

August 12, 2000 DRAFT

**FISHERY QUESTIONS PERTAINING TO EVALUATION OF REOPERATION
OF THE DELTA CROSS CHANNEL AND A THROUGH DELTA FACILITY**

In December 1999, under low flow conditions and high export pumping rates, Delta salinity increased when the Delta Cross Channel (DCC) gates were closed to protect emigrating juvenile Sacramento basin salmon. This experience leads CALFED to consider how to preserve the fish benefits of closing the DCC gates and make progress on water quality improvement goals, particularly during low flow periods. Options range from tide-related operations of the DCC gates (allowing a large fraction of the normal flow of Sacramento River water to pass through the DCC with the gates open only a small fraction of the time) to providing a means to convey Sacramento River water to the northern interior Delta when the DCC gates are closed. The latter would be accomplished by constructing a new channel (or channels) with a fish screen at its intake. That new channel(s) is being called the Through Delta Facility (TDF). The range includes various combinations of the two approaches.

CALFED Management has directed that both options be evaluated, so that a policy decision can be made on the course of action in October 2003. Further, the direction from management is that a TDF will be selected only if water quality and fishery objectives can not be met through reoperation of the DCC and other CVP/SWP facilities (reservoirs and pumps). Nevertheless, the decision deadline dictates proceeding simultaneously on evaluating both options.

The following questions and study outlines describe the work related to fish populations needed for both options. The questions and studies are intended to explore consequences of total diversions ranging from rates permitted by present regulation of DCC operations up to total combined diversions at the present physical capacity of the DCC. If a greater or lesser range is considered appropriate for policy reasons, the appropriate studies, the range of included studies should be adjusted accordingly.

The decision will also require answering questions related to water quality and to fish facilities. Those questions and their accompanying studies are described in separate documents.

Questions Pertaining to Reoperation of the Delta Cross Channel

1. Would opening the DCC gates only at certain tidal stages reduce the diversion of salmon into the Central Delta sufficiently to meet fishery objectives?

The survival of downstream salmon migrants passing through the DCC or Georgiana Slough is substantially less than the survival of salmon remaining in

the Sacramento River. That has led to provisions in the 1995 WQCP requiring closure the DCC during extended periods of time to reduce the fraction of salmon following the route with lower survival, thus improving overall salmon survival.

Some preliminary evaluations indicate that a large fraction of the water diverted through the DCC enters the channel during certain phases of the tide, which include only a small fraction of the day. Depending on the cues salmon use to guide their downstream migration, opening the DCC only during the small fraction of the day when most of the water enters the channel might reduce salmon losses sufficiently to meet fishery objectives.

Proposed studies- During the fall of 2000, several groups of marked hatchery reared salmon will be released during various tidal stages in the Sacramento River just upstream of the DCC. Simultaneous trawling in the DCC and in the Sacramento River immediately below the DCC will measure the fraction entering the DCC during various stages of the tide.

Tidal velocities will be monitored for a three month period in the DCC and in the Sacramento River upstream of the DCC and downstream of Georgiana Slough to determine a complete picture of flows in relation to the tide. In addition, surface drogues will be released upstream of the DCC simultaneously with salmon releases to track flow in relation to fish movement.

Results of both studies will be evaluated and repeated, with appropriate modifications, as needed to answer the question prior to October 2003.

2. Would opening the DCC gates only at certain times related to day or night reduce the diversion of salmon into the Central Delta sufficiently to meet fishery objectives?

Some evidence that salmon may migrate differently during day and night, offering some potential for selectively opening the DCC diurnally to reduce the passage of salmon through it.

Proposed studies- The releases of marked salmon described under Question 1 will be used to track diurnal differences in migration in addition to tracking tidal differences. The results will be used to evaluate the potential for diurnal changes in gate operations to minimize diversion of salmon to meet fishery objectives, either by itself or in conjunction with tidal differences in operations.

3. Would the selective closure of the DCC gates interfere with the upstream migration of fish.

Various fish species migrating up the Sacramento and Mokelumne rivers could have their migrations impaired by operation of the DCC. The most obvious such fishes are adult migratory fish destined for the Sacramento River upstream of the

DCC. An unknown, but considerable, number of such fish follow this route as a result of being attracted by the Sacramento River flowing through the Delta Cross Channel. Tagging studies have document such a migration pattern for salmon, and a similar pattern is probable for a variety of other fishes which spawn in the Sacramento River and rear in the estuary or ocean.

The effect of closure of the DCC on such migrations has not been evaluated, but it is believed that the effect is minimal, due to closures typically being for extended durations. During extended closures, fish migrating to the Sacramento via the lower San Joaquin and Mokelumne rivers presumably use Georgiana Slough as a migration route. Under the frequent short-term closures being contemplated if tidal or diurnal selective operation of the DCC prove feasible to minimize the diversion of downstream migrants, delays in upstream migration could occur. Such delays would be most likely to be harmful for salmon, particularly if they last longer than 24 hours, and particularly for the fall run, because the fall run tends to spawn soon after completing their migration to the spawning grounds.

Proposed studies- Pilot studies will be initiated this fall both to gain insight into whether existing operations of the DCC delay upstream migrant salmon and into how many salmon migrate via the DCC. The densities of fish will be monitored by hydroacoustic surveys in the DCC, Georgiana Slough and the Sacramento River. In the DCC, monitoring would take place prior to closures, during closures and immediately after reopening.

In addition, extend the fall of 2000 "Adult San Joaquin River Chinook Salmon Telemetry Study" to cover this area. Up to eight additional fixed telemetry stations, and if possible, extended mobile survey routes will be considered for this investigation. In addition, consideration will be given to tagging additional salmon, if resources permit.

Follow-up studies would be implemented based on analysis of this fall's studies, and include similar studies with other fish species known to migrate via the DCC.

Questions Pertaining to a Through Delta Facility

4. Would reducing flow in the Sacramento River between the intake of the TDF and the DCC by up to 4,000 cfs affect the survival of downstream migrant salmon? (It is assumed that the new diversion would be operated when the DCC is closed for fish protection and concern exists for water quality in the interior Delta. The implications of this question would be different if the new diversion were used whenever water quality in the interior Delta could be improved.)

Tagging studies suggest that reduced flows from Hood to Chipps Island reduce salmon survival, but the evidence is not definitive. One analytical complication is survival varies with the route taken, and the proportion of salmon taking different routes has not been measured. This specific question can not be

answered fully and directly without constructing the TDF. A partial answer could be gained by measuring survival only from Hood to the DCC and to Steamboat Slough near the Ryer Island Ferry by releasing marked salmon at Hood and measuring survival to the DCC and near the Ryer Island ferry.

Proposed Studies- Analyze existing data by March 31, 2001, assuming salmon split in proportion to flow and that survival is linear in each reach. If CALFED management considers results insufficient for 2003 decision, conduct additional tagging studies in 2002 and 2003, with flows for respective release groups differing by 4,000 cfs, and survival being measured to both Chipps Island, the DCC and to the Ryer Island ferry, and perhaps to Benecia.

5. Would reducing flows in the Sacramento River from the intake of the TDF and DCC by up to 4,000 cfs affect the survival of striped bass eggs?

The question of what Sacramento River flows are needed to suspend and successfully transport striped bass eggs and larvae downstream has been investigated. Diverting 4000 cfs near Hood instead of at the DCC would add about 12 miles to the length of river channel where flows would be lower by that amount. This question can be examined only by measuring survival of eggs and larvae all the way from Hood to at least Rio Vista, because the suspected mechanism involves the cumulative effect of transport time to traditional feeding areas.

Proposed Action- Review existing information by March 31, 2001. The CVPIA b(2) Fish Team examined some of the available information in 1997. If CALFED management considers existing information insufficient for 2003 decision, conduct additional studies in 2002 and 2003, with flows in the Sacramento River reach downstream from Hood differing by 4,000 cfs. Particle tracking model studies would estimate transport rates under different flows to provide insight into the likelihood of significant effects of varying flow by up to 4,000 cfs.

6. How would increases in flow of up to 4,000 cfs in the Mokelumne River between the discharge of the TDF and the discharge of the DCC affect the ecology?

Two different options exist. The TDF might terminate in Snodgrass Slough, thus transforming that dead-end, tidal aquatic ecosystem into a conveyance channel for 4000 cfs of Sacramento River water. This would be of some concern, since the slough as it exists is typical of the shallow water aquatic habitat CALFED calls for increasing as habitat for resident species. On the other hand, this option would minimize changes in the Mokelumne River, as Snodgrass Slough enters the Mokelumne very near the junction with the Delta Cross Channel.

The other option would be to construct a new channel all the way from the Sacramento River diversion point to the Mokelumne River. This option would avoid changes in Snodgrass Slough, except for those associated with some versions of the new channel crossing Snodgrass Slough. That would avoid changes in the ecology of Snodgrass Slough. It would cause seasonal flow changes in the Mokelumne, but the flow increases are within the range now occurring in high flow periods. The resulting higher flows during low flow periods, however, could have significant effects. A question would be whether attracting Sacramento River bound fish farther up the Mokelumne before providing them with a route to the Sacramento would cause greater disruption for the fish in either system.

Proposed Studies- To understand how discharging large volumes of water into Snodgrass Slough or the Mokelumne will change the ecological characteristics, the existing conditions in Snodgrass Slough and the Mokelumne could be compared to conditions in other areas of the Delta where flows are similar to projected future flows in Snodgrass and the Mokelumne. DFG Delta electrofishing surveys have sampled the fish fauna in Snodgrass Slough and elsewhere throughout the Delta. Physical habitat conditions at all sampling locations have been described in general terms. Examine the existing information by March 31, 2001 and if CALFED management considers existing information insufficient for the 2003 decision, conduct additional fish fauna and comparative habitat studies in 2002 and 2003. (Potential effects on upstream migrants would be considered under Question 4.)

7. How many upstream migrant fish of what species would attempt to migrate through the TDF?

Presumably, the number migrating via this route would be the same as the number currently migrating via the DCC, since downstream of the DCC-Mokelumne junction flows would be the same. The issue is the number of current migrants has not been measured, and the consequences would be potentially much more serious, as the new channel would be screened making upstream migration impossible without special design and operating provisions.

Clearly, the best approach is to conduct studies to estimate how many fish currently migrate via the DCC.

An alternative would be to make an estimate of probable maximum numbers by estimating the fraction of the Sacramento River water which would be diverted under various conditions and assume that the fraction of fish following that route would not be greater than that.

Proposed Studies- The studies proposed for Question 3 would provide the information needed for this question.

8. Would the TDF increase straying of salmon? If so, what management measures would be appropriate?

Straying in this context is defined as adult fish returning to some stream other than the stream where they originated. Some straying of upstream migrants undoubtedly occurs, but it is probably neither measurable or manageable. The area of origin is generally not identifiable for upstream migrant fall run salmon captured and tagged in the Delta. Their home stream is generally identified by where they go. If we were able to identify that a fish had strayed, what management measure would be available to get it to the appropriate stream? Given that far larger numbers of salmon originate in the Sacramento River system than in the Mokelumne or San Joaquin, and the ability of salmon to return to the Sacramento once they have entered the San Joaquin/ Mokelumne portion of the Delta is sometimes restricted by operation of the DCC, more salmon likely stray away from the Sacramento than stray toward the Sacramento.

Straying of other runs is probably more subject to study, as essentially all of the other runs originate in the Sacramento system. Hence their appearance elsewhere would be evidence of straying. Such straying would be of considerable concern because of the relative scarcity of those runs.

Another important consideration is that the number straying is not likely to change significantly from the number straying now, particularly if the TDF were to be routed through Snodgrass Slough.

Proposed Studies- Some information on straying exists for salmon originating in the Mokelumne River. Evaluation of this question will be limited to the analysis of that data, and to any information which might be obtained incidental to the tagging studies described for Question 3 to enumerate the number of upstream migrants.

9. How many downstream migrant fish of what species would be exposed to diversion into the TDF, and would their cross-sectional distribution in the river affect fish screening decisions?

Past studies have defined the out-migration patterns, so we know which species are present, the approximate seasonal distribution of each species and run, and when they are most abundant. Those studies also provided information on differences in cross-sectional distribution, but the conclusion was that it is not realistic to minimize entrainment through intake design when diverting substantial amounts of water. If the TDF were to be divided into several small diversions, diversion location might be a significant consideration in minimizing exposure of fish to the diversion.

Proposed studies- Re-evaluate existing information (Schaffter 1980; other) by December 2000 and present CALFED management with a recommendation as to which species need to be accommodated in design of the screens for a TDF. Collect more data on species occurrence, timing, and distribution within the channel in 2001-2003 only if CALFED Management concludes that available information is insufficient for supporting a decision..

10. Would any water quality differences caused by diverting water through the TDF as opposed to the DCC affect fish abundance?

Since the study largely involves a question of the route Sacramento River water follows in getting from the Sacramento River to the junction of the DCC and the Mokelumne River, rather than the amount of water, water characteristics downstream of that junction should be affected little. Considering the similar water quality in the Sacramento and Mokelumne rivers, water quality upstream of the junction would also seem to have little probability of changing significantly. The most likely characteristic to change may be water temperature, due to differences in transport rate and water volumes.

Proposed action- Run water quality and water temperature models to examine in a limited fashion the seasonal range in expected conditions, including air temperature. If the initial model results indicate significant effects are likely, do more extensive evaluations.

Questions Pertaining to Overall Evaluation of Information

11. How do any effects identified in response to Questions 1-10 above and the Questions about Fish Screen Design:

- compare to existing effects of DCC operations,
- affect population sizes for the various fish species,
- compare to other effects of CALFED's Ecosystem Restoration Program, and
- compare to any secondary effects caused by the various option for this program.

All aspects of this question are typically very difficult to answer satisfactorily. Important limitations occur because quantitative effects on populations are very difficult to measure or predict and even relative effects are difficult to estimate when comparing management measures targeting different aspects of a specie's life history. Nevertheless, decision makers will want the best possible judgments as to such answers.

Proposed studies- During preparation of the decision document in 2003, staff will consider the information gathered during studies for this project and information gathered during other programs to provide the best possible answers to these questions. One important aspect of this evaluation will be the status of conceptual

models to be developed for the various species in other portions of the CALFED program.