Hatchery Scientific Review Group
Review and Recommendations

Lower Yakima Mainstem Fall Chinook
Population and Related Hatchery Programs

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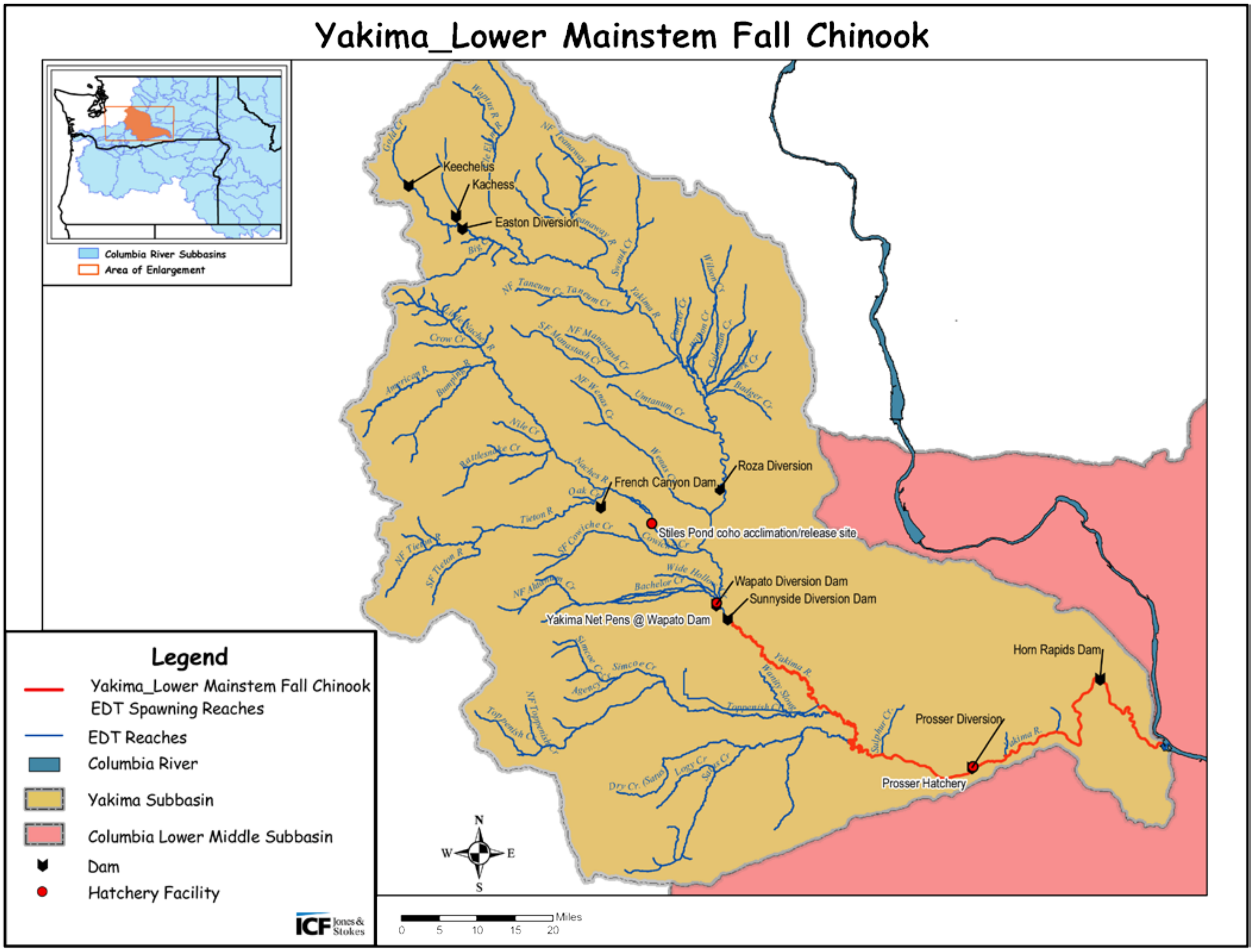

1 Lower Yakima Mainstem Fall Chinook

It is unclear whether a distinct stock of fall Chinook historically existed in the Yakima subbasin or whether fall Chinook in the Yakima have always been a satellite population of Hanford Reach Upriver Brights (URBs). Certainly, the mainstem population is now such a satellite. Based on an electrophoretic analysis of allozyme samples collected from spawning fish in Marion Drain, the mainstem near Benton City, and the mainstem above Prosser Dam, Busack et al (1991) concluded that the Yakima mainstem stock was genetically distinct from the Marion Drain stock, and that the mainstem stock is indistinguishable from Hanford Reach URBs. The scant literature on the subject suggests that historical abundance of fall Chinook probably ranged from about 38,000 (Kreeger and McNeil 1993) to 100,000 fish (1990 Yakima Subbasin Plan). The Kreeger and McNeil figure is based on the assumption that the proportion of the historical fall Chinook run in the Yakima should be the equal to the proportion of the area of the historical Columbia Basin watershed represented by the Yakima subbasin (3.8%). The Yakima Subbasin Plan based its estimate on the amount of suitable spawning habitat for Chinook historically present in the Yakima subbasin and the area occupied by a typical Chinook redd.

The mean adult fall Chinook spawning escapement in the mainstem Yakima River from 1998 to 2006 can be roughly estimated as 5,700 fish, with a range of 1,940 to 13,846. The estimate is crude because turbidity makes redd counts in the lower Yakima unreliable, and because prior to 2003, approximately half of all fall Chinook redds were deposited below the Prosser Dam counting station[1]. The 5,700 fish number represents an expansion of annual Prosser Dam counts expanded by the annual estimate of below-Prosser spawning, plus harvest below Prosser.

Fall Chinook spawn in the Yakima mainstem from Sunnyside Dam (RM 103) downstream almost to the Columbia confluence. Redds are distributed patchily throughout the river. Prior to 2001, the largest and most heavily utilized area was between Horn Rapids Dam (RM 18) and the Benton City Bridge (RM 30). Since then, spawning activity has shifted upstream and is now concentrated between the Chandler Power Plant outfall (RM 35.8) and Prosser Dam (RM 47). From 2001 to 2004, an average of 50% of the return was estimated to spawn above the power plant outfall; in 2005 and 2006, 80% of the spawning escapement occurred above the outfall (Hoffarth-WDFW, personal communication, 2006). Spawning location can vary depending on the amount of submerged aquatic vegetation growth in historic spawning beds in the lower Yakima. When water conditions are favourable for growth of aquatic vegetation in the lowermost reaches of the river, the salmon spawn in areas further upstream. Spawn timing is relatively concentrated above Prosser Dam, beginning about the middle of October, peaking the first week of November, and ending by the third week of November. Spawning in the lower mainstem, however, apparently includes some fish that spawn much later than the norm. WDFW biologists operated a screw trap in the lower river in 1990 and captured 35-mm newly-emergent fry in May, when most fall Chinook were 80- to 100-mm smolts (Busack et al. 1991). A spawning timing of late December or early January would be consistent with a May emergence. On the basis of mean water temperatures and 1,600 temperature units for emergence of fall Chinook (Piper 1987), emergence does not occur in the mainstem before late March and extends into the third week of April. Curt Knudsen (WDFW, personal communication, 1992) estimated

[1] Since 1998, the proportion of the mainstem fall Chinook spawning escapement occurring below Prosser Dam has ranged from 20 to 70% (P. Hoffarth, WDFW, personal communication, 2007). In the 1980s and early 1990s, the proportion was estimated to be ~70%. Several irrigation districts discharging waste water in the lower Yakima River substantially reduced the suspended sediments in their discharges in the mid-1990s. The clarity of the lower Yakima subsequently increased substantially, and an explosive growth of aquatic vegetation occurred inside major fall Chinook spawning reaches. The upriver shift of fall Chinook spawning from the 1980s to the present time may be attributable to vegetation-clogged spawning areas in the lower river.

that the mean proportion of fish that were ocean age 1 through 4 in the mainstem stock was, respectively, 12%, 12%, 66% and 11%, and that the sex ratio for the mainstem stock was 46% males and 54% females. By contrast, the age distribution for Marion Drain fish for the same ages was 48%, 46%, 6% and 0%, and the sex ratio was 73 to 86% males and 14 to 27% females.

Prior to 1999, in-basin harvest of fall Chinook was virtually nonexistent. Since 1999, terminal harvests have ranged from 34 to 2,300 fish, with a mean of 1,025 (HGMP). The Yakama Nation has estimated terminal harvest averages around 12%.

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: Lower Yakima mainstem fall Chinook are part of the Upper Columbia Summer/Fall Chinook run, which NOAA has determined does not warrant listing under the ESA at this time.
- Population Designation: Using a rating system similar to that used by the recovery planners for the Lower Columbia and Willamette results in a designation of Contributing.
- Current Viability Rating: Unknown; SaSSI rates as Healthy.
- Recovery Goal for Abundance: NA, because not listed.
- Productivity Improvement Expectation: Unknown
- Habitat Productivity and Capacity (from EDT): Productivity: 3.29; Capacity: 14,989

2.2 Current Hatchery Programs Affecting this Population

Two hatchery programs currently target the lower Yakima mainstem: a segregated program releasing approximately 1.7 million Little White Salmon (LWS) sub-yearling smolts per year, and an integrated program releasing an average of 320,000 Yakima River stock sub-yearlings per year. Both releases are made at Prosser Hatchery (RM 46.8). The LWS program is the result of the US *v.* Oregon Columbia River Fish Management Plan, which established a short-term production goal for the Yakima subbasin requiring the annual release of 1.7 million Little White Salmon URBs. The long-term production goal for the Yakima subbasin is predicated on construction of a hatchery with a capacity of 3.0 million URBs. The LWS program is part of mitigation for the lost natural production of tens of thousands of adult spawners due to flooding of mainstem habitat from construction of John Day Dam, and is partially funded by the Mitchell Act. The Yakima River stock program is an element of the Yakima/Klickitat Fisheries Project and is funded by BPA.

<u>Little White Salmon Program</u>. From the inception of the LWS program until 1993, two approximately equal releases were made annually, one in the vicinity of Sunnyside Dam at RM 103, and one below Prosser Dam at RM 47. When the Prosser Hatchery, located just below Prosser Dam, was completed in 1994, all LWS releases were shifted there, partly because of the very low survival rates of smolts in the reach from Sunnyside Dam to Prosser Dam.

Fry are trucked from the Little White Salmon Hatchery to large acclimation ponds at Prosser Hatchery in early March. These fish rear in the acclimation ponds until early to mid-April when a volitional release to the river occurs. The size of fish at release varies from 55 to 74 fish per pound. The release time is variable, because water temperatures in the lower Yakima can become lethal in the late spring. Releases as early as late April have occurred during the hottest years and as late as the end of May in cooler years.

In BY2006, an experimental element was added to the LWS program. Specifically, the effect of accelerated vs. conventional release timing was assessed for the LWS stock. This experiment entailed the transfer of 500,000 eyed-eggs in the late fall from LWS to Prosser Hatchery for incubation and rearing. The resulting sub-yearlings were released in 2007, along with the accelerated Yakima-stock fish. Smolt survival for the LWS and Yakima-stock accelerated releases was 34% and 41%, respectively (Neeley 2007). Paired LWS/Yakima-stock releases were made again in BY2007: another 500,000 LWS eyed eggs were to be imported, and the resulting juveniles to be released along with the accelerated Yakima-stock fish and the LWS fish brought in as fry in March. A total of 10,000 fish from each LWS group (accelerated/ conventional) will be PIT-tagged to allow comparison of relative smolt-to-adult survival rates between groups. Currently, only 10% of the 1.7 million LWS fish are coded-wired-tagged and adipose-clipped, limiting the ability to estimate survival. The implementation of PIT-tagging for accelerated and conventional LWS releases will allow SARs between accelerated and conventionally released LWS fish to be compared.

Yakima Program. The "Yakima Program" refers to a separate fall Chinook hatchery program that collects broodstock inside the Yakima River. The intent of this program is to develop a locally-adapted broodstock and, over time, to increase production until the importation of LWS fish can be discontinued.

The Yakima Program collects broodstock from the channel between the headworks of Chandler Canal (at Prosser Dam) and the rotary drum smolt bypass screens about 1 mile below. Adult fall Chinook that pass the ladders above Prosser Dam and, for whatever reason, go back downstream, quite frequently enter Chandler Canal, where flows are low, the spill over the dam crest is minimal, and the thalweg leads directly into the headworks of the canal. Since the program began in 1997, from 100 to 500 adults have been taken as broodstock. Fish in excess of broodstock needs are removed from the canal and released in the river. Because hatchery fall Chinook released into the Yakima River have never been 100% marked, the proportion of naturally-spawned fish in the broodstock cannot be estimated with any precision. Yakama Nation biologists estimate it is probably on the order of 10%. The proportion of Marion Drain fish in the broodstock has not been determined, but is thought to be very small (HGMP).

From its inception, the Yakima Program has been experimental. The original experimental goal was to develop a procedure by which healthy, actively migrating fall Chinook smolts can be produced by mid- to late-April. If successful, passage through the lowermost portions of the river could occur before temperatures become too high. Accordingly, for BYs 1998-2004, approximately half of the Yakima-stock juveniles were assigned to an accelerated group and half to a conventional rearing group. During this time, 100% of these fish were differentially marked with left or right pelvic clips. None of the Yakima stock smolts are coded-wire tagged or adipose-clipped, but between 2,000 and 4,000 are PIT-tagged to facilitate survival estimates. Ponding occurred in the third week of January for the accelerated group and in the second week of February for the conventional group. The accelerated group was usually released around April 20 and the conventional group around May 20. Both groups were allowed a two-week volitional release period, after which all fish were forced into the river. The survival of smolts from release to McNary Dam for release years 1999 to 2005 was greater for the accelerated group than for the conventional group in all years except 2000. Since 2005, the majority of Yakima-stock have been reared using an accelerated treatment.

Beginning with BY2006, the Yakama Nation began another experimental rearing treatment using an in-basin stock to compare an accelerated sub-yearling release vs. a yearling release. A total of

9,000 sub-yearlings (BY2006) were held initially to see if they could be reared to yearlings. About 93% of the retained sub-yearlings survived, and all were released mid-April of 2008 with an equal number of sub-yearlings. Both groups were 100% adipose-clipped and PIT-tagged for monitoring. This experiment will continue with approximately 10,000-fish groups of marked sub-yearlings and marked yearlings being released (simultaneously) in April for a minimum of 3 years. The yearling releases may yield a higher smolt survival and ultimately higher adult returns, accelerating the development of a locally adapted brood stock source.

The total number of Yakima-stock smolts released from 1999 to 2005 has ranged from 192,000 to 561,000, with a mean of 372,000.

Estimated number of hatchery strays affecting this population:

- Hatchery strays from in-basin integrated hatchery program: 285 fish.
- Hatchery strays from in-basin segregated and out-of-basin hatchery programs: 413 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 0.6 to 1.3. Average abundance of natural-origin spawners (NOS) would increase from 758 to 1,247. Harvest contribution of the natural and hatchery populations would go from 5,712 to 2,115.

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 program is sustained by annually importing fall Chinook from outside the basin, a practice that is inconsistent with sustaining natural production. With current facilities, it is not possible to collect sufficient broodstock to sustain a hatchery program.

Current collection facilities are located upstream of historic spawning reaches, making it difficult to collect natural broodstock for an integrated program.

Due to low natural productivity, high pHOS levels and current pre-terminal harvest rates, this population cannot meet the standards of a Contributing population if the hatchery program is managed as a segregated harvest program. If adequate adult collection were possible, the population could sustain an integrated program of 500,000 and be consistent with the standards of a Primary population. Alternatively, the population could sustain an integrated program of 1,000,000 and be consistent with the standards of a Contributing population. If hatchery fish are harvested at a higher rate than wild fish, it may be possible to support larger programs.

Approximately 10% of the hatchery fish are marked. This prevents an accurate determination of the composition of natural-origin fish in the broodstock and on the spawning ground.

Due to changes in habitat conditions in the lower river, spawning habitat has been reduced.

Recommendations

Regardless of the population designation, developing the capability to collect local broodstock should be the first priority. This would increase survival and the likelihood of meeting harvest and conservation goals.

Mark all juveniles from this program to make it possible to identify and manage the origin of broodstock, monitor the natural-origin population and achieve desired harvest rates for hatchery and natural-origin population components.

Implement the most effective means for capturing broodstock.

The HSRG recommends that managers implement a BKD control strategy for their spring and summer/fall Chinook hatchery programs where BKD has proved a recurring problem. Ideally, the strategy should include culling (destroying) eggs/progeny from hatchery- and natural-origin brood that are found to be infected with the BKD agent. However, because brood fish with high levels of the BKD agent are more likely to transmit the agent to their progeny than brood with lesser levels of the agent, the culling of eggs/progeny from infected brood fish, should, at the very least, be applied to those with high levels of the BKD agent (e.g., ELISA OD value of 0.4 and above when broodstock are not in short supply and ELISA OD value of 0.6 and above when broodstock are in short supply). In addition, in programs using ESA-listed natural-origin brood fish, the culling of their eggs/progeny may, at the managers' discretion, be dispensed with.

However, the ESA-listed broodstock should be injected, pre-spawning, with an appropriate antibiotic (preferably, azithromycin at 40 mg/kg fish), and the resulting eggs should be surface-disinfected with an iodophor. All pre-spawning brood injections may be limited to females, ESA-listed or otherwise.

Finally, eggs and hatchlings derived from broodstock found to be heavily infected with the BKD agent should be incubated/reared in isolation from those obtained from broodstock with no or lesser levels of the BKD agent. In addition, the hatchlings should be reared at the lowest possible densities (below current standards), and, at the first signs of infection with the BKD agent, they should be treated with orally administered erythromycin (100 mg/kg fish) for 28 days. The treatment should be repeated if there is evidence that the BKD agent has persisted in the hatchlings.

Table 1. Results of HSRG analysis of current condition and HSRG Solution for Lower Yakima Mainstem Fall 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 Harv	346.6	45%	0%	42%	0.11	758	0.6	2,219	92
	Seg Harv	1,701.0	5%						3,493	102
No Hatchery	None None	-	0%	0%	0%	1.00	1,247	1.3	2,155	-
HSRG Solution	Int Harv	2,010.1	50%	0%	60%	0.40	1,212	0.7	7,896	984
	Seg Harv	-	90%						-	-
HSRG Solution w/ Improved Habitat	Int Harv	2,010.1	50%	0%	54%	0.43	1,546	0.8	8,474	984
	Seg Harv	-	90%						-	-