Recommended BDCP Goals and Objectives for:
Winter Run Chinook

The following summarizes recommended BDCP goals and objectives for winter run Chinook salmon. A single covered fish species goal is recommended that would be the same for all covered fish species.

A series of tables are provided on subsequent pages providing commentary and justification for the recommended objectives. A table is provided for each of the stressors identified in the November 18 document (Table 3.3). References to global goals and objectives, as well as currently proposed conservation measures are provided in order to put each BDCP objective in context. Alpha numeric codes are used to reference specific global goals, global objectives and conservation measures listed at the end of this document. Information displayed in the middle column of each table represents existing information provided to the Science Advisors, including current BDCP Objectives as listed in the November 18, 2010 draft BDCP document. Text shown in *red italics* represents commentary and suggestions from the Science Advisors. The majority of the Advisor's commentary is displayed in the right hand column of the table which is reserved for this purpose (including recommended revisions to objective statements). In some cases commentary is also provided in the middle column for clarity.

Recommended BDCP Covered Fish Species Goal:

Promote conditions within the boundaries of the BDCP that will support (through 2060) the survival, growth and/or successful passage of each life stage of the 11 targeted species for which the waters of the Delta can or do serve as any portion of the species' habitat.

Recommended BDCP Objectives for Winter Run Chinook

1. Increase the extent, diversity and quality of the habitat patch mosaic available for rearing juvenile winter run Chinook salmon on the Sacramento side of the system.

2. Provide spatial diversity and complexity of habitat patch types including shoreline structural heterogeneity to provide for, variation in water depths, shade, refugia from predators [tidal hydrodynamics], variation in water velocities and residence times, salinity gradients from freshwater to brackish water, areas that are only inundated seasonally in response to higher flow events, daily tidal cycles that affect intertidal habitat areas, and permanently inundated subtidal habitats.

3. Promote hydrodynamic conditions that discourage juvenile winter run Chinook from straying into the central and south Delta in order to facilitate outmigration and imprinting on north Delta olfactory cues.

4. Promote conditions and habitat amendments on the Sacramento side of the system that minimize juvenile losses due to predation along outmigration corridors.

5. Promote the removal of physical impediments to the prompt passage of winter-run adult Chinook through the BDCP area.

6. Reduce illegal harvest of adult Chinook salmon.

Table 1 - Winter Run Chinook Salmon – Habitat Loss and Degradation

Category	Information	Comments and Recommendations
Species	Winter Run Chinook Salmon	*Juvenile lifestage*
Global Goals	GG1 and 3	
Global Objectives	VSP1, 2, 3 and 4. CH5 and 6	
Stressors	Habitat Loss - Changes in the extent, access to, and or quality of habitat including habitat variability and food. Food Limitation – Food availability and food web disruptions due to altered co-occurrence with prey or due to effects of foraging by overbite clam. *Food limitation should be considered separately as a function of habitat quality.*	*The word "habitat" can be used in a number of ways and should be better defined to avoid confusion. Habitat should be defined by the species of interest and is basically the space in which a species normally lives. It does not assume any optima, and it is possible that different patches within a species' habitat can function as sources (often attributed with high survival and/or growth) or sinks (attributed with low survival and/or growth) for the population. So, habitat quality – including food value and availability – is a separate issue. Following this logic, habitat loss (a reduction in the physical space available to the species) and habitat degradation (reduction in conditions within the habitat space that promote growth and survival) are two separate stressor categories.* *Recommendation – Acknowledge habitat loss and habitat degradation as two separate stressors. Objectives should address each. Food supply should be viewed as a function of habitat quality.*
BDCP Objectives	CHSA1.1: Increase habitat extent, availability, and quality for juvenile winter un Chinook salmon, including presence of suitable food resources. CHSA1.2: Increase growth rates of juvenile winter run Chinook salmon while rearing in the Plan area. *Growth (CHSA1.2) is implicitly covered under CHSA1.1. Previous studies indicated these habitats increase growth of fish. Requiring increasing growth requires some measure of the baseline of growth rate, which doesn't exist. The Same would hold for survival or passage time.* *An attempt to establish a baseline of growth*	*Increasing the amount or improving accessibility to tidal marshes and floodplains is habitat extent; the rest is habitat quality improvement.* *Recommendation – Revise objectives to read as follows:* *"Increase the extent, diversity and quality of the habitat patch mosaic available for rearing juvenile winter run Chinook salmon on the Sacramento side of the system."* *"Provide spatial diversity and complexity of habitat patch types including shoreline structural heterogeneity to provide for, variation in water depths, shade, refugia from predators [tidal hydrodynamics], variation in water velocities and residence times, salinity gradients from*

	would require measurements now and when compring to growth after an action would require that everything else in the environment was the same.	*freshwater to brackish water, areas that are only inundated seasonally in response to higher flow events, daily tidal cycles that affect intertidal habitat areas, and permanently inundated subtidal habitats."* *It is not necessary to have an objective specific to growth. It is difficult to quantify fish specific measures, particularly changes against an unknown baseline.*
Conservation Measure(s)	CM2 - Yolo Bypass Fishery Enhancement CM4 - Tidal Habitat Restoration CM5 – Seasonally Inundated Floodplain Restoration CM6 – Channel Margin Habitat Enhancement CM7 – Riparian Habitat Restoration	

Table 2 - Winter Run Chinook Salmon – Impingement and Entrainment

Category	**Information**	**Comments and Recommendations**
Species	Winter Run Chinook Salmon	*Juvenile lifestage*
Global Goal	GG1 and 3	
Global Objectives	VSP1, 3 and 4 CH7	
Stressor	Impingement and Entrainment – Mortality due to impingement and entrainment at project and non-project diversions.	*This stressor is closely related to operations (gates and pumping) and altered flows through the Delta that can affect exposure to impingement and entrainment.*
BDCP Objective	CHSA1.6: The total percentage of juvenile Chinook salmon entrained at the CVP and SWP pumps shall not exceed __% of the Juvenile Production Estimate (JPE) (methods for determining JPE and target entrainment percentages to be determined including an analysis of data by water year type to scale the targets accordingly) Oct Workshop Objective #4: Reduce impingement and entrainment of juvenile Chinook salmon Suggestions by NMFS (Dave Swank): Reduce entrainment to less than a combined total (North and South Delta diversions) of 0.20% of the JPE (yes, two tenths of one percent).	*Verifying the suggested value of 0.20% of JPE is not practical. The JPE has a variance associated with it, as do current measures of entrainment. It is doubtful that 0.20% could be distinguished from 2% much less from 0.40%.* *Scaling the objective by water year type implies a level of knowledge and precision that does not exist.* *Recommendation – Do not establish an objective detailing specific levels of entrainment. Focus on creating conditions that will avoid exposure to entrainment. Replace objective CHSA1.6 with:* *"Promote hydrodynamic conditions that discourage juvenile winter run Chinook from straying into the central and south Delta in order to facilitate outmigration and imprinting on*

	This is based on the Effects Analysis result of a 54 to 64% reduction in entrainment of winter-run in the PP, and the actual JPE and loss numbers since we switched to a carcass based estimate of JPE We don't have any current estimates of impingement that I'm aware of; reducing entrainment should also reduce impingement	*north Delta olfactory cues."*
Conservation Measure(s)	CM1 - Water Facilities and Operation CM2 - Yolo Bypass Fishery Enhancement	

Table 3 - Winter Run Chinook Salmon – Juvenile Outmigration through the Delta

Category	Information	Comments and Recommendations
Species	Winter Run Chinook Salmon	*Juvenile lifestage*
Global Goal	GG1 and 3	
Global Objectives	VSP1and 3 CH3 and 7	
Stressor	Altered Flows - Modifications to Delta inflow and outflow rates and flow patterns resulting in deviations from historic migration pathways, delays, reduced survival, and adult straying. Rapid changes in flows and water levels affecting rearing habitat and outmigration success. Directionality of flows thru the Delta.	
BDCP Objective	The 11/18/10 draft BDCP document does not include a specific BDCP Objective for this stressor. The Oct Logic Chain Workshop suggested the following: - Provide hydrodynamic conditions that facilitate rearing, outmigration and imprinting of juvenile salmonids throughout the entire emigration window (Objective #3).	*The recommended BDCP Objective listed in Table 2 above addresses the Altered Flows stressor as well as Impingement and Entrainment. There is no need for an additional objective here.*
Conservation Measure(s)	CM1 – Water Facilities and Operation CM2 - Yolo Bypass Fishery Enhancement CM4 - Tidal Habitat Restoration CM16 – Non-Physical Fish Barriers	*CMs will collectively influence Delta inflows, outflows and hydrodynamics which will affect juvenile outmigration.*

Table 4 - Winter Run Chinook Salmon – Predation and Nonnative Species

Category	Information	Comments and Recommendations
Species	Winter Run Chinook Salmon	*Juvenile lifestage*
Global Goal	GG1 and 3	
Global Objectives	VSP1and 4 CH7	
Stressor	Predation/Nonnative Species - Predation losses, including effects of structures and habitat alterations that promote predators including population effects from predation by introduced species and altered habitat characteristics from invasive species.	*Predator population dynamics are linked to that of their prey. Winter Run Chinook are likely a very small proportion of the total prey field. Is it the predators that are a problem here or the proliferation of exotic prey species populations that are enhancing predator abundance?* *Modification of natural channel margins and riparian habitats, colonization of non-native SAV and FAV, as well as artificial instream structures may change the natural predator-prey dynamics favoring predators (NMFS 2009).* *As was demonstrated in the OCAP RPA review, non-physical barriers intended to keep juvenile Chinook from straying on their outmigration, can contribute to the attraction and concealment of predators and create a predation hotspot. This may be an issue of habitat improvement – providing shallow areas with fine-grained complexity to promote the passage of juvenile salmonids.*
BDCP Objective	CHSA1.8: Reduce susceptibility to, and impact of predation by non-native predatory fish on juvenile outmigrants.	*Recommendation – Replace CHSA1.8 with the following:* *'Promote conditions and habitat amendments on the Sacramento side of the system that minimize juvenile losses due to predation along outmigration corridors'*
Conservation Measure(s)	CM1 - Water Facilities and Operation CM6 – Channel Margin Habitat Enhancement CM13 – Nonnative Aquatic Vegetation Control CM15 – Predator Control CM16 – Non-physical Fish Barriers	*CM13 and 15 may have a low benefit. Remaining predators may just eat more, or other predators may move in. Non-native vegetation may serve just as well as cover for prey as for predators. It's removal could have the opposite effect of increasing predation. It's unclear how effective selective predator control can be in the context of the problem. CM16 – addition of non-physical barriers is likely going to work against as well as for this*

		objective by adding additional predator 'hotspots' along the migration route.

Table 5 - Winter Run Chinook Salmon – Upstream Passage

Category	Information	Comments
Species	Winter Run Chinook Salmon	*Adult lifestage*
Global Goal	GG1 and 3	
Global Objectives	VSP1, 3 and 4 CH1	
Stressor	Passage Impediments/barriers – Barriers to migration and other factors within the Planning Area that reduce or eliminate access to key habitats.	*Adult winter-run Chinook salmon migrating upstream may enter the Yolo and Sutter bypasses, where their migration may be delayed or blocked by control structures. Adjustments are to be made to these control structures to improve fish passage (CM2). However, the complexity in the Yolo Bypass (floodplain and marsh) that was intended to provide improved habitat for juveniles may well serve to delay the migration of adult Chinook.* *Low dissolved oxygen conditions in the area of the Sacramento Deep Water Ship Channel (SDWSC) has also been identified as a threat to adult winter-run migration through the Delta (NMFS 2009). Winter run would be immigrating in the coolest time of the year. It is unlikely DO would be a problem. Results of the Effects Analysis suggest that the BDCP will have no effect on DO for this species (Fig. 5-363).* *The Delta Cross Channel (DCC) has also been identified as a potential problem delaying or blocking passage to winter-run salmon that migrate through the central Delta (NMFS 2009). Physical barriers to immigration are the key issue for adults prior to reaching upstream holding and spawning areas below Keswick Dam. However, it is unclear as to the proportion of adults that immigrate through the central Delta.*
BDCP Objective	CHSA1.5: Increase immigration success by __% and reduce migratory delays by __%. Comments by NMFS (Dave Swank): Since we have no baseline migration rates yet,	*Attempting to quantify specific success targets would be highly subjective and difficult to defend. .*

	let's say no significant observed stranding of adults in Yolo after flows recede; after we have some data on migration rates from acoustic tagging (should have some within 5 years), we could target an increase in migration rate of 50% from any observed impaired rate of migration through the bypass.	*Recommendation – Replace CHSA1.5 with the following:* *"Promote the removal of physical impediments to the prompt passage of winter-run adult Chinook through the BDCP area."*
Conservation Measure(s)	CM2 - Yolo Bypass Fishery Enhancement	

Table 6 - Winter Run Chinook Salmon – Illegal Harvest

Category	**Information**	**Comments**
Species	Winter Run Chinook Salmon	*Adult lifestage*
Global Goal	GG1 and 3	
Global Objectives	VSP1, 3 and 4 CH1	
Stressor	Illegal Harvest – Mortality due to illegal harvest.	
BDCP Goal	CHSA1: (see Table 1)	
BDCP Objective	CHSA1.7: Reduce illegal harvest of adult Chinook salmon (all runs).	*Retain objective as stated*
Location(s)		
Conservation Measure(s)	CM17 – Illegal Harvest Reduction	

Global Goals and Objectives for Winter Run Chinook Salmon:

The following describes global goals and objectives for winter run Chinook salmon as provided by NMFS on April 11, 2011. These reflect draft goals and objectives which have not been formally adopted.

Global Goals

1. *GG1. Abundance* - Attainment of the winter-run Chinook salmon global abundance goal will occur by 2060 with achievement of 6-year geometric mean escapement levels of: 20,000 in the mainstem Sacramento River with no year below 5,000; 3,000 in the Battle Creek watershed with no year below 500; and 500 in a third dependent population with no year below 200.

2. *GG2. Spatial Distribution* - Attainment of the winter-run Chinook salmon global spatial distribution goal will occur by 2060 with restoration of two self-sustaining, independent populations in two watersheds of the Sacramento River drainage, and a third dependent population in the Sacramento River drainage.

3. *GG3. History Diversity* - Attainment of the winter-run Chinook salmon global life history diversity goal will occur by 2060 with restoration of two self-sustaining, independent populations in two watersheds of the Sacramento River drainage, and a third dependent population in the Sacramento River drainage.

Global Objectives

A. *Global VSP Objectives*:
   VSP1. Increase abundance;
   VSP2. Increase spatial distribution;
      a. Secure all extent populations (all populations are important because there are so many "missing" populations in the Central Valley),
      b. Recover populations in each diversity group (only one diversity group for Winter-run)
   VSP3. Protect and increase life history and genetic diversity.
   VSP4. Increase productivity (population growth rate = births-deaths)

   Viable populations should demonstrate a combination of population growth rate and abundance that produces an acceptable probability of population persistence (NMFS Draft Recovery Plan).

B. *Global Critical Habitat Objectives* (from primary constituent elements)
   CH1. Provide access to spawning areas on the Upper Sacramento River, including upstream passage of adults to spawning grounds
   CH2. Provide for adequate quality and quantity of spawning gravels
   CH3. Provide for adequate river flows for successful spawning, incubations of eggs, fry development and emergence, and downstream transport of juveniles
   CH4. Provide water temperatures for successful spawning, egg inclubation, and Fry development
   CH5. Provide habitat areas and prey that are not contaminated
   CH6. Provide riparian (including floodplain) habitat for successful juvenile development and survival
   CH7. Provide adequate downstream migration corridors for successful emigration of juveniles.

BDCP Conservation Measures:

The following summarizes currently proposed BDCP Conservation Measures relevant to aquatic resources.

CM1: Water Facilities and Operation – Construct and operate a "dual conveyance" water delivery system consisting of new North Delta Diversion facilities, an isolated conveyance system to carry water to the existing SWP and CVP facilities in the South Delta. CM1 also defines new operational criteria (near-term water operations) for the existing through-Delta conveyance system until a new dual conveyance system is operational. Near-term operations criteria would replace the existing BOs.

CM2 – Yolo Bypass Fishery Enhancement - Increase frequency and duration of Yolo Bypass inundation and improve upstream and downstream fish passage. Under existing conditions the Fremont Weir is overtopped and spills into the Yolo Bypass in about 70 percent of years. The proposed notch and gates could increase that frequency to about 75-95 percent of years. Specific actions under consideration include weir modifications, new fish ladders, and landscape modifications to manage drainage and avoid stranding.

CM4 – Tidal Habitat Restoration - Increase extent of tidal habitat through levee breaches and other landscape modifications adding:

- 15,000 acres during the near term (NT)
- 22,000 acres during early long term (ELT)
- 49,000 acres during late long term (LLT)

For comparison, the existing intertidal and subtidal habitat within the Delta is 104,000 acres. Increases represent 14% in the NT, 22% in the ELT, and 47% in the LLT compared to existing conditions.

Historic aquatic habitat restoration projects within the Delta have been relatively small (typically less than 100 acres) and not of sufficient to provide substantial benefits to covered fish and ecosystem processes.

CM5 - Seasonally Inundated Floodplain Restoration - Restore up to 10,000 acres of new seasonally inundated floodplain.

- 1000 acres by year 15
- 10,000 acres by year 40

CM6 – Channel Margin Habitat Enhancement - Enhance up to 20 levee miles of channel margin habitat by improving channel geometry and restoring riparian, marsh , and mudflat habitat along levees.

CM7 – Riparian Habitat Restoration - Restore up to 5,000 acres of riparian forest and scrub, in association with the restoration of seasonally inundated floodplain, tidal, and channel margin habitat.

- 400 acres (cumulative) by year 15
- 5,000 acres (cumulative) by year 40

CM13 – Nonnative Aquatic Vegetation Control – Apply existing methods used by CA Dept. of Boating and Waterways *Egeria Densa* and Water Hyacinth Control Programs, including select use of herbicides and mechanical removal.

CM15 – Predator Control – Conduct focused predator control in high predator density locations. High-density "hot-spots" include old structures in or hanging over Delta waterways, abandoned boats, new intake structures, the deep hole just downstream of the Head of Old River, specific locations in Georgiana, Steamboat, and Sutter sloughs, and release sites for salvaged fish from CVP/SWP facilities.

CM16 – Non-physical Fish Barriers - Place Non-physical barriers at the Head of Old River, Delta Cross Channel, Georgiana Slough and possibly Turner Cut, Columbia Cut, the Delta-Mendota Canal intake, and Clifton Court Forebay.

CM17 – Illegal Harvest Reduction – Provide funding to DFG to hire and equip 17 additional game wardens and 5 supervisory and administrative staff.