The United States Fish and Wildlife Service (USFWS) has conducted direct monitoring of juvenile Chinook Salmon Oncorhynchus tshawytscha passage at the Red Bluff Diversion Dam (RBDD), river kilometer (RKM) 391 on the Sacramento River, in Northern California since 1994 (Johnson and Martin 1997). Martin et al. (2001) developed quantitative methodologies for indexing juvenile Chinook passage using rotary-screw traps (RST) to assess the impacts of the United States Bureau of Reclamation’s (USBR) RBDD Research Pumping Plant. Absolute abundance (passage and production) estimates were needed to determine the level of impact from the entrainment of salmonids and other fish community populations through RBDD’s experimental ‘fish friendly’ Archimedes and internal helical pumps (Borthwick and Corwin 2001). The original project objectives were met by 2000 and funding of the project was discontinued.

From 2001 to 2008, funding was secured through a CALFED Bay-Delta Program grant for annual monitoring operations to determine the effects of restoration activities in the upper Sacramento River aimed primarily at winter Chinook Salmon\*. The USBR, the primary proponent of the Central Valley Project (CVP), has funded this project since 2010 due to regulatory requirements contained within the National Marine Fisheries Service’s (NMFS) Biological Opinion for the Long-term Operations of the CVP and State Water Project (NMFS 2009 and 2019).

The project began sampling in 1994 with (4) 2.4-m diameter RST’s which sampled through March of 2020. From March 25, 2020 through June 25, 2020, in order to protect employee health and safety during the Coronavirus global pandemic (COVID-19), sampling ceased. Just prior to resuming sampling operations in July of 2020, (4) 1.5-m diameter and one 2.4-m diameter RSTs were re-installed across the transect at the RBDD site. This new five-trap configuration provides a solution to sampling a location that has become shallower since the RBDD gates were permanently placed in the raised position since August of 2011.

The non-sampled period in 2020 impacted brood year (BY) 2020 late-fall Chinook Salmon Oncorhynchus tshawytscha passage estimates and abundance indices for steelhead/Rainbow Trout O. mykiss and Green Sturgeon Acipenser medirostris. No interpolation for missed samples was performed during this extended break in sampling; therefore, these data should be viewed cautiously and not used for inter-annual comparisons.

The project estimates daily juvenile salmonid fish passage as total passage along with fry (<46 mm FL) and pre-smolt/smolt passage (>45 mm TL) for all four runs of Chinook salmon and O. mykiss. Production estimates are based on a calculated fry-equivalent fish passage estimate that attempts to standardize the passage of fry and pre-smolts alike for between year comparisons of juvenile fish production (see methods doc for details).

The project relies upon a lest-squares regression equation to model daily trap efficiency to estimate fish passage from daily trap catch. A significant statistical correlation has been found between trap efficiency and the amount of water sampled relative to total volume passing the transect each day. Mark-recapture trials have been conducted since 1996 and models have fluctuated in response to changing river conditions and other factors. For instance, it was decided to eliminate RBDD dam operation year trials from the 99-trial additive model after the dam was decommissioned as those data were no longer relevant for future estimates of trap efficiency. Model inputs continue to be evaluated and validated annually with model updating occurring in July of each year, coincident with winter Chinook juvenile passage initiation. Since 2017, winter Chinook catch and resultant passage estimates were revised following genetic analyses of fin clips taken from juvenile length-at-date spring Chinook each fall.

Relative abundance indices are calculated each year for Green Sturgeon and various lamprey species including Pacific Lamprey Entosphenus tridentata, Kern Brook Lamprey Lampetra hubbsi and River Lamprey Lampetra ayresi. In most years, the majority of lamprey caught are juveniles or ammocoetes and described as lamprey fry. Relative abundance methods are detailed in a separate methods document, but relative abundance is basically calculated as catch per unit volume of water sampled (CPUV) and can be done for all species encountered per trap, summed daily and then annually for an index of production (see Martin et al. 2001).

\*The National Marine Fisheries Service first listed winter Chinook Salmon as threatened under the emergency listing procedures for the ESA (16 U.S.C.R. 1531-1543) on August 4, 1989 (54 FR 32085). A proposed rule to add winter Chinook Salmon to the list of threatened species beyond expiration of the emergency rule was published by the NMFS on March 20, 1990 (55 FR 10260). Winter Chinook Salmon were formally added to the list of federally threatened species by final rule on November 5, 1990 (55 FR 46515), and they were listed as a federally endangered species on January 4, 1994 (59 FR 440).

The datasets contained in this data package are raw fish count, trap operations, environmental, and efficiency trial data. USFWS recommends using passage estimates on SacPass - https://www.cbr.washington.edu/sacramento/data/query\_redbluff\_graph.html. Any differing passage estimates generated from the raw data within this data package are not supported by USFWS.