Performance Measure 4.13: Barriers to Migratory Fish Passage

Performance Measure (PM) Component Attributes

Type: Output Performance Measure

Delta Plan Description

Resolve fish passage at priority barriers and select large dams in Sacramento-San Joaquin Watershed, and screen diversions along native, anadromous fish migration corridors within the Delta.[1]

Expectation

Improve fish migration, reduce fish entrainment, and enhance aquatic habitat connectivity by removing priority fish passage barriers and screening Delta diversions.

Metric

Number of priority fish migration barriers and select large dams in the Sacramento - San Joaquin Watershed, and unscreened diversions along native, anadromous fish migration corridors in the Delta and Suisun Marsh.

Baseline

Fish passage barriers, large dams and unscreened diversions listed in:

1. California Department of Fish and Wildlife (CDFW) Priority Barriers (2018)
2. Central Valley Flood Protection Program Conservation Strategy (Appendix K, 2016)
3. Rim dams in the Sacramento - San Joaquin River Watershed[2]
4. Unscreened diversions along native anadromous fish Delta migration corridors

[1] "Resolve" in this context means to construct, modify, or remove a barrier to allow for a proportion of fish to travel past the barrier or former barrier. For unscreened diversions, resolve means to screen the diversion so that juvenile or adult fish are physically protected from entrainment.

[2] Reference the Central Valley Chinook Recovery Plan and/or NOAA Biological Opinions

Target

By 2050, resolve all (100%) priority fish migration barriers, and screen 100% of unscreened diversions within the Delta and Suisun Marsh.

Target to be evaluated annually.

Basis for Selection

General Purpose:

Several species of native, anadromous fish travel through and upstream of the Delta as part of their lifecycle (National Marine Fisheries Service Southwest Region, 2009). Instream barriers or unscreened diversions of water from the streams can impede migratory movements; limit, or cut off access to spawning and rearing grounds and to areas that offer refuge from predation; and exacerbate stressors that adversely affect overall species survival (California Department of Fish and Wildlife et al., 2014; National Marine Fisheries Service Southwest Region, 2009, 2011).

Resolving fish passage barriers and screening diversions to prevent fish from being drawn (entrained) into water diversion pipes is important for the survival of several listed species, including salmonids that migrate through the Delta (California Department of Fish and Wildlife et al., 2014; Merenlender and Matella, 2013).

It is unlikely that all barriers can be resolved – especially large rim dams that provide water supply and flood control benefits. However, resolving many fish passage barriers could contribute to native fish population survival and an increase in species resilience and genetic diversity, among other benefits (California Department of Fish and Wildlife et al., 2014; Department of Water Resources, 2014).

This performance measure tracks instream barriers and unscreened diversions that are resolved for migratory fish passage. “Resolve” in this context means to construct, modify, or remove a barrier to allow for a proportion of fish to travel past the barrier or former barrier. For unscreened diversions, resolve means to screen the diversion so that juvenile or adult fish are physically protected from entrainment.

Barriers, Diversions, and Non-structural Issues

The term “barrier” can refer to several different types of impediments including dams, weirs, and low-flow road crossings such as culverts. Barriers can be partial or complete. Some can change with instream flow, and are therefore affected by water year type, weather, sediment loads, and other factors. Water diversion pipes also pose a risk to fish, especially salmon and steelhead (Vogel 2011). Installing fish screens at these diversions is an effective means of preventing fish entrainment (Goodman et al., 2017; Poletto et al., 2015).

Barriers to migration and unscreened diversions are two of many factors affecting fish survival. Other factors include predation, food availability, suitable habitat and refuge, and water temperature (Department of Water Resources, 2014). The size of a fish population and its use of different migration routes are also important (Perry and Skalski, 2008). The importance of different migration routes depends on factors such as flow, water operations, and infrastructure. For example, when the Delta Cross Channel is closed a lower proportion of migrating fish pass through the interior Delta (Perry and Skalski, 2008), reducing the negative impact on fish migration of unscreened diversions or barriers in the interior Delta.

Within the Delta, reduced survival during migration may result from a combination of lack of suitable refugia and food sources, challenging environmental conditions (e.g., water temperature), and the cumulative effect of unscreened diversions.

However, complete barriers are a major obstacle in the Sacramento and San Joaquin River watersheds. The rim dams (large dams along the 'rim' or edge of the Sacramento and San Joaquin valleys and the Sierra Nevada mountains) especially have dramatically altered fish passage and access to upstream, cool water spawning habitat (Herbold et al., 2018). Rim dams are estimated to have cut off access for salmonids to approximately 80% of their pre-dam accessible habitat (Lindley et al., 2006). This habitat is especially valuable because it is at higher elevation, influenced by snowmelt, and could provide an important climate refuge as water temperatures are projected to rise over the remainder of the 21st century. Without access to this habitat, native runs of salmon may be extirpated over the coming century. As noted in the 2009 Biological Opinion on long term operations of the Central Valley Project and State Water Project, there are likely to be large impacts on salmonid populations due to inadequate cold water available downstream of rim dams, especially in dry and critically dry years (NMFS BiOp, pp. 659-660). Therefore, it is necessary to provide fish passage above rim dams so the fish can access high-elevation, cooler habitat (Ibid., p. 660). Because of the importance of habitat above rim dams, it is important to continue to study and find creative solutions to facilitate fish passage past rim dams.

Prioritization of Barriers and Unscreened Diversions

Due to a large number of barriers and unscreened diversion (about 1,400 on the Delta migratory routes *(2018, Passage Assessment Database).*), and limited resources, resource agencies prioritize the most important barriers to resolve and diversions to screen.

Lists of priority fish passage barriers are identified in:

1) California Department of Fish and Wildlife (CDFW) Priority Barriers in North Central and Central regions (CDFW regions 2 and 4), 2018.
2) Central Valley Flood Protection Program Conservation strategy (2016) Appendix K, and Central Valley Flood System Fish Migration Improvement Opportunities (2014).

3) Rim dams on the Sacramento or San Joaquin Rivers and their tributaries.
4) Unscreened diversions along native, anadromous fish migration corridors within the Delta and Suisun Marsh.

Priority barriers in CDFW North Central and Central regions identified in 2018 are located in the Delta or the Sacramento and San Joaquin River watersheds. CDFW prioritizes barriers[3] across both Coastal and Central Valley watercourses based on these criteria:

1) high likelihood to improve migration for anadromous species;
2) availability of recent data of fish and habitat;
3) willing partners and land access;
4) known political support at a local, State or national level;
5) the site is a barrier to a federal recovery plan "Core" population;
6) the watercourse is an eco-regional significant watershed;
7) CDFW is committed to monitoring before, during and after any barrier improvement project is undertaken;
8) the site is considered to be a "keystone barrier", meaning the barrier was the lower-most in that river or creek.

The CDFW priority barrier list is updated on an annual basis.

Fish Migration Improvement Opportunities (FMIO) study (DWR 2014) and the Central Valley Flood Protection Plan (DWR 2017), Appendix K.

DWR Central Valley Flood Protection Plan contains prioritized fish passage barriers in the Fish Migration Improvement Opportunities study and Appendix K of the CVFPP Conservation Strategy. The priority lists prioritize fish barriers using the two metrics in each of the following three categories:

1. Barrier frequency:
    a. Waterway Hydrology – frequency of migratory corridor containing water.
    b. Barrier Status – Total barrier, Partial, or Temporal
2. Barrier intensity:
    a. Barrier location in the target area - Barriers are given a score to reflect their spatial distribution in the target area. Highest scores for anadromous species are given to barriers farthest downstream
    b. Species Diversity / Presence – Number of anadromous species that can reach the barrier from upstream or downstream.
3. Upstream habitat:
    a. Upstream miles of waterway - When comparing two or more barriers, the barrier with the most upstream miles of habitat (to the next barrier) should get the highest score.

[3] Fish Passage Priorities, CDFW, 2018. Bios ds2817: https://map.dfg.ca.gov/metadata/ds2817.html.

b. Type of upstream habitat – Spawning, rearing, and holding

The DWR priority barriers list does not consider diversions, and there are no plans to regularly update DWR prioritization lists. The lists from these studies are included because they represent the most in-depth analysis of barriers and opportunities for improvements currently available.

Rim dams and climate change: Climate change introduces new stressors to migratory salmon in the Sacramento and San Joaquin River including higher water temperatures and more frequent extreme weather events such as droughts. Central Valley rim dams blocked access to historical, cold water spawning habitat. A spatially explicit model of salmon population dynamics for Butte Creek indicates that due to flow limits and high temperatures, salmon in the system are vulnerable to extinction without access to upstream areas (Thompson et al., 2012). While historically, the climate has been variable in the Central Valley of California (Ingram and Malamud-Roam 2014), salmon had access to heterogeneous habitats, and genetic and phenotypic diversity among populations was high, resulting in population resilience (Herbold et al., 2018). 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).

Linkage to Delta Reform Act and the Coequal Goals

Delta Reform Act: Water Code section 85308, Water Code section 85302 (c)(5)

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

Methods

Baseline Methods

The baseline is all priority barrier identified by CDFW and DWR (herein collectively referred to as ‘passage priorities’).

Target and Analysis Methods

Target is to resolve all fish passage priorities.

Rim Dams, manually identified based on a subset of major rim dams:

- Shasta Dam
- Folsom Dam
- Oroville Dam
- Englebright Dam
- New Bullards Bar Dam

- Daguerre Point Dam
- Friant Dam
- New Melones
- New Don Pedro
- New Exchequer Dams

Fish migration barriers identified in the Sacramento and San Joaquin watershed

Sacramento Fish Migration Barriers	**CVFPP**	**CDFW 2018 Priorities**
Lisbon Weir	Yes	No
Yolo Bypass Road Crossings	Yes	No
Cache Creek Settling Basin	Yes	No
Fremont Weir[4]	Yes	Yes
Oroville-Thermalito Complex	Yes	No
Knight's Landing Outfall Gates[5]	Yes	No
Tule Canal Crossings	Yes	No
Sacramento Weir	Yes	No
Sunset Pumps Diversion Dam	Yes	Yes
Sutter Bypass Weir No. 1	Yes	Yes
Sutter Bypass (multiple structures)	Yes	No
Tisdale Weir	Yes	Yes
Moulton Weir	Yes	No
One-Mile Dam	Yes	Yes
Big Chico Gates (Five-Mile Dam)	Yes	Yes
Lindo Channel Gates	Yes	No
Sewer Pipe Crossing, Dry Creek	No	Yes
Bellota Weir	No	Yes

San Joaquin Fish Migration Barriers	**CVFPP**	**CDFW 2018 Priorities**
San Joaquin River Headgates	Yes	No
Sack Dam	Yes	Yes
Mendota Dam	Yes	Yes
San Joaquin River Control Structure	Yes	No
Donny Bridge	Yes	No
Lost Lake Rock Weir #1 (Lower)	Yes	No
Mariposa Bypass Control Structure	Yes	No

[4] Upstream migration over the Fremont Weir was partially addressed in 2018. However, it remains a barrier to downstream migration until overtopping under high flow conditions.

[5] The KLOG had operational gates added in 2015 as part of the EcoRestore project. It is operated as an intentional barrier to keep migrating salmonids in the mainstem of the Sacramento River under certain conditions.

San Joaquin Fish Migration Barriers	CVFPP	CDFW 2018 Priorities
Mariposa Bypass Drop Structure	Yes	No
Eastside Bypass Rock Weir	Yes	No
Eastside Bypass Control Structure	Yes	No
Dan McNamara Road Crossing	Yes	No
Merced Refuge Weir #1 (Lower)	Yes	No
Merced Refuge Weir #2 (Upper)	Yes	No
Avenue 21 County Bridge	Yes	No
Ave 18-1/2 county Bridge	Yes	No
Pipeline crossing	Yes	No
Eastside Bypass Drop 2 (Upper)	Yes	No
Eastside Bypass Drop 1 (Lower)	Yes	No
Chowchilla Bypass Control Structure	Yes	No
Hosie Low Flow Road Crossing	No	Yes
Central California Traction Railroad Bridge	No	Yes

Data Sources

Primary Data Sources

Data on barriers to fish passage are available from a number of sources. Readily available sources include:

1. California Fish Passage Assessment Database (PAD). The PAD is an "inventory of known and potential barriers to anadromous fish in California".
    a. Content: Mapped man-made and natural barriers to fish movement throughout California, with fish passage status and treatment status if resolved.
    b. Update frequency: three times per year.

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 as a reference or supplemental information.

1. CDFW Priority Barriers. The California Department of Fish and Wildlife (CDFW) provides this list of fish passage priorities for use in the proposal solicitation notice for Proposition 1.
    a. Content: Updated prioritization of fish passage barriers to be available for Prop 1 and Prop 68 proponents.
    b. Update frequency: Annually

Process

Data Collection

1. Council staff will retrieve data from the California Fish Passage Assessment Database, annually.
2. If necessary, Council staff will contact the responsible agencies conducting fish passage improvement activities and restoration projects, to retrieve additional data.
3. Data will then be compiled, analyzed, and calculated for each of the targets
    a. Percentage between the list in the targets and analysis section and the newest available data at the time of analysis
    b. For Unscreened diversions along native anadromous fish migration corridors within The Sacramento-San Joaquin Delta, calculate the percent difference of unscreened diversions between the 2019 PAD dataset with the most recent PAD dataset at the time of analysis
        i. This can be done by using the software ArcGIS (10.4.1) and clipping the PAD dataset with the Native anadromous fish migration corridors layer
        ii. Then query unscreened diversions

Reporting

1. This performance measure will be reported annually.
2. The data can be displayed in charts, graphs, and tables.
3. If necessary, a map can also be used in displaying the resolved barriers / diversions and unresolved barriers / diversions.
4. Display on the Delta Performance Measures Dashboard: https://viewperformance.deltacouncil.ca.gov/.

Additional Notes

Process and Dependency Risks for Rim Dams

Rim dam spatial data will be manually selected as a subset of points in the fish Passage Assessment Database. Status of rim dam passage will be manually compiled and updated by Council staff. Status of rim dams being resolved will heavily depend on biological opinion(s) at the time of analysis; feedback from fish passage experts at CDFW, the National Marine Fisheries Service, the U.S. Bureau of Reclamation (Shasta Dam Fish Passage Evaluation), and other stakeholders or experts

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Appendices

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