Hatchery Scientific Review Group
Review and Recommendations

Willamette – McKenzie Spring Chinook Salmon Population and Related Hatchery Programs

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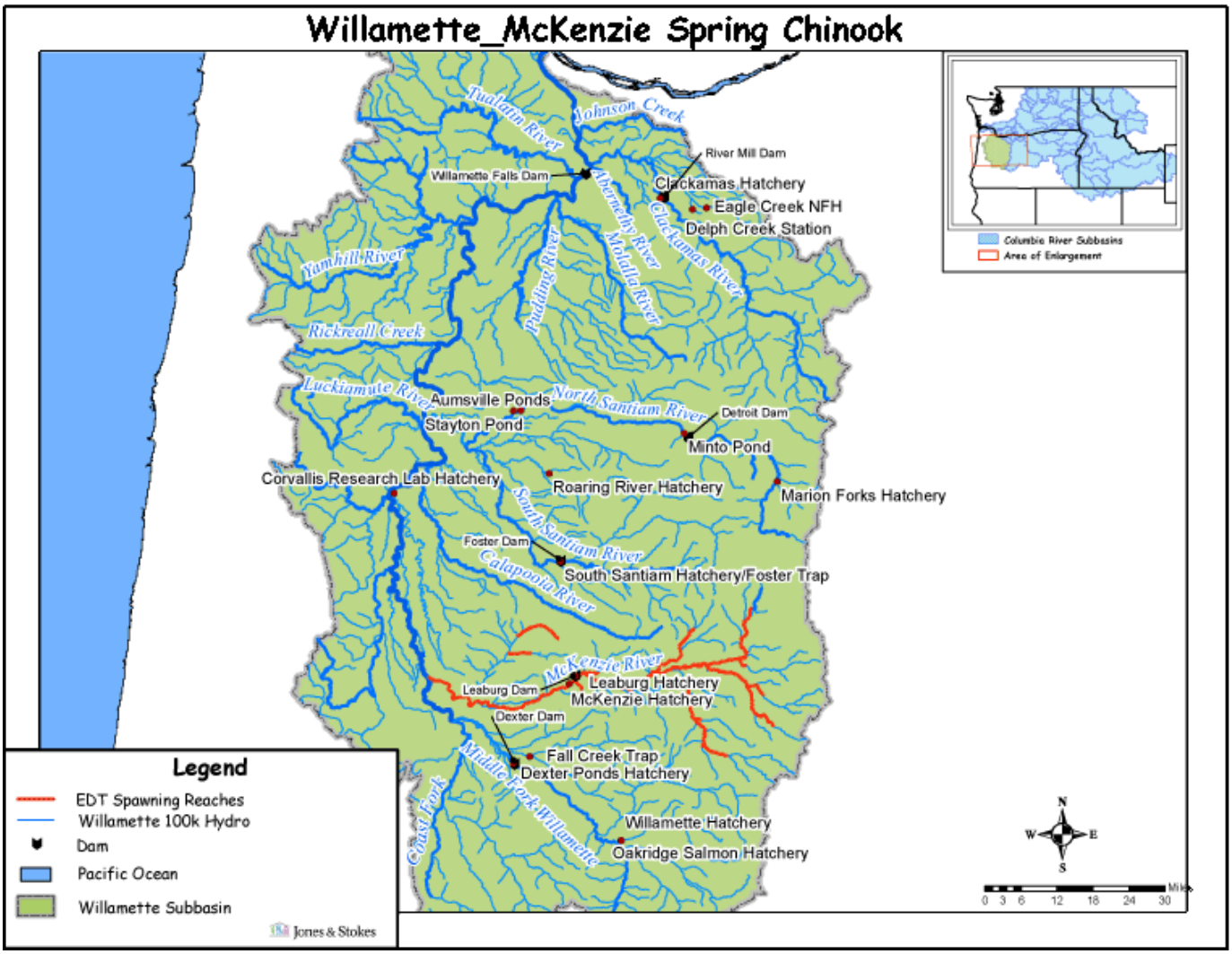

1 McKenzie Spring Chinook Salmon

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 (Meyers et al. 2003). The McKenzie River produced roughly 40% of the spring Chinook run above Willamette Falls (Mattson 1948). Today, four core populations survive in the Clackamas, North Santiam, McKenzie and Middle Fork Willamette subbasins, which historically sustained large populations and may have the intrinsic capacity to sustain large populations into the future (McElhany et al. 2003). The McKenzie subbasin population represents an important element of the genetic legacy of the Upper Willamette ESU. The McKenzie spring Chinook salmon population has been the least influenced by intra- or inter-basin transfers of hatchery stocks and probably has retained a relatively high degree of adaptation to local watershed conditions (Subbasin Plan).

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 run timing adaptation for 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 pass the falls into July and August, which overlaps with the introduced fall run of Chinook salmon (Subbasin Plan).

The timing of the run in the McKenzie River is monitored at Leaburg Dam, where passage usually peaks in June (Howell et al. 1988). A smaller pulse moves above the dam during the September spawning period. The period of peak passage appears to depend on temperature, occurring as early as the second half of May in warmer water years and as late as the first part of July in cooler years. Homolka and Downey (1995) calculated that spring Chinook salmon upstream of Leaburg Dam spawned from very late August until mid-October in 1992, with the peak centered on September 23, representing a shift to later spawning compared to the historical pattern. From 1902 through 1907, hatchery operations on the McKenzie began egg takes in early- to mid-August, and peak egg collections generally occurred during the second week of September (Howell et al. 1988). Changes in water temperature regimes from the dams have affected the spawn timing. In addition, when compared to historical patterns, the current duration of the spawning period appears to have decreased by two-thirds or more from 1919 through 1985 (Lichatowich 2000) (Subbasin Plan).

Historical spawning areas included the mainstem McKenzie River, Smith River, Lost Creek, Horse Creek, South Fork, Blue River, and Gate Creek (Mattson 1948; Parkhurst et al. 1950). It has been estimated that historically there was suitable habitat for 80,000 fish in the McKenzie River Subbasin (Parkhurst et al. 1950). Cougar Dam, at RM 4.5 on the South Fork McKenzie River, was built in 1963 and blocked access to at least 25 miles of high-quality spawning habitat. In 1956, 805 redds were observed in the South Fork (Willis et al. 1960). Although Cougar Dam

was built with fish passage facilities, these did not function as intended and were not used to pass fish until after 1966. Construction of Blue River Dam (at RM 1.8 in 1968) blocked a smaller amount of habitat; the Blue River watershed probably supported a historical population of about 200 adult Chinook salmon (WNF BRRD 1996). The Eugene Water and Electric Board (EWEB) completed construction of its Carmen-Smith project on the upper mainstem McKenzie River in 1963. Of the three dams that make up the Carmen- Smith project, Trail Bridge Dam cut off access to about 4 miles of historical spring Chinook salmon spawning habitat and Smith Dam cut off about 3 miles. Carmen Smith Dam is above a natural barrier to migration (Tamolich pool and falls).

Currently, the McKenzie subbasin supports the largest existing population of Upper Willamette River spring Chinook salmon. From 1994 through 2001, the total escapement to the McKenzie River ranged from 2,992 to 9,548 adults, with an average of 4,726. Downstream of Leaburg Dam, most spring Chinook spawners are hatchery-produced (U.S. Army Corps of Engineers 2000). The total escapement to Leaburg Dam ranged from 1,176 (84% NOR) to 4,428 (76% NOR) adults with an average of escapement of 2,080; the weighted average composition of natural-origin fish over this time period was 72%. For the period 2001-2006, natural-origin recruits made up 60 to 84% of the spring Chinook run above Leaburg Dam, based on carcass recoveries (HGMP 2008).

Most of the current natural production of spring Chinook salmon is above Leaburg Dam (RM 39). Based on aerial redd surveys, approximately 10 to 20% of the Chinook salmon that spawn above Leaburg Dam use the lower few miles of the South Fork McKenzie River (that is, below Cougar Dam), 30 to 40% spawn in the mainstem McKenzie below the confluence with the South Fork, and 45 to 60% spawn in headwater areas above the mouth of the South Fork up to Trail Bridge Dam (USFWS 1994; ODFW 1999a).

The population long-term geometric mean is about 1,500 natural-origin spawners, which is in the very low risk minimum abundance threshold category (McElhany et al. 2007 review draft). In recent years (1990-2005), the geometric mean of natural-origin spawners was 2,104, with an average hatchery fraction of 0.329.

Juvenile McKenzie River spring Chinook salmon demonstrate a variety of outmigration and rearing patterns, varying in nature between years. Zakel and Reed (1984) defined three life history types of wild Chinook at Leaburg Dam:

- Age-0 fry that migrate in late winter through early spring
- Age-0 fingerlings that migrate in the fall
- Yearling smolts that migrate in early spring

Juvenile spring Chinook salmon have been observed passing Willamette Falls as fry, but most appear to rear in the lower McKenzie and mainstem Willamette system. Studies in the 1960s confirm the pattern of rearing in the mainstem of rivers. Scale analyses of returning adults indicated that only 10% had entered the ocean as sub-yearlings, suggesting that a large proportion of the juveniles observed migrating downstream had overwintered in the mainstem Willamette or Columbia rivers (Mattson 1963). ODFW has found spring Chinook fingerlings up some valley floor tributaries as far as 20 miles from the mainstem. Juvenile spring Chinook have been observed during the winter in seasonal streams in the lower Calapooia Subbasin (Colvin, Oregon State University, personal communication, 2004).

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: McKenzie 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 McKenzie spring Chinook population has not been assigned a designation. This population is considered a genetic legacy 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: Productivity 4.5; Capacity 8,000.

2.2 Current Hatchery Programs Affecting this Population

Currently, there is an integrated spring Chinook hatchery program at McKenzie Hatchery. Broodstock collection and all rearing occur within the McKenzie Hatchery. Broodstock goals are 500 males and 500 females. Approximately 350,000 yearlings are released onsite in November and 848,750 age 1+yearlings are released the following February/March (HGMP 2003). In addition, up to 100,000 sub-yearlings are trucked and released in the Mohawk River, tributary to the lower McKenzie River (personal communication, Kelly Reis, ODFW, January 2008).

A number of hatcheries have operated on the McKenzie River since the early 1900s. The McKenzie River Salmon Hatchery, located on Highway 126 between Leaburg and Vida, collects returning hatchery adults and some spring Chinook of natural origin. Broodstock for this program originated from fish collected upstream at the Leaburg Trout Hatchery (near Leaburg Dam) and from mainstem reaches and tributaries of the McKenzie River. Relatively few intra-basin transfers have been received compared to other Upper Willamette River Chinook salmon hatchery stocks. The 2008 HGMP for McKenzie spring Chinook provides a sliding scale for a maximum number of natural-origin fish to be incorporated into the broodstock. This number varies based on the estimated return to the McKenzie subbasin as indexed by Willamette Falls counts through May 31. Broodstock incorporates 20 to 40% natural-origin fish, provided that no more than 20% of the wild run is taken. However, until 2001, when all of the hatchery fish (through age 5) returning to the McKenzie were fin-clipped, the unmarked fish collected for broodstock may have included some of hatchery origin. Since 1996, the percentage of the broodstock of known natural origin has ranged from 9% to 25% (Kruzic 2003); according to ODFW (2003), an average of at least 15% wild fish has been incorporated into the McKenzie Hatchery broodstock each year since 1997 (Subbasin Plan).

Conversely, the rate of spawning by hatchery Chinook salmon in the wild has been high; hatchery fish constituted 50 to 95% of the natural spawners below Leaburg Dam from 2002 through 2005 (HGMP 2008). ODFW (1998) found that coded-wire tags collected from carcasses in the McKenzie River below Leaburg Dam included strays from Clackamas and South Santiam hatchery stocks that had been transferred to McKenzie Hatchery for rearing, but then released in the Clackamas and South Santiam subbasins. Similar recoveries of non-McKenzie hatchery stock were made in 1997 (ODFW 1997). To limit introgression of hatchery fish into the naturally

spawning population, NMFS (2000) directed the federal action agencies for the Willamette Basin hatchery program (the U.S. Army Corps of Engineers and BPA) to limit the number of hatchery-origin fish allowed to pass above Leaburg Dam. However, the Leaburg trap has been inadequate for removing all the hatchery fish during the peak of the run without some level of injury to natural-origin fish.

There are considerable differences in outmigration timing of native and hatchery-produced spring Chinook salmon (Kenaston 2003). Most of the sub-yearlings PIT-tagged at Leaburg Dam during the fall passed Willamette Falls the next spring (March though May). The passage of migrating yearlings tagged at Leaburg Dam during the spring peaked at Willamette Falls in May. The median transit time for tagged yearlings from Leaburg Dam to Willamette Falls was 46 days in 2001 and 53 days in 2002 (Schroeder et al. 2001 and 2002). In comparison, the median travel time to Willamette Falls for juvenile spring Chinook released from the Leaburg Hatchery was 6 days.

Estimated number of hatchery strays affecting this population:

- Hatchery strays from in-basin integrated hatchery program: 577 fish.
- Hatchery strays from in-basin segregated and out-of-basin hatchery programs: 180 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 3.2 to 3.6. Average abundance of natural-origin spawners (NOS) would increase from approximately 4,500 fish to approximately 5,150 fish. Harvest contribution of the natural and hatchery populations would go from approximately 3,100 fish to approximately 1,400 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

This population is one of only two strongholds of natural spring Chinook in the Willamette Basin and therefore is important to the recovery of the ESU. Current hatchery management is consistent with designation as a Primary population.

Productive habitat exists above the dams and population abundance could be increased if juvenile fish passage were provided.

The program currently has some difficulty meeting its recently defined management objective of collecting 25% natural-origin broodstock. With more effective broodstock management, a larger integrated hatchery program could be accommodated and still be consistent with the designation of this as a Primary stock.

Recommendations

The current program could be improved by upgrading trapping facilities to collect natural-origin broodstock and manage the composition of natural spawners upstream of Leaburg Dam.

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 McKenzie 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	1,265.6	80%	0%	10%	0.71	4,495	3.2	3,107	1,730
No Hatchery	None None	-	0%	0%	0%	0.00	5,154	3.6	1,375	-
HSRG Solution	Int Both	1,265.6	80%	0%	10%	0.71	4,495	3.2	3,107	1,730
HSRG Solution w/ Improved Habitat	Int Both	1,265.6	80%	0%	9%	0.74	5,259	3.6	3,311	1,730