Red Bluff Technical Report Abstract

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A research pumping plant was constructed on the Sacramento River in northern California as part of the commitment of the U.S. Bureau of Reclamation to improve fish passage at Red Bluff Diversion Dam; particularly the passage of adult and juvenile chinook salmon (Oncorynchus tshawytscha). Major portions of construction were completed in May of 1995 with installation of two Archimedes pumps and one internal helical pump. During the remainder of 1995 and in 1996, a variety of engineering modifications were made to pumps, screening facilities and fish bypass systems in the plant The pumps ran sporadically during this interval. Fish passage work was conducted on an opportunistic schedule. Various procedures were tested for handling fish and evaluating mortality and injury cause by pump passage. Standardized procedures for conducting fish passage studies emerged from this preliminary work. These procedures, to be used for studies in 1997 and 1998, are described in this report The Archimedes and internal helical pumps never ran simultaneously during 1995 and 1996. As a result, no observations were made to directly compare pump types in regard to mortality and injury associated with passage. Observations on mortality and injury that were made with the Archimedes and internal helical pump were not sufficiently accurate to suggest that differences between these types of pumps exists. Because conditions in the pumping plant and procedures for handling fish were in transition during the period of observation, the information presented here on mortality and injury is preliminary in nature. ft does provides an expectation for the range of results that may merge from standardized studies that will be conducted in 1997 and 1998.

For all pumps combined, a total of twenty-nine trials were conducted in which fish entrained from the Sacramento River were collected in holding tanks in the plant Each trial had a 24-h duration, and separate samples were taken at the end of diurnal and nocturnal periods. In all, 2D different species of fish were entrained. Forty-eight percent of 2332 total fish were juvenile chinook salmon. Seventy-four percent of all species, and 75% of chinook salmon, were taken at night Ninety-six percent of all entrained fish, and 97% of entrained chinook salmon, were alive when collected in the plant. Between 0.6% and 1.2% of live juvenile chinook entrained by any of the three pumps had external injuries.

In a second type of passage study, hatchery-reared juvenile chinook salmon were used as surrogates for riverine juveniles. In 65 separate trials, a total of 2080 juveniles were inserted in pump intakes and collected in downstream tanks. A total of 1725 juveniles were also passed from pump outfalls to holding tanks in 54 trials that were co-conducted with pump insertion trials. For all pumps combined, the calculated pump-effect on direct mortalities was < 1 %. The pump-effect on delayed mortality over 96-h post-passage observation was about 1 %. The pump-effect on injuries during passage, estimated from examination of between 108 and 125 juveniles randomly selected before and after insertion in the pumps' flowstreams (a relatively small number of fish sampled), was zero. Hatchery-reared juvenile chinook used in these7 studies were relatively large; almost exclusively > 46 mm fork length. Studies in 1997 and 1998 will emphasize the use of two size classes of juveniles; small fish with fork length from 30-45 mm, and larger ones from 46-70 mm fork length.

Four additional topics were addressed during 1995 and 1996. Hatchery-reared juveniles (1725) released at outfalls of the three pumps and collected in downstream tanks experienced :51 % direct mortality. Less than 0.1% experienced delayed mortality (96 h), and about 1% of these fish received injuries. These observations suggest that the flowstreams from pump outfalls through screening facilities and bypass channels to collecting tanks in the plant are fish4dendly. A preliminary estimate (~950/\*) was obtained for the efficiency with which chinook salmon entrained from the Sacramento River were captured in tanks in the plant. Exploratory studies conducted on passage of juvenile chinook through terminal (underground) portions of the plant's bypass system showed that residence times were long. A protocol was developed for safely flushing fish from the distal portion of the bypass should later studies show that such a strategy has advantages. In other work, sampling was conducted to relate the abundance of juvenile chinook passing the intake structure of the pumping plant and the abundance of juveniles entrained by the pumps. Passing juveniles were taken by a rotary screw trap, while entrained juveniles were collected in tanks in the plant. Sampling was done over 24-h periods on nine occasions to examine the variability in a pump-take:trap-take ratio. A ratio of about 0.50 was obtained except when juveniles passing the plant were uncommon. This work will continue in conjunction with expansive rotary screw trap sampling of downstream migrants in the river (Johnson and Martin 1997) in order to evaluate the reliability of using this a pump-take:trap-take ratio to extrapolate to percentages of total outmigrating juvenile chinook that the pumping plarit entrains.