

PERSPECTIVES ON SURVIVAL OF DOWNSTREAM MIGRANT SALMON AND OTHER FISHES IN THE SACRAMENTO RIVER UNDER ALTERNATIVES 1, 2 AND 3

One of the most significant fishery issues among CALFED alternatives is the relative survival of salmon migrating down the Sacramento River under various alternatives and in relation to today's conditions.

The principal factors which we can expect to cause differences in salmon survival among the alternatives are losses at fish screens at intakes to diversions off the Sacramento River and higher mortality resulting from being diverted into the Central Delta at unscreened diversions. The following is a rather simple minded analysis based on flow split information from CALFED operations studies for Alternatives 1C, 2B and 3E. Note that the flow split information given us on 11/3 indicates that the average flow through Georgiana Slough is the same for Alternatives 2B and 3E. This seems surprising, since diversion capacity at Hood is 10,000 cfs for Alternative 2B and 15,000 cfs for Alternative 3E. For purposes of illustration, the following analyses are based on flows of 24,000 cfs at I Street.

	Cross Channel Open	Cross Channel Closed	
	Alternative 1C	Alt 1C	Alt 2B/3E
Flow diverted @ Hood	0	0	7,000
Flow through Cross Ch.	6,000	0	0
Flow through Georgiana	3,400	4,200	3,000

Under Alternatives 2B and 3E, about 29% of the flow is being diverted through the screened intake at Hood. If salmon split in proportion to flow and suffer a 10% mortality at the screens, approximately 3% of the run would be lost at the screens. (I am not sure what the best estimate of screen loss is.) Since flow below Hood is reduced, the remaining 97% of the salmon would be concentrated in about 70% of the flow.

Again assuming that salmon split in proportion to flow, the proportion of the population (not the flow) which would be diverted through the Cross Channel and Georgiana Slough under the above scenarios would be:

	Cross Channel Open	Cross Channel Closed	
	Alternative 1C	Alt 1C	Alt 2B/3E
% salmon diverted @ DCC	24	0	0
% salmon diverted @ GS	14	17.5	17

In the past, we have used a generalization that salmon migrating through the Central Delta have a survival rate half that of salmon migrating down the Sacramento River. I understand that a recent independent evaluation concluded that 66% is a better estimate, and I have used that. I am not sure what a good absolute estimate of survival under these conditions is. For illustrative purposes, I have used absolute survivals of 80 and 50 in the Sacramento River to illustrate a range. The resulting overall survivals to Chipps Island are:

	Cross Channel Open	Cross Channel Closed	
	Alternative 1C	Alt 1C	Alt 2B/3E
Sac R 80 % survival	69.6%	75%	73%
Sac R 50% survival	43.5%	47%	45.6%

Note that this analysis does not incorporate any estimate of mortality based on the widely believed hypothesis that reduced flows below a diversion at Hood will lower survival rates.

What does this analysis suggest? It clearly illustrates the obvious that if closing the Delta Cross Channel has no adverse consequences, it has to be a better option for salmon migrating down the Sacramento River than a screened diversion at Hood, although with a mortality of 10% of the fish actually encountering the screen, the difference is small. It would be best if we found out how closing the Cross Channel affects flow splits below Georgiana and made a judgment as to whether that affects fish survival in the Sacramento River or in the San Joaquin portion of the Delta. My understanding from Patricia Brandes is that there is a general belief that negative effects on salmon survival and other fish result, but that there are no estimates of magnitude. Cross Channel gate closure affects water quality on the San Joaquin side adversely when outflows are not high enough to create essentially freshwater conditions in the western Delta, and that currently affects decisions on closing the Delta Cross Channel gates. The real world consequence is that Alternative 1C would not be able to operate with the Cross Channel closed continuously. Hence the effect would be intermediate between the open and closed gate conditions illustrated above.

It seems unlikely that any cross-Delta flows below Georgiana resulting from closing the Delta Cross Channel would have an effect on Sacramento salmon greater than the increased mortality resulting from diversion through the Cross Channel, so the above analysis with the Cross Channel open probably is a maximum estimate of differences.

Patrick Leonard has pointed out that survival of salmon migrating downstream through the Central Delta is likely to be higher under Alternative 3 than under present conditions. The reason for that premise is that salmon migrating through Georgiana Slough under Alternative 3 would not be entrained in a much larger flow of water going primarily to CVP/SWP diversions in the South Delta. The consequence would be a survival for Alternative 3E somewhat greater than that estimated above.

My overall conclusion is a screened diversion at Hood would probably provide a small benefit for salmon outmigrating from the Sacramento, but the difference would not be sufficient to be a major consideration in selecting among alternatives. Patricia Brandes told me she has performed a somewhat similar analysis and reached a similar conclusion about the consequences of alternative strategies for reducing the diversion of salmon from the Sacramento River..

Turning to other species, most young delta smelt and striped bass move down the Sacramento River when they are too small to be screened. The principal species for which some or all of the young would be protected by fish screens are steelhead, white sturgeon and American shad.

There is no information on differential survival in the Sacramento River vs. the Delta for any of these species. The only species for which reasonable inferences may be drawn is American shad. The benefit for American shad would probably be considerably greater than for salmon, as they migrate during lower flow periods when it is probably never feasible to close the Delta cross Channel with Alternative 1C. Furthermore, I believe the evidence indicates shad are more likely than salmon to be drawn all the way across the Delta to the south Delta diversions and suffer direct effects there. The evidence is the many thousands of American shad which show up at the CVP/SWP fish screens in the South Delta, despite the fact that shad spawn mostly in the Sacramento River system. American shad are very vulnerable to mortality in the salvage and trucking process in the South Delta. Hence it is reasonable to believe that less diversion of water from the Sacramento River to the South Delta through unscreened diversions would benefit American shad substantially.