CHAPTER 7
CONCLUSIONS AND RECOMMENDATIONS

The 2009 VAMP moved into the third consecutive dry year and for the first time, the sequential dry-year relaxation of the San Joaquin River Agreement was initiated. This meant that there would be no Target Flow. A minimum base flow of 2,000cfs was maintained. The VAMP coordinated actions to ensure as closely as possible a stable flow rate at Vernalis during the VAMP period. The mean daily flow at Vernalis varied between 1,830 and 2,650 cubic feet per second (cfs) over the 31-day VAMP period. The observed exports during this period averaged 1,990 cfs and ranged from 1,350 cfs to 2,590 cfs. The start of the VAMP Fish experiment was again delayed from the default period to April 19th to May 19th to allow the test fish to increase in size. Flow and fish size were only two factors that presented challenges to the VAMP team to demonstrate that acoustic telemetry technology can be implemented full scale in the South Delta.

Difficulties deploying and maintaining large open-water receivers, loss of the physical barrier at the Head of Old River, tracking smolts through numerous channels, tagging near the limit on tag size for fall run San Joaquin River smolts and maintaining an acoustic receiver network under South Delta conditions presented challenges to VAMP in meeting the second goal of better defining route selection and survival between various reaches in the Delta.

The third goal of the 2009 VAMP was to demonstrate acoustic tagging and release of fall-run smolts can be accomplished without introducing bias in the survival estimates and route selection data. Reaching this goal was challenged by the time consuming data processing from numerous receivers, data interpretation for conditions in the South Delta and understanding and dealing with observed high mortality within certain reaches within the South Delta.

Table 7-1
Summary of VAMP 2009 Issues and Recommendations

CHALLENGE OR ISSUE FACED BY VAMP	RECOMMENDATIONS FOR 2010
The timing of VAMP has been designed to adaptively change with hydrologic conditions.	Continue to identify opportunities when it would be beneficial to change the VAMP period to increase protection for juvenile Chinook salmon outmigration from the San Joaquin River Basin.
Low flow conditions in 2009 emphasized the importance of the ungaged flow on the San Joaquin River and tributaries.	Maintain and increase the frequency of flow-monitoring station maintenance to ensure accurate flow records.
Flow data collected in 2009 near Lathrop, Old River at Head and near Mossdale provided valuable information on the flow split at the Head of Old River.	Continue to use the ADCM flow measurement devices to measure stage and flow at these monitoring sites.
Delays for fish growth push the study into critical water temperature periods.	Continue intensive temperature monitoring throughout the experiment.
	Work with DFG Hatchery specialists to develop strategies to enhance smolt growth prior to the VAMP period.
Deployment of large open-water receivers presents a strong technical challenge.	Develop a long-term commitment with specialist to install these stations
As much as 40% of the study cost in future years may be related to installing the large open-water receivers	Work with the technology manufacturers and other specialists to develop cheaper, long-term solutions for these sites.
Large open-water receivers are a critical component of the survival study and comparisons with prior CWT studies.	Use a consistent study design over multiple years, especially with respect to addressing large-scale questions such as survival to Chipps Island. As part of this recommendation, the large open-water receivers or an alternate technology should be located at Chipps Island each year.
There are numerous routes and channels that the smolts can take in the South Delta especially without the barrier at the head of Old River.	Continue cooperation with the South Delta Temporary Barriers study and the Non-physical barrier study to increase the number of channels VAMP can cover for route selection.
	Use redundant receivers at key exit points for route selection analysis.
Receiver overheating under hot spring Delta conditions.	All future telemetry sites exposed to outdoor ambient conditions should utilize the modified job boxes developed during the 2009 VAMP study (Vogel, 2010).
Importance of route selection at the head of Old River with a non-physical barrier installed.	Deployment of a four-port receiver at the head of Old River when a non-physical barrier is installed should be a priority to detail fish behavior and predatory fish behavior.
Interference from line power sources.	Discontinue the use of AC trickle chargers unless grounding and acoustic noise can be eliminated.
Use of acid batteries presents labor and safety issues.	Use of non-acid batteries should be implemented to avoid safety issues in remote areas.
	Development of solar panels for trickle charging should be developed and tested.
Tag life is still near the limits of time needed for travel through the Delta.	Continue the tag life studies initiated in 2008.
	Continue to distribute tags from all tag manufacture groups across all release groups and taggers so that any survival effect of release group (location, time) or tagger is not confounded with a potential effect of tag batch or tag life on survival.
Availability of test fish from the San Joaquin River Basin.	Develop a long-term supply source from the Merced River Hatchery (MRH) to ensure a continuous source of in-basin smolts.
High mortality being experienced after tagged smolt releases.	Continue evaluation of tagger effects.
	Continue health studies on release groups and tagging procedures.
	Consider additional live-pen studies in reaches of highest mortality with a priority in the Stockton Deep Water Ship Channel and near the Stockton WWTP.
	Continue dummy tagging of release fish
	Continue tagger training and continued development of refresher training courses for previous taggers.
	Work with groups to develop long-term availability of previous taggers to ensure consistency in tagging procedures.
	Evaluate predator effects on tagged smolts under San Joaquin River conditions.
	Evaluate if acoustic-tagged salmon are in “sub-standard condition” resulting from surgery and transport (Vogel, 2010)
	Consider conducting predator avoidance tests on representative tagged salmon using established study protocols (Vogel, 2010).
	Increase the intensity of mobile telemetry to locate high mortality areas or zones.

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Summary of VAMP 2009 Issues and Recommendations

CHALLENGE OR ISSUE FACED BY VAMP	RECOMMENDATIONS FOR 2010
Loss of data due to receiver malfunctions or vandalism.	Develop remote sensing techniques to continuously check on receiver operations.
	Use redundant receivers at key stations to avoid critical data loss including Mossdale, SJR at Lathrop, Old River East side and Chipps Island.
Data processing is time consuming and expensive due to labor costs.	Continue the use of a central ftp site for data downloads to avoid loss of data prior to processing.
	To ensure consistency in how data is processed, develop standardized procedures for how data is handled, reviewed, stored and processed.
	Plan precisely who will be processing data from each receiver and how the transfer of processed data will occur.
	Develop training programs for data processors.
	Develop procedures to compare manual processing with computer marking programs to evaluate accuracy under Delta conditions.
Due to high rates of predation, predator movements after consumption of tagged smolts likely biased smolt survival estimates.	Do not rely solely on the "presence/absence" data processing techniques.
	Develop standard terminology for data analysis including standard definitions for "near-filed, medium-filed and far-field" observations used in the 2009 VAMP study to ensure consistency in data processing and interpretation.
	Continue with manual data processing with an emphasis on marking predator-type movements vs. smolt type movements.
	Work with the acoustic tracking manufacturers to develop more rapid marking programs that identify specific types of smolt behavior.
Due to high mortality, very few smolts released upstream of Vernalis reach as far downstream as Turner Cut.	Focus future work to better define the reason for the high mortality in specific reaches of the San Joaquin River.
	Consider supplemental releases to determine if mortality experiences in the upper reaches of the San Joaquin River are similar to those found further downstream.
Evidence is mounting that the high mortality in certain reaches and near certain points in the river may be associated with predation and this may be limiting survival.	Evaluate acoustic-tagged salmon smolts to determine if they are in a "sub-standard" condition resulting from surgery and transport causing increased vulnerability to predation compared to untagged salmon.
	Increase predator tagging with an emphasis on tagging prior to the start of the tagged smolt release to allow the predators time to adjust and move to locations they are accustomed to during the out-migration period.
	Develop a full study plan for predator tracking to ensure consistency and allow data interpretation between studies.
	Tag predators in known "hot spots" such as bridges, pumping structures, scour holes, etc. to better learn about their habitats during the smolt out-migration period.
	Increase the intensity of mobile monitoring in known predator areas and in the main stem of the San Joaquin River as most acoustically-tagged predators may not hang out around fixed station receivers.
	Conduct an acoustic-tag defecation study to determine how long transmitters remain in the stomach of predators.
	Program predator acoustic tags with a short repetition rate as they swim faster and would move faster by a fixed receiver and also would likely be picked up more readily by mobile monitoring.
	Work with the tag manufacturers to develop a smolt tag that shows different characteristics when it is consumed or in the stomach of a predator.

Considerations for a Future VAMP

Drs. Bruce Herbold and Chuck Hanson developed the original Vernalis Adaptive Management Plan (VAMP) conceptual framework for protection and experimental determinations of juvenile Chinook salmon survival within the lower San Joaquin River in response to river flow and pumping exports. The VAMP experiments were designed to evaluate how juvenile Chinook salmon migration from the San Joaquin Valley is affected by different San Joaquin River flows and different export rates at the State Water Project (SWP) and Central Valley Project (CVP) exports. In addition, the value of a barrier at the head of Old River was to be evaluated. The VAMP studies were designed as a large-scale, 12-year experimental survival study. The year 2010 represents the last year of the first phase of the study. Much has been learned, but not all of the goals have been achieved and salmon populations are of even greater concern now. Thus, a Phase II VAMP is needed.

In recognition of the transition between Phases I and II of the program, Doctors Herbold and Hanson developed the following recommendations aimed at a synthesis of what has been learned during the Phase I studies and for use as part of the scientific foundation for developing the Phase II program along with consideration from the scientific peer review panel recommendations and the acoustic tagging studies recommended under the National Marine Fisheries OCAP-BO. These broader program recommendations include:

• Conduct a comprehensive statistical analysis of juvenile Chinook salmon survival data collected during the Phase I studies and identify trends in survival for juvenile Chinook salmon in regard to all environmental factors measured. Summarize the key findings of the Phase I studies in regard to flows and exports but include any evidence of the impact of other stressors such as water quality impairments and predation.

• Perform a retrospective review of the accomplishments, challenges and constraints that affect the experimental design, implementation, and analysis of the survival studies for use as part of the basis for design of the Phase II investigations.

•Survey stakeholders and agencies to develop relevant questions to be addressed in Phase II. The new Biological Opinions from USFWS and NMFS have greatly reduced the level of exports. Results of the last few years with acoustic tags have highlighted reach-specific mortality impacts. Emphasis in Phase II is likely to address how different river flow and export levels alter the impact of multiple other stressors.

• Explore the potential to include other species and wild-caught salmonids to broaden the value of VAMP, particularly in regard to steelhead.

• Design VAMP Phase II studies that can robustly address the multiple questions of interest with the funding and fish resources available, and that can fit within the framework of opportunities and constraints that have been identified in Phase I.

• Ensure that future studies examine a greater range of San Joaquin River flows than were available in Phase I, even if higher flows are provided for shorter periods of time than targeted in Phase I.

• Integrate VAMP Phase II studies with other fishery studies being conducted or designed for the San Joaquin River and its tributaries, especially the San Joaquin River restoration efforts.

Bruce Herbold

Chuck Hanson