B2 Fish Team Assumptions underlying Delta Actions from Wim Kimmerer, chair/reporter July 29, 1997

At the request of several team members I provide my interpretation of the assumptions underlying each of the Delta Actions.

General assumption in most of the actions:

**Abundance of young is positively related to subsequent recruitment or abundance of adults.**

Put another way, survival between the young stage being protected and recruitment is density-independent. For salmon this assumption would be difficult to test because of high variability in survival in the ocean. As far as I know density-dependent mortality has not been detected in the ocean life-history stages of any salmon stock. In the absence of density-dependent mortality, there should be a linear relationship between abundance of young and recruitment, with the line going through the origin.

Striped bass appear to undergo density-dependent mortality after the first summer (Kimmerer, Rose, Cowan, and Miller in prep.). If so, recruitment would be positively related to abundance of young but through a saturating curve rather than a straight line, so that at high levels the effect on recruitment of increasing the abundance of young fish is smaller than at low levels. In recent years abundance of young is so low that density-independent effects may have more influence on the population than density-dependent effects.

Other common assumptions are listed in the July 23 summary. They include assumptions that **the method used to estimate each effect is unbiased and accurate.**



D-055129

In the case of smolt passage, this means that wild smolts respond similarly to the coded-wire-tagged hatchery smolts used in the survival experiments.

Delta Action 1: Vernalis inflows

**Survival of San Joaquin Basin smolts is positively related to San Joaquin River flow and negatively to export flow.**

Delta Action 2: Head of Old River Barrier

**Survival of San Joaquin Basin smolts is higher when the barrier is in place than when it is not.**

Delta Action 3: X2 Days at Chipps Island

**The abundance or survival of several estuarine-dependent species (including young striped bass and Sacramento River fall-run chinook salmon smolts) is negatively related to X2 in spring.** No assumptions need be made about the nature of this relationship, i.e. whether it has to do with habitat or some other correlate of flow or X2.

Delta Action 4: Minimum Sacramento River flows

**Early survival of striped bass (egg to early larvae) is higher when flow in the Sacramento River is above a value near 13,000 cfs than when it is lower.**

Delta Action 5: Ramping San Joaquin inflows or exports

Two assumptions were presented:

1) Sudden increases in export flows at the end of the pulse flow period would entrain more salmon than would otherwise be entrained.

2) To the extent that DA1 is beneficial to salmon smolts migrating from the San Joaquin River, continuing that benefit would provide additional protection beyond the April-May pulse flow period.

Delta Action 6: DCC Closure

Survival of spring-run salmon smolts migrating through the Delta is higher when the Delta Cross Channel gates are closed than when they are open.

Delta Action 7: Limit exports in July

Exposure of young striped bass to exports is higher in July than in other months.

Survival of young striped bass is inversely related to entrainment toward the export facilities, which increases as export flows increase and X2 moves upstream.

Delta Action 8: Evaluate variation in flows and exports in December and January

Survival of spring run salmon smolts is higher when freshwater flow is high and export flow is low than otherwise. This relationship is inferred and needs to be tested through an Adaptive Management experiment.

These are my suggested additions to Wim's list.

Fish and their early life stages in the Delta are swept along by net (that is, tidally averaged) flows.

Extended (say, two weeks or more) pulses of flow or, simply, higher flows, coming into and through the Delta cause fish to move more rapidly through the Delta, reducing their mortality.

The more rapidly outmigrating fish move through the Delta, the higher their survival to adults.

Delta exports induce net flows toward the export pumps. These net flows in turn draw fish from their normal habitat or off of their normal migration routes and cause significant indirect mortality.

When QWEST, the calculated net flow in the lower San Joaquin River is negative (upstream), fish are drawn up the San Joaquin River to the export pumps.

In general, fish are drawn into the southern Delta by export pumping.

Direct mortality at the export pumps (measured by salvage) is related to the abundance of several species of fish.

Direct mortality at the export pumps is mortality that would not have otherwise occurred.

When fish are present in the southern Delta, the higher the rate of exports, the greater the salvage and, therefore, the greater the effect on abundance of the species being salvaged.



D-055132

The ratio of Delta exports to Delta inflow is a good management tool to improve fish abundance.

There are good relationships between the springtime values of X2 (the distance of the 2 ppt salinity line from the Golden Gate Bridge) and the abundance of several important species (splittail, Delta smelt, longfin smelt, Crangon shrimp, starry flounder, and striped bass), and these relationships form a good basis for controlling X2 to increase the abundance of these species.

The biological validity of X2 rests on the fact that it is primarily a measure of low salinity, shallow water habitat.

The survival of outmigrating salmon smolts passing through the Delta is inversely and significantly directly related to the salvage of these fish at the export pumps.