Performance Measure 4.6: Doubling Goal for Central Valley Chinook Salmon Natural Production

Performance Measure (PM) Component Attributes

Type: Outcome Performance Measure

Delta Plan Description

Achieve the state and federal doubling goal for Central Valley Chinook salmon natural production relative to the period of 1967-1991 levels.

Expectation

The annual natural production of all Central Valley Chinook salmon runs is 990,000 fish, doubling 1967-1991 levels.

Metric

Combined annual natural production of all Central Valley Chinook salmon runs (fall, late fall, spring, and winter).

Baseline

Set by the Central Valley Protection Improvement Act (CVPIA), the baseline is the 1967-1991 Chinook salmon natural production average of 497,054 for all Central Valley runs.

Target

The 15-year rolling average of natural production for all Chinook salmon runs: (1) will be 990,000 by 2065, doubling the baseline of 497,054; (2) the slope of the 15-year rolling average is greater than zero (i.e. positive).

This metric will be measured annually.

Basis for Selection

Enacted by the US Congress in 1992, the Central Valley Project Improvement Act (CVPIA) requires improvements to water management to protect fish and wildlife, including achieving the state and federal doubling goal for Central Valley Chinook salmon natural production relative to 1967-1991 levels. Although the CVPIA spurred much action and changes to water management, extensive drought periods have contributed to lower salmon natural production levels: the 1992-2015 average was 381,368 compared to the 1967-1991 baseline average of 497,054 (Fig. 1). Given the importance of this species for commercial and recreational fishing, and its cultural value, there is considerable interest in tracking its status. Moreover, salmon are a strong

indicator species of ecosystem health and of the effects of habitat restoration and water quality improvement projects because these anadromous fish use the vast range of aquatic ecosystems—from headwaters to the ocean (DOC 2014). Additionally, salmon play an important ecological role during their migration upstream to spawn by transferring nutrients from the ocean to wildlife and vegetation in the Central Valley (Merz and Moyle 2006). They are a critical food resource for terrestrial predators and scavengers, connecting ocean and forest habitats hundreds of miles apart (Wilson et al. 1998). Therefore declines in the capacity of a watershed to support all stages of salmon can indicate declining ecosystem health (Cummins et al. 2008).

Salmon populations are dependent on a wide variety of factors in the rivers, Delta, and ocean, including suitability of spawning and rearing habitat, predation, and food availability (DOI 2011). They can be sensitive to changes in water quality, flow, turbidity, and temperature. Moreover, stressors affect various salmon life stages differently (DOC 2014). Degrading conditions in recent decades have caused major declines in Central Valley Chinook salmon populations, resulting in listing of winter-run Chinook salmon as an endangered species and spring-run Chinook salmon as a threatened species under the federal Endangered Species Act (ESA).

Salmon population dynamics are dependent on many factors that occur outside the Delta (e.g., spawning habitat, water temperatures) that can be directly managed through operations as well as other factors that cannot be managed (e.g., ocean food web productivity). Management of water operations, habitat restoration, and increased coordination among agencies in the Delta can help contribute towards the doubling goal (Cummins et al. 2008, Herbold et al. 2018, Dahm et al. 2019). Current management seeks to improve salmon adaptive capacity in response to climate change by reconnecting and restoring habitats to facilitate ecosystem processes, providing refuge from temperature stress and predation risk as well as increase food availability (Crozier et al. 2019).

In 2018, the State Water Board gathered an independent advisory panel to recommend development of biological goals for the Bay-Delta Water Quality Control Plan. The panel indicated the baseline for the doubling goal overestimated the natural-origin population and efforts should be to improve estimates of natural-origin versus hatchery salmon such as clip tagging all hatchery fish to clearly distinguish between natural-origin and hatchery fish (Dahm et al. 2019). Instead of the doubling goal, the panel suggests the focus should be on a growing population of natural-origin salmon (Dahm et al. 2019).

This measure tracks 1) the achievement of the doubling goal as a 15-year rolling average of natural production for all Chinook salmon runs, and 2) increase in natural-origin population as a positive slope of the 15-year rolling average.

Linkage to Delta Reform Act and the Coequal Goals

Delta Reform Act: WC 85302(c)(1), WC 85302(c)(2), WC 85302(c)(3), WC 85302(c)(4), WC 85302(c)(5)

Ecosystem performance measures to remove barriers to fish migration (PM 4.13), increase seasonal inundation (PM 4.15), restore natural habitats (PM 4.16), and promote functional flows (PM 4.2) track outputs and outcomes that contribute to achieving the salmon doubling goal. Together with this performance measure (PM 4.6), the set of the ecosystem measures assess the status and trend of the health of the Delta's estuary and wetland ecosystem for supporting viable populations, habitats, and processes (WC 85211(a)).

Delta Plan Core Strategy: 4.4 Protect Native Species and Reduce Impact of Nonnative Invasive Species

Methods

Baseline Methods

The baseline is the average number of annual natural production of all Central Valley Chinook from 1967-1991 which was 497,054 fishes. This was set by the Central Valley Protection Improvement Act (CVPIA).

Target and Analysis Methods

The target is 1) doubling the baseline to 990,000 expressed as the 15-year rolling average of natural production for all Chinook salmon runs; and 2) an upward (positive) slope of the 15-year rolling average, of the natural production for all Chinook salmon runs. The 15-year rolling average is intended to account for annual and short-term variability of salmon production.

Data Sources

Primary Data Sources

1) US Fish and Wildlife Service (USFWS) ChinookProd.
   http://www.fws.gov/lodi/anadromous_fish_restoration/afrp_index.htm
   a) Content: Assesses progress toward the CVPIA doubling natural production goal. These data are based upon California Department of Fish and Wildlife (CDFW) Grand Tab data. Estimates of adult salmon are based on counts entering hatcheries and migrating past dams, carcass surveys, live fish counts, and ground and aerial redd counts. ChinookProd is a spreadsheet database maintained by the USFWS Anadromous Fish Restoration Program (AFRP) which calculates natural production of each salmon run along with the combined value of all runs (Fig 1). Therefore ChinookProd is a data source and an analytical tool.
   b) Update frequency: Annual.
2) CDFW Grand Tab.

http://www.calfish.org/ProgramsData/Species/CDFWAnadromousResourceAssessment.aspx

a) Content: Provides estimates of adult salmon escapement (returning spawners) for different run types and watersheds. Estimates are provided by the CDFW, USFWS, Department of Water Resources (DWR), East Bay Municipal Utilities District, US Bureau of Reclamation (USBR), Lower Yuba River Management Team, and Fisheries Foundation of California. Grand Tab does not characterize whether fish are wild or hatchery origin, just whether the adults are spawning in river (natural) or in hatchery. Tabular reports of salmon escapements by salmon run and rivers are provided. Escapement data and visualizations are available through the Central Valley Prediction and Assessment of Salmon website (SacPAS): http://www.cbr.washington.edu/sacramento/data/query_adult_grandtab.html.

b) Update frequency: Annual.

Alternative Data Sources

Alternative data sources will be used if the primary data sources become unavailable or insufficient. Alternative data sources can be used concurrently with the primary data sources depending on best available science and the availability of the primary source.

1) USFWS Comprehensive Assessment and Monitoring Program (CAMP) Annual Report. https://www.fws.gov/cno/fisheries/CAMP/Documents-Reports/

a) Content: Annual report that provides update on progress of the Anadromous Fish Restoration Program and the salmon doubling goal.

b) Update frequency: Annual.

Process

Data Collection

DSC will download data from Primary data source #1 every October 1. DSC will contact the data owner (USFWS) for QA/QC questions, if necessary. With these data, DSC will calculate slope of 15-year rolling averages of the natural production of all runs combined.

Monitoring and field data on salmon natural production are collected by USFWS, CDFW, NMFS, USFWS, and other organizations administering long-term monitoring surveys (DOI 2011).

USFWS ChinookProd makes calculations to estimate annual natural production of each Chinook salmon run from each watershed include up to four components:

1) in-river spawner abundance (i.e., escapement)

2) hatchery returns
3) in-river harvest by anglers
4) ocean harvest

In-river spawner abundance is based on the CDFW GrandTab report. If there is a salmon hatchery in a watershed, hatchery returns are quantified by counting the number of salmon that enter those fish hatcheries. In-river harvest is estimated using best professional judgment based on CDFW angler harvest surveys. Ocean harvest is based on reporting by the Pacific Fishery Management Council (PFMC). Natural production of all runs is the sum of each run as reported in Fig. 1.

Reporting

Reporting of this performance measure will include bar graphs such as Fig. 1 showing the annual natural production of all salmon runs and the status compared to the baseline. The 15-year rolling averages will be plotted against year and a slope will be calculated to measure if the salmon population is growing (positive slope).

References

Crozier, L. G., McClure, M. M., Beechie, T., Bograd, S. J., Boughton, D. A., Carr, M., ... & Hazen, E. L. (2019). Climate vulnerability assessment for Pacific salmon and steelhead in the California Current Large Marine Ecosystem. *PloS one*, *14*(7), e0217711. https://journals.plos.org/plosone/article/file?id=10.1371/journal.pone.0217711&type=printable

Cummins, K., Furey, C., Giorgi, A., Lindley, S., Nestler, J., & Shurts, J. (2008). Listen to the river: an independent review of the CVPIA Fisheries Program. *Prepared under contract with Circlepoint for the US Bureau of Reclamation and the US Fish and Wildlife Service.* https://escholarship.org/content/qt30d7b0g7/qt30d7b0g7.pdf. Last accessed March 15, 2010.

Dahm, C., W. Kimmerer, J. Korman, P.B. Moyle, G.T. Ruggerone, and C.A. Simenstad. (2019). Developing Biological Goals for the Bay-Delta Plan: Concepts and Ideas from an Independent Scientific Advisory Panel. A final report to the Delta Science Program. Sacramento: Delta Stewardship Council.

Herbold, B., Carlson, S. M, Henery, R., Johnson, R. C, Mantua, N., McClure, M., et al. (2018). Managing for Salmon Resilience in California's Variable and Changing Climate. *San Francisco Estuary and Watershed Science*, 16(2). Retrieved from https://escholarship.org/uc/item/8rb3z3nj

Merz, Joseph E., and Peter B. Moyle. Salmon, wildlife, and wine: marine-derived nutrients in human-dominated ecosystems of central California. *Ecological applications*

16.3 (2006): 999-1009. Available online at: https://sciences.ucf.edu/biology/king/wp-content/uploads/sites/106/2011/08/Merz-and-Moyle-2006.pdf

U.S. Department of Commerce (DOC), National Oceanic and Atmospheric Administration, National Marine Fisheries Service, and Southwest Fisheries Science Center. (2014, July). *Life Cycle Modeling Framework for Sacramento River Winter-Run Chinook Salmon*. Retrieved March 2016, from Southwest Fisheries Science Center: https://swfsc.noaa.gov/publications/TM/SWFSC/NOAA-TM-NMFS-SWFSC-530.pdf

U.S. Department of the Interior (DOI), U.S. Fish and Wildlife Service, and U.S. Bureau of Reclamation. (2011). *Comprehensive Assessment and Monitoring Program: Assessment of Anadromous Fish Production in the Central Valley California between 1992 and 2010*. Retrieved 2016, from U.S. Fish and Wildlife Service: http://www.fws.gov/sacramento/fisheries/CAMP-Program/Documents-Reports/Documents/2011_CAMP_annual_report.pdf

Willson, Mary F., Scott M. Gende, and Brian H. Marston. Fishes and the forest. *BioScience* 48.6 (1998): 455-462. https://www.researchgate.net/profile/Scott_Gende/publication/246198931_Fishes_and_the_Forest/links/5481ea0f0cf2e5f7ceaaabf1.pdf

Appendices

Please contact Scott.Navarro@deltacouncil.ca.gov if you have questions regarding accessibility.

Figure

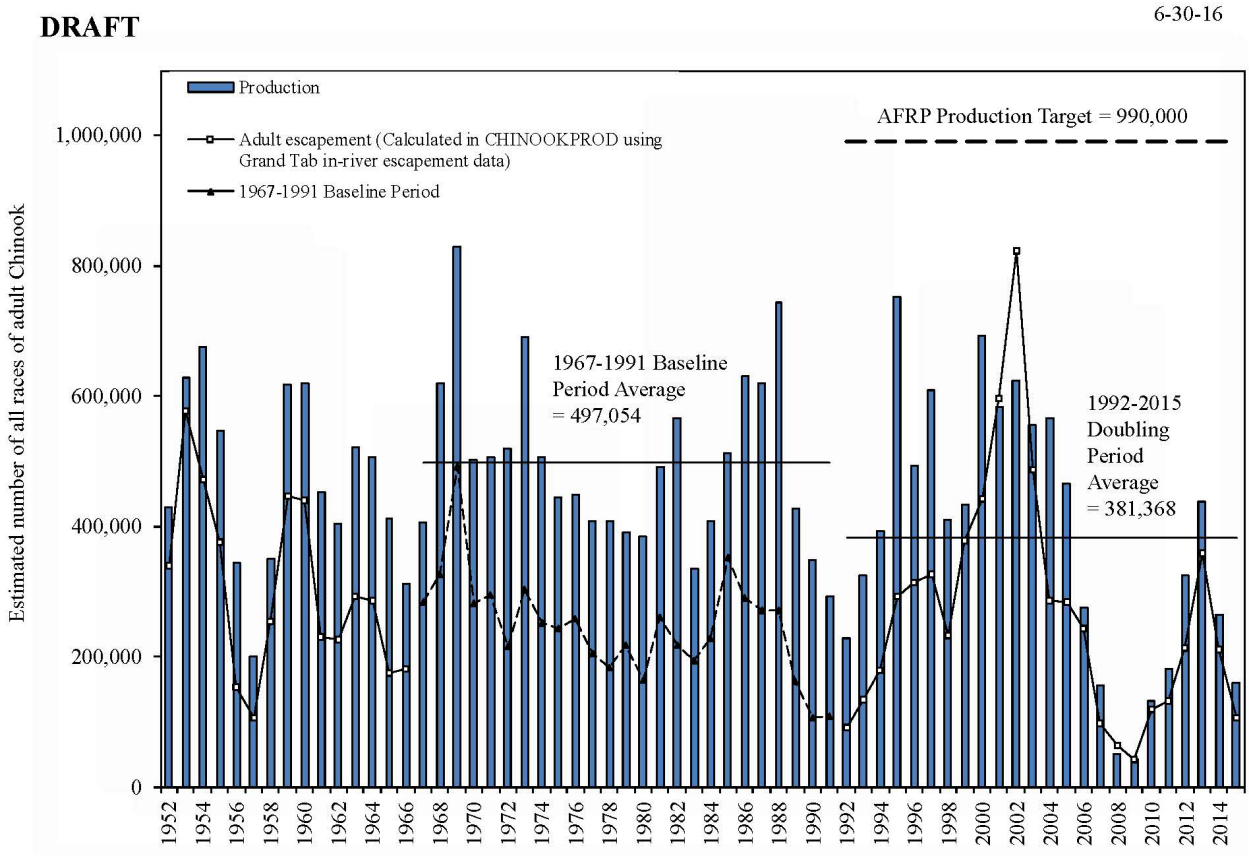

Figure 1. Estimated yearly natural production and in-river escapement of all races of adult Chinook Salmon in the Central Valley rivers and streams. 1956 to 1966 and 1992 to 2015 numbers are calculated in CHINOOKPROD using numbers from CDFG Grand Tab (Apr 11, 2016). 1967-1991 Baseline Period numbers are from Mills and Fisher (CDFG, 1994).