ERP DIRECTED ACTION

DETERMINATION OF AGE STRUCTURE AND COHORT RECONSTRUCTION OF CENTRAL VALLEY CHINOOK SALMON POPULATIONS

Reference
Ecosystem Restoration Program
Prop 50 Bond Funded
Project No. DFG-05####

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ERP DIRECTED ACTION
Determination of Age Structure and Cohort Reconstruction of Central Valley Chinook Salmon Populations

Project Lead

Name: Stan Allen, Pacific States Marine Fisheries Commission

Regional Coordinator

Name: Allen Grover, Senior Environmental Scientist, Ocean Salmon Project, California Department of Fish and Game

Cost of Project: $ 738,298

Cost Share Partners: Cost-sharing will occur in the form of in-kind services of permanent staff time, equipment, and facilities. Specifically, it is estimated that the DFG will provide funding of approximately $ 66,000 over the length of the project for staff, or 1,570 hours of permanent biologist (0.25 PY per year) staff time over the course of the study to oversee project staff. Additionally, field staff of various agencies will be providing in-kind services for the field collections of scale samples.

List of Subcontractors : N/A

Other Technical Experts:

Melodie Palmer-Zwahlen
Ocean Salmon Project
Department of Fish and Game

Proposal Outline

1. Executive Summary

In recent years, the CALFED Ecosystem Restoration Program (ERP), the Central Valley Project Improvement Act Program (CVPIA), and other programs, have provided hundreds of millions of dollars for the restoration of habitat for Chinook salmon in the Central Valley. The focus of restoration activities has been habitat restoration for the improvement of naturally-spawning populations. However, it is not possible to monitor the success of these actions in restoring naturally-spawning populations of Chinook salmon, or monitor the success of meeting recovery goals, without determining the age structure of returning adults and the relative contribution of hatchery fish to adult populations.

Currently, the age of salmon returning to spawn in Central Valley streams is not determined on a consistent basis, even for the listed stocks of winter and spring-run Chinook. Some escapement monitoring programs collect scale samples, but currently, very few scales are analyzed for age determination. This lack of aging data precludes accurate reconstruction of the size of each brood year at various points in the life cycle, and thus precludes accurate life cycle modeling.

Annual estimation of run size at age is a key component in the determination of the proportion of naturally produced salmon in the Central Valley. Run size estimates are derived from summing estimates of harvest, hatchery returns and spawning fish for each tributary of the Central Valley that supports Chinook salmon. The age structure of each of these run size estimates can be determined through information gained from coded-wire tag (CWT) recoveries and scale analysis.

The CALFED Science Program selected adult escapement of Central Valley Chinook salmon, Butte Creek spring-run Chinook salmon, and Sacramento River winter-run Chinook salmon, as key performance indicators of the success of ecosystem restoration programs (Science Program Indicators Workshop, April 23-24, 2003). However, the Science Program indicators report states that the cohort replacement rate (CRR) is "widely considered to provide a more accurate picture of population trends than does the raw escapement estimate, which lumps returning adults of all age classes". The CRR is not calculated routinely for Central Valley Chinook populations because the CRR requires information on the age structure of each run.

When age data are available, cohort reconstructions of each brood can provide population parameters such as total ocean abundance, ocean harvest rates, maturation rates, stray rates and the relationship between younger ages in-river to predict older ages remaining in the ocean.

These data needs will be fulfilled through the following project objectives: 1) to accurately determine age of all Chinook salmon populations returning to the Central Valley, 2) using the aging data in combination with CWT recovery data, to reconstruct the size of each returning year class at various points in the life cycle, and 3) to estimate population parameters for development of full life cycle models for each Chinook run.

The Central Valley aging and cohort reconstruction program will be similar in design to the program already in place in the Klamath River Basin. In each year, age-specific escapement

estimates, coupled with the CWT recovery data on the Basin's hatchery stocks, allow for a cohort reconstruction of the hatchery and natural components of Klamath River fall-run Chinook.

The outcome of this project will be an accurate, coordinated database of the age structure of Chinook salmon, linked to databases with hatchery release, CWT recovery, and escapement data in a comprehensive Chinook salmon population data system. Reporting will include semi-annual progress reports and a final technical report on results of the cohort reconstruction analysis. Work will be performed by one biologist and two biological technicians at the Department of Fish and Game's Ocean Salmon Project headquarters in Santa Rosa.

This proposal directly responds to two key goals of the CALFED Ecosystem Restoration Program's (ERP) Draft Stage 1 Implementation Plan: Goal 1 – At-Risk Species and Goal 3 – Harvestable Species. Recommended research and monitoring programs for adult Chinook salmon in the CALFED Comprehensive Monitoring Assessment and Research Program plan (1999) include the analysis of scales to determine age at escapement. This project will also help to assess the progress of Chinook salmon populations in meeting the doubling goals of the Central Valley Project Improvement Act.

2. Project Background and Information

In recent years, the CALFED Ecosystem Restoration Program (ERP), the Central Valley Project Improvement Act (CVPIA) Program, and other programs, have provided hundreds of millions of dollars for the restoration of habitat for Chinook salmon in the Central Valley. Chinook salmon are a "big R" species included in the CALFED Multi-Species Conservation Strategy (MSCS), a key species for which the CALFED ERP Program has established a goal for recovery within the ERP ecological management zones. A parallel goal of the federal CVPIA is to ensure that the natural production of anadromous fish in Central Valley streams will be sustainable, on a long-term basis, at levels at least twice the average levels of natural production in the 1967 through 1991 period.

Information needs for the "big R" species include status and trends in the species' populations. Monitoring and evaluation that assess the cumulative response to many restoration actions is needed, along with project-specific monitoring, to evaluate the effect of restoration efforts on populations of key species. Evaluating the success of restoration actions and the impact of changes in water operations is difficult or impossible without adequate monitoring and evaluation of the key parameters of populations the actions are intended to benefit.

The focus of restoration activities for Chinook salmon has been habitat restoration for the improvement of naturally-spawning populations. However, it is not possible to monitor the success of these actions in restoring naturally-spawning populations of Chinook salmon, or monitor the success of meeting recovery goals, without determining the age structure of returning adults and the relative contribution of hatchery fish to adult populations. Currently, the age of salmon returning to spawn in Central Valley streams is not determined on a consistent basis, even for the listed stocks of winter and spring-run Chinook. Some escapement monitoring programs collect scale samples, but currently, very few scales are analyzed for age determination. This lack of aging data precludes accurate reconstruction of

the size of each brood year at various points in the life cycle, and thus precludes accurate life cycle modeling.

Annual estimation of run size at age is a key component in the determination of the proportion of naturally produced salmon in the Central Valley. Run size estimates are derived from summing estimates of harvest, hatchery returns and spawning fish for each tributary of the Central Valley that supports Chinook salmon. The age structure of each of these run size estimates can be determined through information gained from CWT recoveries and scale analysis.

The CALFED Science Program selected adult escapement of Central Valley Chinook salmon, Butte Creek spring-run Chinook salmon, and Sacramento River winter-run Chinook salmon, as key performance indicators of the success of ecosystem restoration programs (Science Program Indicators Workshop, April 23-24, 2003). However, the Science Program indicators report states that the cohort replacement rate (CRR) is "widely considered to provide a more accurate picture of population trends than does the raw escapement estimate, which lumps returning adults of all age classes". The report states that the CRR is not calculated routinely for Central Valley Chinook populations because the CRR requires information on the age structure of each run. Because aging studies are not performed as a standard part of escapement monitoring, any estimates of CCR now depend on assumptions about the population age structure, based on inferences from hatchery populations and qualitative observations about the dominance of 3-year old fish in most escapement runs. Any estimate of historic trends using CCR as the indicator is qualitative. Scale aging data are therefore needed as a component in the use of adult Chinook salmon escapement data as an indicator of the success of ecosystem restoration programs.

When age data are available, cohort reconstructions of each brood will provide population parameters such as total ocean abundance, ocean harvest rates, maturation rates, stray rates and the relationship between younger ages in-river to predict older ages remaining in the ocean. Using these population parameters and ocean harvest data, a model can be constructed to predict ocean fishery impacts given a proposed fishing season and ocean escapement back to the river.

The Central Valley aging program will be similar in design to the scale aging program already in place in the Klamath River Basin. In each year, age-specific escapement estimates, coupled with the CWT recovery data on the Basin's hatchery stocks, allow for a cohort reconstruction of the hatchery and natural components of Klamath River fall Chinook (KRTAT 2003; Goldwasser et al. 2001). See Attachment 1 for an example of this analysis for 2002. Cohort reconstruction results enable forecasts to be developed of the upcoming year's ocean stock abundance, percent of spawners expected in natural areas and ocean fishery contact rates, as described each year in an annual report (KRTAT 2003). These forecasts are essential inputs to the Klamath Ocean Harvest Model (KOHM) (Mohr et al. 2001), the model used by the Pacific Fishery Management Council to forecast the effect of fisheries on the Klamath River fall Chinook stock. The KOHM is considered a state-of-the-art model for managing Chinook stocks. It has allowed increased ocean harvest opportunity of Klamath stocks, while achieving the Pacific Fishery Management Council's Fishery Management Plan goals for Klamath fall Chinook. When data are available for Central Valley runs, including scale aging data, an ocean harvest model similar to the KOHM can be constructed.

Figure 1 shows the conceptual model of the relationship between the Central Valley Chinook

salmon age structure program and estimates of total production and cohort replacement rates. Adult Chinook numbers are estimated in the ocean harvest, inland harvest, in-river spawning, and hatchery returns. The sum of these estimates for each run is the estimate of total annual run size. Age structure data, combined with estimates of total annual run size, allow calculation of the cohort replacement rate (CRR). Trends in the CRR, as described in the Science Program indicators report, will be a better measure of the success of restoration programs than raw estimates of total production.

Scale aging has been conducted in the past on a sporadic, inconsistent basis in the Central Valley. However, there has been no coordinated program or comprehensive database developed for scale aging data.

Cohort reconstruction analyses are being used for Central Valley stocks to compare straying rates between hatchery release groups (in-basin vs. out-of-basin releases). In 2003, the Department of Water Resources provided funding for a biologist to work with the DFG's Ocean Salmon Project staff to begin to collect, verify, and summarize Central Valley CWT recoveries from 1980 through 2003. Other pertinent data, including Chinook salmon escapement estimates and harvest estimates are also being gathered and verified. This biologist has successfully gathered this information for one cohort, and is beginning the creation of the databases needed for cohort reconstruction of fall and spring-run stocks in the Feather River. This proposal would continue this database development for more cohorts and Central Valley stocks, and allow for expansion of the cohort reconstruction analysis, using age structure data.

Cohort reconstruction analyses are also being used to evaluate ocean harvest impacts on winter and spring-run Chinook. In November 2001, the National Marine Fisheries Service proposed that the Pacific Fishery Management Council (Council) amend the Fisheries Management Plan (FMP) to specify recovery and long-term conservation objectives for Sacramento River winter and spring-run Chinook salmon. The Council, at its March 2002 meeting, directed NMFS and the DFG to form a workgroup to develop alternatives for FMP conservation objectives. A seven-member workgroup was formed consisting of representatives of the Council, NMFS, DFG, and USFWS. The workgroup compiled and evaluated the available information on fishery impacts and status of the two stocks, using cohort reconstruction analysis for 1998, 1999, and 2000 winter-run hatchery and wild Butte Creek spring-run cohorts (Grover et al. 2004). This analysis is on-going and although it has not yet resulted in recommendations for fishery management changes, the analysis provides a basis for further understanding the life cycle dynamics of these runs.

3. Project Goals and Objectives

This project will fulfill the above-described data needs through the following objectives: 1) to accurately determine age of all Chinook salmon populations returning to the Central Valley, 2) using the aging data in combination with coded-wire tag (CWT) recovery data, to reconstruct the size of each returning brood year at various points in the life cycle, and 3) to estimate population parameters for development of a full life cycle model for each Chinook run.

4. Approach/Methodology

Analysis of scale samples will be the technique used in this study for age determination. Sample size requirements to detect the difference between ages within a particular run estimate were calculated by Mr. Michael Mohr, NOAA Fisheries Southwest Science Center. A minimum of 550 scales will need to be collected at random and analyzed for age, from each of fourteen runs of Central Valley Chinook salmon. Based on these requirements, it is estimated that one biologist and two biological technicians will be needed for the program. Scales will be analyzed from the following Chinook salmon populations:

- Mainstem Sacramento River - fall, late-fall, and winter-run
- Clear Creek - fall-run
- Battle Creek - fall-run
- Butte Creek - fall and spring-run
- Yuba River - fall-run
- Feather River – fall, spring-run
- American River - fall-run
- Mokelumne River - fall-run
- Stanislaus River - fall-run
- Tuolumne River - fall-run
- Merced River - fall-run

Existing escapement surveys on these streams can feasibly collected the required number of scale samples (550). It will not be feasible to collect the required number of scales from other populations, such as Mill and Deer Creek spring-run, due to the differences in survey methods and low abundance. However, scales from these populations will be sampled and analyzed as feasible.

Scale preparation and reading will be conducted using optical scanners and computer-aided software to speed reading and allow for the collaboration of readers in the same or different locations. Each scale will be read independently by two readers, and a third reader will be used to resolve any disagreement between the two primary readers. The validation of scale-based age determination will be accomplished by using scales of known-age CWT recoveries each year. Statistical methods (Kimura and Chikuni 1987, Cook and Lord 1978, Cook 1983) will then be used to correct for the potential of reader ageing-bias, by correlating known-age CWT scales with their corresponding scale-read age assignments.

Once age-structured run size estimates have been determined, coast-wide ocean harvest CWT data will be used to reconstruct monthly ocean abundances for each stock in the Central Valley. These analyses start at the oldest age of a particular brood which is usually age-5 in river and proceed backward in time to the youngest age observed, usually age-2 in river. The estimation of the brood's ocean wide abundance is conducted at the beginning of each month and is a function of harvest, sublegal mortality, drop off mortality and natural mortality. Each year ocean escapement is accounted for by the age specific run size estimates.

Given a long time series of cohort-reconstructed brood years, a number of population parameters will be estimated and then used as a predictive tool in future modeling. For example, the relationship between age-2 in-river escapement to age-3 ocean abundance just after the run can be constructed. From this relationship and a new estimate of age-2 in-river escapement, the ocean abundance of age-3 fish available for harvest in the next year's ocean

fishery will be predicted. This will also be done for age-3 in-river to age-4 ocean wide abundance. Using the ocean harvest data and the ocean abundance estimates, the contact rates by time area fishery will be estimated. These contact rates can then be used to estimate ocean fishery impacts on a stock and evaluate if a proposed fishing season will provide enough fish to return to spawn. From the brood-specific proportion natural data, a forecast of hatchery and natural spawners can be made.

Tasks to be conducted are as follows:

Task 1. Project Management. Project management tasks will be coordinated jointly by the PSMFC and DFG. The PSMFC, as the Principle Investigator, will be responsible for ensuring that all semi-annual fiscal and programmatic reports are completed and delivered to the CBDA. Additionally the PSMFC will manage project personnel for the project. One biologist and two biological technicians will be hired through the PSMFC for the project.

The DFG will be directly responsible for overall project coordination, and for any invoices and other costs primarily related to equipment items. The DFG will be responsible for writing semi-annual fiscal and programmatic reports detailing work performed during each six month period. A final technical report will be prepared, presenting results of the scale aging and cohort reconstruction analyses.

Task 2. Scale Analysis. Determine age structure of Central Valley Chinook salmon populations by scale analysis. Assist in the field collection of scales in Chinook escapement surveys. Prepare and read scales using optical scanners and computer-aided software to speed reading and allow for the collaboration of readers in the same or different locations. Validate scale-based age determination by using scales of known-age CWT recoveries each year. Construct reader bias correction matrices to statistically adjust age determination among readers. A minimum of 550 scales will be collected, prepared and analyzed for age, from each of fourteen runs of Central Valley Chinook salmon.

Task 3. Coded-wire Tag Data Summary. Verify and summarize available Central Valley CWT recovery data from 1980 through 2003. Gather and verify other pertinent data, including Chinook salmon escapement estimates and harvest estimates.

Task 4. Cohort Reconstruction. Estimate population parameters for each Central Valley Chinook population for use in the development of a full life cycle model. Reconstruct the size of each brood year's ocean abundance by month, for hatchery and natural populations. Analyze the effects of ecosystem restoration actions on cohort size and cohort replacement rates.

Task 5. Data management and reporting. Develop coordinated database for Central Valley Chinook age data. Link database with hatchery release, CWT recovery, and escapement databases in a comprehensive Chinook salmon population data system.

Project Feasibility

Analysis of scales to determine age of Chinook salmon is the primary method used throughout the West Coast. It is a cost-effective method proven to yield accurate results. The technology to be used, optical scanners and computer-aided software, is the state-of-the-art method for scale age determination. Existing escapement surveys on the target streams can feasibly collect the required number of scale samples.

Cohort reconstruction analysis based on age-structured escapement data and CWT recovery data will also follow well-established methods used throughout the West Coast.

This project will not require environmental impact documentation under NEPA/CEQA as it will include only laboratory and office work. Permits and agreements needed for scale collections in the field are already in place. Private property access will not be needed. No third party impacts will occur.

Expected Outcomes and Products
The outcome of this project will be an accurate, coordinated database of the age structure of Chinook salmon, linked to databases with hatchery release, CWT recovery, and escapement data in a comprehensive Chinook salmon population data system. The database will be coordinated with Interagency Ecological Program (IEP) databases, the CVPIA Comprehensive Assessment and Monitoring Program (CAMP) database, and other appropriate CALFED monitoring databases. Databases generated will be made available for use by co-management agencies and the public upon request. A series of interim semi-annual fiscal and technical reports and a final technical report will be generated. The final report will include data summaries and results of cohort reconstructions.

Work Schedule
Table 1 outlines start dates, milestones, timeline, and completion dates for each task and subtask on a relative month basis (assuming the contract begins October 2005). Work will be conducted over a 36-month period. Adjustments will be made as needed, should the contract start at an alternate date.

5. Subcontractors (description of tasks and qualifications)
There will be no subcontractors for this project.

6. Tasks and Deliverables (Description)
A series of interim semi-annual fiscal and technical reports, and a final technical report will be generated. The final report will include age data summaries and results of cohort reconstructions.

7. Special Equipment and Supplies required
Optical scanners, computers, and computer-aided software, will be required for use in scale age determination. Computers and software will be used in the cohort reconstruction analysis.

8. Environmental Permitting Requirements
No CEQA documentation is required for this project. No other state or local permits are required for this project.

The staffs of the PSMFC, DFG and USFWS are covered under the existing DFG and USFWS ESA permits for any scale collection work to be performed in this proposal.

9. Species Impacted/Affected

Winter, spring, fall, and late fall-run Chinook salmon in the Central Valley.

10. Stakeholders and Interested Parties

Project reports will be available to the public through the CALFED and DFG Ocean Salmon Project websites. Results will be regularly reported to the IEP Central Valley Salmonid Project Work Team and the Salmonid Escapement Project Work Team. Project results will be reported to the Pacific Fishery Management Council for use in ocean harvest management (in the Salmon Technical Team process). In addition, report copies will be available at the Pacific States Marine Fisheries Commission (PSMFC) Calfish website (http://www.calfish.org). Calfish is a multi-agency cooperative program designed to gather, maintain, and disseminate fish and aquatic habitat data and data standards. Project results will also be presented annually at meetings of the Pacific Coast Federation of Fishermen's Associations and other stakeholder groups.

Literature Cited

CALFED Bay-Delta Program. 1999. Comprehensive Monitoring, Assessment, and Research Program Plan.

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Cook, R.C. 1983. Simulation and application of stock composition estimators. Canadian Journal
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Grover, A. et al. 2004. Recommendations for developing Fishery Management Plan conservation objectives for Sacramento River winter Chinook and Sacramento River spring Chinook. Interagency Workgroup Progress Report to the Pacific Fishery Management Council. February 19, 2004. http:/www.pcouncil.org/bb/2004/0304/exc7.pdf

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KRTAT (Klamath River Technical Advisory Team). 2003. Ocean abundance projections and prospective harvest levels for Klamath River fall Chinook, 2003 season. Available from U.S. Fish and Wildlife Service, 1829 South Oregon Street, Yreka, CA, 96097.

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11. Exhibits (Attached)

Exhibit A – Budget Detail
Exhibit B – Task Deliverables

EXHIBIT A

BUDGET DETAIL
Determination of Age Structure and Cohort Reconstruction of Central Valley Chinook Salmon Populations

Project Totals

Labor	Benefits	Travel	Supplies and Expendables	Services and Consultants	Equipment	Lands and Rights of Way	Other Direct Costs	Direct Total	Indirect Costs	Total
386,031	177,105	10,952	34,040		10,000		23,869		96,301	738,298

Year 1 (Months 1 to 12)

Task	Labor	Benefits	Travel	Supplies and Expendables	Services and Consultants	Equipment	Lands and Rights of Way	Other Direct Costs	Direct Total	Indirect Costs	Total
1: Project Management & Administration	9,926	4,696	1,000	440				7,362		3,514	26,938
2: Scale Analysis	67,454	33,904	2,000	15,300		10,000				19,299	147,957
3: Coded-wire Tag Data Summary	19,763	8,410	400	300						4,331	33,204
4: Cohort	10,979	4,672	400	300						2,453	18,804

Reconstruction Analysis											
5: Data Management and Reporting	**10,979**	**4,672**		**300**						**2,393**	**18,344**
Totals	**119,101**	**56,354**	**3,800**	**16,640**		**10,000**		**7,362**		**31,990**	**245,247**

Year 2 (Months 13 to 24)

Task	Labor	Benefits	Travel	Supplies and Expendables	Services and Consultants	Equipment	Lands and Rights of Way	Other Direct Costs	Direct Total	Indirect Costs	Total
1: Project Management & Administration	**10,712**	**4,916**	**976**	**500**				**8,002**		**3,766**	**28,872**
2: Scale Analysis	**72,931**	**35,438**	**2,000**	**7,300**						**17,650**	**135,319**
3: Coded-wire Tag Data Summary	**21,266**	**8,830**	**300**	**300**						**4,604**	**35,300**
4: Cohort Reconstruction Analysis	**11,815**	**4,906**	**300**	**300**						**2,598**	**19,919**
5: Data Management and Reporting	**11,815**	**4,906**		**300**						**2,553**	**19,574**
Totals	**128,539**	**58,996**	**3,576**	**8,700**				**8,002**		**31,171**	**238,984**

Year 3 (Months 25 to 36)

Task	Labor	Benefits	Travel	Supplies and Expendables	Services and Consultants	Equipment	Lands and Rights of Way	Other Direct Costs	Direct Total	Indirect Costs	Total
1: Project Management & Administration	11,532	5,146	976	500				8,505		3,999	30,658
2: Scale Analysis	78,526	37,004	2,000	7,300						18,725	143,555
3: Coded-wire Tag Data Summary	22,895	9,287	300	300						4,917	37,699
4: Cohort Reconstruction Analysis	12,719	5,159	300	300						2,772	21,250
5: Data Management and Reporting	12,719	5,159		300						2,727	20,905
Totals	138,391	61,755	3,576	8,700				8,505		33,140	254,067

EXHIBIT B

SCHEDULE AND LIST OF DELIVERABLES
Determination of Age Structure and Cohort Reconstruction of Central Valley Chinook Salmon Populations

Task	Task Title	Deliverable	Estimated Completion Dates
1	Project Management & Administration	• Semi-Annual Progress Report	• Semi-annual fiscal and programmatic reports throughout the contract term. Due 10th of July, Jan. each year.
		• Invoices	• Monthly, 10th of the month following billing period.
		• Draft Technical Report	• July 2008
		• Final Technical Report	• September 2008
		• Project Close-Out Report	• November 2008
		• Final Invoice	• November 2008
2	Scale Analysis	• Age determination of over 10,000 scale samples per year	• June 2008
3	Coded-wire Tag Data Summary	• Verification/summary of available Central Valley CWT recovery data from 1980-2003	• June 2008
4	Cohort Reconstruction Analysis	• Cohort reconstructions by brood year	• June 2008
5	Data Management and Reporting	• Coordinated database for Central Valley Chinook age data, linked to other relevant databases	• July 2008

Note: Public Participation and Environmental Compliance and Permitting are not separate tasks in this proposal since they are not required as part of this project. Project Close Out is included in Task 1, Project Management and Administration.

12. Other Attachments (Table 1. Project Timeline, Figure 1. Conceptual Model, Response to Review Comments)

Table 1. Timeline for Determination of Age Structure/Cohort Reconstruction Project for Central Valley Chinook Salmon. (Relative Schedule and Milestone dates assuming contract signed October 2005)

Task	Task Title	Relative Milestones Month 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36	Relative Completion Schedule
	Sign Contract		October 2005
1	**Project Management**		Oct 2005 – Sept 2008
	Semi-annual fiscal and technical reports		10th of July, January each year
	Draft Technical Report		July 2008
	Final Technical Report		September 2008
2	**Scale Analysis**		
	Assist in field collections		Oct – Dec, 2005 – 07
	Prepare and read scales		Oct 2005– June, 2008
	Validate age determinations		Apr 2006– June, 2008
3	**Coded-wire Tag Data Summary**		Dec 2005 – June 2008
	Collect and summarize CV CWT recovery data		Dec 2005 – June 2008
4	**Cohort Reconstruction Analysis**		April 2006 – June 2008
5	**Data Management and Reporting**		
	Develop coordinated database		April 2006 – July 2008

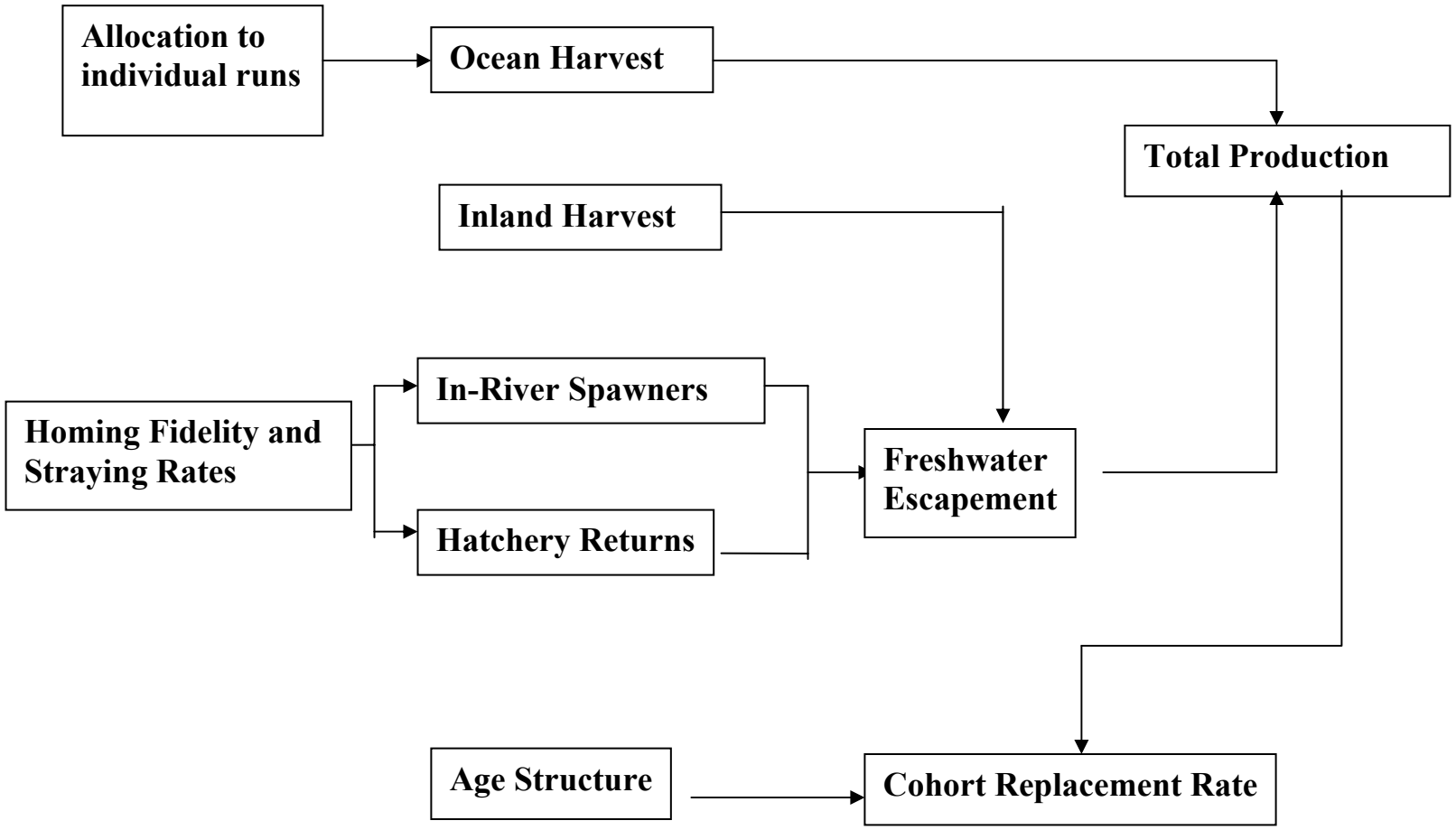

Figure 1. Conceptual model of the relationship between the Central Valley Chinook salmon age structure program and estimates of total production and cohort replacement rates. (Science Program Indicators Workshop, April 23-24, 2003)

Response to Review Comments
Determination of Age Structure/Cohort Reconstruction
for Central Valley Chinook Salmon
2005 Science Program Proposal Solicitation Package

This project proposal was submitted in the 2005 CALFED Science Program proposal solicitation process. The following summarizes and responds to review comments from that process.

Technical Review
The summary rating of each of the two technical reviewers was "excellent". One reviewer stated that the proposal identifies a gap in current knowledge that prevents a comprehensive assessment of populations and their response to CALFED restoration activities. This reviewer also stated that the age structure data generated by the project will be high quality; the methods proposed are rigorous and consider the usual errors and bias associated with ageing data. The second reviewer stated that the study is well founded in existing knowledge and the conceptual model is well laid out.

Technical Synthesis Panel Review
The Technical Synthesis Panel stated that there is strong reason to support the intensive and consistently performed study proposed. The panel found the proposal would provide valuable information on the age structure of Chinook salmon.

Selection Panel Review
The Selection Panel stated that the project is on-topic and of strategic importance to water storage and transfer actions. The study would provide the basis for improved investigation of how ecosystem conditions and water management strategies influence Chinook populations, as well as providing a more precise monitoring of the success of management and restoration actions. The Panel felt that the project would provide key information that has long been needed. The Panel felt strongly that salmonid management in the system is dependent on the availability of this kind of information. However, the panel was unanimous in its opinion that funding the project through the Science proposal solicitation was inappropriate as it is essentially a baseline monitoring project. The panel believed that the project should be funded by the CALFED Ecosystem Restoration Program.

Response to Review Comments
We concur that the data generated by this project will be of high value in the improvement of Central Valley salmon management. Data will allow for improved evaluation of the effects of ecosystem conditions and water management strategies on Chinook populations, and will provide for more precise monitoring of the success of management and restoration actions. The Ecosystem Restoration Program Implementing Agency Managers (ERPIAMs) approved this project for ERP funding as a Directed Action in June 2005 due to its high value for monitoring the success of management and restoration actions.

Complete review comments are available at:

https://solicitation.calwater.ca.gov/solicitations/2004.01/public_proposal_reviews?proposal_id=0230