Joaquin Basin

Project Information

1. **Proposal Title:**

   Proposal to Coded-Wire Tag Wild Juvenile Chinook to Determine Contribution of Fry, Parr and Smolt Emigrants to Adult Recruitment from the San Joaquin Basin

2. **Proposal applicants:**

   Doug Demko, S.P. Cramer & Associates, Inc.

3. **Corresponding Contact Person:**

   Doug Demko
   S.P. Cramer & Associates, Inc.
   P.O. Box 247 Mi Wuk Village, CA 95346
   209 586-5020
   demko@dcs-chico.com

4. **Project Keywords:**

   Anadromous salmonids
   At-risk species, fish
   Biostatistics

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: 37.741

   Longitude: -121.041

   Datum:

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

The project will be conducted at two locations on the Stanislaus River. The upstream location is at river mile 40.6, which is within the Oakdale City limits on the property of the City of Oakdale Waste Treatment Facility off of Liberini Road. The second site is downstream at river mile 8.6, which is within Caswell State Park off of Austin Road outside of Ripon City limits. The longitude/latitude listed above is half-way between the two project sites.

10. **Location - Ecozone:**

    13.1 Stanislaus River

11. **Location - County:**

    San Joaquin, Stanislaus

12. **Location - City:**

    Does your project fall within a city jurisdiction?

    Yes

    If yes, please list the city: City of Oakdale

13. **Location - Tribal Lands:**

    Does your project fall on or adjacent to tribal lands?

    No

14. **Location - Congressional District:**

    18th

15. **Location:**

    California State Senate District Number: 12, 5

    California Assembly District Number: 25, 17

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

    3

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: 0

Total Requested Funds: $523,950.00

b) Do you have cost share partners already identified?

Yes

If yes, list partners and amount contributed by each:

Tri-Dam Project $345,000.00

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?

Yes

If yes, identify project number(s), title(s) and CVPIA program.

11332-9-J010	**Evaluate the use of radio-tagged juvenile chinook salmon to identify cause and location of mortality**	**AFRP**
11332-0-M007	**Juvenile salmon outmigration monitoring at Caswell**	**AFRP**

Funds direct from BOR	**Evaluation of Smolt Survival**	**AFRP (Funds Direct from Burea of Reclamation)**

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

Proposal to Coded-Wire Tag Wild Juvenile Chinook to Determine Contribution of Fry, Parr and Smolt Emigrants to Adult Recruitment from the San Joaquin Basin

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.

      The proposed project is research only and does not constitute an action that will require CEQA/NEPA compliance.

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 Required, Obtained

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 Required

Rivers and Harbors Act

CWA 404

Other

PERMISSION TO ACCESS PROPERTY

Permission to access city, county or other local agency land. Agency Name: City of Oakdale	Required
Permission to access state land. Agency Name: Caswell State Park	Required
Permission to access federal land. Agency Name: Army Corps	Required
Permission to access private land. Landowner Name: Bob Brochini	Required

6. **Comments.**

#5. An on-going project we are conducting on the Stanislaus River has already obtained permission to access these properties, but we will obtain additional permission access for the proposed project.

Land Use Checklist

Proposal to Coded-Wire Tag Wild Juvenile Chinook to Determine Contribution of Fry, Parr and Smolt Emigrants to Adult Recruitment from the San Joaquin Basin

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).

   The proposed project involves research only.

4. **Comments.**

Conflict of Interest Checklist

Proposal to Coded-Wire Tag Wild Juvenile Chinook to Determine Contribution of Fry, Parr and Smolt Emigrants to Adult Recruitment from the San Joaquin Basin

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):

Doug Demko, S.P. Cramer & Associates, Inc.

Subcontractor(s):

Are specific subcontractors identified in this proposal? No

Helped with proposal development:

Are there persons who helped with proposal development?

Yes

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

Andrea Phillips S.P. Cramer & Associates

Ray Beamesderfer S.P. Cramer & Associates

Steve Cramer S.P. Cramer & Associates

Chrissy Sonke S.P. Cramer & Associates

Comments:

Budget Summary

Proposal to Coded-Wire Tag Wild Juvenile Chinook to Determine Contribution of Fry, Parr and Smolt Emigrants to Adult Recruitment from the San Joaquin Basin

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**
2.1	Tag juvenile chinook with coded-wire tags	3370	127660	3740	8550	3850	0	87950	1200	232950.0	0	232950.00
3.1	Gather hydrologic data	65	3920	130	0	0	0	0	0	4050.0	0	4050.00
		3435	131580.00	3870.00	8550.00	3850.00	0.00	87950.00	1200.00	237000.00	0.00	237000.00

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**
2.1	Tag juvenile chinook with coded-wire tags	2720	104160	3040	8550	3850	0	0	1200	120800.0	0	120800.00
3.1	Gather hydrologic data	65	3920	130	0	0	0	0	0	4050.0	0	4050.00
		2785	108080.00	3170.00	8550.00	3850.00	0.00	0.00	1200.00	124850.00	0.00	124850.00

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**
2.1	Tag juvenile chinook with coded-wire tags	2665	99320	2930	8550	3850	0	0	1200	115850.0	0	115850.00
2.2	Gather CWT recovery data	140	11520	280	0	0	0	0	0	11800.0	0	11800.00
3.1	Gather hydrologic data	65	3920	130	0	0	0	0	0	4050.0	0	4050.00
3.2	Analysis of environmental effects	40	3820	80	0	0	0	0	0	3900.0	0	3900.00
3.3	Analysis of life stage dependent factors	40	3820	80	0	0	0	0	0	3900.0	0	3900.00
4.1	Analysis of hatchery vs. natural life-history parameters	30	3040	60	0	0	0	0	0	3100.0	0	3100.00
5.1	Describe salmon flow requirements	80	6540	160	0	0	0	0	0	6700.0	0	6700.00
5.2	Prepare final project report	80	6540	160	0	0	0	0	0	6700.0	0	6700.00
5.3	Post project presentations	70	5960	140	0	0	0	0	0	6100.0	0	6100.00
		3210	144480.00	4020.00	8550.00	3850.00	0.00	0.00	1200.00	162100.00	0.00	162100.00

Grand Total=<u>523950.00</u>

Comments.
Objective 1 in each year will be paid in full by the Tri-Dam Project and is not included in the above total.

Budget Justification

Proposal to Coded-Wire Tag Wild Juvenile Chinook to Determine Contribution of Fry, Parr and Smolt Emigrants to Adult Recruitment from the San Joaquin Basin

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

Task 2.1 includes 3000 hours of technician time to successfully tag 70,000 juvenile chinook per year based on 2 technicians working 8 hour days and one technician working 4 hour days for approximately 150 days. In years 2 & 3 the technician hours will be reduced to 2400 hours of 2 technicians working 8 hours per day for 150 days. Biologist hours estimated for task 1.1 are 370 hours to coordinate, schedule and supervise the field work. Hours allocated for three Biologists (I, II & III) assigned to the project the first year are as follows: Bio I 150 hrs, Bio II 120 hrs, and Bio III 100 hrs. Year 2 estimated 120 hrs for Bio I, 100 hrs for Bio II and 100 hrs for Bio III. Year 3 estimated 120 hrs for Bio I, 100 hrs for Bio II and 45 hrs for Bio III. Task 2.2 will only be conducted in Year 3 and the breakdown of hours is as followed: Bio I 40 hrs, Bio II 30 hrs, Bio III 30 hrs, Senior Consultant 20 hrs and Principal Scientist 20 hrs. Task 3.1 will require 50 hours of Bio I time and 15 hours of Bio II time for each of the three years. Task 3.2 and Task 3.3 will only be conducted in Year 3 and each task will require 10 hours each of Bio II, Bio III, Senior Consultant and Principal Scientist. Task 4.1 will be conducted in Year 3 only and will require 5 hours each of Bio II and Bio III and 10 hours each from Senior Consultant and Principal Scientist. Task 5.1 and Task 5.2 will be conducted only in Year 3 and will require 20 hours each of Bio I, Bio II and Bio III, and 10 hours each of Senior Consultant and Principal Scientist. Task 5.3 will be conducted in Year 3 only and will require 10 hours each of Bio I, Senior Consultant and Principal Scientist, and 20 hours each of Bio II and Bio III.

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

The amounts listed for salary are SPCA's billing rates minus the benefit rates listed below. The billing rates include actual pay rates plus all overhead for each category of employee for each hour worked. Besides the employee pay and benefits, the billing rate includes costs associated with operation of the company such as Project administration (invoicing, payroll, et.), office rental, electricity, basic phone charges, internet connections, copy machine rental, employee taxes, company insurance for office and equipment, office supplies and furniture, salary employee bonuses, all overhead associated with each employee (disability insurance, workman's comp, vacation pay, holiday pay, etc.),company truck lease, etc. The following rates apply to the each category of employee listed in the project: Technicians $34/hr Bio I $58/hr Bio II $68/hr Bio III $88/hr Senior Consultant $108/hr $Principal Scientist $118/hr The actual employee pay is approximately 45% of the above billing rates plus the benefits listed below.

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

Technicians receive $1/hr for insurance and all other categories receive $2/hr for insurance.

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

Travel for each year is for transporation to and from tagging site each day, and is calculated as 80 miles round trip 4 times per week to Caswell for approximately 22 weeks, and 10 miles round trip to Oakdale 3 times per week for 22 weeks. It also includes cost of rental truck for 5 months (@ approximately $900/4 weeks), gas ($2/gal)and cost of mileage ($0.30/mi) during tagging period. Each year travel costs are estimated at $8,550.

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

Supplies for each year of the project will require $3850. This includes $2850 for 5K spools of coded-wire tags, and $1000 for misc. field supplies such as waterproof paper, waders, nets, MS-222, stress coat, etc.

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.

Not applicable to this project.

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.

Equipment will be purchased during the first year and will consist of 2 Mark IV CWT injectors and QCD separators for $65,000, Holding tanks with pumps for $6500, Protective fencing to enclose tanks for $1500 and a mobile tagging trailer for $15,000. The tagging trailer will be equipped with everything needed to tag the fish.

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.

The project management aspects are included in each of the tasks as supervision by Bio I, II and III. In addition, task 5.2 was created for report preparation and task 5.3 was created for giving post-project presentations. The cost of quarterly project reports is built into the billing rates as part of the project admimistration.

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

Other direct costs are communication costs required for project. These costs are the costs not included in overhead such as long-distance charges, field cell phone charges, and conference call charges. The amount is estimated at $100/month times 12 months per year for three years.

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.

All indirect costs are included in our billing rates and are described above under salary rates. The billing rates include salary + benefits.

Executive Summary

Proposal to Coded-Wire Tag Wild Juvenile Chinook to Determine Contribution of Fry, Parr and Smolt Emigrants to Adult Recruitment from the San Joaquin Basin

The recent discovery that a large share of juvenile chinook outmigrate as fry during the late winter rather than as smolts during mid spring has established the strong possibility that survival of these fry migrants may be a key factor driving the dramatic fluctuations in populations of chinook salmon, particularly in the San Joaquin Basin. Although chinook are regarded as at-risk species, the mechanisms driving the population fluctuations are still speculative. As a result, the actions needed to recover stable populations are uncertain. There are substantial implications to management of salmon, land, and water that hinge on whether the previously ignored migrations of fry and parr, which precede the intensively managed time window of mid April to mid May, contribute significantly to production of adults. Chinook fry and parr migrate at a different time and use different habitats than smolts. CalFed, the Anadromous Fish Restoration Program, and other federal and state funded programs are presently investing large sums of money to improve priority habitat for juvenile salmon in the Sacramento and San Joaquin rivers, their tributaries and the Delta. Water management in particular is focused on producing desirable passage conditions for smolts in the mid spring. However, if fry that migrate out of the tributaries in winter are important contributors to adult runs, then it may be more profitable to direct a portion of restoration efforts at improving rearing habitat and passage conditions for fry during winter. Thus, there is an urgent need to determine the adult contribution derived from fry migrants and the factors that control that contribution. In order to determine relative contribution for fry, parr and smolt migrants, we will use coded-wire tags (CWTs) to permanently mark about 70,000 naturally-produced juvenile chinook emigrating from the Stanislaus River during each of three consecutive years for a total of 210,000. The adult contribution of fry has received little study in the past because we have lacked a means to effectively mark them. New technology now makes it possible to mark chinook fry with CWTs. The CWTs will be applied to chinook captured at two trapping stations that are operated annually under separate funding, and distinct tag codes will be used to distinguish fry, parr, and smolts. Tagged fish will be recovered in ocean fisheries and on spawning grounds by ongoing state and federal programs. Comparisons of recovery rates per 1,000 fish tagged will provide of a means of estimating the proportion of adults produced by fry, parr and smolt migrants. Variation between years in recovery rates of fish tagged as fry, relative to those for fish tagged as parr and smolts,will provide indications of how river conditions affect adult contributions from fry and parr migrants. The timing and location for recoveries of tagged juveniles within freshwater and the Bay-Delta will indicate rearing distribution and requirements. These fish could be recovered as adults up to 4 years after they are tagged. An analysis will be conducted and a report prepared for CalFed describing results of tagging efforts and the recoveries of tagged juveniles in freshwater or the Bay-Delta at the end of the 3 year study period (November 2005). Contract mechanisms are in place to analyze and report adult recoveries of these CWTs in future years through the annual reports to the U.S. Fish and Wildlife Service and Tri-Dam Project regarding outmigrant monitoring in the Stanislaus River. A comprehensive, stand-alone report analyzing all data will be completed in December 2008. The funding to collect and analyze data after the 3 year project term will be provided by Tri-Dam Project.

Proposal

S.P. Cramer & Associates, Inc.

Proposal to Coded-Wire Tag Wild Juvenile Chinook to Determine Contribution of Fry, Parr and Smolt Emigrants to Adult Recruitment from the San Joaquin Basin

Doug Demko, S.P. Cramer & Associates, Inc.

Proposal to Coded-Wire Tag Wild Juvenile Chinook to Determine Contribution of Fry, Parr and Smolt Emigrants to Adult Recruitment from the San Joaquin Basin

A. PROJECT DESCRIPTION: PROJECT GOALS AND SCOPE OF WORK

1. PROBLEM

Presently, water management practices are implemented to protect smolts as they migrate from their natal streams, through the Sacramento and San Joaquin rivers and on into the Delta during April and May. Generally, river flows are increased and Delta exports are decreased to protect outmigrating smolts. New information from studies of juvenile fall-run chinook outmigration from Central Valley streams over the last decade have revealed the surprising result that the majority of juveniles emigrate from their natal streams as fry during January through March, rather than as smolts from April through May. Rotary screw trap monitoring in the Stanislaus River has demonstrated that the proportion of juvenile chinook emigrating as fry varies substantially between years, and tends to be high in high flow years. Similarly, outmigrant sampling conducted by the CDFG in the San Joaquin River at Mossdale from January through June of 1940 and 1941 also demonstrated more juveniles migrated as fry than as smolts (Hatton and Clark, 1942). The discovery of this historical data coupled with recent rotary screw trap data has created a new awareness that the large number of fall-run chinook juveniles migrating as fry in high flow years may be important contributors to the high returns of adult fall-run chinook in subsequent years. No studies have been completed to determine if fry and parr migrants contribute significantly to adult returns, or if such returns are influenced by stream flow or other environmental conditions during winter. Thus, we are lacking sufficient data to determine if current management practices are providing adequate protection for all life history strategies.

There are substantial implications to resource management that hinge on addressing the question of relative contribution of fry, parr and smolt emigrants to adult chinook recruitment. CalFed, the Anadromous Fish Restoration Program (AFRP), and other federal and state funded programs are presently investing large sums of money to improve priority habitat for juvenile salmon in the Sacramento and San Joaquin rivers, their tributaries and the Delta. Consequently, the importance of the fry outmigration needs to be evaluated and its relative priority established with regard to (1) other outmigration life history strategies of fall-run chinook, (2) water management actions, and (3) ongoing and future restoration actions.

We have developed a study plan with five objectives to achieve this goal. First, the abundance of juvenile migrants that are fry, parr, or smolts will be estimated so the adult contribution rates of tagged fish can later be applied to these total numbers of outmigrants. Second, adult contribution rates of fry, parr, and smolt emigrants will be estimated from recovery of individuals that were marked at their time of emigration. Third, the variation in

relative contribution rate between years will be examined for correlation to environmental conditions in freshwater. Fourth, potential differences in the behavior of hatchery and natural migrants will be evaluated. Finally, the implications that life stage contribution rates have for water management or habitat restoration will be described, and study findings will be communicated to resource managers. Tasks and activities to accomplish each objective are described in the study plan presented in section 3.

2. JUSTIFICATION

The recent discovery that a large share of juvenile chinook outmigrate as fry during the late winter rather than as smolts during mid-spring has established the strong possibility that survival of these fry migrants may be a key factor driving the dramatic fluctuations in populations of chinook salmon, particularly in the San Joaquin Basin. The study described here is designed to provide new information about the needs of juvenile fall-run chinook salmon in relation to life-history strategy and the influence of river conditions during emigration, by evaluating the relative contribution rates of fry, parr, and smolt outmigrants to adult recruitment over a range of environmental conditions (Figure 1).

Now that we know the majority of juvenile chinook emigrate from their natal river as fry in many years, the strong possibility exists that infrequent boom years of chinook runs in the San Joaquin Basin may be driven by those years in which fry migrants survive to adulthood in significant numbers. We urgently need to determine the extent that adult returns are produced by these early migrants, and to determine how water management and habitat restoration may influence that contribution rate. This information will help fisheries and water operations managers determine if changes are needed in water use strategies to provide better protection to outmigrants to benefit salmon production.

There has been a widespread assumption among biologists, based on cursory studies, that chinook migrating as fry provide little, if any, contribution to adult returns. This may be true in many years, when environmental conditions in the Delta are unfavorable for survival, but there is also evidence that survival of fry migrants may be high enough to produce large numbers of adults in some years when environmental conditions are favorable. We have a working hypothesis that dramatic fluctuations in returns of adult chinook between years is at least partially related to the intermittent occurrence of environmental conditions that enable fry migrants to survive passage through the San Joaquin River and Delta and reach adulthood. No studies have been conducted to directly test this hypothesis, but CWT studies at Coleman Hatchery have demonstrated that fed fry can survive to adulthood at high rates in some years. Cramer (1990) found that survival to adulthood could be estimated for several CWT marked groups released from Coleman Hatchery as fed fry (< 60 mm fork length), and although survival to adulthood was typically poor (<1%), one group of fed fry released in 1982 survived at the high rate of 7% (better than survival of smolts released in many years). Cramer (1990) found that exceptional survival of that group was likely related to the coincidence of a high flow event that followed shortly after release of the tagged fed fry in

1982. Similarly, high returns of adult chinook to the San Joaquin Basins tend to coincide with brood years for which flows were high at the time of juvenile migration.

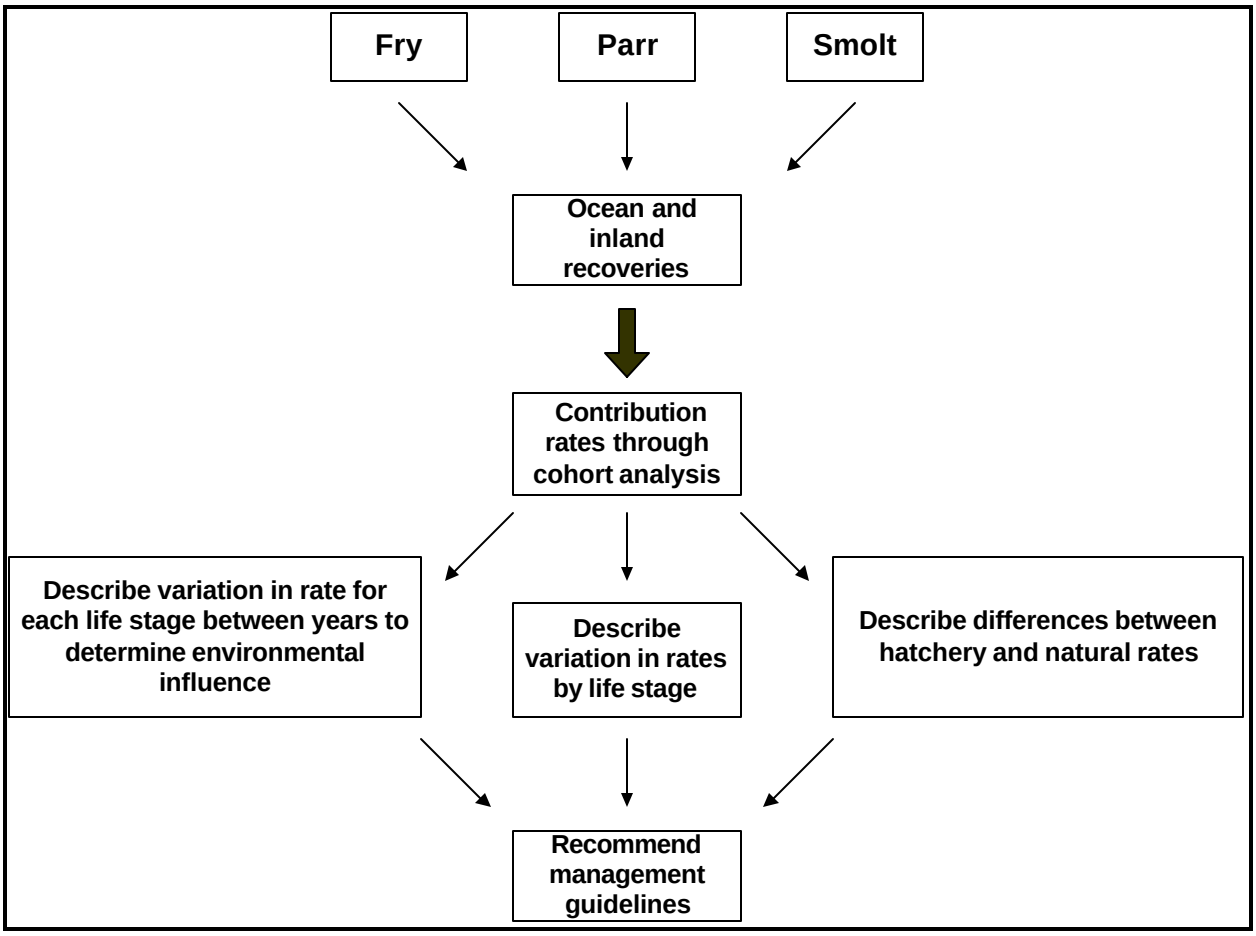

Figure 1. Conceptual diagram illustrating the proposed actions and the expected outcome of the project.

It is urgent that studies begin immediately to resolve the questions about contribution rate from chinook fry migrants, because we must wait several years after tagging for these fish to become adults. We now have the technology to complete the tagging of fry, and there is no need to continue operating on speculation about the conditions under which fry migrants might contribute to adult returns. The Stanislaus River provides an excellent opportunity to complete the needed studies, because:

1. annual sampling of juvenile migrants is already underway at two locations, and large numbers of juveniles that could be tagged are captured at each location, and

2. continuity of the project to analyze data beyond the contract horizon for CalFed is

assured through funding by Tri-Dam Project.

3. APPROACH

GOAL: DETERMINE RELATIVE CONTRIBUTION OF FRY, PARR AND SMOLT EMIGRANTS TO RECRUITMENT OF ADULT FALL CHINOOK FROM THE SAN JOAQUIN BASIN

In order to determine relative contribution for fry, parr and smolt migrants, we will use coded-wire tags (CWT's) to permanently mark about 70,000 naturally-produced juvenile chinook each year emigrating from the Stanislaus River in three consecutive years. The CWT's will be applied to chinook captured at two trapping stations that are operated annually under separate funding, and distinct tag codes will be used to distinguish fry, parr, and smolts. Tagged fish will be recovered in ocean fisheries and on spawning grounds by ongoing state and federal programs. Comparisons of recovery rates per 1000 fish tagged will provide of a means of estimating the proportion of adults produced by fry, parr and smolt migrants. Variation between years in recovery rates of fish tagged as fry, relative to those for fish tagged as parr and smolts, will provide indications of how river conditions affect adult contributions from fry and parr migrants.

Five objectives will be completed to achieve this goal (Figure 2). First, the abundance of juvenile migrants that are fry, parr, or smolts will be estimated, so the adult contribution rates of tagged fish can later be applied to these total numbers of outmigrants. Second, adult contribution rates of fry, parr, and smolt emigrants will be estimated from recovery of individuals that were marked at their time of emigration. Third, the variation in relative contribution rate between years will be examined for correlation to environmental conditions in freshwater. Fourth, potential differences in the behavior of hatchery and natural migrants will be evaluated. Finally, the implications that life stage contribution rates have for water management or habitat restoration will be described, and study findings will be communicated to resource managers**.** Tasks and activities to accomplish each objective are described in the following study plan.

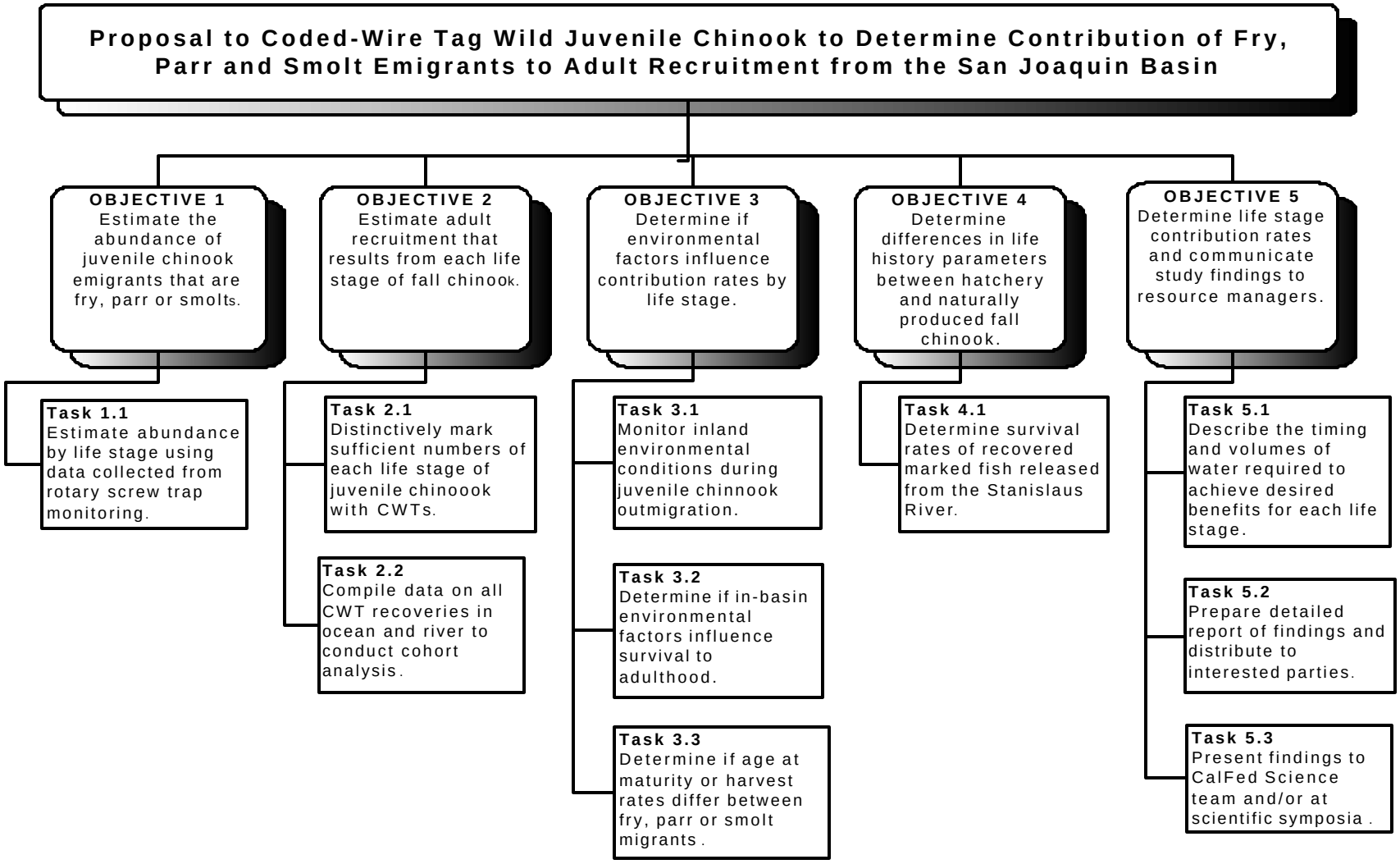

Figure 2. Step-down diagram illustrating all project objectives and tasks.

Objective 1. Estimate the Abundance of Juvenile Chinook Emigrants that are Fry, Parr or Smolts.

Working Hypothesis: *The relative abundance of emigrants within each lifestage varies depending upon the environmental conditions during the outmigration period.*

We propose to use the Stanislaus River for our study stream, because the abundance of juvenile outmigrants is already being estimated there annually by outmigrant trapping studies at two locations, during late December through May of each year. The uppermost site at Oakdale (mile 40.6) is near the lower limit of fall chinook spawning, and is funded by the Oakdale and South San Joaquin Irrigation Districts. The lowermost site at Caswell State Park (mile 8.6) is 30 miles downstream of any chinook spawning, and is funded by the U.S. Fish and Wildlife Service through the AFRP. Because these studies at both locations are already funded, no funding is needed from CalFed to estimate abundance of fry, parr and smolt migrants. Further, the fish captured at these two sites can be used as a source for the marked fish required to accomplish Objective 2 that follows. Although outmigrant sampling is also conducted annually on the Mokelumne, Tuolumne, and Merced rivers, greater numbers of juveniles are captured in the two operations on Stanislaus River, and achievement of sufficient sample sizes will not be a limiting factor for achieving confidence in study results. Further, the sampling at two sites separated by over 30 miles on the Stanislaus River offers a unique opportunity to distinguish the effects of environmental factors during passage through the natal stream from those during passage through the San Joaquin River and Delta. Unlike the Caswell site on the Stanislaus River, the trapping sites on the Mokelumne, Tuolumne, and Merced rivers are not widely separated from the lower limit of fall chinook spawning, and thus do not provide an opportunity to distinguish environmental effects on survival in the natal river from those in the lower San Joaquin River and Bay-Delta.

Objective 2. Estimate Adult Recruitment that Results from Fry, Parr and Smolt Emigrants of Fall Chinook.

Working Hypothesis: *Fry emigrants may contribute greatly to adult returns in some years, but little in others, while contributions from smolts are more stable.*

Task 2.1 Distinctively mark fry, parr, and smolt emigrants to enable their identification as adults in sufficient numbers to achieve satisfactory statistical precision for estimates of adult contribution.

Until developments within the last few years in the technology for application of coded-wire tags (CWT's), there was no reliable technique for marking chinook fry with distinct codes that would last and be readily detectable through adulthood. Recent technology advances by Applied Marine Technologies Inc. in tagging methods has made it possible to successfully

apply CWT's on chinook fry down to 30 mm fork length, and this technology is already being successfully applied in Butte Creek by CDFG.

By replicating the tagging over three successive years and using fish captured at two trapping locations, we expect to achieve sample sizes that will produce statistically dependable comparisons of survival rates between life stages of migrants (Table 1). Ideally, tag groups should include 50,000 individuals, but recoveries from smaller sample sizes can provide insight into survival, ocean contribution to catch, and age at maturity when tagging is continued over multiple years. Smaller numbers of fish tagged annually will require greater numbers of years of data from ocean fisheries before trends can be readily discerned. However, the need to begin taking steps to acquire this information is urgent.

Based on Stanislaus River rotary screw trap catches at Oakdale and Caswell from 1996 through 2001, we expect catches to be in the range of 14,000 to 226,000 fry, 2,000 to 21,000 parr and 1,000 to 15,000 smolts. Tables and text within the section describing the feasibility of this project present a more detailed account of numbers captured at each trapping site by lifestage, and the ocean and inland recovery rates for CWT groups released in the Stanislaus from 1986 through 1989.

Table 1. Target sample sizes for coded wire tagging of rotary screw trap catches at Oakdale and Caswell.

	Yr 2003	Yr 2004	Yr 2005
Fry (<45mm)	50,000	50,000	50,000
Parr (45-79 mm)	10,000	10,000	10,000
Smolt (>80mm)	10,000	10,000	10,000

We propose similar methodology to that used on Butte Creek by CDFG since 1995. After removal from the screw trap, chinook will be placed in holding tanks for later tagging. Every attempt will be made to tag fish within 24 hours of capture, after which they will be held for an additional 24 hours to evaluate tag retention and possible mortality. Fish are passed through a QC machine when tagged to be sure the tag was implanted, however it is not uncommon for tags to be shed soon after implantation. To account for this, fish will be re-run through the QC machine before release. Fish were held on Butte Creek for up to 10 days from the time of capture to the time of release, however to avoid possible changes in behavior associated with extended captivity we will not hold fish longer than 5 days.

Fish will be tagged and held near each trap site at locations we have used for holding test fish since 1995. Holding tanks will be set up on shore with a pumped river water system,

similar to that used for the fiberglass tanks at the Merced River Hatchery and the stainless steel tanks used by S.P. Cramer & Associates at the Glenn-Colusa Irrigation District from 1992-1994. Precautions, such as back-up systems, will be taken to avoid fish loss as a result of equipment failure or vandalism.

Ten unique tag codes will be reserved for each site each year. This will allow us to change the code approximately every two weeks or when river conditions change. At times when there are two distinct size classes migrating, typically late March to early April, fish will be sorted and different tag codes used for each size class.

Task 2.2 Assemble data on raw and expanded recoveries of these CWT's in ocean fisheries and returns to the river of spawning fish to conduct cohort analysis.

Activity 2.2.1 Obtain raw and expanded recoveries of CWT's in ocean fisheries from the regional database managed by PSMFC.

Excellent monitoring programs are in place to sample ocean fisheries at all major ports of landing on the West Coast. Sampling intensity at each port is designed to examine at least 20% of the landed catch for the presence of CWT's and to accurately estimate what the sample percentage is each year at each port. The PSMFC supervises assembly, in electronic format, of all CWT recoveries and appropriate expansion rates for each fishery recovery. These data are posted on Regional Mark Database, which operates as a computer bulletin board from which data can be downloaded.

Activity 2.2.2 Obtain raw recovery data and determine sampling rates for CWT tagged fish that return to spawn.

Spawn surveys conducted by CDFG recover CWT's and estimate fraction of spawners sampled in the Stanislaus River, as well as other spawning areas in the San Joaquin Basin. There may also be opportunity to recover CWT tagged fish as they enter the Stanislaus River at an adult weir that is proposed to be installed in the lower river for research on salmon and steelhead. Monitoring for marked fish at the proposed weir would substantially increase the number of CWT's recovered, but is not absolutely necessary to accomplish the objectives of this study.

Activity 2.2.3 Use cohort analysis to estimate survival, harvest rates and maturity rates for distinctly marked groups of fry, parr and smolts.

Cohort analysis proceeds backward in time from the oldest age group to the youngest, using recovery data from catches and spawning surveys to reconstruct the population as it must have been. These reconstructed estimates of abundance at each age can then be used to calculate the proportion that were harvested or matured at each age. This analytical method is in standard use by harvest management agencies up and down the West Coast. The

analysis will be conducted near the end of the 3 year project term, and will include all recovery data available to that point. Inland and ocean recovery data sets will be incomplete as fish may be recovered up to 5 years after they are tagged. Comprehensive analysis will be conducted once all recoveries can be accounted for.

Activity 2.2.4 Conduct statistical analysis across multiple broods of estimated survival, harvest rates and maturity rates to determine the mean and confidence intervals of these parameters for fry, parr, and smolts.

It will be necessary to conduct the analysis across multiple brood years in order to achieve satisfactory statistical power for detecting differences in contribution between life stages.

Objective 3. Determine if variation in freshwater environmental factors influences contribution rates by fry, parr, or smolts.

Working Hypothesis: *The timing and magnitude of environmental events influences contribution rates of fry relative to parr or smolts.*

Task 3.1 Obtain daily values of flow, temperature, turbidity, export pumping rates during the January through May when juvenile chinook are in the Stanislaus River and Bay-Delta.

Locations at which past studies have indicated these variables may be most important are the lower Stanislaus River and the San Joaquin River near Vernalis or Stockton. Data is available from the USBR, the USGS, DWR and the CDFG at numerous sites within the Stanislaus and San Joaquin rivers. We have monitored temperature with hourly recording thermographs at six stations on the Stanislaus since 1998 and have recorded daily turbidity at the Oakdale and Caswell trapping sites during the sampling periods since 1996.

Task 3.2 Conduct statistical analysis to determine if juvenile-to-adult survival is related to environmental factors during juvenile migration.

We will use multiple regression and analysis of variance as statistical techniques to determine if survival to adulthood is related to flow, temperature, or turbidity at the time when marked groups were emigrating from the river. These methods of analysis have been successful for detecting environmental effects on survival of hatchery chinook from the Sacramento Basin (Cramer 1990).

Task 3.3 Conduct statistical analysis to determine if age at maturity or harvest rates differ between fry, parr, or smolt migrants.

Analysis of variance between CWT groups will be used to determine if life stage at emigration produces significantly different age at maturity or harvest rates. Studies with hatchery chinook generally show that earlier dates of release tend to cause earlier age at maturity (earlier releases get a head start on ocean growth), and that age at maturity influences contribution to ocean catch. For example, fish that mature at age 4 face two full summers of ocean fisheries while those maturing at age 3 face only one summer of ocean fishing. Thus, the life history dynamics, including the harvestable surplus could differ between adults produced from different types of juvenile migrants.

Objective 4. Determine if there are differences in life history parameters between hatchery and naturally produced fall chinook in each basin.

Working Hypothesis: *Hatchery chinook behavior and survival rates differ from that of naturally produced chinook.*

A long-standing question among harvest managers is whether the survival, harvest, and maturity rates estimated from marked hatchery fish can be used as reasonable surrogates for natural fish. Groups of CWT marked juveniles are released in the San Joaquin tributaries and other locations throughout the Sacramento- San Joaquin basin in most years to evaluate smolt survival. This study will provide an opportunity to compare the estimates for marked natural fish to those from marked hatchery fish released the same year.

The survival rates can be calculated by a number of methods including recoveries at the Mossdale trawl, Chipps Island and other juvenile recovery points, as well as by ocean recoveries and inland returns. Data will be obtained from all sampling points at which tagged juveniles from the Stanislaus may be recovered.

Objective 5. Determine the Implications that Life Stage Contribution Rates Have for Water Management or Habitat Restoration, and Communicate Study Findings to Resource Managers.

Working Hypothesis: *The environmental needs of emigrants differs by lifestage and science-based guidelines for water management are lacking*.

Task 5.1 Describe the timing and volumes of water required to achieve desired benefits for each life stage.

From the analysis of data collected under different environmental conditions we will gain insight about the range of optimum conditions for survival at each lifestage. Based on these descriptions water management guidelines can be evaluated to ensure outmigration conditions are beneficial for all lifestages, recognizing the constraints of water availability in dry years. Although this evaluation will be limited with only 3 years of data, it will begin to define these relationships, and if continued will refine these definitions with each subsequent

year of study.

Task 5.2 Prepare detailed report of findings for distribution to interested parties.

In keeping with the high priority we place on the sharing of information, a detailed report of findings will be prepared and submitted to CalFed at the end of the study and will also be widely distributed to resource managers within the Central Valley. We will also post links on our website where frequent activity summaries can be viewed as the study progresses, and the final report can be downloaded when the study is completed.

Inland and ocean recovery data will be incomplete for all groups, as these fish could be recovered up to 5 years after they are tagged. An analysis will be conducted for CalFed based on all information available at the end of the 3 year study period (November 2005), and updates will be provided in the annual Stanislaus River outmigrant monitoring reports in 2006 and 2007. A comprehensive stand-alone report, analyzing all data will be completed in December 2008.

Task 5.3 Prepare and give Power Point presentation to the CalFed Science team and/or present at scientific symposia.

A Power Point presentation will be prepared and presented to the CalFed Science team and other audiences at request. The presentation will include a voice over such that it can be distributed on CD and will not require our presence each time it is presented.

4. FEASIBILITY

We have 5 years of data for captures of juvenile chinook at the Oakdale and Caswell trapping sites to demonstrate the potential for obtaining juveniles to tag (Tables 2 and 3). These data indicate that the target sample sizes listed in Table 1 can be achieved in most years.

Given that target sample sizes can frequently be achieved or exceeded, the next question is whether sufficient numbers of adults will be recovered to complete the analyses we have identified. Most recoveries will come from ocean fisheries that land 50-80% of adults, and an additional but lesser number will come from inland recoveries of adults that return to spawn.

Most adult recoveries of CWTs are likely to come from ocean fisheries, so we investigated past data on ocean recoveries. For CWTs released in the Stanislaus in 1986 and 1988, there were 8 to 80 recoveries for every 10,000 tagged chinook tagged released near Caswell and 3 to 30 for every 10,000 released near Oakdale. If harvest rates are reduced compared to those in the late 1980's, recovery rates will be reduced similarly.

Expected inland recovery rates were calculated based on the recovery of CWT returns to the Stanislaus from Stanislaus smolt survival releases conducted in 1986, 1988 and 1989. Smolts were released from Knights Ferry and the mouth, and subsequently as adults, were recovered during spawning surveys. The proportion recovered for each release year was calculated, and the minimum and maximum rates were used to estimate expected recovery for outmigrant catches at Oakdale and Caswell from 1996 through 2001 had these fish been tagged. Oakdale catches were expanded by the minimum and maximum rates for smolts released at Knights Ferry (Table 2), and Caswell catches were expanded using data from releases at the mouth (Table 3).

Numbers of inland recoveries would be substantially increased if an adult weir were fished in the river, as is being proposed separately. The effectiveness of an adult weir was demonstrated in the early 1990's when a trap was operated by CDFG to capture upstream migrating adults at Orange Blossom Bridge. If expected recoveries are based on the recovery rates including trapped fish, they would essentially be twice that presented in the tables below, with the exception of the upper bounds for fish tagged at Caswell which would remain unchanged.

Table 2. Expected inland adult recoveries from juveniles tagged at Oakdale.

Year	Period Sampled	Fry Catch	Expected Recovery	Parr Catch	Expected Recovery	Smolt Catch	Expected Recovery
1996	Feb 01 - Jun-08	15,743	0.6 to 1.3	2,471	0.1 to 0.2	12,197	0.5 to 1.0
1998	Jan 26 - Jul 15	12,788	0.5 to 1.0	3,759	0.2 to 0.3	6,992	0.3 to 0.6
1999	Jan 18 - Jun 30	20,565	0.8 to 1.6	6,322	0.3 to 0.5	1,367	0.1 to 0.1
2000	Dec 16 - Jun 30	116,104	4.6 to 9.3	2,699	0.1 to 0.2	551	0.0 to 0.0
2001	Dec 12 - Jun 29	161,717	6.5 to 12.9	12,454	0.5 to 1.0	526	0.0 to 0.0

Table 3. Expected inland adult recoveries from juveniles tagged at Caswell.

Year	Period Sampled	Fry Catch	Expected Recovery	Parr Catch	Expected Recovery	Smolt Catch	Expected Recovery
1996	Feb 5 - Jul 2	676	0.0 to 0.2	31	0.0 to 0.0	1,761	0.0 to 0.5
1998	Jan 8 - Jul 16	12,195	0.2 to 3.7	5,061	0.1 to 1.5	2,647	0.1 to 0.8
1999	Jan 18 to Jun 30	37,452	0.7 to 11.2	2,148	0.0 to 0.6	1,634	0.0 to 0.5
2000	Dec 16 - Jun 30	64,151	1.3 to 19.2	8,607	0.2 to 2.6	949	0.0 to 0.3
2001	Dec 22 - Jun 28	978	0.0 to 0.3	8089	0.2 to 2.4	849	0.0 to 0.3

Another issue affecting feasibility of the project is whether we can obtain the necessary sampling permits to capture juveniles for tagging. All SPCA staff hold current scientific collecting permits issued by the CDFG for screw trapping in the Stanislaus River. As stipulated in the requirements of the permit, a letter of authorization will be obtained from the CDFG Region 4 Senior Fishery Biologist before sampling activities begin. We have fulfilled this requirement and the additional requirements imposed by Region 4 for numerous projects conducted in recent years and thus have become familiar with the procedure.

5. PERFORMANCE MEASURES

The primary performance measures for this study will be reaching the target number of tagged emigrants and producing a report and presentation of findings upon completion of the study. Weekly activity reports will be posted on our website and distributed via e-mail, describing the size and number of emigrants tagged between January and June of each year.

6. DATA HANDLING AND STORAGE

Data sheets from tagging and release will be organized into binders, with separate sections for each tag code released. QA/QC procedures similar to those we currently use for USFWS/AFRP projects will be employed. If desired, copies of data sheets will be provided to the CalFed ERP. Copies of all data sheets will be provided to CDFG Region 4 for historical preservation, as well as to Tri-Dam Project. Data summaries and graphs will be posted on the internet as they are created. All data recorded will be entered into a database, and recovery data downloaded from the PSFMC will be imported into the database, such that electronic summaries can easily be generated.

7. EXPECTED PRODUCTS/ OUTCOMES

The immediate outcome of this project is that naturally-produced juvenile chinook from three brood years will have been distinctively coded-wire tagged according to life stage, laying the necessary foundation to determine whether fry or parr migrants contribute substantially to adult returns, in comparison to contributions from smolt migrants. As the tagged fish become adults, the expected outcome is an estimate of the proportion of wild adult returns that are composed by fish that emigrated as fry, parr, or smolts. Further, we will be able to determine whether these proportionate contributions by life stage vary between years, and what environmental factors correlate to that variation. These findings will be of immediate use to water managers that must determine when and how stored water will be released to aide survival of rearing and migrating juveniles. They will also be used to determine potential effects of export pumping at during the winter. If fry migrants contribute substantially to adult returns, then habitat restoration efforts may need added emphasis on shallow water and near shore habitats in the Delta where fry are likely to rear. Our findings and discussion relative to these questions will be presented and distributed in a scientific report to be funded by TriDam Project.

Although this project is specific to the Stanislaus, trends in size at emigration and emigration timing of juvenile chinook are similar throughout the Central Valley. Thus, findings on the Stanislaus will likely provide needed information for water management and habitat restoration in other Sacramento-San Joaquin streams.

8. WORK SCHEDULE

Anticipated start and completion dates for the objectives, tasks, and activities discussed above are presented in Table 4. Objective 1, estimation of juvenile emigrants, and Task 2.1 of Objective 2, tagging juvenile emigrants, must be conducted simultaneously. The remainder of the project from Task 2.2 to Task 5.3 involves obtaining data which will be collected by other agencies and the analysis of said data. Should funds only be available to fund a portion of the project, field activities (estimation and tagging) could be funded as a first phase and the analysis as a second phase.

Monthly:	1-2 page summaries of progress posted to website
Quarterly:	Reports to CalFed ERP, Stanislaus Fish Group, SJ Salmon Project Work Team, and Central Valley Salmon Escapement Project Work Team
October 30, 2005	Draft Report & Database
November 30, 2005	Final Report
December 2008	Final analysis of all returns. This report is funded by Tri-Dam and is necessary due to the delayed recovery of fish which were tagged as juveniles.

Table 4. Proposed Yearly Work Schedules

Year 1	Objective/Task	Start	Finish	2002	2003										
				Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	**Objective 1 Estimate juvenile salmon numbers**	12/01/02	06/30/03													
2	**Objective 2 Task 2.1 Tag juvenile salmon**	12/01/02	06/30/03													
3	**Objective 3 Task 3.1 Gather hydrologic data**	12/01/02	06/30/03													

Year 2	Objective/Task	Start	Finish	2003	2004										
				Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
1	**Objective 1 Estimate juvenile salmon numbers**	12/01/03	06/30/04												
2	**Objective 2 Task 2.1 Tag juvenile salmon**	12/01/03	06/30/04												
3	**Objective 3 Task 3.1 Gather hydrologic data**	12/01/03	06/30/04												

Year 3	Objective/Task	Start	Finish	2004	2005										
				Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
1	**Objective 1 Estimate juvenile salmon numbers**	12/01/04	06/30/05												
2	**Objective 2 Task 2.1 Tag juvenile salmon**	12/01/04	06/30/05												
3	**Task 2.2 Gather CWT recovery data**	06/01/05	08/31/05												
4	**Objective 3 Task 3.1 Gather hydrologic data**	12/01/04	06/30/05												
5	**Task 3.2 Analysis of environmental effects**	09/01/05	10/30/05												
6	**Task 3.3 Analysis of life stage-dependent factors**	09/01/05	10/30/05												
7	**Objective 4 Analysis of hatchery vs. natural life history parameters**	09/01/05	10/30/05												
8	**Objective 5 Task 5.1 Describe salmon flow requirements**	10/01/05	11/30/05												
9	**Task 5.2 Prepare final project report**	10/01/05	11/30/05												

B. APPLICABILITY TO CALFED ERP AND SCIENCE PROGRAM GOALS AND IMPLEMENTATION PLAN AND CVPIA PRIORITIES

1. ERP, SCIENCE PROGRAM AND CVPIA PRIORITIES

ERP Strategic Goals

The proposed study will provide new information necessary for many of the CALFED ERP strategic goals to be reached. First, considerable uncertainty exists about why at-risk species are in decline, and how to best facilitate the recovery of these species. The strategic goals state that "ERP actions must address the immediate needs of at-risk species as well as gain additional information about how they respond to modifications to ecosystem functions and processes." Until the immediate needs of all lifestages of juvenile chinook emigrants are identified, one cannot ensure that their needs are met. Studies have been conducted to evaluate how smolts respond to modifications to ecosystem functions and processes, namely flow, exports and temperature; however, little attention has been devoted to obtaining a better understanding of how chinook fry are affected by these variables. The strategic goals recognize that we must maximize opportunities that improve our understanding of the best methods for restoring at-risk species and their habitat to achieve recovery of at-risk native species. With complementary studies on-going in the Stanislaus River, and a wealth of juvenile data collected over the last decade, this is a prime opportunity to take the next step in answering many questions which have arisen since sampling began in 1993. Few systems in the Sacramento-San Joaquin basin have such a solid foundation of outmigrant data or ongoing sampling efforts to work from.

Another goal of the program is to identify threshold flows for critical ecosystem processes, particularly how they affect at-risk species. From rotary screw trap sampling on the Stanislaus and Tuolumne rivers, and historical data from the San Joaquin River at Mossdale, we have found that fry tend to migrate in large numbers when flows are high. On the Stanislaus River in 2001 however, we found that freshets triggered movement past Oakdale, but the fry were not detected at the Caswell trapping site 31.5 miles downstream. In past years, when freshet flows were of higher magnitude, fry were detected at Caswell within a few days to 2 weeks after they were detected at Oakdale. This suggests that there may be a threshold flow, above which fry continue to migrate out of the Stanislaus and below which they remain in the river between Oakdale and Caswell to rear. Identifying this threshold flow and how it affects juvenile survival is imperative to the successful management of the species, and it would be a transferrable principle for application to other streams.

As a harvestable species, maintaining and enhancing the chinook salmon population for sustainable harvest is of great importance. By identifying the needs of juvenile emigrants by lifestage, management practices can be tailored to provide conditions most beneficial to their survival. Measures to increase survival are necessary for the population to recover to sustainable levels sufficient for harvest.

CALFED Science Program Goals in relation to the ERP

A basic premise of the CalFed Program is that five interconnected applications of science must progress together. These are 1) adaptive management, 2) monitoring, 3) interdisciplinary knowledge of critical unknowns, 4) improving the scientific basis of water management and 5) broad communication of science knowledge and scientific activities. The proposed project will help these applications progress in unison by providing information key to the adaptive management of fall-run chinook salmon and allowing us to make better use of existing data by building on two existing monitoring programs to advance the scientific basis of regulatory activities.

Implementation Plan Priorities

The proposed project addresses three implementation plan priorities, one of multi-regional scale and two specific to the San Joaquin Region. Priority MR6 is to ensure recovery of at-risk species by developing conceptual understanding and models that cross multiple regions. This includes studies designed to develop a greater understanding of the influences of flow and the use of various rearing areas on the survival of chinook emigrants. Although the study is proposed for the Stanislaus River only, similar trends in outmigration have been observed throughout the Central Valley. Thus, greater understanding of outmigration dynamics in the Stanislaus River will likely be applicable throughout the Sacramento-San Joaquin drainage.

Priority SJ4 is to implement actions to improve the understanding of at-risk species in the region. Most studies of chinook in the San Joaquin Basin have focused on smolt survival and monitoring outmigrant abundance. Although recent and historical data show large numbers of fry exiting the system in high flow years, there has been little effort expended to investigate the relative importance of fry emigrants in relation to contribution rates, nor has there been much interest in identifying their needs. The proposed study is designed to evaluate the relative contribution rates of emigrants by lifestage and identify how survival is affected by the environmental conditions juveniles experience. The evaluation of survival in relation to different flow regimes is also consistent with priority SJ6.

CVPIA and AFRP Goals consistent with the ERP

Section 3402 states the purpose and goals of the CVPIA. Two of these goals relate directly to the ERP and to the proposed project. The first is to protect, restore and enhance fish, wildlife and associated habitat in the Central Valley and Trinity basins. In order to reach this goal we must first develop an understanding of how to protect and restore populations and their habitat. In the case of the chinook salmon, this requires an understanding of how environmental factors such as flow affect what locations and habitats are used by juvenile emigrants and how that in turn affects their survival to adulthood. Stanislaus River flow is affected by the CVP and thus operations may directly influence the survival of juvenile

emigrants. The second goal of the CVPIA is to evaluate the effects of the CVP on fish and wildlife. New findings may support changes in operations to benefit chinook emigrants.

Under section 3406(b)(1) the CVPIA authorizes the Anadromous Fisheries Restoration Program (AFRP) to develop within 3 years of enactment and implement a program which makes all reasonable efforts to ensure that, by 2002, natural production of anadromous fish in Central Valley rivers and streams will be sustainable, on a long-term basis, at levels not less than twice the average levels attained during the period of 1967-1991. Some of the objectives identified by the program to meet this goal are directly addressed by the proposed project.

The AFRP seeks to improve habitat for all lifestages of anadromous fish by providing flows of suitable quality, quantity and timing and improved physical habitat. In order for this to occur we must start by determining the needs of juvenile emigrants by lifestage. This requires that a second goal, to collect fish and habitat data, be addressed to provide the information needed to determine what is "suitable" for the optimum survival of the population.

2. RELATIONSHIP TO OTHER ECOSYSTEM RESTORATION PROJECTS

A similar on-going project began in the Sacramento River basin in 1995 on Butte Creek to evaluate the emigration of spring run chinook salmon and their contribution to ocean harvest. That project has demonstrated that chinook fry can successfully be coded wire tagged, and that tagging as few as 15,000 juveniles can provide recoveries at Delta sampling locations, in the ocean and inland, thus providing valuable information about the effects of environmental conditions and ocean harvest on the health of the population. The proposed project is designed to provide similar, yet more detailed, information about San Joaquin fall-run chinook. Note that studies in Butte Creek deal with spring-run chinook and those in the Stanislaus River will deal with fall-run chinook. These different runs have different age-at-maturity schedules and harvest rates. There is also indication that variation in outmigrant survival between years is greater in the San Joaquin Basin than in the Sacramento Basin. Although there are differences between the two basins in specific environmental factors, it is also likely that some of the findings from this study will have application throughout the Central Valley.

3. REQUESTS FOR NEXT PHASE FUNDING

This project is not the next phase of an existing ecosystem restoration project currently or previously funded by the CALFED Program or the CVPIA. Should the project be approved and results from the first 3 years are promising, a request will be made for an additional 3 years of funding from CalFed. It is probable that extending the study will provide opportunity to examine effects of environmental conditions that are not experienced during the first three years of study. For example, 2001 is the first year since 1995 in which river flows were low and relatively stable in the Stanislaus River until fish were of smolt size (December through mid-April). Tri-Dam will fund rotary screw trapping at Oakdale for the duration of the proposed

project and will continue to fund such monitoring should additional years be funded by CalFed. Additional cost-share for the project will be provided by Tri-Dam for future, more in-depth analyses of the data collected from the first 3 years of study and additional years, should the project continue.

4. PREVIOUS RECIPIENTS OF CALFED PROGRAM OR CVPIA FUNDING

S.P. Cramer and Associates received CVPIA funding (AFRP and B2) for juvenile salmon outmigrant sampling on the Stanislaus River at Caswell State Park from 1997 through 2001. Funding was also received from the AFRP in 1999 for an evaluation of the use of radio-tagged juvenile chinook salmon to identify cause and location of mortality, and from B2 in 1999 for an evaluation of smolt survival in the Stanislaus River.

5. SYSTEM-WIDE ECOSYSTEM BENEFITS

Similar movements of fall-run chinook salmon fry have been documented throughout the Sacramento-San Joaquin basin. Hatton and Clark (1942) found that at Hood Station on the Sacramento River during 1899 and 1939-1940, "the maximum numbers migrated during February or March, with as high as 70% of the total number of migrants being taken during the peak month". Thus, further investigation on the Stanislaus into the relative contribution rates of fry will provide needed information for management actions to be tailored to their needs throughout the Central Valley. It is noteworthy that this finding by Hatton and Clark was reached over 60 years ago, and we still have not determined what opportunities exist to gain adult production from fry emigrants. We need to resolve this issue immediately, rather than continuing to forego the potential benefits that could be achieved from management actions to enhance survival of fry migrants.

An added benefit of this project is that release of tagged chinook at the Oakdale trapping site, with subsequent recoveries at Caswell, will provide a means for ground truthing the annual estimate for abundance of juveniles passing Oakdale. Traditionally, abundance estimates have been calculated by constructing a model based on trap efficiency test results and applying an expansion factor to daily catches. Confidence intervals are typically broad, which has lead to criticism of the abundance estimates by some. As an alternative method of estimation, we could use the ratio of tagged to untagged chinook captured at Caswell to expand catches at Oakdale. It can be assumed that ratio of tagged to untagged fish captured at Caswell is representative of the ratio of tagged to untagged chinook at Oakdale. Given a known number of chinook are captured, tagged and released at Oakdale, the catch can be expanded based on the ratio of tagged to untagged chinook captured at Caswell.

6. ADDITIONAL INFORMATION FOR PROPOSALS CONTAINING LAND ACQUISITION

The proposed project will not require land acquisition.

C. QUALIFICATIONS

Corporate Qualifications

S.P. Cramer & Associates, Inc. (SPCA) was established in 1987 to provide innovative problem solving on issues relating to salmon and trout on the Pacific Coast. We are reputed for our investigative work in determining why fish populations have or may change in response to specific actions. The core of the firm is composed of three Senior Fisheries Consultants, each with over 20 years of noteworthy experience. Our support staff includes a Biologist Project Leader, four Biologist Assistant Project Leaders, a Computer Applications Specialist, a Statistician, a Fisheries Facilities Engineer, a GIS specialist and a seasonal staff of 10 to 18 Fisheries Technicians.

SPCA has been conducting research on the Stanislaus River for private water rights holders, CAMP, and AFRP since 1993, and are therefore very familiar with basin issues, key watershed participants, and the actions necessary to conduct the proposed project. Since we have been involved in Stanislaus River issues for so long, we have had the opportunity to work with a number of different watershed interests, including agency biologists, private researchers, and the public. SPCA has conducted numerous fisheries investigations, monitoring and assessments in the Sacramento-San Joaquin basin. Past and on-going fisheries work include, but are not limited to annual monitoring of juvenile chinook outmigration, adult migrant trapping, radio tracking and electrofishing.

Key Personnel

Andrea Phillips will coordinate and supervise field personnel and data collection activities and assist in data analysis and report preparation. Since 1995 she has assisted Doug Demko in the coordination of field research activities on the Stanislaus River and other tributaries to the San Joaquin River, which has required considerable networking and coordination with state, federal and local government personnel, private consultants and others conducting research in the area. Her contacts within the basin and her knowledge of San Joaquin Basin research and issues past and on-going, will allow her to coordinate with the various entities who will be collecting data needed for the analyses proposed.

Andrea has supervised many outmigrant tagging operations throughout the San Joaquin Basin and has been contacted by researchers on both the West and East Coast for recommendations and training. Specific to the proposed project, she has first-hand experience managing field staff responsible for coded wire tagging daily rotary screw trap catches on the Mokelumne River. Additionally, she has developed a relationship with those conducting similar research on Butte Creek, allowing her to learn from their pilot efforts over the last few years.

Doug Demko will manage and coordinate the proposed project activities within SPCA, and

will supervise data analysis, interpretation and report preparation activities. Doug has worked in the Stanislaus Basin since 1993. He has led a variety of field sampling projects and has gained the respect of state and federal fisheries biologists as an expert in migrant fish sampling. His experience in the Stanislaus River is more extensive than most researchers, and includes leading research projects such as screw trapping, smolt survival studies, radio tracking, predator surveys, resident trout population estimates, habitat surveys, and limiting factors analyses. Additionally, he recently obtained a law degree which has furthered his understanding of water law and endangered species issues.

Steve Cramer will provide knowledge and expertise to the interpretation of the data with his 27 years as a fisheries researcher and team leader. His first 13 years were invested with the Oregon Department of Fish and Wildlife directing major research programs on the Rogue and Columbia basins. Since founding SPCA in 1987, he has consulted for private firms, state and federal agencies, and Native American tribes. He has led numerous projects that pioneered new understanding and solutions for sustaining salmon and trout populations in the western United States.

Ray Beamesderfer will conduct the statistical analysis and provide expertise to the interpretion of the data. Ray has conducted original research and analyzed applied problems of fish biology for almost 20 years. He has extensive experience with salmon, steelhead, sturgeon, warmwater sportfish, and nongame species; has published numerous scientific articles on fish sampling, population dynamics, and species interactions; and has special expertise in the use of statistics and computer modeling to solve difficult fish questions. He recently joined us from the Oregon Department of Fish and Wildlife where he analyzed Columbia River fish and fishery information to forecast runs, regulate sport, commercial and Treaty Indian fisheries, and assess Endangered Species impacts and risks.

D. COSTS

The total cost of the proposed project is $868,950 of which we are requesting $523,950 from CalFed. The remaining funds, 40% of the total cost, will be provided by Tri-Dam Project for rotary screw trap sampling and deriving statistically-based outmigration estimates for each lifestage. Additionally, they will provide funding for further analysis of the data collected as it will not be fully available at the end of the 3 year term. Inland and ocean recovery data will be incomplete for all groups, as these fish could be recovered up to 5 years after they are tagged. An analysis will be conducted for CalFed based on all information available at the end of the 3 year study period (November 2005), and updates will be provided in the annual Stanislaus River outmigrant monitoring reports in 2006 and 2007. A comprehensive stand-alone report, analyzing all data will be completed in December 2008. The funding to collect and summarize data as it comes available after the 3 year term, and the additional analysis required, will be provided by the Tri-Dam Project at an estimated cost of $15,000.

We have been in contact with others conducting similar work in California and Oregon to compare our estimated field costs as an extra measure of certainty. We have found our budget to be reasonable with comparison to others, including the project extension funded by CalFed on Butte Creek. SPCA has conducted numerous cohort analyses in California, Oregon and Washington and therefore we are confident that the amount budgeted for this portion of the project is also reasonable.

Objective 1, estimation of juvenile emigrants, and Task 2.1 of Objective 2, tagging juvenile emigrants, must be conducted simultaneously. The remainder of the project from Task 2.2 to Task 5.3 involves obtaining data which will be collected by other agencies and the analysis of said data. Should funds only be available to fund a portion of the project, field activities (estimation and tagging) could be funded as a first phase and the analysis as a second phase.

E. LOCAL INVOLVEMENT

This project is supported by Tri-Dam Project, both financially and conceptually. Tri-Dam Project has committed to outmigrant monitoring at Oakdale since 1993, and from this data has identified questions with potential management implications which need to be answered through focused study. Specific to this project, Tri-Dam Project will continue to provide approximately $115,000 per year for the monitoring at Oakdale which will capture outmigrants for tagging, and for the statistical analysis necessary to yield outmigration estimates for each lifestage each year. This translates to a cost-share of $345,000 during the project period and 40% of the total project cost. Tri-Dam Project will also provide approximately $15,000 for annual updates in 2006 and 2007, and for the comprehensive report to be completed in December 2008.

F. COMPLIANCE WITH STANDARD TERMS AND CONDITIONS

The proposed project has been developed in compliance with all of CalFed's standard terms and conditions presented in Attachment D of the August 2001 PSP. The applicant has reviewed and will comply with CalFed's terms and conditions. The applicant also understands that the contract terms will apply to any sub-contracts that may be entered into to complete the proposed work. There are no conflicts of interest in performing this work.

G. LITERATURE CITED

Cramer, S.P. 1990. Contribution of Sacramento Basin hatcheries to ocean catch and river escapement of fall chinook salmon. S.P. Cramer & Associates, Inc. contract report for California Department of Water Resources, Sacramento.

Cramer, S.P. and D. B. Demko. 1997. The status of late-fall and spring chinook salmon in the

Sacramento River Basin regarding the Endangered Species Act. S.P. Cramer & Associates, Inc. contract report for Association of California Water Agencies and California Urban Water Agencies, Sacramento.

Fisher, F.W. 1995. Central Valley coded-wire tag recoveries from hatcheries and inland waters, 1975 through 1994. California Department of Fish and Game, Inland Fisheries Division, Office Report, Sacramento.

Hatton, S.R. and G.H. Clark. 1942. A second progress report on the Central Valley fisheries investigations. California Fish and Game Bulletin. Vol. 28, No. 2, pp. 116-123.