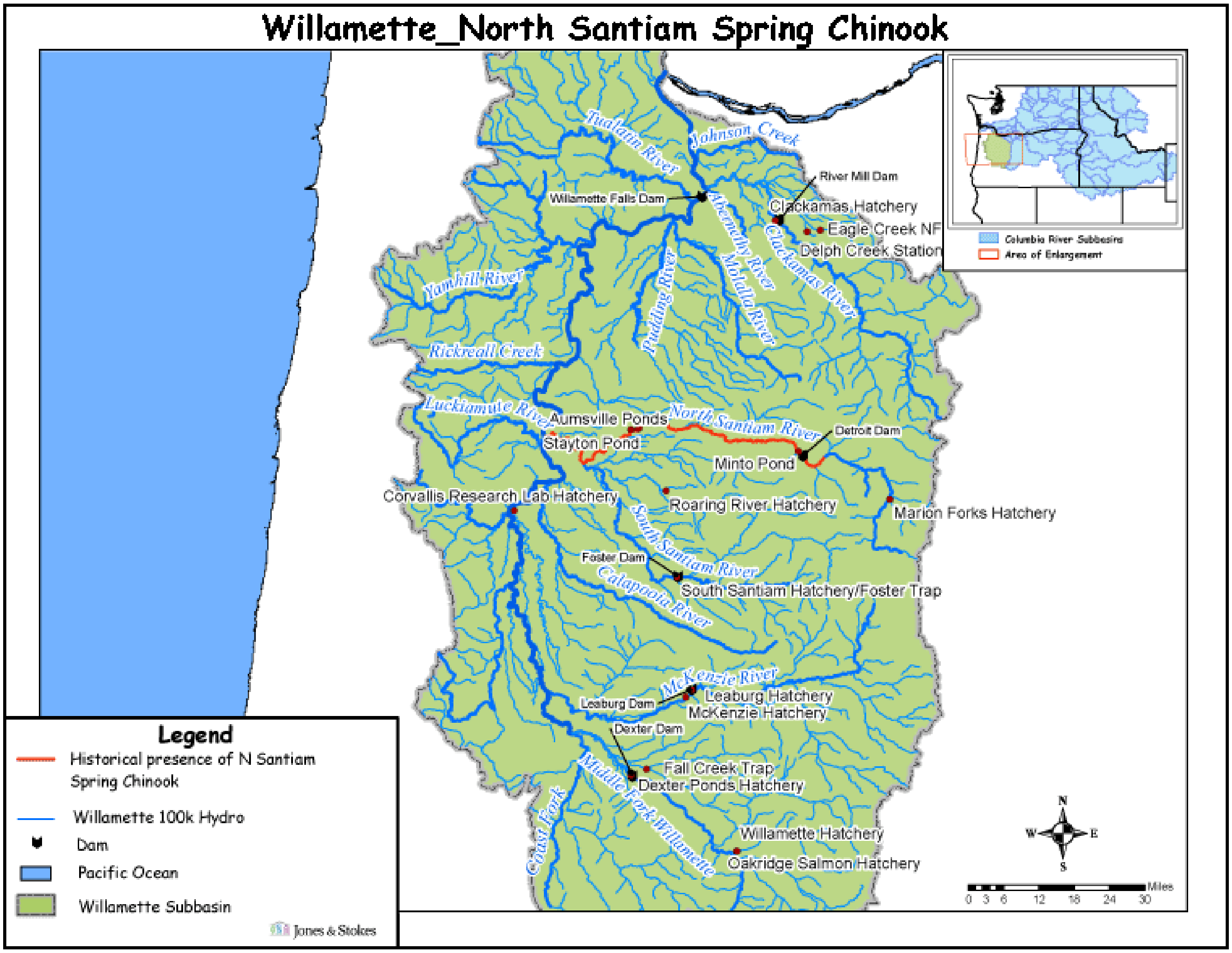
Hatchery Scientific Review Group
Review and Recommendations

Willamette – North Santiam Spring Chinook Salmon Population and Related Hatchery Programs

January 31, 2009



1 North Santiam Spring Chinook Salmon

This population is part of the Upper Willamette River Chinook ESU. Historically, there were seven demographically independent populations of spring Chinook salmon in this ESU: Clackamas, Molalla/Pudding, Calapooia, North Santiam, South Santiam, McKenzie, and Middle Fork Willamette—all eastside tributaries (Meyers et al., 2003). Today, the North Santiam is one of four core populations (Clackamas, North Santiam, McKenzie and Middle Fork Willamette). Historically, the North Santiam sustained a large population and may have the intrinsic capacity to sustain a large population into the future (McElhany et al., 2003) (Subbasin Plan).

Historically, the mainstem North Santiam River was free of natural barriers up to its headwaters, approximately 35 mainstem miles above the current site of Detroit Dam (WNF DRD 1995). Parkhurst et al. (1950) estimated that the historical habitat could accommodate at least 30,000 adults. All access to upstream spawning habitat was lost, because the dam was built without fish passage facilities (Subbasin Plan). Before Detroit Dam was built, adult Chinook salmon spawned in the upper reaches of the North Santiam River and in headwater tributaries such as the Little North Fork, Breitenbush River, Blowout Creek, and Marion Creek (WNF DRD 1994, 1996, and 1997). Mattson (1948) estimated that 71% of the spring Chinook production in the North Santiam subbasin occurred above the dam site. The mainstem Santiam River below the confluence with the North and South Santiam rivers also is believed to have supported spawning spring Chinook salmon (Wevers et al., 1992). Since dam construction, spring Chinook salmon have been restricted to the area below Big Cliff Dam. Currently, spring Chinook salmon spawn and rear primarily in the first 10 miles of the North Santiam River below the Minto barrier weir and trap (Schroder et al., 2001), but also as far downstream as Stayton (Subbasin Plan).

Estimates of the historical abundance of spring Chinook salmon in the North Santiam Subbasin range from 8,250 adults in 1934—excluding fish that spawned downstream of the current site of Detroit Reservoir (in the lower mainstem North Santiam and the Little North Santiam rivers)—to 2,830 in 1947 for the subbasin as a whole (Wallis 1963; Mattson 1948) (Subbasin Plan).

Based on the proportion of marked hatchery adults at return versus release, ODFW (1995) concluded that fewer than 300 naturally produced spring Chinook salmon adults returned to the subbasin in 1994. Currently, the Little North Santiam River watershed has the largest spring Chinook salmon production potential of all accessible streams in the Santiam River Subbasin (U.S. Army Corps of Engineers 2002). Midsummer snorkel surveys of the Little North Santiam River during the period 1991 to 1995 observed adult spring Chinook counts that ranged from 0 to a maximum of 242 in 1994. There are no dams on this tributary and it is not subjected to the negative water temperature impacts from the storage reservoirs. Systematic aerial inventories of fall and spring Chinook salmon spawning within the Santiam River watershed began in 1970. During these inventories, it was difficult to distinguish between spring Chinook salmon and the introduced fall Chinook salmon redds in the lower basin, because so much introgression of fall Chinook spawning into areas once used by spring Chinook salmon had occurred (U.S. Army Corps of Engineers 2002). From 1991 to 1994, redd counts in the North Santiam River upstream of the confluence with the Little Santiam ranged from 80 to 112 (Willis et al. 1995) (Subbasin Plan).

Approximately 296 to 661 spring chinook redds were documented annually between 2001 and 2005 in four areas of the North Santiam basin upstream of Bennett dams (McElhany et al. 2007 review draft). These surveys indicated a relatively low redd density in this population. Of the fish that return nearly all are of hatchery origin (85%-97%). In addition, as seen elsewhere in the Willamette basin, there is a high estimated pre-spawning mortality. Although the pre-spawning mortality estimates are not considered very precise, it appears that more than half the females that return to the river die before spawning. Taken together, these data indicate little, if any, natural production of spring Chinook in the North Santiam.

Before the Willamette Falls fish ladder was constructed, passage by returning adult spring Chinook salmon was possible only during the winter and spring high flow periods, resulting in an earlier run timing relative to other Lower Columbia River populations. The early run timing of the Upper Willamette population is viewed as an adaptation to flow conditions and optimal passage at Willamette Falls (Myers et al. 2003). This adaptation to run timing during optimal flow conditions at the falls has led to significant local genetic adaptation relative to other Columbia River spring Chinook salmon (Myers et al. 2003) (Subbasin Plan).

Spring Chinook salmon begin to appear at the base of Willamette Falls (RM 26) in February. The majority of the run ascends the falls in April and May and completes its migration back to natal spawning grounds through July. Historically, passage over Willamette Falls was likely related to flow and temperature; passage increased when the river levels dropped and water temperatures exceeded 53.0 degrees F (ODFW 1990). As a result of the fish ladder at Willamette Falls, the current run of spring Chinook salmon over the falls extends into July and August, which overlaps with the introduced fall run of Chinook salmon (Subbasin Plan).

The earliest recorded observation of spring Chinook salmon spawning occurred at the North Fork Santiam hatchery rack (RM 65 at a site that is currently under Detroit Reservoir) on August 22, 1947 (Mattson, 1948). Spring Chinook salmon spawned near the rack in mid-August and continued spawning as late as the third week in October (Subbasin Plan). Changes in water temperature regimes from the dams have affected spring Chinook spawn timing. Mattson (1962) noted that as a result of the thermal effects of Lookout Point and Dexter dams, spawning below Dexter was delayed until early October and lasted through November.

Schroeder et al. (2006) reported that based on the otolith data, 12% of the spring Chinook salmon carcasses collected between the Upper and Lower Bennett dams and Minto (including the Little North Santiam River) in 2001 were wild fish; 14% collected in 2002 were wild fish; 3% collected in 2003 were wild fish; and 14% collected in 2004 were wild fish. Schroeder et al. (2006) estimated a natural-origin run of spring Chinook salmon to the North Santiam subbasin of 220 fish in 2001, 604 fish in 2002, 271 fish in 2003, and 489 fish in 2004, based on passage at Upper and Lower Bennett dams, adjusted by the percentage of non-fin-clipped carcasses with induced thermal marks recovered upstream of the dams.

ODFW released a total of 933 hatchery-origin adults into the Breitenbush and North Santiam rivers in 2000 and 1,068 adults in 2001 to assess the potential for establishing a naturally reproducing run above the reservoir. Limited surveys shortly after release indicate that these fish spawned successfully, and snorkel surveys during the summer of 2001 confirmed the presence of naturally produced juveniles (Mamoyac and Ziller 2001) (Subbasin Plan).

Spring Chinook salmon also spawn in the Little North Santiam River up to Henline Creek (Olsen et al. 1992). There appear to be declining numbers of fish in the system, with 801 counted in 1946, 273 in 1954, 236 in 1971, and 242 in 1991 (Willis et al. 1995, BLMS 1998; U.S. Army Corps of Engineers 2000); counts dropped below 16 per year during 1992 through 1995 (Willis et al. 1995). In the period 1998 through 2001, redd counts in the Little North Santiam varied from 11 to 39 (Lindsay et al. 1998) (Subbasin Plan).

Juvenile spring Chinook salmon begin their downstream migration from the North Santiam River at a variety of ages and sizes. Craig and Townsend (1946) showed that juveniles began moving downstream during March, soon after emergence. Changes in the water temperature regimes below the dams also have affected juvenile outmigration patterns. Cramer et al. (1996) report that Chinook salmon fry in the North Santiam River move downstream in late November. This shift in emergence and migration timing is presumed to result from warm incubation temperatures below the dam. Emigration of juvenile fish was continuous throughout summer and fall.

2 Current Conditions

2.1 Current Population Status and Goals

This section describes the current population, status, and goals for the natural population.

- ESA Status: North Santiam spring Chinook are part of the Upper Willamette River Chinook Salmon ESU, which was listed as threatened under the ESA in March 24, 1999 (64 CFR 14308).
- Population Description: The North Santiam spring Chinook population has not been assigned a designation. This population is considered a core population by TRT and was given a Primary designation for the HSRG review.
- Recovery Goal for Abundance: Unknown.
- Productivity Improvement Expectation: Unknown.
- Habitat Productivity and Capacity: A population productivity of 2.0 and capacity of 1,000 was used in the HSRG analysis.

2.2 Current Hatchery Programs Affecting this Population

The native population of spring Chinook in the North Santiam has been affected by hatchery production since the first egg-take by the Oregon Fish Commission (OFC) in 1906 (Wallis, 1963). Although over the past century most of the fish released into the North Santiam have come from locally collected broodstock, stocks outside the ESU also have been released. The current program at Marion Forks Hatchery began in 1951, to mitigate for the loss of spring Chinook production upstream of Detroit and Big Cliff dams (completed in 1953). Hatchery fish have probably spawned in the wild every year since this hatchery program began (Subbasin Plan).

Spring Chinook adults are captured and spawned at Minto pond, located about 31 miles downstream of Marion Forks Hatchery, 4 miles below the base of Big Cliff Dam and adjacent to Minto Dam on the North Santiam River. Broodstock goals are 300 males and 300 females; however, collection has ranged from 400 to over 600 from 1992 to 2002 (2004 HGMP). All fish are reared at Marion Forks Hatchery from early egg incubation to smolt. Marion Forks Hatchery is located 17 miles east of Detroit, Oregon, between Horn Creek and Marion Creek, near the confluence with the North Santiam River (RM 73). Fish are transported to the Minto Pond for short-term acclimation or directly to the North Santiam for release (660,000 yearling release). In addition, 100,000 sub-yearling fingerlings (summer release) are released into Detroit Reservoir. These fish are to provide a resident Chinook fishery and are not expected to contribute to anadromous production.

The target number of natural-origin fish incorporated into the program's broodstock is 180 fish (30% of the broodstock), although the proportion used depends on the number of hatchery and natural-origin fish counted at upper Bennett Dam or at Willamette Falls. During low run years (less than 3,000 fish at upper Bennett Dam), up to 50% of the natural-origin fish may be used as broodstock. During high run years (more than 7,000 fish at upper Bennett Dam), up to 20% of the natural-origin spawning population may be used. Until a low impact video counting/monitoring station is installed at the Bennett dams, counts at Willamette Falls will determine the appropriate percent of natural-origin fish in the broodstock (North Santiam Spring Chinook Draft HGMP 2007). Until 2001, it was not possible to identify wild from hatchery adults returning to Minto. In 2001 all fish used for brood were known hatchery fish. After otolith analysis of unmarked fish incorporated into the hatchery broodstock, it has been determined that <1% of the 2002 and 2003 broodstock were natural-origin fish. In 2004, 2.1% were natural-origin fish. In 2005, 3.6% were natural-origin and in 2006, 36.2% were natural-origin fish (North Santiam Spring Chinook Draft HGMP 2007).

Genetic analyses of naturally produced juveniles from the North Santiam River indicated that the fish were most closely related to other naturally and hatchery-produced spring Chinook from the Upper Willamette River ESU (although they were still significantly different, P>0.05) (Myers et al. 1998). Wild fish probably have been incorporated into the hatchery broodstock since the collections began at the Minto weir. However, until the 2001 return year, hatchery fish could not be distinguished from wild fish, and the numbers of hatchery fish that have spawned in the wild and the numbers of wild fish that have been incorporated into the hatchery program have been unknown. Now that all hatchery fish are externally marked, the current management strategy, as outlined in NMFS 2000, is to incorporate some wild fish into the broodstock and to control the percentage of hatchery fish spawning in the wild (Subbasin Plan). Fish marked in the North Santiam River return primarily to the North Santiam (95%); there are few recoveries outside the upper Willamette River basin (W/LC TRT 2002) (Subbasin Plan).

Estimated number of hatchery strays affecting this population:

- Hatchery strays from in-basin integrated hatchery program: 1,271 fish.
- Hatchery strays from in-basin segregated and out-of-basin hatchery programs: 178 fish.

3 HSRG Review

The HSRG has developed guidelines for minimal conditions that must be met for each type of program as a function of the biological significance of the natural populations they affect. For populations of the highest biological significance, referred to as Primary, the proportion of effective hatchery-origin spawners (pHOS) should be less than 5% of the naturally spawning population, unless the hatchery population is integrated with the natural population. For integrated populations, the proportion of natural-origin adults in the broodstock should exceed pHOS by at least a factor of two, corresponding to a proportionate natural influence (PNI) value of 0.67 or greater. For Contributing populations, the corresponding guidelines are: pHOS less than 10% or PNI greater than 0.5. It is important to note that these represent minimal conditions, not targets. For example, the potential for fitness loss when effective pHOS is 5% is significantly greater than it would be at 3%. For Stabilizing populations, we assume the current pHOS or PNI would be maintained.

The HSRG analyzed the current condition and a range of hatchery management options for this population, including the effect of removing all hatchery influence, and arrived at one or more proposed solutions intended to address the manager’s goals, consistent with the HSRG guidelines for Primary, Contributing, and Stabilizing populations. The solution included in the cumulative analysis is the last option described in the Observations and Recommendations box below.

In order to highlight the importance of the environmental context, two habitat scenarios were considered: current conditions and a hypothetical 10% habitat quality improvement.

See HSRG Observations and Recommendations in the box below for more information.

3.1 Effect on Population of Removing Hatchery

The No Hatchery scenario is intended to look at the potential of the natural population absent all hatchery effects with projected improved fish passage survival in the Snake and Columbia mainstem (FCRPS Biological Opinion May 5, 2008).

Our analysis estimated adjusted productivity (with harvest and fitness factor effects from AHA) would increase from 0.8 to 1.6. Average abundance of natural-origin spawners (NOS) would decrease from approximately 410 fish to approximately 300 fish. Harvest contribution of the natural and hatchery populations would go from approximately 1,750 fish to approximately 80 fish.

3.2 HSRG Observations/Recommendations

In the Observations and Recommendations box below, we describe elements of the current situation (Observations) that were important to evaluate the natural population, and where applicable, the hatchery program(s) affecting that population. We also describe a solution (Recommendations) that appeared to be consistent with manager's goals. However, this is not the only solution. In some cases, more than one solution is described.

Summary results of this analysis are presented in Table 1. The adjusted productivity values reported for each alternative incorporate all factors affecting productivity (i.e., habitat quality, hatchery fitness effects, and harvest rates).

Observations

The hatchery population was established with local stock and has had limited introductions from other stocks. The purpose of the current program (approximately 760,000 smolts) is to provide fish for harvest and to act as a gene bank for North Santiam spring Chinook until access to quality habitat in the upper watershed is reestablished. Significant habitat capacity still exists above the flood control facilities, but there is no juvenile collection or passage. Approximately 30% of the historic habitat capacity is downstream of the dams. If the hatchery programs were terminated, the abundance of natural spawners would drop below 500 fish.

The hatchery program attempts to incorporate natural-origin adults into the broodstock, but does not achieve the standards of a Contributing population, because of insufficient natural production. Unlike other Willamette spring Chinook programs, only one release strategy is used, due to the cold rearing water conditions.

The facility designed for adult collection currently is being used for both adult collection and as an acclimation facility. It is subject to flooding, placing the population at risk.

No quantitative information on habitat capacity and productivity was provided. Given the assumptions used, we were unable to develop any hatchery scenarios (including the no hatchery scenario) that demonstrated improvement over current natural population abundance.

Recommendations

Unless habitat conditions are better than we have assumed or passage conditions are improved, the program is consistent with the criteria for a Stabilizing population. This program should be continued. If and when habitat conditions improve, there is opportunity to manage broodstock and natural escapement composition at Bennett Dam.

Improve or replace the acclimation facilities at Minto Pond. Improvement in adult handling and holding also would be beneficial.

The HSRG recommends that managers continue to implement their apparently successful BKD strategies, which include culling.

Table 1. Results of HSRG analysis of current conditions and HSRG solution for North Santiam Spring Chinook. The light green row indicates the natural population and yellow indicates the segregated hatchery population, if applicable. A 10% habitat improvement is applied to the HSRG Solution to evaluate the additional effect of improved habitat towards conservation objectives.

Alternative	Type and Purpose	Prog Size (/1000)	HOR Recapture	Additional Weir Efficiency	Effective pHOS	PNI	NOS Esc	Adj Prod	Harvest	Hatchery Surplus
Current	Int Both	752.2	50%	0%	73%	0.01	409	0.8	1,748	570
No Hatchery	None None	-	0%	0%	0%	1.00	306	1.6	82	-
HSRG Solution	Int Both	752.2	50%	0%	73%	0.01	409	0.8	1,748	570
HSRG Solution w/ Improved Habitat	Int Both	752.2	50%	0%	71%	0.01	454	0.9	1,760	570