

Fall-run/late fall-run Chinook salmon

Life History

Fall-run Chinook salmon are the most widely distributed run of Chinook salmon in the Central Valley. According to Moyle (2002), the fall-run are an unambiguous ocean-type Chinook salmon adapted for spawning in lowland reaches of big rivers and their tributaries. They move up from the ocean in late summer and early fall in mature condition and typically spawn within a few days or weeks of arriving on the spawning grounds. Specific cues triggering adult fall-run Chinook salmon to return to their spawning grounds from the Pacific Ocean are not well understood. The ability for Chinook to find their natal streams for spawning is related to their long-term olfaction memory and vision (Healey 1991) and may be stimulated by higher streamflow and changes in water turbidity, temperature and oxygen content (Allen and Hassler 1986). Preferred upstream migration temperatures range between 38°F to 56°F (Bell 1991). Boles (1988) recommends water temperatures less than 65°F for adult Chinook salmon migration, and Lindley *et al.* (2004) report that adult migration is blocked when temperatures reach 70°F, and that fish can become stressed as temperatures approach 70°F. Juvenile fall-run Chinook typically emerge from the gravel in winter and spring and move downstream within a few months, to rear in mainstem rivers or estuaries before heading to the ocean (Kjelson *et al.* 1982).

Spawning occurs from October through December and peaks in October in the Sacramento River and in November in the American River. Egg incubation and alevin development rate is temperature dependent. Fry emergence is completed within about 83 days following spawning at an average developmental water temperature of 12 C. Following emergence from the gravel in winter and early spring the majority begin to move downstream immediately with most of the remainder moving downstream within a few months before summer when temperatures in the lower rivers and delta warm to well above optimal levels. A few fall-run juveniles remain in the cooler tributaries over the summer and into the next winter before emigrating to the ocean.

Current status

The fall-run population in 2014 is expected to be larger than the run that produced these predominantly three year old fish in the fall of 2011. The fall-run returning to the system in August and September have been migrating quickly upstream to within close proximity of the dams where the cooler water exists in the Sacramento and American rivers based on angler survey data (Rob Titus, pers comm.). In addition some atypical pre-spawning mortality of fall-run has been observed in the lower Sacramento River during the angler surveys.

Chinook salmon were present in the American River at Nimbus Dam in August with angler catches being observed daily in Nimbus Basin. Water temperatures in the American River in 2014 have been warmer than average due to the dry conditions and low Folsom storage. Chinook spawning in the American River typically begins in October in the areas closest to Nimbus Dam. When water temperature drops to 60 F heavy spawning begins throughout the

spawning reach between Nimbus Dam and Paradise Beach. This is expected to occur around the first of November in 2014 based on water temperature modeling. A power bypass is being planned in coordination with the fishery agencies to help in transitioning from a 60 F spawning temperature into the late November period when water temperature should naturally cool with atmospheric conditions to an optimal egg incubation temperature of 56 F and below. Recent habitat restoration actions in the American have increased spawning and rearing habitat availability at the current relatively low flow levels above what would have otherwise been available.

Biological Analysis of Action

American River

The proposed action will result in higher flows in the American River than would otherwise occur in the October and November period. The base flow in the American River under the flow management standard as specified in the 2009 NMFS RPA would be 800 cfs in October and into November. The transfer of water out of Folsom will result in flows up to 1,400 cfs in October and possibly higher than the base 800 cfs in November. The specific flow schedule would be developed in consultation with the fishery agencies to be most beneficial to salmonids.

Reclamation will work to balance flows and water temperatures to meet the RPA for steelhead as a first priority and then to support fall-run Chinook spawning. A power bypass is planned to occur to access cold water below the power intakes that otherwise would be unavailable for release. Figure 1 displays temperature modeling results of various flows. The power bypass provides significantly cooler temperatures benefitting Chinook spawning and egg incubation. The higher flows with the proposed action provide improved conditions for adult Chinook salmon upstream migration and holding. If higher flows above 800 cfs are extended into the November time period (potentially as high as 1,100 cfs based on fishery agency discussions) the higher flows will increase spawning habitat availability but would add an additional tradeoff of potential redd dewatering if it stays dry and the flows subsequently need to be dropped lower than 800 cfs while eggs are still in the gravel. The fishery agencies are weighing these risks to recommend a preferred flow schedule. In any case the increased flows down the American River, in this critically dry year, during the adult holding and transition to the spawning period are a beneficial effect to Chinook salmon in and migrating to the American River. There is a low level of uncertainty in this assessment based on the known base compared with the effect of the increased water to be released on a fish friendly schedule and with additional operational flexibility to manage for fall-run Chinook salmon.

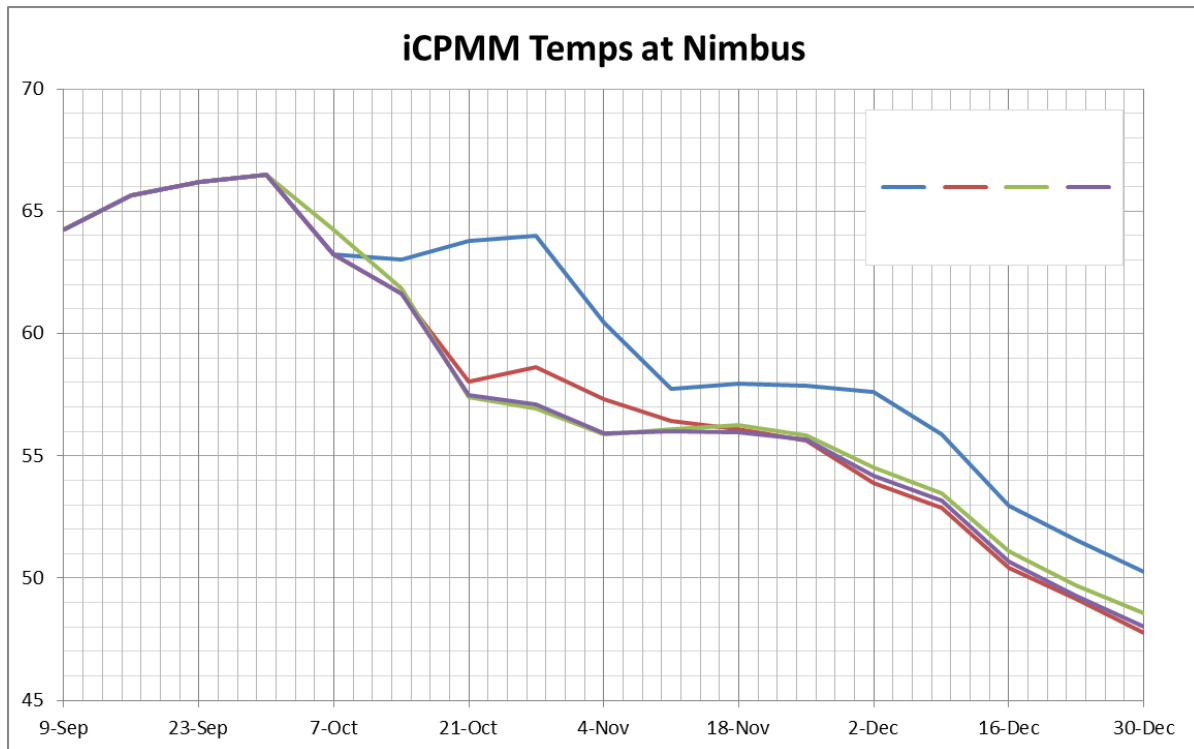


Figure 1. Temperature modeling results of four American River flow scenarios. The blue line shows temperature with no power bypass and the other three scenarios include a power bypass at Folsom.

Sacramento River

The proposed action has resulted in additional water stored in Shasta Reservoir than would have otherwise been available for release in the October to November period. The water was made available in Shasta by the transfer parties not taking water from the system during the summer of 2014. This lowered the release that was needed from Shasta to meet standards during the summer.

The additional water in Shasta Reservoir results in additional operational flexibility to manage for all species during the October and November period. During the early part of this period the flows need to be kept up to prevent dewatering winter-run Chinook salmon eggs at the request of the fishery agencies. The majority of the transfer water can likely be utilized during this period in support of winter-run egg incubation. Once the fry have emerged from the shallowest winter-run redds the flows would be dropped to reach the 3,250 cfs base flow as soon as possible to avoid fall-run Chinook spawning in areas that could be subsequently dewatered. The operational flexibility provided by this transfer either results in no effect to fall-run Chinook or potentially benefits fall-run Chinook. The benefit would be the result of what could have occurred if higher summer flows had resulted in winter-run Chinook spawning at higher elevation areas than what

actually occurred. Had winter-run spawned at higher elevations then the flows would potentially need to be kept higher to support survival of those fish. The subsequent drop to 3,250 cfs would then be a larger drop and result in additional fall-run redd dewatering than would occur with the water transfer. In addition the cold water pool would be smaller in 2015 due to the need to hold flows higher longer. Therefore the effect would either be no effect or a beneficial effect to fall-run Chinook. This conclusion has a moderate level of uncertainty based on the inability to know if winter-run would have spawned at a different elevation than actually occurred which may have resulted in need to hold a different flow level during the early part of fall-run spawning.

Delta

The proposed action will augment delta exports in the October through November 15 period to forecasted levels of 3,000 to 4,000 cfs in combination between the two export facilities. Adult fall-run Chinook would be passing through the delta and heading upstream to spawning tributaries at that time. The additional flows into the delta could provide a slight benefit to upstream migrating Chinook. Since the adults are migrating upstream against the flow they would not be attracted to the change in flows towards the export facilities.

The exports would be greater than the inflows to the delta from the San Joaquin River with or without the proposed action. Straying of fall-run Chinook can occur when olfactory cues from the tributaries are sparse. Flows throughout the system are lower than normal in the fall of 2014 due to the dry conditions so that although exports would be greater than San Joaquin inflow the relative inflow from the San Joaquin in comparison with inflow from the Sacramento is not significantly different than what occurs most other years.

A few large juvenile fall-run Chinook from the 2013 brood year are rearing in the cooler tributaries but are not expected to enter the delta until significant rainfall occurs. RPA actions in effect to protect listed species would protect these fall-run juveniles if this were to occur. No fry from the 2014 brood year would be emerged from the gravel during the proposed action period so there would be no delta effects on them.

In conclusion the proposed action would result in a slight beneficial effect to fall/late fall-run Chinook passing through the delta enroute to the Sacramento River and no significant effect to fall-run Chinook enroute to the San Joaquin River tributaries.

Summary of effect on fall/late fall-run Chinook salmon

The proposed action results in no significant effect on Central Valley fall/late fall-run Chinook salmon. No or beneficial effects occur in the Sacramento River, beneficial effects occur in the American River, and no significant effects occur to Chinook migrating up the San Joaquin River.

References

Appendix O: Biological Review Extended Water Transfer Period Fall-run/late fall-run Chinook salmon

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