

Progressively better protection was provided for some fish species in the Delta by new regulatory requirements added throughout the historical reference period (1991-1995). These changing requirements complicated efforts to assess EWA effects on fish salvage or survival indices, especially assessments that relied on comparisons among the historical record, modeled base, and EWA simulation. Water users assert that such comparisons also may be confounded by water demand discrepancies between the historical operations and the base and EWA simulations.

1. EWA consequences for salmon were assessed by comparing entrainment losses and Delta survival indices estimated using several survival models. Upstream habitat benefits of EWA water acquisition and management also were considered.

2. EWA actions simultaneously reduced entrainment and improved Delta survival of juvenile salmon by reducing SWP/CVP exports and augmenting river flows into the Delta during selected periods from October to June. Curtailment decisions were based on interpretation of the historical CVP/SWP salvage records. Actions were taken to protect all four chinook races from the Sacramento Basin and fall-run chinook from the San Joaquin Basin. Most of these races are not abundant, hence, actions sometimes were taken when only a few fish were present in the historical salvage. Steelhead entrainment loss in the Delta is not believed to be a serious problem, because most steelhead survive the fish salvage system. No information is available relating steelhead survival to Delta conditions. Due to substantial overlap in Delta occurrence, actions to protect salmon often benefitted multiple races and other species, including steelhead. Juvenile salmonids also benefitted from actions taken to protect delta smelt or splittail.

3. By curtailing exports during periods of high salmon densities in the south Delta, EWA actions reduced juvenile salmon entrainment and improved Delta survival more efficiently (more fish saved per acre-foot export change) than prescribed monthly export limits. Targeted curtailments lack the safety margins associated with more traditional protection measures and, therefore, require monitoring of sufficient intensity to detect variation in migration patterns of rare races.

4. EWA modifications of base operations increased Delta salmon survival. The (base + EWA) condition, however, sometimes produced lower survival than in the historical record for one or more races of Sacramento basin salmon, particularly in wetter years and in late Stage 1 simulations. Survival lower than in the historical period is not conducive to species recovery and suggests EWA assets and actions were insufficient. This outcome also occurred a few times in the "prescriptive standards" simulation. Some reductions in salmon survival resulted from increases in exports that were needed to reduce EWA water debts.

5. Upstream water releases associated with EWA operation are likely to increase the capacity and flexibility managers have to improve upstream habitat conditions for salmonids. Achieving these benefits requires that EWA operations do not constrain other upstream programs designed to improve conditions for fish. Upstream benefits cannot be estimated, in part because the simulations were not specific about which streams were subject to flow manipulations by EWA water management.