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

Performance Measure (PM) Component Attributes

Type: Outcome Performance Measure

Description

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

Expectations

The annual average natural production of all Central Valley Chinook salmon runs is 990,000 fish by 2065, which is double the 1967-1991 levels.

Metric

Fifteen-year rolling annual average natural production of all Central Valley Chinook salmon runs (fall, late fall, spring, and winter). This metric is measured annually.

Baseline

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

Targets

1) The 15-year rolling annual average of natural production for all Central Valley Chinook salmon runs is 990,000 by 2065, nearly doubling the baseline of 497,054.
2) The slope of the 15-year rolling annual average of natural production for all Central Valley Chinook salmon runs is greater than zero (i.e., positive) for the period of 2035-2065.

Basis for Selection

Enacted by the U.S. Congress in 1992, the 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 since 1992: the 1992-2015 average was 381,368 compared to the 1967-1991 baseline average of 497,054 (Figure 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 effectiveness of habitat restoration and water-quality improvement projects because these anadromous fish use the vast range of aquatic ecosystems, from headwaters to the ocean (NMFS 2014). Salmon also 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).

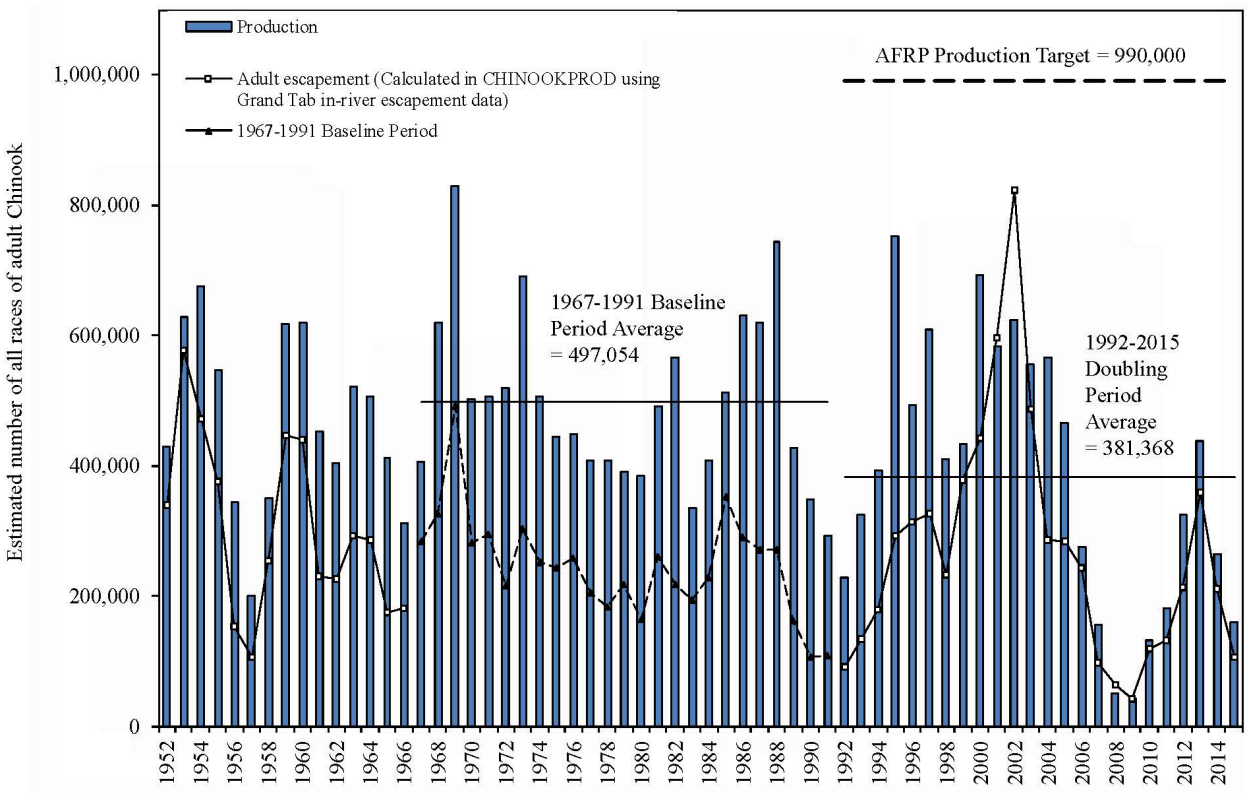

Figure 1. Estimated Yearly Natural Production and In-River Escapement of all Races of Adult Chinook Salmon in the Central Valley Rivers and Streams

This chart illustrates the estimated annual natural production and in-river escapement of all races of adult Chinook Salmon in the Central Valley rivers and streams. The x-axis shows time, starting from 1952 through 2014 in two-year increments. The y-axis shows the estimated number of all races of adult Chinook, ranging from 0 to 1,000,000, in increments of 200,000. Vertical bars represent annual production of all races of Chinook, while a line graph represents the annual adult escapement. The escapement estimates were calculated in CHINOOKPROD using Grand Tab in-river escapement data.

The chart shows that both production and adult escapement are variable, but that they tend to increase and decrease together. Production and escapement both rose by roughly 200,000 adult Chinook between 1952 and 1953. Production increased the following year, while escapement dropped slightly. Both production and escapement fell in the subsequent three years, to a regional low in 1956 of roughly 200,000 adult Chinook produced and roughly 100,000 escaped. Production and escapement both rose over the next two years, and then varied in concert with one another, peaking in 1969 at more than 800,000 produced and 500,000 escaped. In 1992, production and escapement hit a regional low at less than 250,000 adult Chinook produced and roughly 100,000 escaped. Between 1992 and 2002, both production and escapement generally increased. Production hit a regional peak of more than 750,000 in 1995 and escapement peaked in 2002 at more than 800,000 adult Chinook. Both production and escapement then declined to a low of roughly 50,000 Chinook produced and escaped in 2009. Production and escapement increased between 2009 and 2013 to a regional high of roughly 450,000 produced and 350,000 escaped, then dropped over the next two years.

Figure 1. Estimated Yearly Natural Production and In-River Escapement of all Races of Adult Chinook Salmon in the Central Valley Rivers and Streams (contd.)

The central message of the chart is conveyed through comparison of a baseline period average, a doubling period average, and a production target. The chart shows that the 1967-1991 baseline period average equals 497,054 adult Chinook. The chart shows the 1992-2015 doubling period average equals 381,368. The target for the doubling period was 990,000 fish. The chart illustrates that the 1992-2015 average falls well below the target. Please contact the Delta Stewardship Council with any questions regarding this figure.

Source: USFWS Anadromous Fish Restoration Program 2016

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 (USFWS and Reclamation 2011). They can be sensitive to changes in water quality, flow, turbidity, and temperature. Moreover, stressors affect various salmon life stages differently (NMFS 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.

Salmon population dynamics are dependent on many factors that occur outside the Delta (e.g., spawning habitat, water temperatures) that can be managed through flow and non-flow management actions such as water operations, fishing regulations, habitat restoration, 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 salmon doubling goal (Cummins et al. 2008; Herbold et al. 2018; Dahm et al. 2019). Current ecosystem management seeks to improve the adaptive capacity of salmon in response to climate change by reconnecting and restoring habitats to facilitate ecosystem processes, providing refuge from temperature stress and predation risk, and by increasing food availability (Crozier et al. 2019).

In 2018, the State Water Resources Control Board (SWRCB) charged an Independent Scientific Advisory Panel with developing methods for formulating biological goals for the Bay-Delta Water Quality Control Plan. The Advisory Panel concluded that the baseline for the doubling goal overestimated the natural-origin population (by underestimating hatchery-origin Chinook salmon in total returns) and therefore the doubling goal for natural-origin salmon might also be overestimated (Dahm et al. 2019). Because of the uncertainty in the baseline calculations, an increase in the natural production (positive trend) may provide a better goal, rather than the goal to double the natural production (Dahm et al. 2019).

This performance measure tracks: 1) the achievement of the doubling goal as a 15-year rolling annual average of natural production for all Chinook salmon runs by 2065, and 2) an increase in natural-origin population as a positive slope of the 15-year rolling annual average for the period of 2035-2065.

Linkages to Delta Reform Act and the Coequal Goals

Delta Reform Act

Achieving the target of positive slope in the 15-year annual average of natural production for all Chinook salmon is a measure of "Conditions conducive to meeting or exceeding the goals in existing species recovery plans and state and federal goals with respect to doubling salmon populations" (Water Code section 85803(c)(5)).

This performance measure works together with other performance measures—Fish Migration Barriers (PM 4.13), Increase Seasonal Inundation (PM 4.15), Acres of Natural Communities Restored (PM 4.16), and Subsidence Reversal for Tidal Reconnection (PM 4.12)—to assess the status and trends in "the health of the Delta's estuary and wetland ecosystem for supporting viable populations of Delta fisheries and other aquatic organisms" (Water Code section 85211(a)).

Delta Plan Core Strategy

4.4 Protect Native Species and Reduce Impact of Nonnative Invasive Species.

Baseline Methods

The baseline is the average number of annual natural production of all Central Valley Chinook from 1967-1991 which is 497,054 fishes. This was set by the Central Valley Project Improvement Act (CVPIA) of Public Law 102-575, passed by Congress in 1992.

Target Methods

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

The primary data sources listed below will be used for tracking this performance measure:

1) U.S. Fish and Wildlife Service (USFWS) ChinookProd. Assesses progress toward the CVPIA doubling goal for natural production. 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.
    a) Content: ChinookProd is a spreadsheet database maintained by the USFWS Anadromous Fish Restoration Program, which calculates natural production of each salmon run along with the combined value of all runs (Figure 1). ChinookProd is both a data source and an analytical tool.
    b) Update Frequency: Updated annually.
2) CDFW Grand Tab. Provides estimates of adult salmon escapement (returning spawners) for different run types and watersheds. Estimates are provided by the CDFW; USFWS; California Department of Water Resources; East Bay Municipal Utilities District, U.S. Department of the Interior, Bureau of Reclamation (Reclamation); 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. Escapement data and visualizations are available through the Central Valley Prediction and Assessment of Salmon website (SacPAS).
    a) Content: Tabular reports of salmon escapements by salmon run and rivers.
    b) Update frequency: Updated annually.

Alternative Data Sources

Alternative data sources will be used if the primary data sources become unavailable or insufficient. Alternative data sources may 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 Annual Report. https://www.fws.gov/cno/fisheries/CAMP/Documents-Reports/
    a) Content: Annual report that provides updates on progress of the Anadromous Fish Restoration Program and the salmon doubling goal.
    b) Update frequency: Updated annually.

Process

Data Collection and Assessment

Every year, Council staff will update the status of this performance measure by:

1) Downloading data from primary data source #1 every October 1. Council staff will contact the data owner, USFWS, for quality assurance-quality control questions, if necessary.
2) Calculating the 15-year rolling annual average of natural production for all Chinook salmon runs.
3) Calculating the slope (linear regression) of 15-year rolling annual averages of natural production for all Chinook salmon runs.
4) Displaying results such as bar graphs (e.g., Figure 1) showing the rolling 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).
5) Reporting results on the Performance Measures Dashboard.

Process Risks and Uncertainties

Current monitoring effort do not adequately characterize whether fish are wild or of hatchery origin. Consistently and comprehensively estimating the contribution of hatchery-origin salmonids in the catch and spawning grounds is the greatest deterrent to reasonably accurate production estimates of natural-origin salmonids (Dahm et al. 2019).

The USFWS ChinookProd estimates of annual natural production of each Chinook salmon run from each watershed includes four components:

1) In-river spawner abundance (i.e., escapement): In-river spawner abundance is based on the CDFW Grand Tab 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.
2) Hatchery returns.
3) In-river harvest by anglers.
4) Ocean harvest: Ocean harvest is based on reporting by the Pacific Fishery Management Council.

Climate change poses another uncertainty to reaching salmon doubling targets. To help address this, Council staff will work with SWRCB and other agencies to track abundance as well as density-dependence survival rates, distribution, diversity, and life stage survival rates of Central Valley salmon in order to better adaptively manage their populations. Moreover, there is a need to investigate how these population parameters are affected by management actions.

Reporting

Annually, Council staff will report the status of this performance measure by:

1) Posting annual updates on the Performance Measures Dashboard
2) Providing results in Council annual reports published in January
3) Communicating management-relevant results at Council and Delta Plan Interagency Implementation Committee (DPIIC) public meetings
4) Presenting findings at technical interagency groups, professional gatherings, and conferences.

Every five years, Council staff will assess and report the status of this performance measure and provide conclusion and findings:

1) To be reported in the Five-year Review of the Delta Plan.
2) To inform the Five-year review recommendations, Council's adaptive management and other relevant decision makings.

References

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