Dry year v. wet year protection. These final criteria index values represent a larger relative increase in survival over current survival rates in dry and critical years (compared to wetter years) so as to protect salmon populations from declining to the critically low levels of recent years. The results from taggedfish releases on the San Joaquin River show significantly different survival at high versus low flow conditions (USFWS 1992b; Brandes 1994). Most of the release studies have been performed at flows below 5,000 cfs, and it is clear from the relation between survival indices and experimental flow conditions that these conditions are very poor for smolt survival and are inadequate to protect the Fish Migration designated uses. The average survival index for these low flow conditions is 0.09, whereas these index values have attained values as high as 1.5 on the San Joaquin (a Jersey Point release).42 Although there is less information at higher flows, the experimental results do indicate that survival has been substantially higher under these conditions. The average survival index at these higher flows is 0.48.

To address this relative difference in survival during high and low flow periods, EPA is adopting criteria index values reflecting a relatively larger improvement in survival in low flow years than in high flow years. That is, conditions for migrating fish in drier periods have been relatively worse, so the criteria index values applicable to the drier periods must reflect conditions that are relatively more improved in order to protect the Fish Migration designated use.

Although the final criteria call for relatively higher protection in drier years, it is also particularly important in the San Joaquin basin to protect salmon during periods of higher flow conditions. The years of higher flows have been the only times recently when the Fish Migration use has come close to being attained, and protection in these productive years is important for buffering the salmon population against permanent loss of salmon runs when conditions are poor. To address these special concerns across the spectrum of hydrological conditions, these final criteria index values, on average, increase wet year survival by a factor of 1.8 and critically dry year survival by a factor of 4.

EPA has considered the concerns expressed by some CUWA workshop participants about using the USFWS models to establish criteria index values. The CUWA workshop participants developed a consensus, based not on the USFWS-modeled values but on their independent scientific judgment, that an increase in measured survival index values of two to three times recently observed values would be appropriate in critical years (Kimmerer 1994b). As stated above, the CUWA workshop participants also endorsed relatively higher protection in drier years as opposed to wetter years (Kimmerer 1994b). EPA agrees with these scientific judgments, and believes that measured criteria index values in these ranges must be attained to protect the designated uses on the San Joaquin.

The criteria index values shown as a continuous function in Figure 6, even though developed with the assistance of the USFWS model, are wholly consistent with the findings of the CUWA workshop participants (Kimmerer 1994b). In addition, these target values are, on average, consistent with the historical 1956-70 average survival index for the more protective wetter years of that period (wet, above normal, and below normal water years) as calculated using the USFWS model (Brandes 1994). The target values are also consistent with the CVPIA goal of doubling anadromous fish populations. For comparison, the final criteria index value line is displayed in Figure 7 with the recent historical survival line (based on the tagged fish release results) and a line representing twice the recent historical survival line.

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approximately 5 recoveries from a release of 50,000 fish at Mossdale, 55 miles upstream of the smolt recovery site at Chipps Island.

 $^{^{\}rm 42}$ These numbers are not "scaled", and are thus indices showing survival relative to other index values. The 0.09 average index value represents