American White Pelican

EXPECTED OUTCOMES

Covered species are a special group of species, all native to the Delta, that have been imperiled by past human activities. The BDCP includes goals and objectives designed to contribute to the protection, conservation, and recovery of these species.

Chapter 9 of the public Draft BDCP includes an analysis of the water supply reliability benefits and estimated annual water deliveries of BDCP. For more information, see the Alternative BDCP Approaches section beginning on page 96.

The BDCP conservation measures are expected to benefit 56 species, 11 of them fish, and 14 natural communities, and reduce the effects of a broad range of ecological stressors in the Delta. Based on the effects analysis the BDCP will conserve all 56 species covered by the Plan. State and federal fish and wildlife agencies will further review this information before making permit determinations under NCCPA and ESA.

The expected outcomes of BDCP implementation are analyzed and described in Chapter 5, Effects Analysis, of the public Draft BDCP, which reflects extensive scientific study throughout the Delta region. The effects analysis describes how implementation of all 22 conservation measures and covered activities would affect ecosystems, natural communities, and covered species in the Plan Area. Proposed actions will result in fundamental, systemic, and long-term physical changes to the Delta. These changes include substantial alterations to water conveyance and management and extensive restoration of tidal, floodplain, and terrestrial communities.

The effects analysis presents a systematic, scientific evaluation of the potential beneficial, adverse, and net effects of the BDCP on biological resources. The effects analysis also provides state and federal fish and wildlife agencies with information needed to consider issuance of permits and authorizations for the BDCP.

A broad range of analytical tools, including hydrologic and hydrodynamic models, temperature models, water quality models, biological lifecycle models, habitat models, conceptual models, and literature reviews were used to assess the effects of BDCP activities on covered species and natural communities over the 50-year BDCP implementation period.

The effects analysis is long and very complex due to:

- Size of the Plan Area
- Large number of natural communities and covered species addressed by the Plan
- Scale of covered activities
- Duration of BDCP implementation (50 years)
- High variability within the Delta in terms of hydrology, salinity, potential impacts of climate change, and more

Tools Used to Develop the Effects Analysis

The BDCP EA uses literature reviews and a total of 68 environmental and biological models to determine net effects. Chapter 5 of the public Draft BDCP provides the full list of models used. The following is a brief description of the types of models used in the EA.

Conceptual Models

Conceptual models organize information within a logical structure that provides a plausible explanation for a phenomenon. A conceptual model describes key attributes, linkages, and structure associated with an issue. Conceptual models explicitly lay out assumptions and logic underlying arguments and assessments and are commonly used as a first step in developing qualitative or quantitative models.

Qualitative models

Qualitative models likewise describe a logical relationship between variables. These models are often used to develop working hypotheses of how a particular system works.

Quantitative models

Quantitative models are used to understand environmental and biological functions. These models reflect a conceptual understanding of the relationship between attributes, processes, and outcomes. Quantitative models are often data-intensive, requiring a great deal of quantitative information to develop the model, and more such information to test its predictions.

Environmental Models

Environmental models set the stage for the analysis of biological effects by describing key physical conditions, including flow, temperature, salinity, and turbidity.

Biological Models

Biological models link environmental change, often characterized by the environmental models, to change in biological performance. Biological performance is typically measured as a change in abundance, survival, or physical impact, such as the percentage of a species life stage entrained in pumps.

Habitat Suitability Models

Habitat suitability models evaluate multiple attributes of the environment as habitat for the various life stages of species.

Population and Life History Models

Life history models integrate the effects of multiple stressors across multiple life stages to evaluate impacts of actions at population scales. Currently, the application of life history models is limited because of the difficulty in capturing all of the expected changes from the BDCP in one model.

Chinook Salmon
(CDFW)

Effects Analysis on BDCP Proposed Conservation Measures to Improve the Delta Ecosystem

Analytical comparisons in the effects analysis use the following intervals over the Plan's 50-year lifespan:

Current Conditions – Current conditions are those that exist prior to implementation of the BDCP. Chapter 2 of the public Draft BDCP describes the existing ecological conditions in the Study Area.

Near-Term (NT) Conditions – NT conditions are expected under the BDCP in the first 10 years of implementation. During this period, the BDCP is expected to address a substantial portion of the planned aquatic and terrestrial restoration with associated improvements in water quality and food production. Also during this period, the new water facilities will be constructed but no new operations will occur. Climate conditions in the NT reflect physical analysis of the 2020 conditions.

Early Long-Term (ELT) Conditions – ELT conditions reflect BDCP actions from years 10 through 15. During this period, significant changes in the Delta environment will result from the BDCP. Operation of the new water facility is expected to begin during this period while changes to tidal, floodplain, and terrestrial environments made during the first 10 years of BDCP implementation would begin to mature. ELT climate conditions reflect physical analysis of the 2025 conditions.

Late Long-Term (LLT) Conditions – LLT conditions reflect full implementation of BDCP actions from years 15 through 50. All planned habitat restoration will have occurred by year 40, along with full application of the new water facility and full implementation of most other conservation measures. LLT climate conditions reflect physical analysis of the 2060 conditions.

Development of the Effects Analysis

To evaluate the effects of BDCP actions, comparisons are made between an environmental baseline condition and conditions expected to occur under BDCP. The environmental baseline reflects the existing or pre-implementation condition in the Plan Area. The effects analysis compares all conservation measures at various times during BDCP implementation. As required by the ESA, the effects analysis also describes the level of take (loss, harm, or harassment of species) and the effect of that take from BDCP actions.

The BDCP conservation measures will be implemented at different times over the 50-year period, and according to conditions expected at the following intervals:

- Current (immediately preceding BDCP implementation)
- Within 10 years (Near Term)
- Within 15 years (Early Long-Term)
- Within 50 years (Late Long-Term)

The effects analysis also considers climate change impacts over the entire 50-year implementation period.

Net Effects

The BDCP EA evaluates the combined effects of all covered activities, including the conservation measures, to determine the net effect of implementing the Plan for:

- Ecosystems and landscapes
- Natural communities
- Covered plants and wildlife
- Covered fish

To calculate the net effects, different methods were developed for each of the categories listed above. For each category, the positive and negative effects were combined to determine the overall net effect.

The following sections focus on the net effects of BDCP. For details regarding the positive and negative effects for each category, see Chapter 5, Effects Analysis, of the public Draft BDCP.

BENEFICIAL BDCP EFFECTS
\+
ADVERSE BDCP EFFECTS
NET BDCP EFFECTS

To calculate the net benefit of BDCP actions, the EA summarizes the positive and negative effects of the plan to determine the net effect to each covered species.

Environmental Baseline

The biological response to BDCP conservation measures are evaluated against an environmental baseline of existing biological conditions, such as:

- Current regulatory requirements such as Biological Opinions
- Extent of species habitats
- Water quality and pollutant inputs
- Water temperatures
- Flow

Temporary and Construction Effects

The following section focuses on net effects of BDCP actions, which include temporary and construction effects. For more specific information about temporary and construction-related impacts considered, see Chapter 5, Effects Analysis, of the public Draft BDCP. The EIR/EIS includes additional information regarding temporary and construction impacts of BDCP actions.

Scientific Uncertainty

Because the Delta is an ecologically complex estuary, there is a degree of scientific uncertainty. Where a high level of uncertainty is associated with the potential for a conservation measure to achieve plan objectives, that uncertainty will be addressed through research, monitoring, and the adaptive management program.

Details about how climate change factors into the effects analysis are available in the following appendices of the public Draft BDCP:

Appendix 2.C, Climate Change Implications and Assumptions, provides an overview of the scientific understanding of climate change and observed and projected changes anticipated in California and the Plan Area.

Appendix 5.A.1, Climate Change Implications for Natural Communities and Terrestrial Species, summarizes the projected effects of climate change in California and the Plan Area that are relevant to the BDCP natural communities and terrestrial (non-fish) covered species.

Appendix 5.A.2, Climate Change Approach and Implications for Aquatic Species, characterizes the projected effects of climate change on aquatic covered species (fish) and identifies the approach and methods used to incorporate climate change into the BDCP models.

Climate Change

Change is natural and inevitable in the Delta. The change in the global climate system is one of the factors affecting the Delta in several ways. Over the last 100 years, sea level has risen approximately 0.6 feet at the Golden Gate Bridge, and levels are expected to continue to rise. An additional increase of 1.5 feet or more by 2060 is predicted. This change will cause changes in the position, location and depth of tidal habitat, and may also change tidal mixing and salinity patterns in the Delta. It will also increase water pressure against Delta levees, potentially causing instability and seepage. As warmer average temperatures push snow levels higher in the Sierra Nevada mountain range, more winter precipitation will fall as rain. More intense storm runoff and peak flood events will further stress levees. Multiple levee failures from a single flood are possible, depending upon water levels, tides, wind, and other factors. The Effects Analysis explicitly considers the effects of climate change over the 50-year implementation period by incorporating calculated assumptions of sea level rise, temperature increase, and changes in seasonal precipitation and runoff patterns upstream of the Delta into relevant analyses during years 10 through 15 and years 15 through 50 of BDCP implementation. These future conditions provide points of comparison to starting operations, which also include the same assumptions of climate change. Sea level is assumed to increase by 0.49 feet by the end of year 15 of BDCP implementation and by 1.54 feet above present level by year 50 of BDCP implementation.

The BDCP would partially isolate water deliveries from increasingly stressed Delta levees, while using state-of-the-art fish screens and water project operating rules that minimize potential impacts to fish spawning and migratory patterns. The proposed project also would help California cope with changing weather patterns by enabling the capture of large amounts of winter flood flow that coincide with times of more minimal ecological risk. A more reliable facility would also boost the state's ability to respond to the natural differences in the amount of precipitation the state receives from one year to the next.

In some cases, the effects of climate change will overshadow the ecological benefits of the BDCP. For example, temperature-related effects modeled in the BDCP and predicted to occur by the end of the permit term (2064), are caused solely or substantially by climate change.

Climate Change Adaptation

Conservation measures will provide numerous benefits to the Bay-Delta ecosystem, natural communities, and covered species that are expected to reduce species vulnerability to the adverse physical and biological effects of climate change.

Expected Climate Change Adaptation Benefits	Description
Enhanced ecosystem services	Restoration of wetlands, floodplains, and riparian habitats will restore ecosystem functions that benefit humans as well as species, including, among others, flood control, water purification, and sediment retention.
Protection from sea level rise	Increased wetland plant biomass, including below-ground production, helps to promote natural growth and the ability of the marsh to keep pace with sea level rise. A wider and more extensive marsh plain in tidal wetlands and a wider floodplain in river systems increases protection of upland habitat and human structures from flooding and storm surges, which are predicted to worsen with climate change.
Carbon sequestration and climate change mitigation	Marsh grasses, microalgae, phytoplankton and woody biomass included in riparian restoration remove carbon dioxide from the atmosphere. Marsh soils store carbon from marsh organisms, helping to control carbon dioxide emissions that contribute to climate change.
Protection of migrating birds	The brackish marshes in the North Bay and Suisun Marsh provide an important resting place for birds along the Pacific Flyway. Due to sea level rise, these birds will experience increasing loss of mudflats used for forage and resting during long-distance migration. Tidal wetland restoration will help to offset this habitat loss.
Increased upland transition zones	The tidal wetland restoration will have a wide upland transition area, providing refuge for wetland animals during extreme high tides (predicted to increase with climate change) and opportunities for wetland migration upslope in response to sea level rise.
Reduction in risks of levee failure	When wetlands behind levees dry out, the organic matter in the soil oxidizes, which can increase subsidence. This increase can reduce the stability of levees and increase the risk of levee failure during flooding, resulting in saltwater intrusion into aquifers and farmlands. Restoration will increase wetland persistence and reduce subsidence.
Natural water management	Improved floodplain connections to rivers will restore the ability of floodplains to absorb flood flows and provide a reservoir of water to help aquatic species withstand droughts.
Increased resilience to threats from invasive species	Seasonally inundated floodplains provide more resilience to invasive species by increasing numbers and health of native species.
Increased habitat variability	A mosaic of habitats that can be used by different species that have evolved to use specific habitats helps to support species diversity.
Increased habitat complexity	Wetland restoration will include networks of channels within marshes that are used by fish for foraging, refuge, and movement in and out of the marsh. Currently, such channel networks are rare.
Increased habitat patch size and connectivity	Protection and restoration of a variety of natural communities will increase the patch size and connectivity of these habitats. Increasing patch size will tend to increase population sizes of native species, which provides more resiliency against a changing climate. Increasing connectivity allows more genetic exchange among populations and movement to more suitable habitats as environmental conditions change.

Assessing Ecosystem and Landscape Effects

A variety of models were used to evaluate the effects that the BDCP would have at the ecosystem and landscape level in the Plan Area. Ecosystem and landscape effects are those that affect general ecological processes. Models, including conceptual models, analyzing ecosystem and landscape effects of BDCP implementation evaluated foodwebs, flows, water quality, water temperature, dissolved oxygen, sediment, salinity, and contaminants. All of these factors are known to be important in achieving high-quality habitats for fish, plants, and wildlife.

Ecosystem and Landscape Effects

The BDCP ecosystem and landscape effects analysis describes the indirect and ecosystem-level effects on covered species during construction and operation of the water facilities and following habitat restoration.

Overall, the BDCP will result in substantial ecosystem and landscape level effects through:

- Restoring, enhancing, and protecting more than 110,000 acres of terrestrial and aquatic habitat
- Shifting the location, amount, and timing of diversion of SWP/CVP water from the Delta

The BDCP results in the following landscape and ecosystem-level effects:

- Substantially improved south Delta flows in the Plan Area
- Increased frequency and duration of flooding of the Yolo Bypass, especially in drier years
- Increased access to habitat for covered species, including channel margin and riparian habitat and other natural communities
- Potential for increased aquatic food production and availability
- Changes in lower Sacramento River flows and outflows, depending on the specific outcome of the decision trees

December 2013

Ecosystem and Landscape Effects

Flow

The BDCP would fundamentally change how water flows through the Delta. While the existing south Delta facilities will continue to operate at times, BDCP actions would shift about half of exports to the north Delta intakes which would improve natural east-to-west flows (outflow to Bay). The timing of Delta exports and outflows will be adjusted to specifically benefit the aquatic ecosystem and covered fish species. Appendix 5.C, Attachment 5C.A, of the public Draft BDCP provides additional detail on BDCP changes to Delta flows.

Water Quality

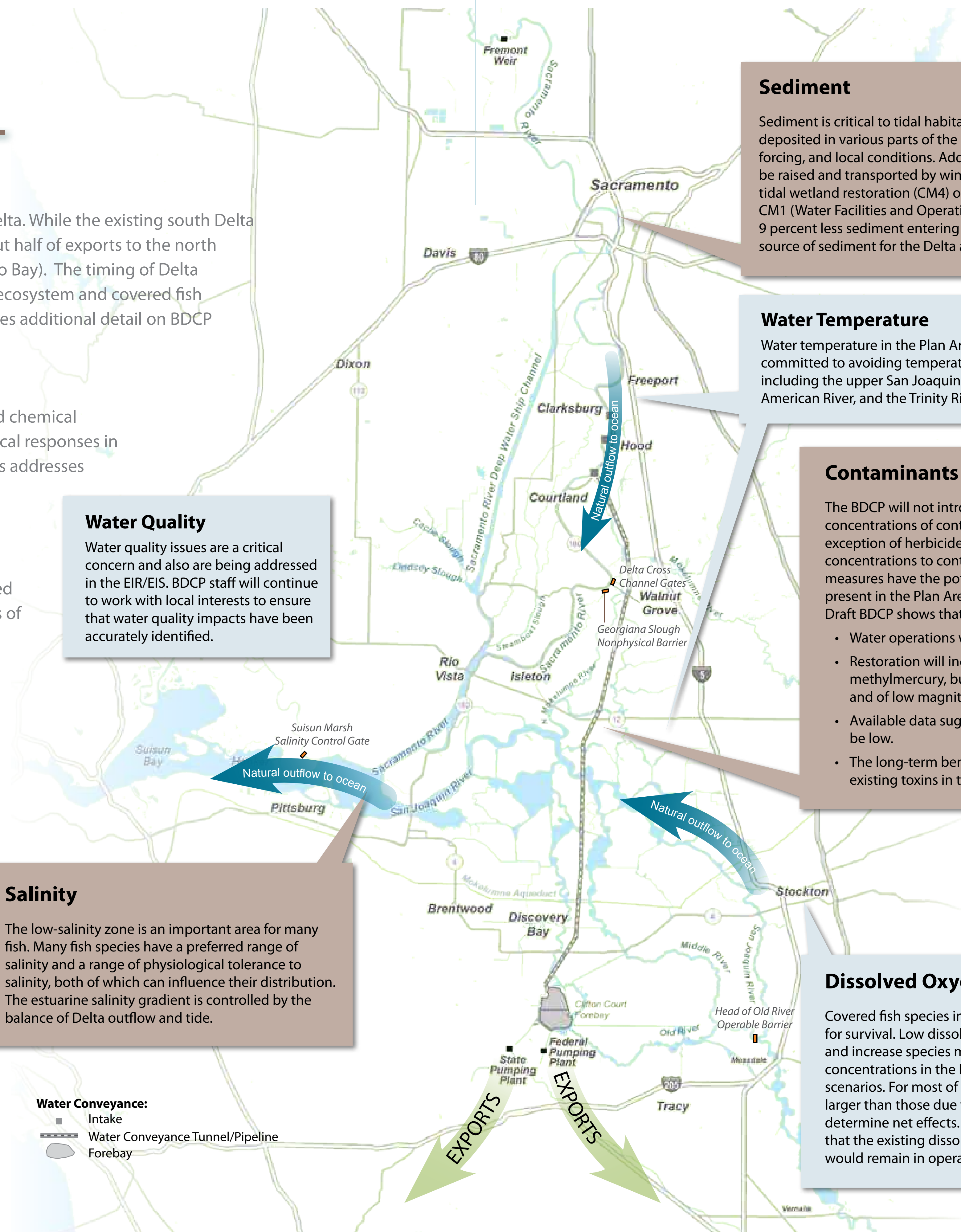
Water quality is defined by both the physical (temperature, turbidity) and chemical properties of water (salinity, pollutant concentrations) that cause biological responses in covered fish species. The map on the right shows how the effects analysis addresses water quality.

Aquatic Habitat and Foodweb

The proposed tidal marsh, channel margin, floodplain, and riparian restoration measures are expected to increase suitable habitat for covered fish species and restore important ecological functions of the Delta. Uses of this restored habitat by covered fish include:

- Adult holding, foraging, and spawning
- Egg and larval development
- Juvenile rearing

BDCP aquatic restoration is expected to provide increased production of periphyton, phytoplankton, zooplankton, macroinvertebrates, insects, and small fish that contribute to the aquatic foodweb. The BDCP's extensive habitat restoration will promote linkages between various habitat types, mimicking historical conditions. Overall, the restoration of tidal natural communities has the potential to provide a large net benefit to several covered fish species, although fully achieving this potential will require careful design, and, when appropriate, management of restored areas. If monitoring results identify adverse effects that will not support meeting the expected biological outcomes, the existing and future restoration actions will be modified and refined as part of adaptive management.



Sediment

Sediment is critical to tidal habitat. Sediment eroded from upstream areas is deposited in various parts of the Delta, depending on factors such as flow rate, tidal forcing, and local conditions. Additionally, sediments already in the Plan Area can be raised and transported by wind or water with the potential to redistribute as tidal wetland restoration (CM4) occurs. Implementation of dual-conveyance under CM1 (Water Facilities and Operation) was estimated to result in approximately 8 to 9 percent less sediment entering the Plan Area from the Sacramento River, the main source of sediment for the Delta and downstream subregions.

Water Temperature

Water temperature in the Plan Area will not change due to the BDCP. The BDCP is committed to avoiding temperature changes in the Plan Area, as well as upstream, including the upper San Joaquin River and tributaries, the Sacramento River, the American River, and the Trinity River.

Water Quality

Water quality issues are a critical concern and also are being addressed in the EIR/EIS. BDCP staff will continue to work with local interests to ensure that water quality impacts have been accurately identified.

Contaminants

The BDCP will not introduce new contaminants or increase the concentrations of contaminants in the Plan Area directly, with the exception of herbicides, which will be applied in limited and safe concentrations to control invasive aquatic weeds. Some conservation measures have the potential to change how contaminants already present in the Plan Area are mobilized. Appendix 5.D of the public Draft BDCP shows that:

- Water operations will have few to no effects on toxins in the Delta.
- Restoration will increase bioavailability of certain toxins, especially methylmercury, but the overall effects are expected to be localized and of low magnitude.
- Available data suggest that species exposure to contaminants will be low.
- The long-term benefits of restoration may reduce exposure to existing toxins in the environment and eliminate sources.

Salinity

The low-salinity zone is an important area for many fish. Many fish species have a preferred range of salinity and a range of physiological tolerance to salinity, both of which can influence their distribution. The estuarine salinity gradient is controlled by the balance of Delta outflow and tide.

Dissolved Oxygen

Covered fish species in the Delta require high dissolved oxygen levels for survival. Low dissolved oxygen levels can create passage barriers and increase species mortality. The simulations of dissolved oxygen concentrations in the Delta found only minor differences among the BDCP scenarios. For most of the regions, differences due to climate change were larger than those due to the effects of BDCP operations, in models used to determine net effects. The BDCP also includes CM14, which would ensure that the existing dissolved oxygen machine in the San Joaquin River would remain in operation.

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Natural Communities

Natural communities are distinct and recurring collections of plants and animals associated with specific physical environmental conditions and ecological processes.

Assessing Effects for Natural Communities

To assess the Plan's effect on natural communities, the amount of habitat lost was quantified for natural community types. In addition to the quantitative effects analysis, the effects of BDCP were assessed qualitatively by considering such factors as landscape connectivity, natural community patch size, hydrologic connectivity, native biodiversity, and presence of rare species. Beneficial effects on natural communities were evaluated based on the ecosystem and natural community goals and objectives provided in Section 3.3 and implementation of the conservation measures described in Section 3.4 of the public Draft BDCP. The net effects on each natural community were then assessed, taking into consideration losses, restoration, protection, and enhancement, and the anticipated quality of the natural communities conserved relative to that of habitat lost.

In general, covered activities are expected to result in an increase in the quantity and quality of natural community types covered in the BDCP. The BDCP is expected to have a net increase of 82,545 acres protected. This substantial increase in restored, protected, and conserved habitat will support ecosystem connectivity, accommodate sea level rise, and support ecosystem services in the Delta such as nutrient transport, sediment capture, and flood-flow reduction. Restoration of tidal natural communities in particular is expected to benefit a large number of covered species including delta smelt, longfin smelt, salt marsh harvest mouse, California black rail, and Suisun thistle.

BDCP Effects on Natural Communities

The following table provides the anticipated net effects for natural communities. Overall, the BDCP is expected to improve the amount, quality, and condition of natural communities within the Plan Area. The average increase in protected lands is 52 percent, not counting cultivated lands.*

**To avoid skewing average protection in the positive direction, the total increase in cultivated lands natural community protection was not included. The increase in cultivated lands protection is unusually large due to the low number of existing, protected cultivated land acres and the large increase in acres protected.*

Covered Natural Community Types	Existing Condition		Net Effect of BDCP Implementation					
			Total Expected Modeled Habitat			Total Expected Modeled Habitat Protection		
	Total Extent in Plan Area (Acres)	Conservation Lands (Acres)	Total Extent in Plan Area (Acres)	Net Change in Total Extent in Plan Area (Acres)	Percent Change in Total Extent over Existing	Total Protected in Plan Area (Acres)	Net Change in Extent Protected (Acres)	Percent Change in Extent of Protected over Existing
Tidal perennial aquatic	86,263	41,260	86,056	-207	0%	41,074	-186	0%
Tidal brackish emergent wetland	8,501	8,380	14,500	5,999	71%	14,380	6,000	72%
Tidal freshwater emergent wetland	8,856	4,927	32,843	23,987	271%	28,918	23,991	487%
Valley/foothill riparian	17,644	5,508	21,926	4,282	24%	10,727	5,219	95%
Nontidal freshwater perennial emergent wetland	1, 385	654	2,058	673	49%	1,408	754	115%
Nontidal perennial aquatic	5,489	1,424	5,589	101	2%	1,754	330	23%
Alkali seasonal wetland complex	3,723	2,910	3,723	-	0%	3,087	177	6%
Vernal pool complex	11,284	6,292	11,284	-	0%	6,959	667	11%
Managed wetland	70,698	64,984	57,420	-13,278	-19%	60,028	-4,956	-8%
Other natural seasonal wetland	276	227	276	-	0%	227	-	0%
Grassland	76,315	20,816	75,798	-517	-1%	29,631	8,815	42%
Inland dune scrub	19	14	19	0	0%	14	-	0%
Cultivated lands	481,909	61,942	426,338	-55,571	-12%	103,676	41,734	67%
Total**	**772,363**	**219,338**	**737,832**	**-34,531**	**-4%**	**301,884**	**82,545**	**38%**

***Totals may not sum directly due to rounding.*

Assessing Effects for Covered Plants and Wildlife

To determine BDCP effects, it is necessary to determine three outcomes for each covered species: the effects of incidental loss or harm, the beneficial effects expected to result from the conservation strategy, and the net effect on the species during the BDCP term.

Developing the EA and determining the net effects for covered plants and wildlife involved several steps:

- A thorough review of the most current scientific information regarding species range, habitat use, and stressors was conducted. Using the information gathered from current literature, plant and wildlife species occurrence data, and expert review and input, geographic information system (GIS) was used to develop habitat models.
- The GIS habitat models were used to conduct a quantitative assessment of the anticipated amount of habitat to be adversely and beneficially impacted by BDCP. In some instances, precise impact footprint were included, such as for CM1 (Water Facilities and Operations), while hypothetical estimates were used for others, such as CM4 (Tidal Natural Communities Restoration). Species occurrence information was used to supplement the quantitative analysis.*
- Using this combination of quantitative and qualitative information, a determination was made as to whether the net effects on each species will result in conservation of the species.

The Plan's contribution to recovery was guided by the proportion of a species' range and lifecycle within the Plan Area and the level of effect on that species. For example, all else being equal, the Plan's obligation to contribute to recovery for a species with a small portion of its range in the Plan Area is less than the Plan's obligation to conserve another species with a large portion of its range in the Plan Area. For listed species, conservation of a species is defined as the use of all methods and procedures that are necessary to bring any endangered species or threatened species to the point at which the measures provided under the ESA are no longer necessary. For non-listed species, contribution to recovery is defined by the BDCP's contribution to factors that prevent the species' need to become state- or federally listed in the future.

A protected area is a location which receives safeguards because of its recognized natural, ecological, and/or cultural values. They are areas set aside to maintain functioning natural ecosystems, to act as refuges for species and to maintain ecological processes that cannot otherwise survive.

** Use of species occurrence information in the affects analysis factors in the often incomplete nature of data sets.*

Swainson's Hawk

BDCP Effects on Covered Plants and Wildlife

The following table provides EA results for covered terrestrial species. The BDCP will result in a net beneficial effect for all terrestrial species in terms of total extent of habitat, extent of protected habitat, or both.

Species	Existing Condition		Net Effect of BDCP: Total Expected Modeled Habitat Protection		
	Total Extent in Plan Area (Acres)	Protected (Acres)	Total Protected Acres in the Plan Area	Net Change in Extent Protected	Percent Change in Extent of Protected over Existing
Riparian brush rabbit	6,012	531	1,820	1,289	243%
Riparian woodrat	2,166	100	490	390	390%
Salt marsh harvest mouse*	35,586	35,332	35,966	634	2%
San Joaquin kit fox	5,327	1,073	2,089	1,016	95%
Suisun shrew	7,515	7,317	13,168	5,851	80%
California black rail	25,382	21,394	34,322	12,928	60%
California clapper rail	6,716	6,120	12,088	5,968	98%
Greater sandhill crane	186,026	43,006	47,180	4,174	10%
Least bell's vireo	15,528	5,093	6,147	1,054	21%
Suisun song sparrow	27,708	26,567	29,361	2,794	11%
Swainson's hawk	480,120	100,007	148,509	48,432	48%
Tricolored blackbird	416,745	105,273	174,057	68,784	65%
Western burrowing owl	401,550	87,345	113,204	25,859	30%
Western yellow-billed cuckoo	12,395	4,199	7,692	3,493	83%
White-tailed kite	514,434	130,872	170,321	39,359	30%
Yellow-breasted chat	14,547	5,112	7,850	2,738	54%
Giant garter snake	83,795	29,475	336,255	306,780	1041%
Western pond turtle	102,046	48,757	85,248	36,490	75%
California red-legged frog	7,925	1,788	3,201	1,413	79%
California tiger salamander	36,018	15,021	21,410	6,389	43%
Valley elderberry longhorn beetle	34,049	10,115	16,569	6,454	64%
California linderiella	11,472	6,311	6,953	642	10%
Conservancy fairy shrimp	11,472	6,311	6,953	642	10%
Longhorn fairy shrimp	11,472	6,311	6,953	642	10%
Midvalley fairy shrimp	11,472	6,311	6,953	642	10%
Vernal pool fairy shrimp	11,472	6,311	6,953	642	10%
Vernal pool tadpole shrimp	11,472	6,311	6,953	642	10%

** While there will be a net decrease in managed wetlands that provide habitat for salt marsh harvest mouse, there will be a net increase in tidal brackish marsh providing habitat with higher long-term conservation value consistent with the recovery plan for this species.*

BDCP Effects on Fish Species

Assessing Effects for Covered Fish

BDCP implementation will result in incidental take of covered fish species. In some cases, the overall take of covered fish as a result of the conservation measures is not quantifiable. Instead, take was evaluated by determining the magnitude and direction of positive or negative effects. These positive and negative effects were considered in light of the importance of that effect to the species, and overall net effects determinations were made. The predicted effects of the Plan will be compared to actual measurements of fish population trends in real-time to ensure permit compliance and to adaptively manage the BDCP.

For fish, the following types of effects could result from the BDCP:

- Reduction in entrainment (capture) of fish in water diversions
- Modification of river flow and Delta outflow
- Increase in suitable habitat
- Increase in food and foraging
- Permanent indirect and other indirect losses

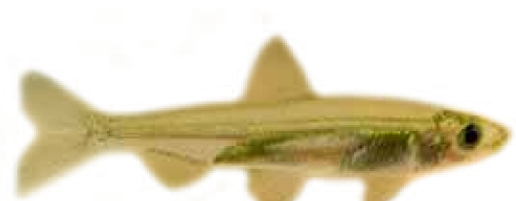
Several of these activities are predicted to benefit covered fish species by increasing habitat and food resources, and more natural flow patterns. Adverse conditions that could result in take are dependent on flow conditions and are evaluated in a detailed quantitative analysis.

Habitat Restoration

The BDCP habitat restoration actions have two principal objectives:

- Increase the amount and quality of available habitat for covered fish species to address their unique life history stage needs
- Enhance the ecological function of the Delta

Chinook Salmon



Delta Smelt

BDCP Effects on Covered Fish

This section describes the net effects on fish based upon modeling focused on potential changes in water flow under the various BDCP scenarios. The species-specific effects included an analysis of potential changes to aquatic habitat, including water temperature, water quality, and lifecycle patterns.

Upstream Effects

The BDCP does not change Shasta or Folsom operations and, therefore, does not affect Sacramento River or Lower American River flows. However, the BDCP may result in changes in the seasonal releases at Oroville Reservoir, which will change spring and summer flows in the Feather River. As such, the following changes to the environment and related effects on fish may occur in upstream habitats as a result of BDCP:

- No effects on spawning and egg incubation in the Sacramento River, Trinity River, Clear Creek, Lower American River, or the San Joaquin River are estimated to result from the BDCP, with the exception of a possible slight reduction for Sacramento River spring-run Chinook in some years.
- Small to moderate reductions in flows during some summer and fall months are expected in the Feather River.
- Small to moderate increases in flows during the spring in the Feather River.

The Delta is a critical migratory corridor for adult fish returning to their spawning grounds and is habitat for several native estuarine species, including imperiled delta smelt and longfin smelt.

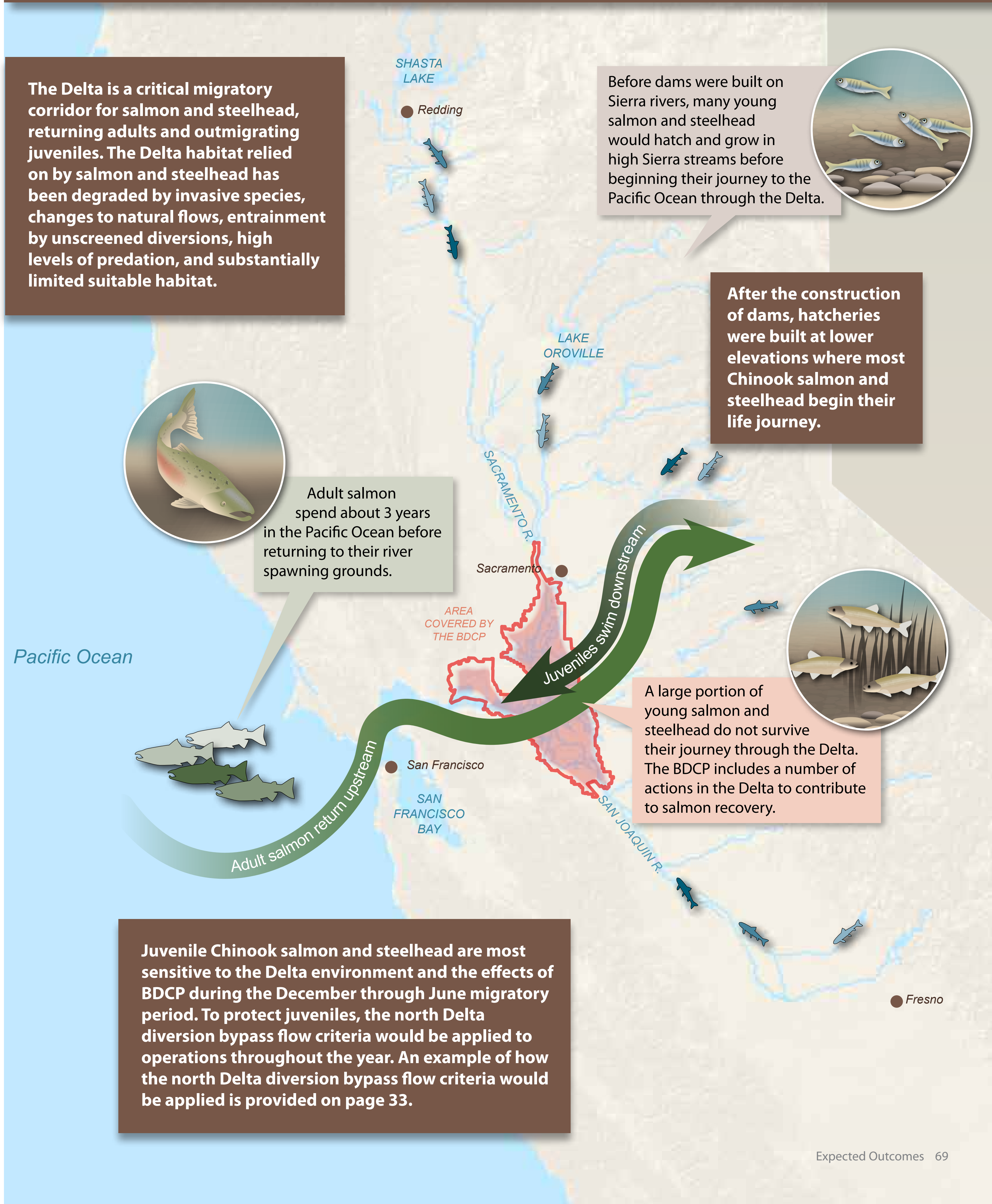
BDCP Effects on Chinook Salmon and Steelhead

Chinook salmon and steelhead are environmentally, commercially, and culturally important species whose habitat will be affected by BDCP activities. Four races (runs) of Chinook salmon and steelhead are seasonally present in the Plan Area and were considered in the effects analysis. All five species have seen dramatic declines in population numbers over the last 150 years. Today, it is estimated that 95 percent of juvenile San Joaquin River salmon and 60 percent of Sacramento River salmon do not survive as they migrate through as a consequence of numerous direct and indirect stressors. The diagram on the right illustrates how salmon and steelhead use the Delta during a portion of their lifecycle and the challenges they face under current conditions.

Chinook Salmon and Steelhead included in the Effects Analysis

Species	Description	Federal ESA Status	California ESA Status
Winter-run Chinook	Spawning habitat is limited to the upper Sacramento River and possibly Battle Creek. March is the peak month for returning adults entering the Sacramento River basin. Peak emigration of young fish into the Delta is November but can begin in October and continue through early May. Many winter-run Chinook hold and rear in the Sacramento River for several months before reaching the Delta where they typically remain for several more months.	Endangered	Endangered
Spring-run Chinook	Spawning habitat is limited to the Sacramento River and a few of its tributaries. The Feather River Hatchery currently produces a large number of spring-run salmon. Adults begin migration upstream in March. Young spring-run emigrate downstream between November and April, with some fish in the Delta into the summer.	Threatened	Threatened
Fall-run and Late Fall-run Chinook	Fall-run Chinook are present in the Sacramento River and San Joaquin River systems. Late-fall run Chinook are currently only present in the Sacramento River system. Adult fall-run Chinook typically migrate through the Delta from June through December. Fall-run juveniles typically emigrate downstream and enter the Delta in the spring. Late-fall run Chinook migrate into the Sacramento River from October through April. There is a good deal of uncertainty about when young late-fall Chinook enter the Delta.	Species of Concern	N/A
Steelhead	Steelhead are present in both the Sacramento River and San Joaquin River systems, though the San Joaquin River population is small. Steelhead typically emigrate in the fall, winter, and spring. Young steelhead typically spend 1 to 2 years in their home streams before quickly emigrating through the Delta region.	Threatened	N/A

Salmon and Steelhead Lifecycle

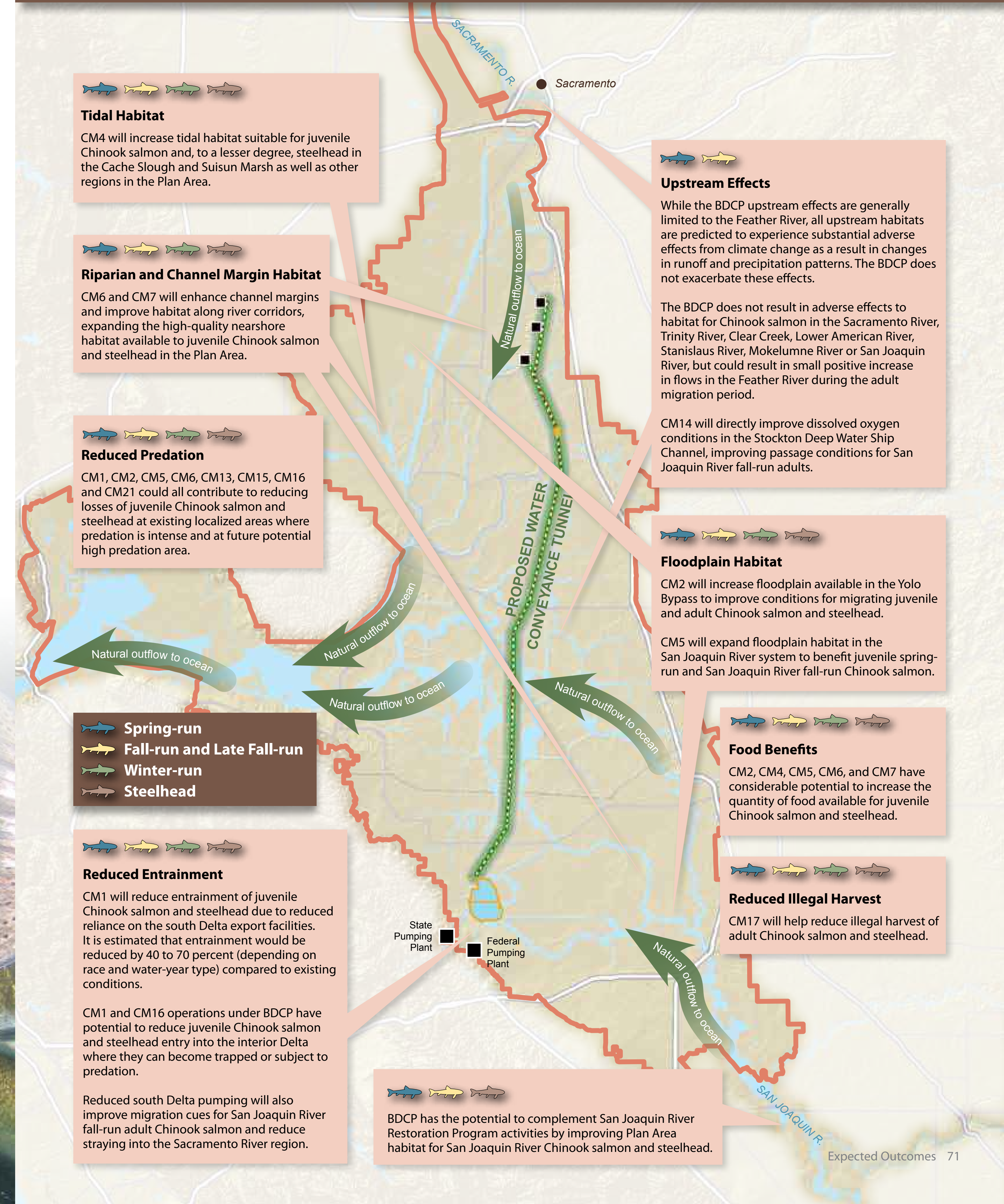


Effects on Chinook Salmon and Steelhead

The net effect of the BDCP on Chinook salmon and steelhead is expected to be positive. The magnitude of benefits of the BDCP for Chinook salmon and steelhead at the population level cannot be quantified with certainty. Nonetheless, expanded and improved habitat, increased food supplies, and reduced entrainment are just a few benefits of BDCP. These positive effects have the potential to increase the resiliency and abundance of Chinook salmon and steelhead compared to existing conditions. The BDCP should contribute to recovery of the species and may help them cope with expected climate change and other ongoing threats to recovery. Increasing air and water temperatures, as well as a general shift in hydrologic regime (rain-dominated rather than snow-dominated), will increase stresses to Central Valley Chinook salmon and steelhead regardless of the BDCP. The BDCP will not directly address the main effects of climate change but, by expanding habitat, increasing habitat diversity, and increasing the number of productive habitat locations in the Delta, the BDCP may lead to a more robust Chinook salmon and steelhead population with the resiliency and diversity necessary to better cope with a changing environment. The map on the right highlights key benefits of BDCP for Chinook salmon. Chapter 5, Sections 5.5.3 through 5.5.6., of the public Draft BDCP provides specific information on BDCP effects for each species.

Chinook Salmon
(CDFW)

BDCP Benefits to Chinook Salmon and Steelhead



Tidal Habitat

CM4 will increase tidal habitat suitable for juvenile Chinook salmon and, to a lesser degree, steelhead in the Cache Slough and Suisun Marsh as well as other regions in the Plan Area.

Riparian and Channel Margin Habitat

CM6 and CM7 will enhance channel margins and improve habitat along river corridors, expanding the high-quality nearshore habitat available to juvenile Chinook salmon and steelhead in the Plan Area.

Reduced Predation

CM1, CM2, CM5, CM6, CM13, CM15, CM16 and CM21 could all contribute to reducing losses of juvenile Chinook salmon and steelhead at existing localized areas where predation is intense and at future potential high predation area.

Reduced Entrainment

CM1 will reduce entrainment of juvenile Chinook salmon and steelhead due to reduced reliance on the south Delta export facilities. It is estimated that entrainment would be reduced by 40 to 70 percent (depending on race and water-year type) compared to existing conditions.

CM1 and CM16 operations under BDCP have potential to reduce juvenile Chinook salmon and steelhead entry into the interior Delta where they can become trapped or subject to predation.

Reduced south Delta pumping will also improve migration cues for San Joaquin River fall-run adult Chinook salmon and reduce straying into the Sacramento River region.

Upstream Effects

While the BDCP upstream effects are generally limited to the Feather River, all upstream habitats are predicted to experience substantial adverse effects from climate change as a result in changes in runoff and precipitation patterns. The BDCP does not exacerbate these effects.

The BDCP does not result in adverse effects to habitat for Chinook salmon in the Sacramento River, Trinity River, Clear Creek, Lower American River, Stanislaus River, Mokelumne River or San Joaquin River, but could result in small positive increase in flows in the Feather River during the adult migration period.

CM14 will directly improve dissolved oxygen conditions in the Stockton Deep Water Ship Channel, improving passage conditions for San Joaquin River fall-run adults.

Floodplain Habitat

CM2 will increase floodplain available in the Yolo Bypass to improve conditions for migrating juvenile and adult Chinook salmon and steelhead.

CM5 will expand floodplain habitat in the San Joaquin River system to benefit juvenile spring-run and San Joaquin River fall-run Chinook salmon.

Food Benefits

CM2, CM4, CM5, CM6, and CM7 have considerable potential to increase the quantity of food available for juvenile Chinook salmon and steelhead.

Reduced Illegal Harvest

CM17 will help reduce illegal harvest of adult Chinook salmon and steelhead.

BDCP has the potential to complement San Joaquin River Restoration Program activities by improving Plan Area habitat for San Joaquin River Chinook salmon and steelhead.

BDCP Effects on Green and White Sturgeon

Green and white sturgeon are long-lived species that use the Plan Area as a migration corridor, feeding area, and juvenile rearing area. Both species have been observed throughout the region, including Suisun Bay and the Yolo Bypass.

Green and white sturgeon are two of the largest fresh water fish in North America and are often sought by anglers for their impressive size. Green sturgeon can grow up to 7 feet and weigh more than 300 pounds. White sturgeon can grow up to 19 feet and weigh more than 1,000 pounds. Green sturgeon typically spawn in the Sacramento and Feather rivers from January through May. White sturgeon typically spawn in the Sacramento, Feather, and San Joaquin rivers during late winter and spring. Both species spawn multiple times during their lives. Most sturgeon spend the majority of their lives in the brackish and deep waters of the estuary.

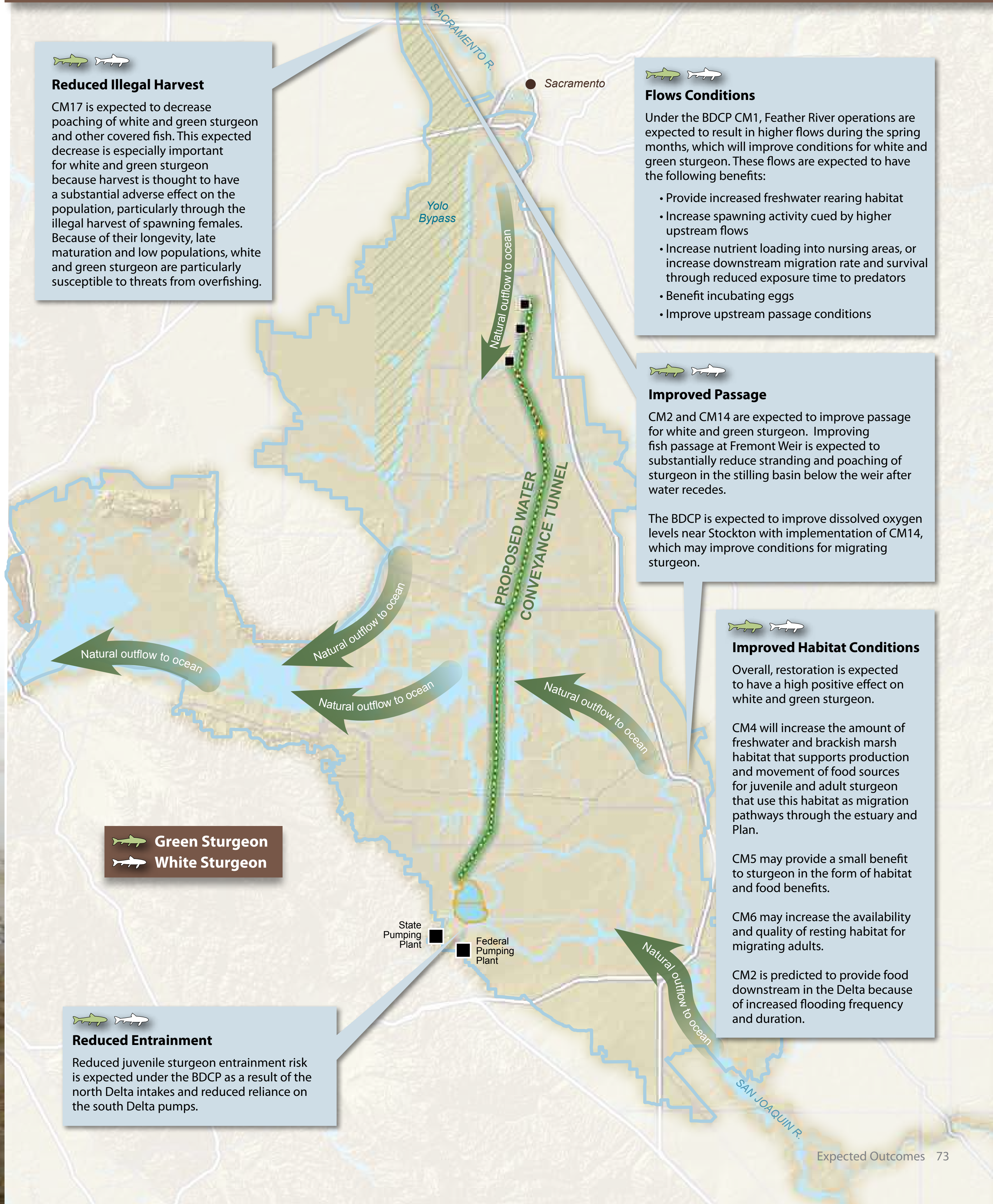
The positive effects of the BDCP on the sturgeon populations include increased suitable habitat, greater food production, improved passage, reduced entrainment in the south Delta, and reduced illegal harvest.

Green Sturgeon

White Sturgeon

(USFWS)

BDCP Benefits to Green and White Sturgeon



Reduced Illegal Harvest

CM17 is expected to decrease poaching of white and green sturgeon and other covered fish. This expected decrease is especially important for white and green sturgeon because harvest is thought to have a substantial adverse effect on the population, particularly through the illegal harvest of spawning females. Because of their longevity, late maturation and low populations, white and green sturgeon are particularly susceptible to threats from overfishing.

Flows Conditions

Under the BDCP CM1, Feather River operations are expected to result in higher flows during the spring months, which will improve conditions for white and green sturgeon. These flows are expected to have the following benefits:

- Provide increased freshwater rearing habitat
- Increase spawning activity cued by higher upstream flows
- Increase nutrient loading into nursing areas, or increase downstream migration rate and survival through reduced exposure time to predators
- Benefit incubating eggs
- Improve upstream passage conditions

Improved Passage

CM2 and CM14 are expected to improve passage for white and green sturgeon. Improving fish passage at Fremont Weir is expected to substantially reduce stranding and poaching of sturgeon in the stilling basin below the weir after water recedes.

The BDCP is expected to improve dissolved oxygen levels near Stockton with implementation of CM14, which may improve conditions for migrating sturgeon.

Improved Habitat Conditions

Overall, restoration is expected to have a high positive effect on white and green sturgeon.

CM4 will increase the amount of freshwater and brackish marsh habitat that supports production and movement of food sources for juvenile and adult sturgeon that use this habitat as migration pathways through the estuary and Plan.

CM5 may provide a small benefit to sturgeon in the form of habitat and food benefits.

CM6 may increase the availability and quality of resting habitat for migrating adults.

CM2 is predicted to provide food downstream in the Delta because of increased flooding frequency and duration.

Reduced Entrainment

Reduced juvenile sturgeon entrainment risk is expected under the BDCP as a result of the north Delta intakes and reduced reliance on the south Delta pumps.

Delta Smelt

The delta smelt is a small, translucent fish endemic to the Sacramento-San Joaquin Bay Delta estuary. The delta smelt life history includes spawning during spring in freshwater areas followed by juvenile migration to the low-salinity zone and other turbid, open-water, low-salinity areas of the Plan Area to feed and mature in the summer and fall.

Longfin Smelt

Longfin smelt is an anadromous fish endemic to the west coast of North America. The Delta is an important migratory corridor for adult longfin smelt moving upstream to spawn and a rearing habitat for young longfin smelt on their way back to the San Francisco Bay. Adult longfin smelt are typically present in the Delta portions of the Plan Area from November through March. Young longfin smelt can be found in the Delta between late winter months and June.

BDCP Effects on Delta Smelt

The BDCP's main beneficial effect for delta smelt is potentially greater food production from habitat restoration, with some minor benefits related to reduced entrainment, and an adaptively managed level of fall outflow as determined prior to tunnel operation. The BDCP is expected to have at least a minor beneficial effect on the species, but a potential for larger benefits depending on actual food production and use of restored habitats by the delta smelt population.

Delta and longfin smelt are the two species to which to decision trees will be applied in the BDCP prior to the implementation of CM1 (See Chapter 3, Section 3.3, of the public Draft BDCP for additional information.) For delta smelt, a decision tree will develop fall outflow operations by including the evaluation of fall outflow conditions per the USFWS Biological Opinion Reasonable and Prudent Alternative (2008). For longfin smelt, a decision tree will develop spring outflow operations by evaluating a range of effects of spring outflow operations within the capabilities of the CVP/SWP.

BDCP Effects on Longfin Smelt

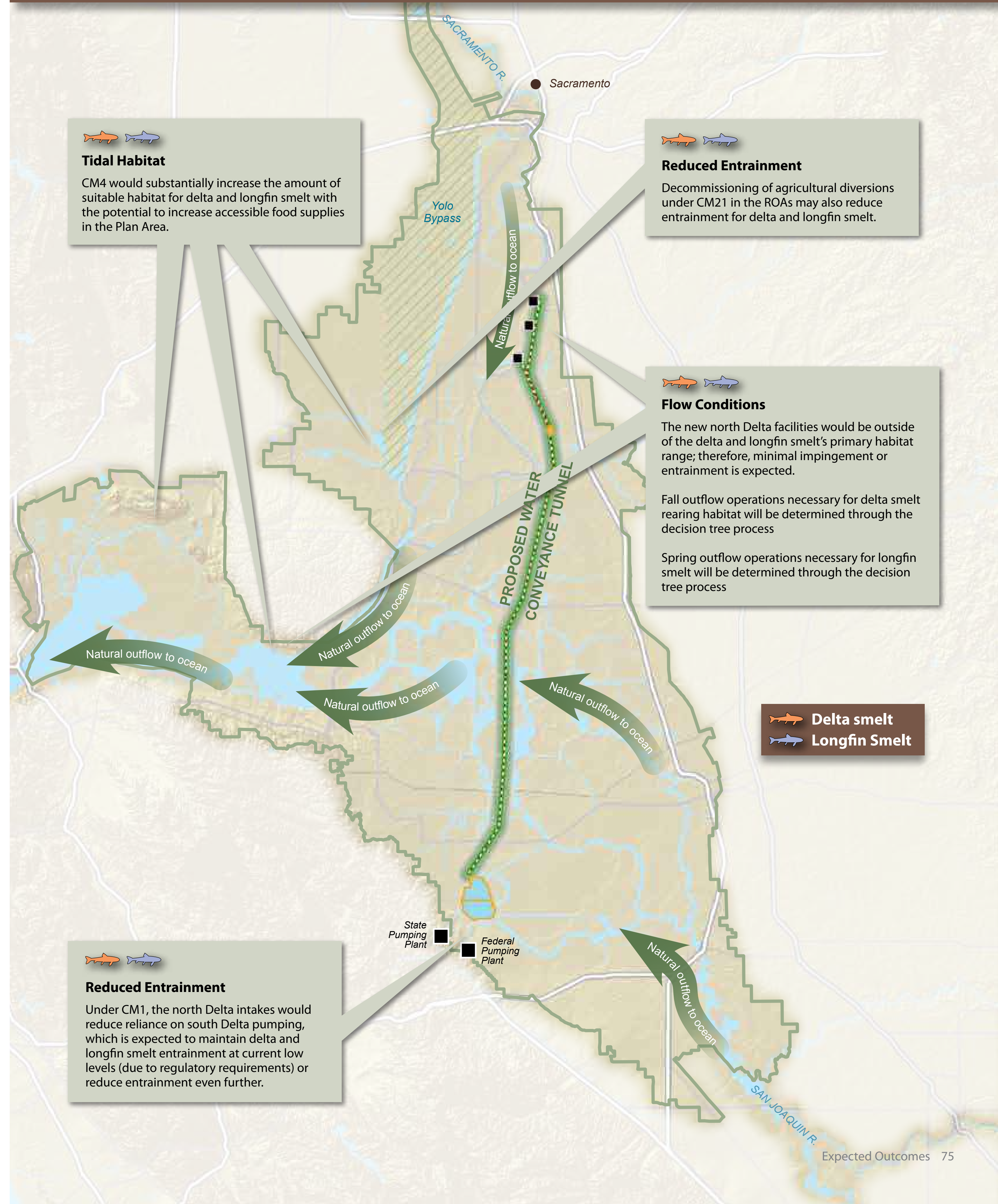
Overall, the BDCP is expected to have a positive effect on longfin smelt, including reduced entrainment and increased food.

Adaptive Management

Habitat restoration design and adaptive management will increase the magnitude of benefits for delta and longfin smelt through efforts such as careful siting and sizing of restoration areas and flow management. The monitoring and adaptive management program will provide the opportunity to address existing uncertainties and alter the BDCP to maximize its long-term benefits. The Adaptive Management Team will provide the ability to respond in the event that the conservation measures do not achieve plan biological objectives, or if potential threats to the species occur as a result of project operations, changes in species distributions or abundance, or other factors.

Delta Smelt

BDCP Benefits to Delta and Longfin Smelt



Pacific and River Lamprey

Knowledge of the relative effects of different stressors on Pacific lamprey is very limited, and even less is known about river lamprey. Pacific lamprey spend the majority of their 9- to 12-year lifespan upstream. Except during the periods when they migrate upstream to spawn and downstream toward the ocean after rearing upstream, river lamprey spend 3 to 5 years of their 6- to 7-year lifespan upstream, with the remainder of their lifespan spent in the ocean. A number of stressors affect upstream life stages of both species. Passage barriers include dams, culverts, water diversions, and tidal gates.

BDCP Effects on Pacific and River Lamprey

Overall, despite high uncertainty based on a deficiency of available scientific knowledge of lamprey, the EA concluded that the BDCP will provide a small net benefit to both Pacific and river lamprey. There will be small net positive effects on Pacific and river lamprey juveniles and adults and negligible effects on their eggs and larva.

Benefits of the BDCP will be similar in magnitude between Pacific and river lamprey, although benefits to Pacific lamprey would be somewhat greater than those to river lamprey because of improved flows during the migration period. If monitoring during BDCP implementation indicates additional methods to improve conservation, conservation measures will be adaptively managed to improve conditions for both species of lamprey to the extent practicable. However, the effects of climate change on upstream flows and water temperatures are expected to be mostly adverse and likely will offset some of the predicted benefits of the BDCP.

Pacific Lamprey

River Lamprey

(Reclamation)

December 2013

Sacramento Splittail

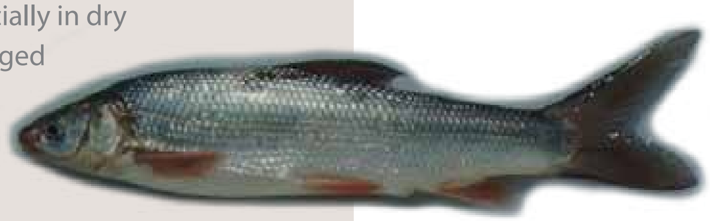
Sacramento splittail is a freshwater fish native to the San Francisco estuary and its associated watershed.

Splittail abundance is strongly related to hydrologic conditions, with wet years producing much stronger year classes than dry years. Consequently, splittail abundance varies greatly from year to year.

Splittail can live 5 to 7 years and tolerate a wide range of water quality conditions, including salinity, temperature, and dissolved oxygen levels. In spring, when California's Central Valley experiences large amounts of snowmelt and/or rain runoff, adult splittail will move to inundated floodplains or margins of the rivers in the valley to spawn. The Yolo Bypass provides the largest spawning area. Lack of spawning habitat, especially in dry years and during prolonged droughts, is a primary stressor of splittail and their floodplain habitat has been diminished over the last several decades.

BDCP Effects on Sacramento Splittail

Sacramento splittail abundance has been highly variable, which has produced inconsistent findings concerning its regulatory status. The BDCP is expected to have a positive effect on the abundance, productivity, and diversity of splittail populations and reduce risk to its survival. The BDCP would greatly increase available spawning habitat through CMs 2, 4, 5, and 6. In particular, increases in dry-year floodplain habitat in the Yolo Bypass are expected to substantially benefit splittail. These increased spawning habitats will result in an enlarged spawning stock, especially if restoration actions increase availability of rearing and foraging habitat for juveniles and adults.



Sacramento Splitail