Bay Delta Conservation Plan
Other Stressors Working Group
June 16, 2009

HANDOUT #3

New Proposed Other Stressors Conservation Measures

Note to reviewers: These two draft conservation measures are proposed for addition to the Other Stressors Conservation Measures.

OSCMXX: Reduce the effects of predators on covered fish species by ~~modifying channel geometry~~conducting localized predator control of high predator density locations. The BDCP Implementing Entity will reduce the effects of predators on covered fish species by conducting localized predator control using a variety of methods ~~modifying the channel geometry of~~in locations in the Delta that are known to have high densities of predators ("predator hot spots") at a funding level of $___ over the term of the BDCP. The BDCP Implementing Entity will examine existing bathymetry data, fish monitoring data, and radio and acoustic tagging study results to determine the locations and causes of predator hot spots throughout the Delta. Locations of hot spots likely include areas with physical parameters that favor predators, such as deep holes, shaded habitat, and abrupt depth changes. The BDCP Implementing Entity will use a variety of methods to control predator populations in hot spots, including modification of channel geometry, targeted removal of predators, and/or other focused methods as dictated by site-specific conditions and intended outcome/goal. ~~If the cause is identified and is a physical parameter, the BDCP Implementing Entity will modify the channel geometry to eliminate the cause.~~ Preference for which hot spots to remove will be given to areas of high overlap with covered fish species, such as migratory routes or spawning and rearing habitats.

Problem Statement: Although a natural part of the estuarine ecosystem, predation in the Delta has been identified as a major stressor to BDCP covered fish species (DRERIP models). Habitat for fish predators generally consists of a specific suite of attributes that allow them to forage more efficiently, such as dark locations adjacent to light locations or deep pools that allow the predator to hide and ambush their prey. There are multiple locations in the Delta that contain these physical attributes and attract predatory fish, such as striped bass, that prey upon covered fish species.

Hypotheses: ~~Removing predator~~Conducting localized predator control at ~~-~~hot spots in the Delta is expected to reduce local predator abundance, thus reducing predation mortality of Chinook salmon (ODFW 1998, Lindley and Mohr 2003, Nobriga et al. 2003, Nobriga and Feyrer 2007, 2008), steelhead (ODFW 1998), Sacramento splittail (Moyle et al. 2004, Nobriga and Feyrer 2007, 2008), and delta smelt (Stevens 1966, Moyle 2002, Nobriga and Feyrer 2007, 2008), and possibly longfin smelt (Nowak et al. 2004), green sturgeon (J. Israel pers. obs.), and white sturgeon.

Adaptive Management Considerations: Monitoring would consist of assessing the abundance, distribution, and size of predator species before and after implementation of predator control in hot spots to determine the performance of the action. In addition, survivorship of covered species would be monitored using acoustic tagging studies or similar techniques.

The BDCP Implementing Entity would use results of effectiveness monitoring to determine whether the action result in measurable benefits to covered fish species and to identify adjustments to funding levels, methods, or other related aspects of the program that would improve the biological effectiveness of the program. Such changes, once approved through the adaptive management decision making process, will be effected through subsequent annual work plans. If results of monitoring indicate that the action does not substantially and cost-effectively benefit covered fish species, the BDCP Implementing Entity, in coordination with Fishery

Agencies, may terminate this conservation measure. If terminated, remaining funding would be deobligated from this conservation measure and reallocated to augment funding for other more effective conservation measures identified in coordination with the Fishery Agencies through the BDCP adaptive management process.

OSCMXX: Improve the survival of outmigrating juvenile salmonids by using non-physical barriers to re-direct them away from channels in which survival is lower. The BDCP Implementing Entity will install non-physical barriers at the junction of channels with low survival of outmigrating juvenile salmonids to deter fish from entering these channels. Potential locations will include the Head of Old River, the Delta Cross Channel, Georgiana Slough, Turner Cut, and Columbia Cut at a total cost of $____ for the first year and $____ for annual operations and maintenance costs after the first year. Non-physical barriers will include a combination of sound, light, and bubbles similar to the three-component barrier used in the 2009 DWR Head of Old River Non-Physical Barrier Test Project (M. Holderman pers. comm.). Barriers will be installed and operated during October-June when salmonid smolts are migrating downstream toward the ocean.

Other locations may be considered by the BDCP Implementing Entity if, for example, future research demonstrates differential rates of survival in Sutter and Steamboat Sloughs relative to the mainstem Sacramento River or in the Yolo Bypass relative to the mainstem Sacramento River. Previous evidence suggests that, under a barrier configuration that was effective in deterring salmon smolts, the barrier was not effective in deterring delta smelt (Bowen et al. 2008). It is not known whether this was a result of the configuration (e.g., sound frequency) of the barrier or the poor swimming ability of delta smelt that was swamped by high flows (Bowen et al. 2008). If demonstrated to be effective in deterring for delta smelt and longfin smelt, barriers could also be installed at the lower end of Old and Middle Rivers and Three Mile Slough (if salinity manipulation is not needed) to deter these species from moving into these channels.

Problem Statement: Juvenile salmonids experience low survival rates while migrating through the Delta towards the ocean. Survival rates vary among routes taken through the Delta (Brandes & McLain 2001, Perry and Skalski 2008), likely as a result of differential exposure to predation, entrainment at state and federal water export facilities, or other factors (J. Burau pers. comm.).

Physical barriers have been used in the Delta, such as the Delta Cross Channel gates and the rock barrier at the Head of Old River, to prohibit the entry of fish into channels where survival rates are low. Physical barriers are effective at prohibiting entry of salmonids into channels, but also alter flow dynamics in these channels, likely affecting tidal flows, sediment loads, bathymetry, water supply reliability, potential for noxious algal blooms, toxic concentrations, and other water quality parameters. Operation of non-physical barriers would not change the physical configuration of the channel and, therefore, would not cause flow-related effects, while improving survival of salmonids by deterring them from entering particular channels.

Hypotheses: Installation and seasonal operation of non-physical barriers is hypothesized to:

- Improve survival of juvenile salmonids migrating downstream (Welton et al. 2002). The three component non-physical barrier has shown promising results in laboratory experiments on Chinook salmon that emulated the Sacramento River/Georgiana Slough flow split (Bowen et al. 2008) and a field experiment on Atlantic salmon (*Salmo salar*)

smolts in the River Frome, UK (Welton et al. 2002). In addition, preliminary evidence suggests that the barrier was effective in deterring acoustically-tagged Chinook salmon juveniles from entering the head of Old River during a 2009 pilot study (M. Holderman pers. comm.). Sound is known to affect the behavior of salmonids (Vanderwalker 1967, Knudsen et al. 1992, 1994). By keeping juvenile salmonids out of channels that are known to have lower salmonid survival, fish can avoid predation, entrainment, and other sources of mortality that result in the lower survival observed in these channels.

Adaptive Management Considerations: The BDCP Implementing Entity would conduct and review monitoring to assess the effectiveness of using non-physical barriers. The BDCP Implementing Entity would use results of effectiveness monitoring to determine whether operations of non-physical barriers result in measurable benefits to covered fish species and to identify adjustments to funding levels, methods, or other related aspects of the program that would improve the biological effectiveness of the program. Such changes, once approved through the adaptive management decision making process, will be effected through subsequent annual work plans. If results of monitoring indicate that operations of non-physical barriers do not substantially and cost-effectively benefit covered fish species, the BDCP Implementing Entity, in coordination with Fishery Agencies, may terminate this conservation measure. If terminated, remaining funding would be deobligated from this conservation measure and reallocated to augment funding for other more effective conservation measures identified in coordination with the Fishery Agencies through the BDCP adaptive management process.