ROGUE SPRING CHINOOK SALMON CONSERVATION PLAN COMPREHENSIVE ASSESSMENT AND UPDATE

OREGON DEPARTMENT OF FISH AND WILDLIFE

January 4, 2019

ODFW MISSION
TO PROTECT AND ENHANCE OREGON'S FISH AND WILDLIFE AND THEIR HABITATS FOR USE AND ENJOYMENT BY PRESENT AND FUTURE GENERATIONS

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1. Executive Summary

In September 2007, the Oregon Fish and Wildlife Commission formally adopted the *Rogue Spring Chinook Salmon Conservation Plan*, a conservation plan developed under Oregon's Native Fish Conservation Policy for spring Chinook Salmon in the Rogue Species Management Unit. The plan calls for annual reports on SMU status in relation to desired status, as well as comprehensive assessments of the efficacy of the plan during intervals not to exceed every 15 years. This document is the first comprehensive assessment, and summarizes progress towards the attainment of desired status with the management strategies adopted in the conservation plan.

Returns to the Rogue River of naturally produced spring Chinook Salmon (NPCHS) have improved since adoption of the conservation plan, but have not yet achieved desired status (10 year average ≥ 15,000). The 10 year average has increased from 7,596 fish in 2007, when the plan was adopted, to 9,663 fish in 2017. Among other status elements in the plan, desired status criteria are currently being met for September spawner distribution (% above Shady Cove) and spawner composition (% hatchery). In addition, observations from recent years have shown substantial spawning activity in early September, timing that is consistent with historical observations for NPCHS in the Rogue River.

A variety of actions related to management strategies identified in the *Rogue Spring Chinook Salmon Conservation Plan* have been implemented. These include seasonal changes in operation of Lost Creek Reservoir by the U.S. Army Corps of Engineers (USACE) to benefit spring Chinook; removal or notching of three mainstem dams on the Rogue River to improve fish passage; changes in fishery management to protect early-run NPCHS; development of a preseason forecast of abundance, and habitat enhancement on Big Butte Creek. Moving forward, ODFW will not only continue close coordination with USACE to ensure that reservoir operations meet fishery enhancement requirements, but will also request gravel augmentation below the dam; pursue funding to place spawning gravel in Big Butte Creek; and develop a pilot project to encourage harvest of non-native pikeminnows. Management actions implemented since adoption of the Conservation Plan have improved the status of spring Chinook Salmon, and planned actions will build on this progress.

Based on the improved current status of NPCHS and beneficial management actions that have been implemented, additional fishery opportunities are proposed for NPCHS that are consistent with re-building toward desired status. The proposed regulation changes are tied to abundance triggers and continue to avoid direct harvest of the earliest portion of the run. Recent genetic research has indicated that protecting early returning fish is critical for conserving NPCHS in the Rogue River. Additional research on the genetic composition of Chinook Salmon in the Rogue River is planned, and will help inform future management decisions.

Finally, although the abundance of NPCHS has increased since adoption of the *Rogue Spring Chinook Salmon Conservation Plan*, hatchery returns have not met expectations in recent years. Several management actions are planned or underway to improve hatchery performance and returns. Specific changes include: increased hatchery production poundage, replacing the hatchhouse water supply and treatment infrastructure to minimize disease, lowering rearing densities, altering release size and timing to improve survival, and selecting broodstock to better

match the historical age and run timing of NPCHS above Lost Creek Reservoir. In addition, a trap has been constructed at the Cole Rivers Hatchery outfall to reduce the number of hatchery spring Chinook on the spawning grounds. Collectively, these actions are expected to produce stronger hatchery returns in coming years, improve fishing opportunities, and reduce risk from hatchery spring Chinook to NPCHS.

Overall, plan implementation has been successful, with NPCHS returns increasing, desired status criteria either improving or being met, and major actions completed or on-going. No major revisions to the plan's desired status or management strategies are warranted or proposed with this *Comprehensive Assessment and Update*. However, this *Comprehensive Assessment and Update* calls for ODFW to continue plan implementation actions, improve several aspects of monitoring, evaluation, and research, and adaptively manage the fishery for improvements through: 1) a cautious abundance-based increase in fishing opportunity on NPCHS consistent with not having reached a desired status to date, 2) changes to the hatchery spring Chinook program to strengthen performance.

2. INTRODUCTION

In September of 2007, the Oregon Fish and Wildlife Commission (OFWC) formally adopted the Rogue Spring Chinook Salmon Conservation Plan (hereafter referred to as "Plan"), which is a conservation plan developed under Oregon's Native Fish Conservation Policy (Oregon Administrative Rule 635-007-0502 through 0509) for Spring Chinook Salmon in the Rogue Species Management Unit (SMU). The Plan calls for the Oregon Department of Fish and Wildlife (ODFW) to complete annual reports that will include, at least, the following elements: (1) SMU status in relation to the desired status and conservation status statements embedded in the conservation plan, (2) summaries of annual efforts to monitor SMU attributes, (3) implications of any research or evaluation projects completed during the reporting year, (4) any updated assessments of population attributes completed during the reporting year, and (5) presentation of the rationale associated with any changes in management actions made during the reporting year. The information in the annual reports also constitutes the same information to be provided in the status reviews described in the Plan. Ten annual reports have been completed. A copy of the conservation plan, along with annual progress reports previously completed, is available on the ODFW website at:
http://www.dfw.state.or.us/fish/CRP/rogue_spring_chinook_conservation_plan.asp

The Plan also calls for a comprehensive assessment to occur within 15 years. This document serves as an early comprehensive assessment of the Plan. Within this document, the ODFW will evaluate current status relative to desired status using metrics described in the Plan; provide updates on completed management actions; and list recommendations for further actions needed towards attainment of desired status of NPCHS defined within the Plan.

The Plan outlines several management strategies and actions to address primary limiting factors and achieve desired levels of various measureable criteria (abundance, spawner distribution, spawner composition, persistence): reservoir operation; limiting spawning habitat; and fishery impacts that exceed optimum for a portion of the population. **The Plan also outlined management strategies and actions to maintain at sustainable levels of abundance the historical life history characteristics of NPCHS. This was an important preference coming from the Public Advisory Committee, which advised ODFW during development of the Plan, because early run NPCHS were the fish that declined most precipitously following dam construction.** Early run NPCHS are generally larger, migrate the farthest upstream to spawn, spawn the earliest, enter the river when conditions are better for fishing in the lower river, and are available for longer time in the fishery in the upper river. Serendipitously, emerging information from genetic research has also indicated that protecting early returning fish is critical for conserving NPCHS in the Rogue River.

Implementation of the Plan began in 2008. Immediate reductions in freshwater harvest increased spawner escapement in 2008-2011, but it was not until 2012 that offspring produced after Plan implementation began to dominate the annual returns. In the remainder of this document, the phrase "initial post-Plan returns" refers to the 2008-2011 returns while the phase "full post-Plan returns" refers to the 2012-2017 returns.

3. MONITORING RESULTS AND SMU STATUS

Monitoring of SMU attributes is designed to produce metrics that characterize the current status of the SMU. All possible monitoring needed to update SMU status was completed by ODFW each year, with results from 2017 presented in Table 1 and Table 2.

The ability to monitor NPCHS changed significantly with the removal of Gold Ray Dam in 2010 and the allied loss of the fish counting station. Beginning in 2011, all monitoring has been based on counts of spring Chinook Salmon carcasses found (1) in the Rogue River between Cole M. Rivers Hatchery and the historical pool upstream of Gold Ray Dam and (2) in the lower mile of Big Butte Creek. These locations are the primary spawning areas of NPCHS in the Rogue River Basin (Figure 1).

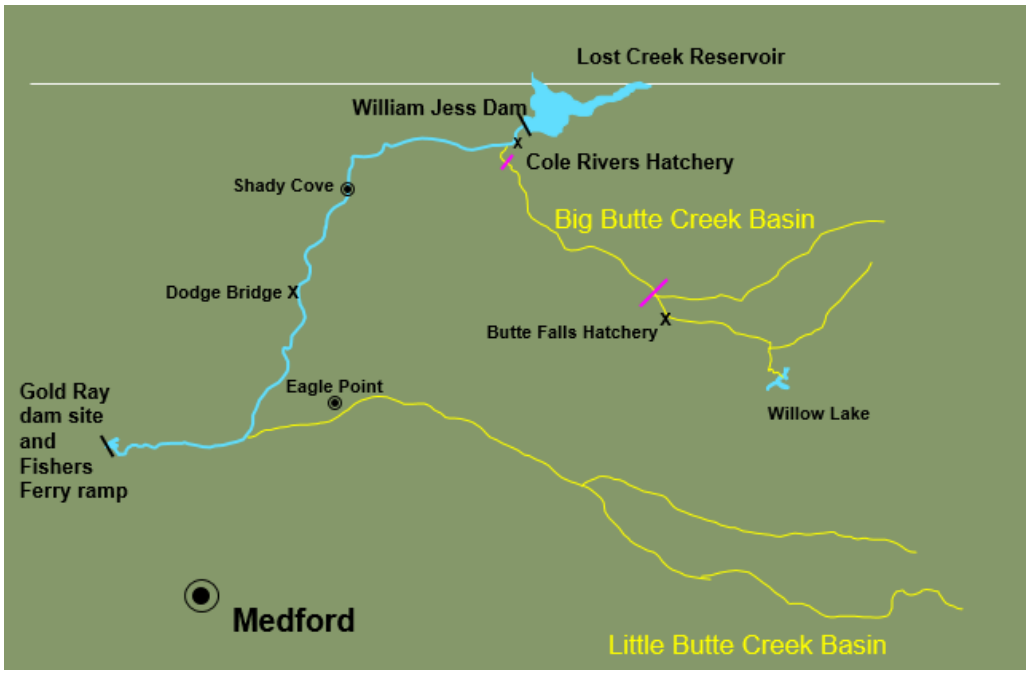

Figure 1. Map of primary Spring Chinook spawning habitat in the upper Rogue River.

Before Gold Ray Dam was removed, ODFW calibrated results from spawner surveys to dam counts. This relationship is now used to estimate abundance at the former dam site using spawner surveys. During the 2004-2010 surveys of fish that spawned in September, carcass counts of naturally produced fish averaged 15% (95% confidence interval = ±2%) of the number of live counterparts that passed Gold Ray Dam. This relationship will be used to estimate the number of live fish that passed the historical site of Gold Ray Dam, until some better estimation methods can be developed through future analyses or research. However, no analogous methods could be devised to estimate the percentage of jacks in the run and adult migration timing at Gold Ray Dam. These two management criteria for NPCHS in the Rogue SMU were thus abandoned beginning in 2011. Results for the three criteria identified in the Plan that are still being monitored are presented below, along with several additional indicators of status.

Table 1. Comparisons of singular elements of desired status for NPCHS in the Rogue Spring Chinook Salmon Species Management Unit with current status at the time of plan adoption and in 2017. Desired status elements are described in the conservation plan, and the plan also called for the description of current status based on average values noted during the previous ten years (where available).

Status Element	Desired Status	Current Status (2007)	Current Status (2017)	2017 Est.
Abundance (at Gold Ray Dam)	**≥15,000**	**7,596(98-07)**	**9,663(08-17)**	**10,240[a]**
Sept. Spawner Distr.[b] (% above Shady Cove)	**≥40%**	**61% (03-07)[c]**	**58% (08-17)**	**61%**
Spawner Composition (% hatchery)	**≤15%**	**14% (04-07)[c]**	**5% (08-17)**	**1%**

[a] *Metric estimated as described in the text.*

[b] *This element only covers September spawners because October spawners cannot be distinguished from fall Chinook salmon that spawn in overlapping areas.*

[c] *Ten years data not available at the time*

Table 2. Status of the Rogue Spring Chinook Salmon Species Management Unit as compared to adopted conservation criteria. Conservation criteria are based on a three year running average, except where noted

Status Element	Conservation Criterion	Conservation Status (years)
Abundance[a] (at Gold Ray Dam)	**<3,500**	**10,240(2017)[b]**
Abundance (at Gold Ray Dam)	**<5,000**	**11,711 (2015-2017)**
Sept. Spawner Distribution[c] (% above Shady Cove)	**<30%**	**54% (2015-2017)**
Spawner Composition[d] (% hatchery)	**>25%**	**1.5% (2016-2017)**

[a] *During any single year.*

[b] *Metric estimated as described in the text.*

[c] *This element only covers September spawners because October spawners cannot be distinguished from fall Chinook salmon that spawn in overlapping areas.*

[d] *Average during two consecutive years*

Abundance (at Gold Ray Dam)

An estimated 10,240 NPCHS passed the historical site of Gold Ray Dam during 2017 (Table 1). This estimate was derived from the recovery of 1,510 carcasses of unmarked fish and 26 carcasses of unexamined fish (all assumed to be naturally produced). Since adoption of the Plan, current status for abundance (10-year average) has increased from 7,596 NPCHS in 2007 to 9,663 NPCHS in 2017 (Table 1). Although abundance of NPCHS has not reached desired status, it currently far exceeds the conservation criterion identified in the Plan (Table 2). Rogue fish have experienced a multi-year drought 2013-2015, historically warm ocean temperatures in 2014 and one of the largest El Niño's on record in 2015-2016. Nevertheless, analysis of trends in Rogue River NPCHS abundance show a significant difference between the period before (1981-2007) and the period after (2008-2017) Plan implementation (Figure 2).

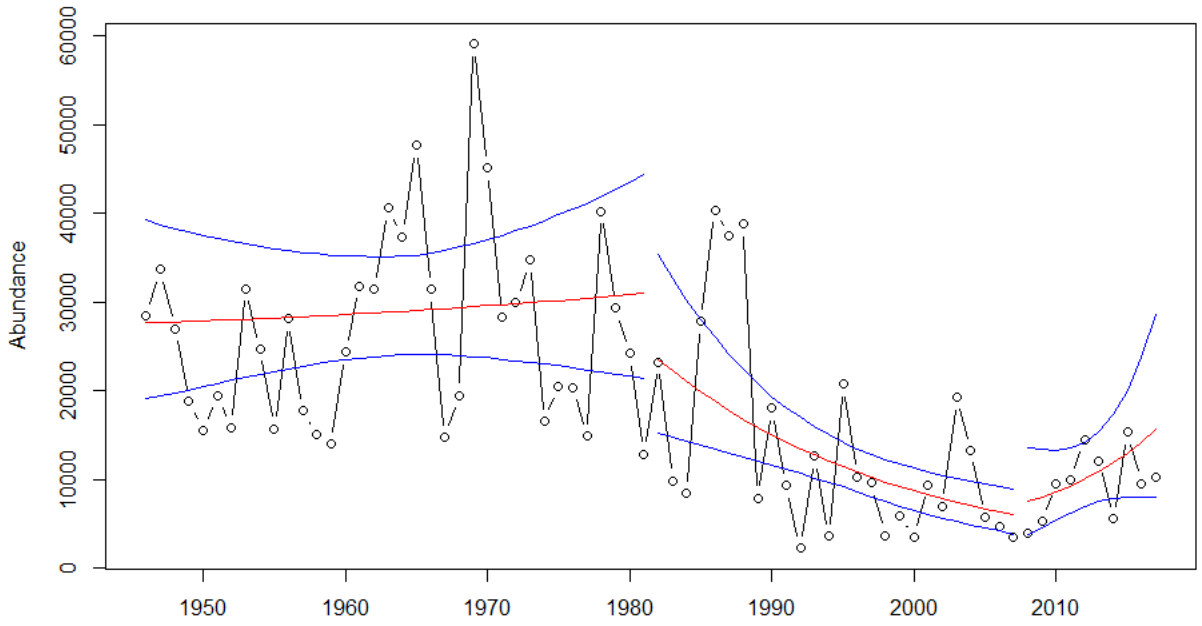

Figure 2. Abundance of NPCHS in the Rogue River above historical Gold Ray Dam site, 1946-2017. Red lines indicate trends before construction of William Jess Dam (1946-1980), after dam construction and before implementation of the Plan (1981-2007), and after Plan implementation (2008-2017). Trend lines, 95% credible intervals (blue lines), and statistical comparisons are based on geometric mean rate of inter-annual change.

Comparing trends in abundance of Rogue NPCHS to nearby Chinook populations has been utilized as an assessment technique since Rogue Basin Project studies associated with dam construction by the US Army Corps of Engineers (USACE). North Umpqua spring Chinook Salmon have a local/southern distribution in the ocean similar to Rogue NPCHS, and abundance has historically co-varied between the two populations (Figure 3). The primary report on Spring Chinook (ODFW 2000) used a comparison of Rogue NPCHS abundance pre- and post-dam

construction relative to a statistical control (North Umpqua NPCHS) to verify the impact William Jess Dam/Lost Creek Reservoir on Rogue NPCHS. Data for this analysis considered post-dam returns to begin in 1981, four years following the completion of Jess Dam/Lost Creek Reservoir in 1977. Most Rogue NPCHS return as four year old adults.

To compare trends in abundance between Rogue and North Umpqua NPCHS, we used Analysis of Covariance (ANCOVA). Five ANCOVA models were compared to evaluate potential differences between the two populations during periods before (1981-2007) and after (2008-2017) Plan implementation. ANCOVA models were compared using an information theoretic approach, which indicated support for multiple models. Although this analysis did not identify significant differences between the two populations, abundance trends since 2012 (full post-Plan returns) do suggest divergent trends in recent years. From 2012 to 2017, NPCHS abundance in the North Umpqua River declined considerably, but Rogue NPCHS abundance remained relatively stable (Figure 4). NPCHS in the Trinity River in northern California provide additional context regarding spring Chinook Salmon trends in the region. Trinity NPCHS abundance generally tracked Rogue NPCHS abundance before Plan implementation (Figure 3), but has declined sharply in recent years (Figure 4). Continued monitoring of these populations in coming years will help determine if this short-term pattern indicates a significant difference in NPCHS abundance trends between the Rogue and neighboring populations following Plan implementation.

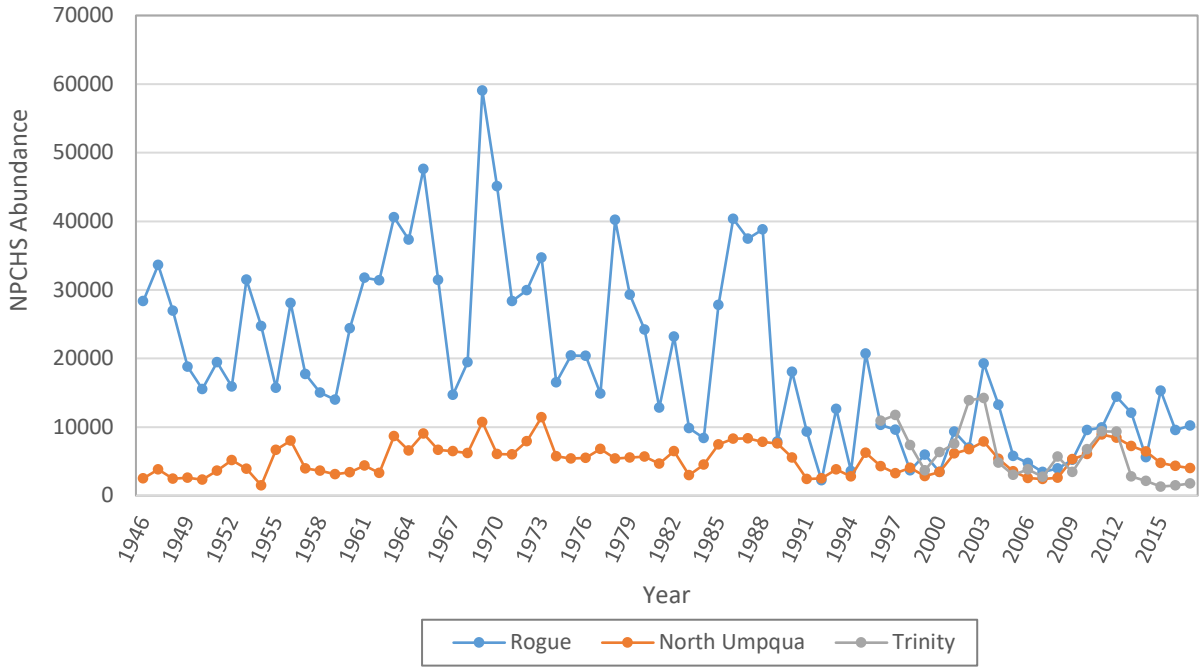

Figure 3. NPCHS abundance in the Rogue River and the North Umpqua River since 1946 when monitoring began at Winchester Dam. Estimated NPCHS abundance in the Trinity River since 1996 (CDFW 2018) is also shown.

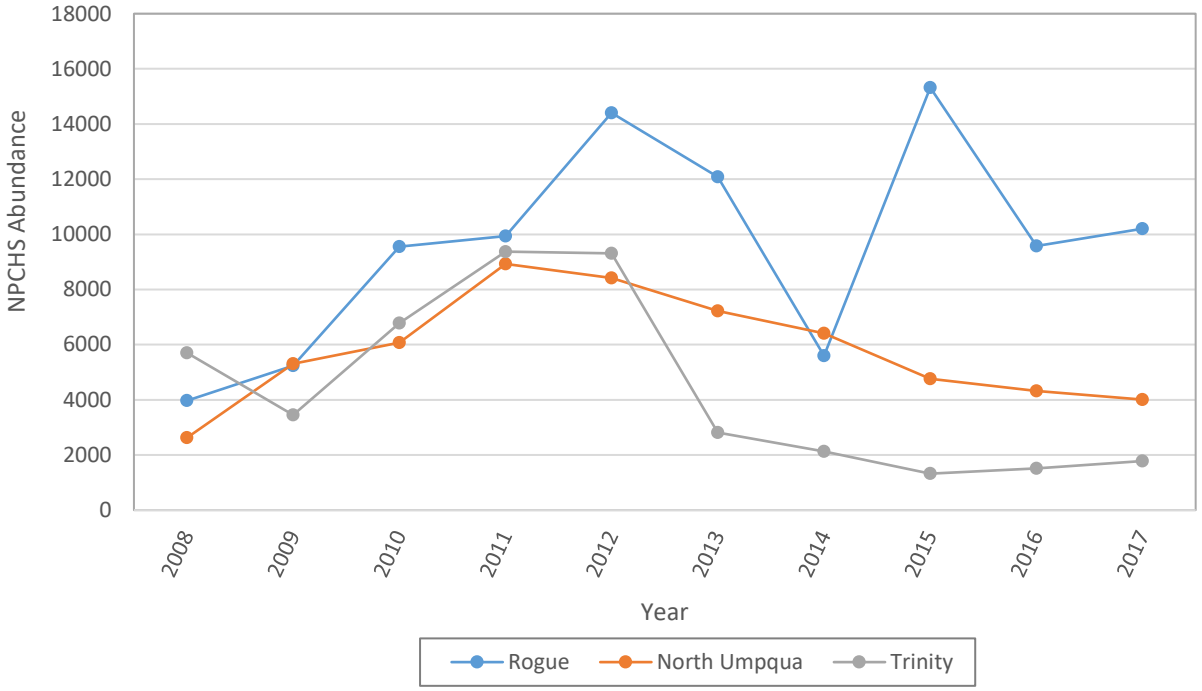

Figure 4. NPCHS abundance in the Rogue River and neighboring spring Chinook populations in the North Umpqua River and Trinity River (CDFW 2018) since Plan implementation began in 2008.

Using the approach from Rogue Basin Project studies described above (ODFW 2000), trends in abundance of Rogue NPCHS can also be expressed as a percentage of combined populations of Rogue NPCHS and North Umpqua NPCHS (Figure 5), or as a percentage of the total abundance of naturally produced spring and fall Chinook Salmon in the Rogue River (Figure 6). Fall Chinook Salmon in the Rogue River tend to return at a younger age than NPCHS, and so abundance comparisons in Figure 6 are based on fall Chinook Salmon abundance the year before corresponding NPCHS returns. Groupings in Figures 5 and 6 correspond to returns before William Jess Dam/Lost Creek Reservoir (before 1981), post-dam returns before conservation plan implementation (1981-2007), initial post-Plan returns (2008-2011) and full post-Plan returns (2012-2017). The contribution of Rogue NPCHS to total NPCHS abundance in the Rogue River and North Umpqua River declined following construction of William Jess Dam/Lost Creek Reservoir (Figure 3; ODFW 2000), but appears to be trending upward in recent years (Figure 5). The same is true for the contribution of Rogue NPCHS to the total abundance of naturally produced Chinook Salmon in the Rogue River (Figure 6). There is substantial variation in these relationships and additional years of data will be needed to determine if the trend observed in recent years represents a significant change following Plan implementation.

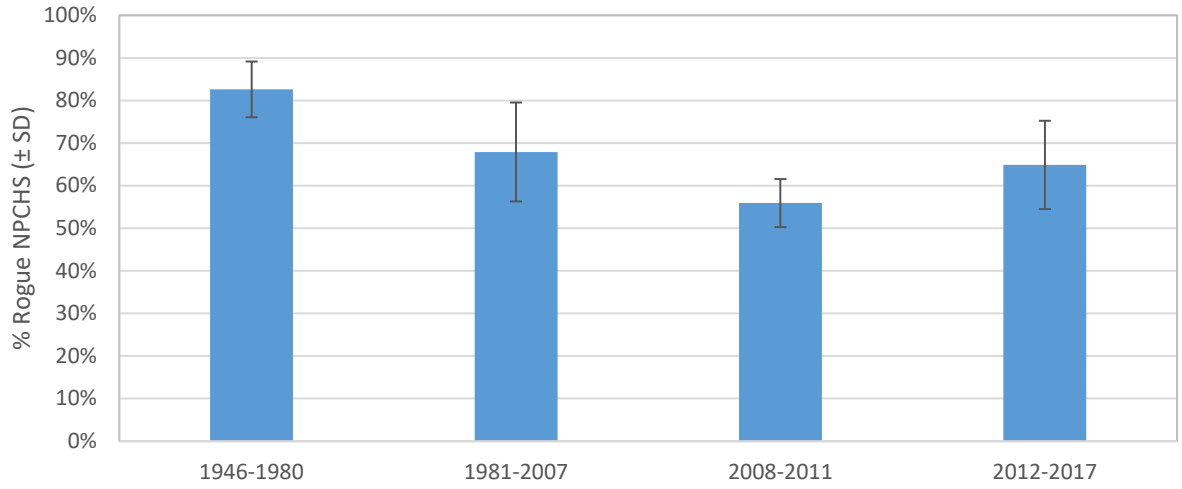

Figure 5. Rogue NPCHS abundance as a percentage of combined Rogue NPCHS and North Umpqua NPCHS abundance (± standard deviation).

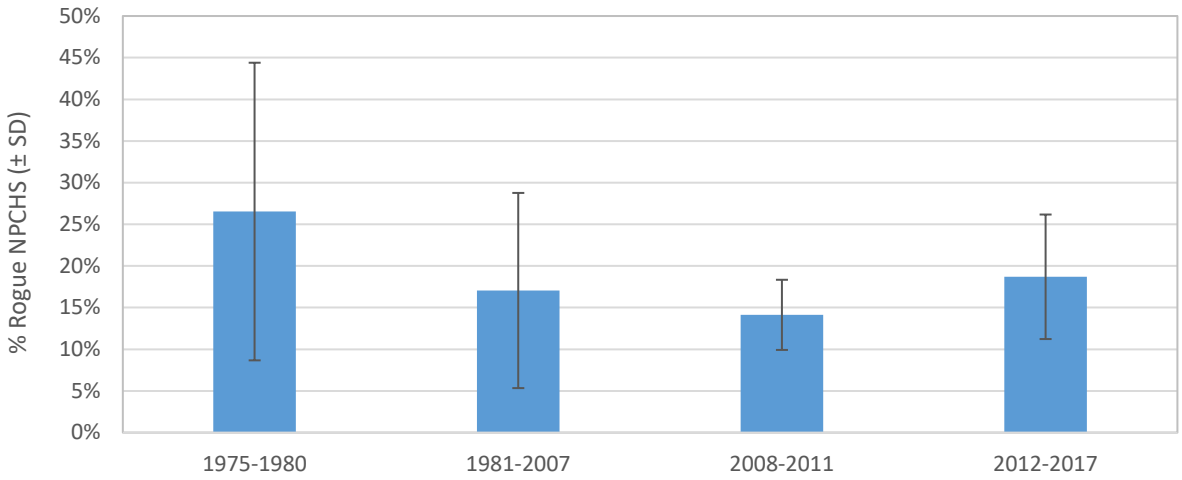

Figure 6. Rogue NPCHS as percentage of combined Rogue NPCHS and Rogue naturally produced fall Chinook Salmon (year N-1) abundance (± standard deviation).

September Spawner Distribution (% above Shady Cove)

The percentage of September NPCHS spawners that spawn upstream from the Highway 62 bridge in Shady Cove currently exceeds the desired status criterion of 40%, and has not changed appreciably since 2007 (Table 1).

Spawner Composition (% hatchery)

The percentage of hatchery fish among spring Chinook spawning naturally in the Rogue River was only 1% in 2017, and has average 5% over the last 10 years. These values are far below the desired status identified in the Plan, and have dropped substantially from the percentage of hatchery spawners at the time the Plan was adopted (Table 1).

Additional Status Indicators

Spawn Timing

A primary metric for monitoring progress toward restoring the historical life history characteristics of Rogue NPCHS and the early run portion of the population was the migration timing metric. This can no longer be monitored following the removal of Gold Ray Dam. September spawner distribution remains as a related metric, since previous surveys found that almost all early run NPCHS spawn upstream of Dodge Bridge (eight miles below Shady Cove). This metric also provides a tool for identifying a loss of spawning habitat quantity and quality downstream of Jess Dam. Now additional data are being collected during spawning surveys that provide evidence of rebuilding among the early run component.

Rogue Basin Project studies documented a shift toward later spawn timing of NPCHS in the river below William Jess Dam/Lost Creek Reservoir following construction of the dam (ODFW 2000). Cole Rivers reported in 1943 that the onset of NPCHS spawning was around September 1st near the site of McLeod (two miles below barrier dam at Cole Rivers Hatchery). In post-impoundment broods, early September spawning was stilled observed below William Jess Dam, but dropped substantially from pre-dam levels (ODFW 2000). The Plan, adopted in 2007, states that, "Spawning takes place from the middle of September through the end of October".

The Plan focuses on restoring the early run component of NPCHS, which are the fish that spawned early as well. Surveys conducted since post-Plan broods began to return are finding evidence of spawning in early September. In each year surveyed since 2013, NPCHS have been observed spawning in late August or early September between Cole Rivers Hatchery and Shady Cove, a reach that includes McLeod. In 2013-2014 and 2017-2018, the Rogue was floated in a driftboat to count redds from Cole Rivers Hatchery to the boat ramp in Shady Cove. In 2016, the survey consisted of spot checks from the banks of the river at Rogue Elk Park and McGregor Park. No survey was conducted in 2015. Results are in Table 3 below.

Table 3. Observations of early September spawning by NPCHS in the Rogue River, 2013-2018.

Survey Date	Reach	Observations
Sept 4, 2013	Cole Rivers to Shady Cove	50 redds
Sept 5, 2014	Cole Rivers to Shady Cove	35 redds
Sept 7, 2016	Rogue Elk and McGregor	redds observed
Aug 30, 2017	Cole Rivers to Shady Cove	23 redds (some vacant) and 22 spawning adults
Aug 30, 2018	Cole Rivers to Shady Cove	9 redds, 22 live adults spawning
Sept 6, 2018	Cole Rivers to Shady Cove	88 redds, 139 live adults spawning

The presence of redds in early September with post-Plan returns is a positive sign that management actions taken to protect early run NPCHS are helping maintain historical life history characteristics. Increased spawning during this period would be an indicator of re-building of the early run portion of the population. An annual survey of redds is proposed to monitor this return of early spawning fish. With the help of volunteers in our Salmon Trout Enhancement Program (STEP), ODFW will implement an annual boat survey beginning in 2018 from Cole Rivers Hatchery to Shady Cove to quantify early September spawning.

Age Structure

With the removal of Gold Ray Dam in 2010, ODFW lost the ability to track the proportion of jacks in the population of NPCHS, one of the original metrics for desired status in the Plan. Since 2010, ODFW has been retrieving scales from a sub-sample of carcasses collected during spawning ground surveys in order to collect age composition data for each run year. These data are critical for recruit per spawner analyses, pre-season forecasting and monitoring brood year survival. An additional benefit of aging returns is the ability to track the contribution of age classes to a return year/brood year. Earlier returning, older NPCHS were more prevalent before William Jess Dam/Lost Creek Reservoir became operational (ODFW 2000). After adjusting for changes in age selective harvest, studies found that about 50% of NPCHS produced before the dam matured at age five. After dam construction, about 50% of NPCHS matured at age four (ODFW 2000).

Age composition is important, because older fish tend to return earlier when water conditions are better for fishing in the lower river, and then are present in the fishery for a longer time in the upper river. The Plan focuses on restoring the early run component of NPCHS, which should mean more age five NPCHS on the spawning grounds. Therefore, age data may also assist tracking the restoration of early run NPCHS. Below are graphs showing the age composition of spawners in each return year since scale collection began in 2010 based on the estimated number of spawners (Figure 7) and the proportion of returning spawners (Figure 8). No statistically significant trends in age structure have emerged, but there is some indication that the proportion of age 4 spawners has declined while the proportion of age 5 spawners has increased during the period from 2010-2017 (Figure 8). The 2017 return year was a notable exception to this pattern, with a lower proportion of age 5 fish, and higher proportions of age 2 and age 3 fish compared to previous years. ODFW plans to continue collection and analysis of scales to track age composition as an important status indicator.

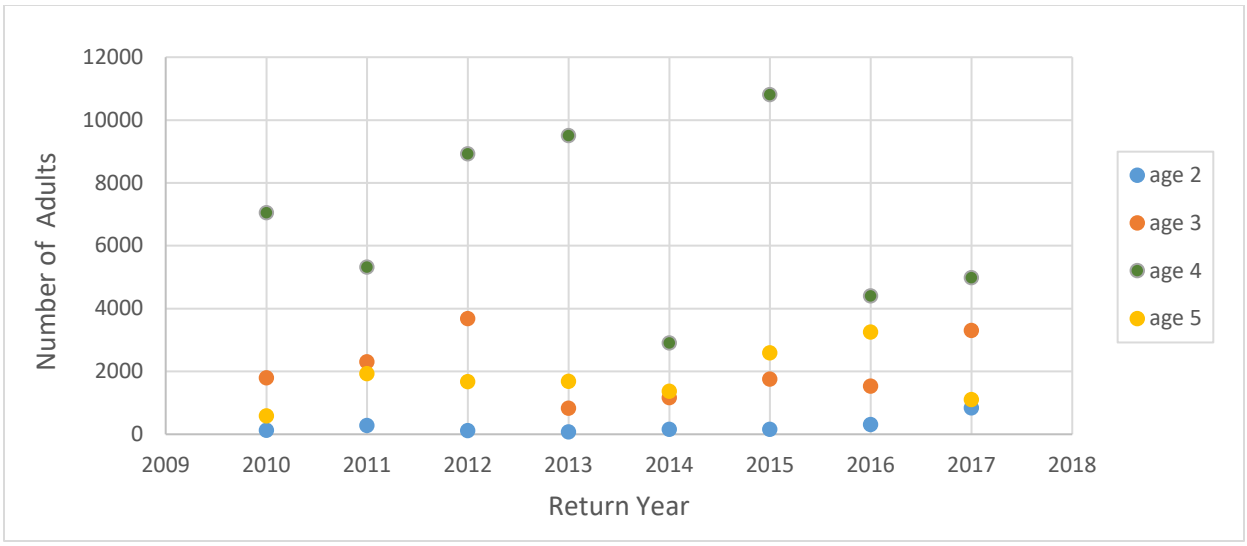

Figure 7. Estimated number NPCHS adults of four different ages based on scale samples collected from NPCHS post-spawn carcasses in 2010-2017.

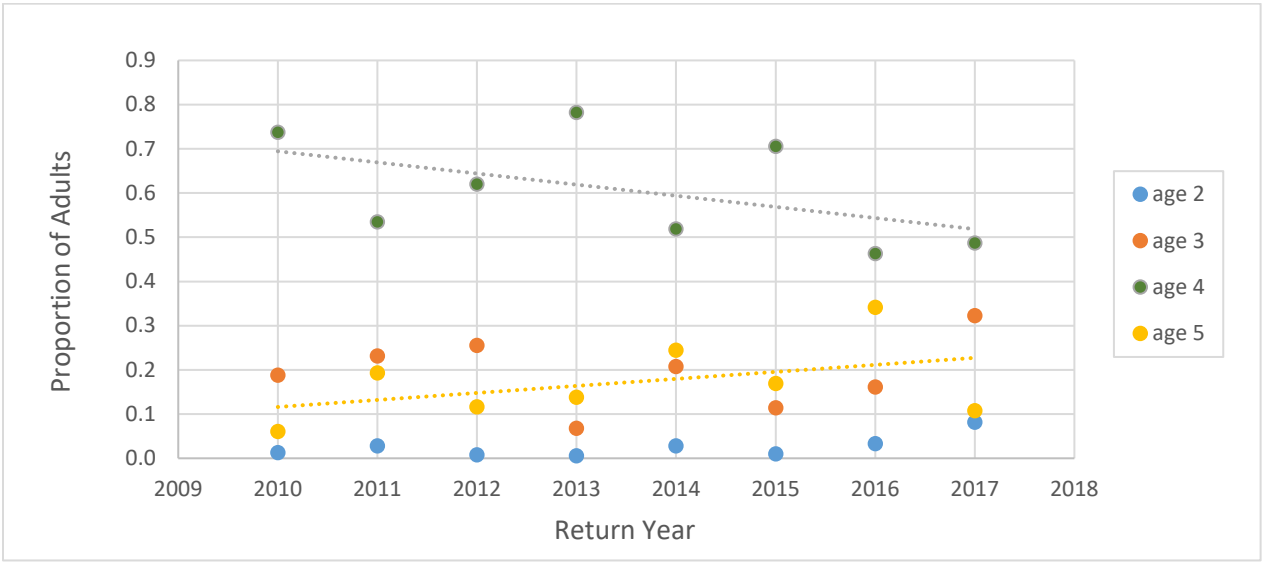

Figure 8. Estimated proportion of NPCHS adults of four different ages based on scale samples collected from NPCHS post-spawn carcasses in 2010-2017. Dotted lines indicate linear trend lines for the proportion of age 4 and age 5 adults, neither of which were statistically significant.

Recruits Per Spawner

This review provides the first update of the recruits per spawner analysis since the Plan adoption. To start, models were run to test the effect of environmental variables on recruitment. None of the models indicated the environmental variables had a meaningful effect on year to year

survival. The variable most closely (not statistically significant) correlated with year to year survival was the onset of spring upwelling.

Therefore, ODFW has determined that a basic Ricker model is the best fit for Rogue NPCHS data at this time. The Ricker model illustrated in Figure 9 uses known age data from 1981-1994, estimated age data from 1995-2009, and known age data from 2010-2016. The recruits per spawner (R/S) model results are for the historical Gold Ray Dam site, meaning the number of NPCHS adults estimated at Gold Ray Dam each year, and recruits counted at Gold Ray Dam in subsequent years. Freshwater harvest was added to the estimate of recruits, but ocean harvest and pre-spawn mortality were not. The abundance level where the population is at equilibrium (Neq), with the number of spawners producing a similar number of recruits, is very close to the desired status level of 15,000 listed in the Plan. In the future, when sufficient post-Plan returns are available, it will be valuable to update this analysis by comparing pre- and post-Plan recruits per spawner. Future updates to the analysis could also potentially incorporate information from research on the genetics of Rogue Chinook Salmon.

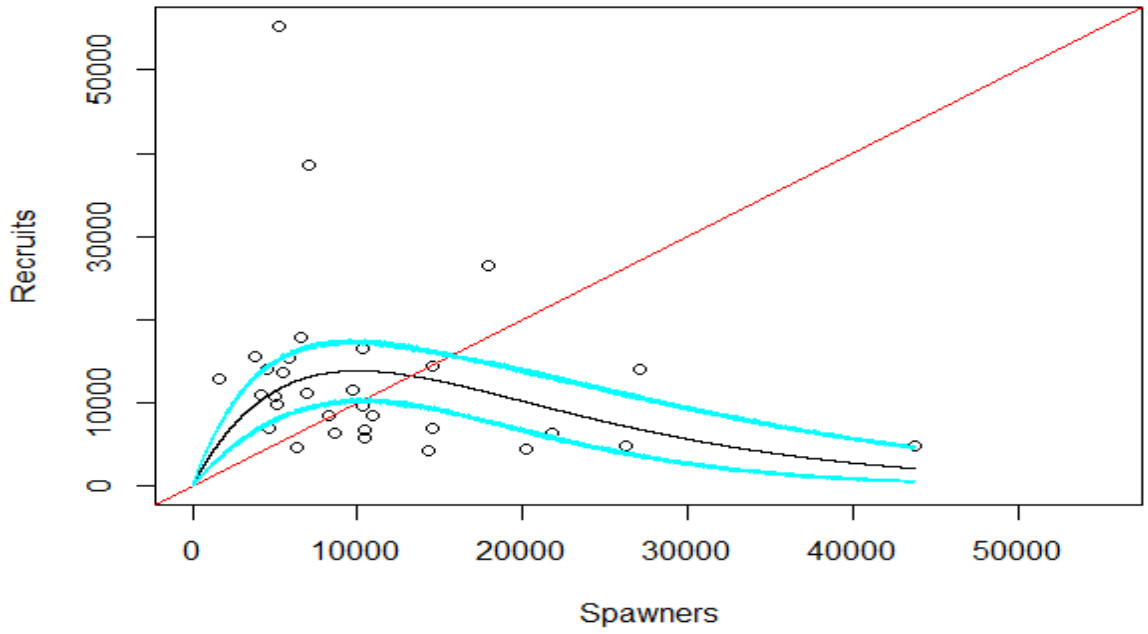

Figure 9. Recruits per spawner analysis for Rogue River NPCHS. The black line in the figure above comes from the point estimates of the Ricker recruitment parameters, and the cyan lines give a 95% uncertainty envelope on the expected recruitment. Note that this envelope is not attempting to include 95% of the data. The red line is 1:1, indicating population replacement.

MANAGEMENT STRATEGIES

The Oregon Fish and Wildlife Commission adopted Alternative 9 as the preferred suite of management strategies to be employed by ODFW to address factors limiting production of NPCHS. This section presents each management strategy separately with a summary of completed management actions and accomplishments, and planned actions.

4. MANAGEMENT STRATEGY 9.1

Management Strategy 9.1 is being implemented to maintain habitat quantity and quality in the Rogue downstream of Lost Creek Reservoir.

4A. Actions 1.1-1.12

Most of the action items within this management strategy relate to seasonal operations of Lost Creek Reservoir by the USACE, and most have been completed (see annual reports at https://www.dfw.state.or.us/fish/CRP/rogue_spring_chinook_conservation_plan.asp). Unique in Oregon and possibly nationwide, Congress authorized the construction of USACE dams in the Rogue with "fishery enhancement" as a primary purpose. Dam operation is the primary driver of habitat quantity and quality in the remaining spawning habitat for NPCHS in the upper Rogue. Outside of flood control operations, USACE must operate William Jess Dam/Lost Creek Reservoir in a manner that meets the fishery enhancement purpose. A total of 125,000 acre feet of reservoir water storage is allocated to fish needs downstream in summer.

ODFW makes recommendations on reservoir operations to help USACE meet its fishery enhancement requirement. Coordination between ODFW and USACE, in concert with OWRD, increased significantly in 2012. A weekly coordination call is held, in addition to the annual meetings and periodic training for Corps staff by ODFW biologists. As part of increased ODFW effort dedicated to reservoir management beginning in 2012, Rogue District staff added field surveys and empirical observations to help guide recommendations real time. Specific improvements in reservoir operation, implemented to protect and produce more NPCHS are listed below. The first returns of NPCHS from improved reservoir operations did not begin until 2016.

Lower risk of redd dewatering

NPCHS are the first fish to spawn in the "fall through spring" spawning cycle for anadromous fish in the Rogue Watershed. Early run NPCHS begin to spawn in early September. If NPCHS spawn at high river flows in September, the redds can be dewatered and the embryos killed when releases from Lost Creek decrease river flows during the reservoir fill season that begins the following January.

Riverside landowners have contacted ODFW in past years to complain about redds being dewatered. In late September 2007 a Shady Cove resident called ODFW to report dewatered

spring Chinook redds along his property. Lost Creek outflows had dropped from about 1800 cfs release on September 17 to about 1,000 cfs release on September 25 (see Figure 10 below).

Figure 10. NPCHS redd along shoreline in Shady Cove September 2007

To reduce this risk of redd dewatering, the release from Lost Creek Reservoir must drop to around 1200 cfs when NPCHS spawn, and remain near that level (ODFW, 2000). Unfortunately releases over the past twenty years have not reached the level needed to protect spawning spring Chinook until mid-late September (between September 15 and September 22 in most years). ODFW believes that egg to fry survival has decreased as a result of redds being dewatered.

Field observations were collected in September 2013 to further investigate redd dewatering. On September 10th, 2013 biologists from USACE conducted a redd survey on the Upper Rogue between Shady Cove and Dodge Bridge, when the release from Lost Creek was 1,850 cfs. A total of 36 redds were observed, including several redds in side channels directly adjacent to the riverbank. Water depths over some redds at this level of river flow were measured at only four to six inches (Figure 11 below). During the reservoir fill season beginning in January 2014 the reservoir release dropped to 900 cfs. ODFW believes egg to fry survival was decreased in at least some of these redds due to dewatering.

Figure 11. NPCHS redd near shoreline of side channel near Shady Cove, 9.13.13.

ODFW funded an aerial photo survey a few days later. Below is a photo (Figure 12) that shows the location of NPCHS redds close to the shoreline near Shady Cove on September 14, 2013 when the release from Lost Creek was 1450 cfs. Again, during the reservoir fill season the release from Lost Creek dropped to 900 cfs in early January 2014.

Figure 12. NPCHS redds along the shoreline near Shady Cove, 9.14.13.

Aided by empirical observations since Plan adoption, ODFW has recommended that releases from Lost Creek Reservoir decrease by around September 10th to better protect and produce more NPCHS. Decreasing the reservoir release earlier in September accomplishes a second

management need by reducing flows that attract NPCHF into NPCHS habitat in the upper Rogue. This may become the most critical action in reservoir management in the future. Emerging science from genetic research has some researchers stating that NPCHF pose a direct threat to NPCHS through interbreeding (see **MONITORING, EVALUATION AND RESEARCH NEEDS** section below for further explanation).

The number of NPCHS spawning the first week in September appears to be increasing, and is a sign that the early run fish are in a rebuilding phase. Even better protection of redds would come from dropping the release at Lost Creek on September 1, but there is a conflicting fishery objective in the first 10 days of September (minimize pre-spawning loss among upstream migrating NPCHF).

NPCHS production improved in side channels of Rogue

ODFW has identified a side channel at McLeod that annually supports large numbers (up to several hundred fish) of spawning NPCHS. ODFW believes that developing embryos, alevins and fry have perished at this side channel when reservoir releases drop during the fill season. To maintain fish production at this location, ODFW has developed a recommendation to maintain a minimum flow of 1150 cfs at the McLeod USGS gauge through most of the fill season January-April. This minimum flow at McLeod has been an objective for reservoir operation since 2012.

ODFW monitored this side channel closely during the 2013-2015 drought (see figures 13, 14), when refill at Lost Creek was questionable and a full reservoir is more urgently needed for fish in summer. ODFW worked with Corps biologists to delay reservoir decreases each spring to allow as many fry to emerge from the gravel as possible before the reservoir release dropped. A salvage operation was considered to remove fry at risk of being stranded as river flows dropped, but the monitoring showed that at least some water flowed through the side channel when the flow at McLeod dropped to 875 cfs.

Maintaining flow in the McLeod side channel is likely to benefit rearing conditions in downstream side channels as well. Additional side channel monitoring is planned to document use by NPCHS at different flows and to look for opportunities to protect and enhance NPCHS.

Figure 13. Snorkel survey McLeod side channel

Figure 14. NPCHS fry McLeod side channel

Corps temperature model completed in year 2015

In a long awaited development, USACE completed the temperature model for use on the Rogue. The model was used to evaluate a variety of scenarios during drought year 2015. The model was utilized in June 2015 to slightly adjust release temperatures during a low flow/high ambient air temperature event. The model suggested a brief decrease in temperature would not affect winter release temperatures and it did not (Figure 15). Furthermore the model has been used at the Applegate project since 2015.

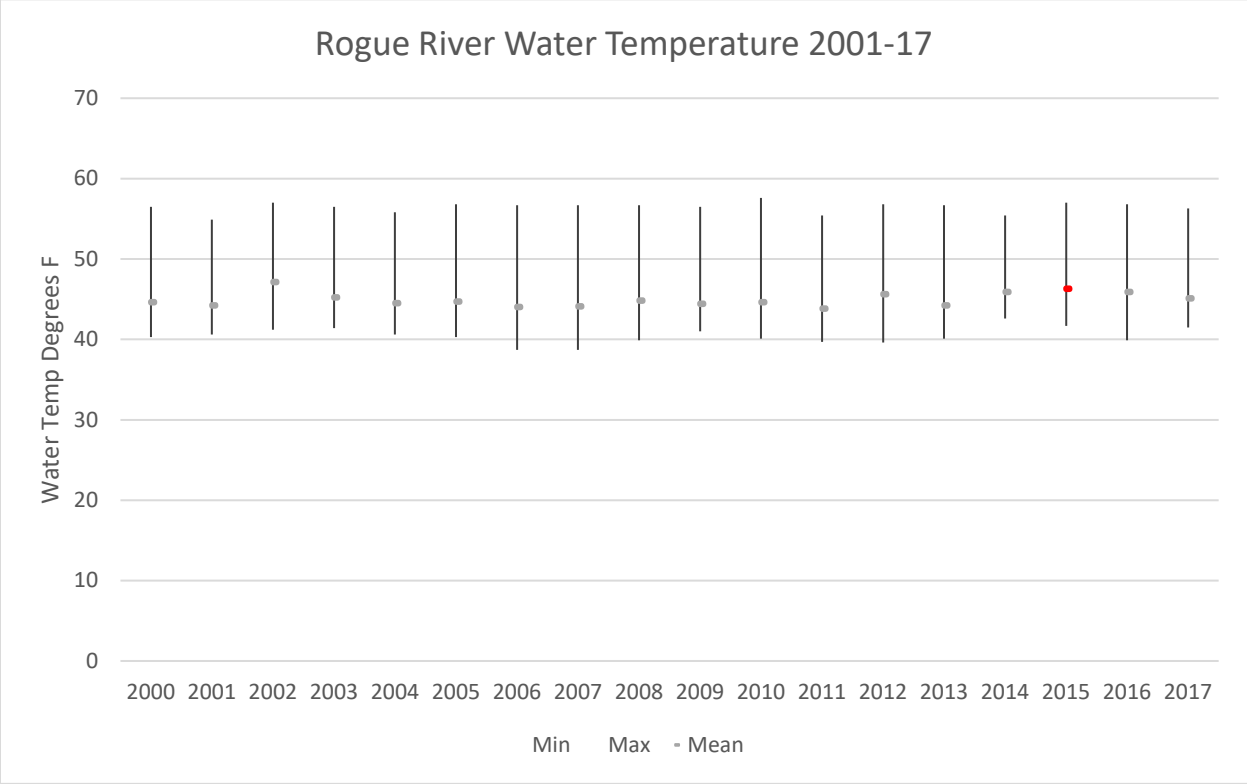

Figure 15. Minimum, maximum and mean water temperature Rogue River from September through March measured at USGS gauge, McLeod, 14337600, 2001-2017.

No epizootic during multi-year drought 2013-2015

While much of western Oregon experienced a single year of drought in 2015, the Rogue experienced more severe conditions. According to the National Weather Service, 2013 was the driest calendar year on record in Medford. Following that, both Jackson and Josephine counties issued drought declarations in 2014 and 2105.

When hot weather overlaps low river flows at a time when adult fish abundance is high in the Rogue, disease spreads quickly. The primary cause is a bacterium, *Flexibacter columnaris*. Thousands to tens of thousands of fish can be lost if an epizootic takes place. ODFW works with OWRD and USACE to release water from Lost Creek Reservoir to minimize prespawning mortality in adult Chinook.

To monitor for signs of stress or dead fish during the 2013-2015 drought, ODFW recruited observations from USFS and BLM personnel, and volunteer help from the BLM HOSTS at Marial Campground. The first sign of stress is fish gathering in big numbers along the shoreline of the Rogue where small tributaries of the canyon contribute cooler water to the river. Below is a photo of adult Chinook holding at the mouth of Stair Creek (Figure 16).

Figure 16. Adult Chinook holding at mouth of Stair Creek July 2014, Robyn Janssen, Rogue Riverkeeper photo

In addition to careful reservoir management throughout the drought, USACE released carryover storage in 2015. Despite severe conditions no significant loss of fish was observed on the Rogue. Conversely, large numbers of dead fish were observed in 2015 in several other rivers including the Columbia, Willamette, Deschutes, Santiam, and Clackamas.

4B. Action 1.13.

In this action ODFW supports improvements of fish passage facilities. The purpose of this action is to increase the survival rates of migrant juvenile and adult NPCHS.

Removal or notching of older mainstem dams

Between 2008 and 2010, three older dams were either notched or removed from the mainstem Rogue. Gold Hill Dam (rivermile 121) was removed in 2008, Savage Rapids (rivermile 107) was removed in 2009, and Gold Ray Dam (rivermile 126) was removed in 2010. For the first time in decades, native migratory fish on the Rogue have free passage along 157 miles of river below the velocity barrier at Cole Rivers Hatchery.

The benefits to fish passage from these projects cannot be understated. Adults no longer need to spend energy finding and struggling to pass out-of-date fish ladders, especially when conditions

for passage were poor during very high and very low river flows. Body condition is very important for spring Chinook living off fat reserves for months in summer holding pools prior to spawning. Upstream passage by juveniles is possible now after being virtually impossible when the dams were in place, and downstream passage is improved. No longer do juveniles fall onto rocks at Savage Rapids or bedrock near the fish ladder at Gold Ray.

To measure initial fish response, ODFW conducted redd counts in the former reservoirs upstream of Savage Rapids and Gold Ray Dam. Chinook began spawning at each site the first spawning season following deconstruction. Redds were observed in September at Gold Ray in 2011, 2012 and 2013, an indication of use of the newly restored habitat by NPCHS.

The first full year without mainstem barriers in the path of upper Rogue migratory fish was 2011. Because most Rogue salmon and steelhead return as four year old adults, the first returns following mainstem dam removal began in 2015. ODFW expects to learn more about the effects of dam removal on fish abundance over the next four to five generations of returns.

Gold Hill Irrigation District passage improvement

Improvements to Gold Hill Irrigation District infrastructure were completed 2014-2015. The Gold Hill Irrigation District operates a partial channel spanning dam on the Rogue upstream of the community of Gold Hill. A new headgate/intake structure was built and the upper half of the ditch was piped.

The improvements, funded by OWEB, reduced the total volume of water entering the diversion ditch and at the same time reduced the likelihood of juvenile salmon and steelhead entering the ditch. Water in excess of the water right formerly was diverted back in to the Rogue halfway down the ditch, creating false attraction that caused fish (including adult Chinook) to try to swim up into the ditch. The risk of false attraction was eliminated. Finally, discharge elevation improvements were made to the bypass pipe sending downstream migrants back to the river from the fish screen. Risk to juveniles was reduced.

Little Butte Creek

While Big Butte Creek is the lone tributary of the Rogue that supports a spawning population of NPCHS on an annual basis, Little Butte Creek is the focus of significant effort to restore fish habitat for a variety of native fish species, including restoration of safe upstream and downstream fish passage. Restoration may provide a window of opportunity for NPCHS.

Streamflow and water quality challenges are the primary reasons that Little Butte Creek flowing through Eagle Point is not considered to be important habitat for NPCHS. But improvements to passage and water quality are taking place that may help produce Spring Chinook on years when conditions allow entry into Little Butte Creek. Fish passage has been restored at three mainstem diversions on Little Butte Creek since the 1990s. In 2005, a new ladder was constructed on the Little Butte Mill Dam in downtown Eagle Point to improve passage. In 2018, ODFW is building

a ladder on Walcott Dam. When damboards are in place during the irrigation season, upstream fish passage ends at Walcott Dam just downstream of the forks of Little Butte.

The new fish ladder at Walcott will be a significant benefit for fish passage on mainstem Little Butte Creek during the irrigation season. Work is needed at one or two other diversions, but upstream passage for Chinook is expected to improve dramatically. ODFW will monitor Chinook response by conducting spawning surveys in both forks of Little Butte as passage work is completed, including looking for evidence of use by NPCHS.

Figure 17. Walcott Dam during irrigation season, Little Butte Creek.

4C. Action 1.14

ODFW continued to participate in a wide variety of habitat protection activities. ODFW reviewed and commented on numerous plans and permit applications for development activities, fill and removal projects, mining operations, forest operations, and water rights to ensure that activities were done in a way that minimized impacts to fisheries resources. One example is listed below.

Protection of Big Butte streamflow

Under water law implemented by the Oregon Water Resources Department, municipal water rights that are currently undeveloped can only be used in a way that maintains fish persistence over time. ODFW is allowed an opportunity to provide feedback on how these water right are used in the future. ODFW worked with the City of Medford to protect the fish resources of Big Butte Creek during future water development by encouraging Medford to divert its remaining Big Butte water downstream in the Rogue itself at their Duff Treatment Plant.

Medford has two municipal water rights on Big Butte Creek. The undeveloped portions of these rights are, for S-10120 “all the waters of Big Butte Creek”, and for S-8092, 19.2 cfs from Big

Butte Springs. It is important to note that flow in Big Butte Creek averages around 60 cfs during spring Chinook spawning and if implemented, these diversions would greatly reduce or eliminate streamflow in Big Butte Creek.

Since Big Butte Creek is crucially important habitat for salmonids and Spring Chinook in particular, ODFW's advice on the development of the additional water was two-tiered. If Medford diverts water from Big Butte Creek itself, such diversions would be subject to cut-off criteria at identified monthly target flows. Essentially, this would mean little or no diversion in most months. But if Medford diverted from the Duff location at river mile 131 (almost downstream extent of spring Chinook spawning), then such diversion would be subject to curtailment, rather than cutoff. The curtailment percentage will depend on the degree to which the mainstem Rogue target was being missed. In May through November the percent curtailment would likely range from 20-55%

4D. Action 1.15

ODFW has continued to assist cities and counties with implementation of ordinances that protect riparian protection. ODFW helped the community of Shady Cove develop and implement a new riparian ordinance. ODFW also has continued to implement projects to encourage good stewardship by streamside landowners, primarily through activities in the Salmon Trout Enhancement Program (Action 1.15 in the conservation plan). The most recent project involved working with other agencies to develop a poster to encourage stewardship among cannabis growers. The poster was distributed to supply stores around Jackson and Josephine counties.

4E. Planned actions

- ODFW will continue close coordination with USACE and OWRD to coordinate reservoir operation and help USACE meet fishery enhancement requirements. ODFW will also continue to recommend: September releases from Lost Creek at or near 1200 cfs by around September 10; target flows at the McLeod gauge of 1150 cfs during most of the fill season at Lost Creek January-April. These recommendations have been implemented since 2012, and the first returns benefitting from this management began in 2016.

- ODFW will request that USACE repeat a gravel survey downstream of William Jess Dam and initiate actions to replenish spawning gravel. We request that planning a pilot project for gravel augmentation begin by 2019 unless not supported by survey data.

- ODFW will investigate side channels for opportunities to protect or enhance NPCHS.

- ODFW will investigate additional opportunities for fish passage improvements in tributary confluences, to increase survival rates of juvenile NPCHS that may migrate upstream with freshets.

- ODFW will attempt to place spawning gravel in at least three sites along the mainstem Rogue for strategic spawning gravel enhancement—McLeod side channel, Trail Creek riffle, private sites, and Shady Cove side channel.

- ODFW will investigate temporary releases of hatchery spring Chinook in the forks of Little Butte Creek if sufficient natural production is not observed in two years following construction of the fish ladder at Walcott Dam.

5. MANAGEMENT STRATEGY 9.2

Management Strategy 9.2 is being implemented to enhance the production of NPCHS in Big Butte Creek. The intent of this strategy is to increase the amount of habitat available. Big Butte is the lone Rogue tributary that supports a self-sustaining, annual run of spring Chinook salmon. Immediately following plan adoption ODFW began investigating options for enhancing production in this spring-fed, critically important tributary of the upper Rogue.

5A. Actions 2.1-2.3

An extensive review took place soon after Plan adoption to evaluate passage at a partial barrier in lower Big Butte Creek, and improving spawning habitat.

Evaluation of South Fork Big Butte upstream of Butte Falls

ODFW evaluated the potential to produce spring Chinook in South Fork Big Butte upstream of the barrier falls at the community of Butte Falls. In 2008, staff in the ODFW Aquatic Inventories Program queried stream habitat survey data to determine likely places for spring Chinook salmon to spawn. The data came from a 1997 survey of six miles of South Fork Big Butte Creek.

The dominant habitat was rapids throughout the survey of South Fork Big Butte above the falls. Little spawning gravel was found, and very little quality spawning habitat is available (see Figure 18 below). The result of this evaluation shows that releases of spring Chinook adults upstream of Butte Falls will not substantially increase production due to a lack of spawning habitat. Furthermore, because of the high gradient, rapid dominated habitat, ODFW will not pursue gravel augmentation within the South Fork.

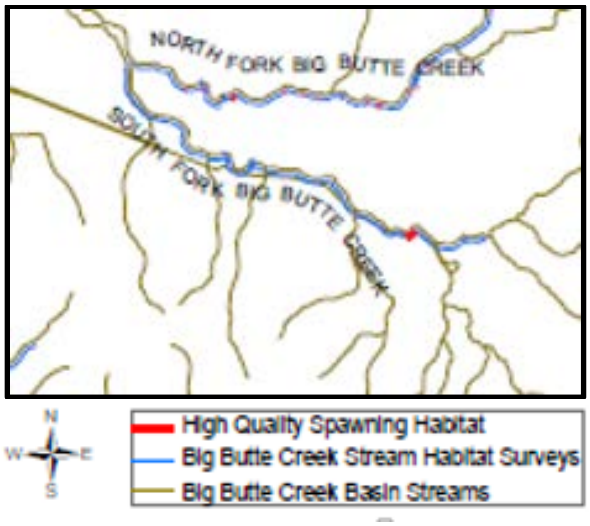

Figure 18. Graph showing paucity of high quality spawning habitat for NPCHS in SF Big Butte Creek

Evaluation of Mainstem Big Butte Creek

In 2007, ODFW completed an expanded spawning ground survey for spring Chinook in Big Butte Creek between river mile one and six. Findings indicated few fish spawned anywhere except in the lower gradient section between river mile one and two. In addition, ODFW reviewed historical data and findings of habitat surveys completed in 1995 and 1997. Results from the habitat surveys indicated that much of Big Butte Creek is in a constrained channel with little spawning habitat, but that there are localized low gradient sites that show potential for projects designed to improve spawning habitat.

In 2008 and 2009, ODFW completed comprehensive spawning surveys in Big Butte Creek with funds allocated by the Restoration and Enhancement Board (as part of enhanced Rogue surveys, Project 07-110 and Project 09-013). These surveys were designed to determine how to optimize upstream passage and spawner distribution (Actions 2.1 and 2.2 in the Plan) and to provide guidance in relation to enhancement of spawning habitat (Action 2.3 in the conservation plan).

Key findings from surveys of spring Chinook spawning and habitat in Big Butte Creek:

- 10.8 miles of NPCHS spawning habitat is available between Crowfoot Falls at river mile 0.6 and Butte Falls at roughly river mile 13.3 (Excluding a 1.9 mile reach that is dominated by steep boulder rapids and bedrock between Netherlands Road Bridge and McNeil Creek)

- Estimates of spawning gravel in 0.6 miles below Crowfoot Falls ranged from 756 m2 to 1160 m2.

- Estimates of spawning gravel in 10.8 miles above Crowfoot Falls (below Butte Falls) totaled 1,100 m2 in 2008 and ranged from 864-1328 square meters in 2009.

- Every October flow in Big Butte Creek increases by approximately 70 cfs as the Eagle Point Irrigation District performs canal maintenance creating an artificial freshet of water. After maintenance the flow is reduced by approximately 70 cfs as the canal is watered up again. An interesting finding in 2009 was the increase in available spawning gravel at flows of 136 cfs (compared to a flow of around 63 cfs before maintenance began).

- Superimposition is a concern below Crowfoot Falls. A return of 3,970 wild spring Chinook to the upper Rogue resulted in a count of 145 redds per mile below the falls. A return of 5,234 resulted in a count of 310 redds per mile below the falls.

- Less than 25% of the observed attempts by CHS to pass Crowfoot Falls in October 2008 were successful. Success increased during a natural freshet on October 4, 2008 when flows reached 80 cfs. During the freshet it appeared that the relative amount of streamflow flowing through the ladder increased, potentially increasing attraction flow.

- Using average redd densities observed during the surveys, approximately 16 additional redds can be expected for every 100 m2 of spawning gravel added to Big Butte Creek during habitat construction work.

5B. Action 2.4.

ODFW initiated habitat work to produce more spring Chinook in Big Butte in 2010. To start, a large wood project was completed with R&E funding (project 09-160) to try to capture spawning gravel. Conifers with rootwads were tipped over off the neighboring hillslope and placed in the creek in jams of 3-5 trees each. A site visit during the summer of 2011 failed to find any improved spawning habitat for spring Chinook salmon, but the trees provided excellent habitat for juvenile salmonids.

In 2012 ODFW applied for and received funding from the Fish Restoration and Enhancement Program (R&E) to place spawning gravel in the creek (Project 11-106). A total of approximately 150 cubic yards was placed in August 2012 just upstream of the large wood project. Boulder clusters were also placed with the spawning gravel. Chinook spawners were observed using the placed gravel in September and October. Painted rocks were set out at the project after the end of the spawning period, and almost all were still present the following year despite a sizable high flow peaking at 3000 cfs near the mouth of Big Butte Creek in early December. In August 2013 an additional 100 yards of gravel was placed in Big Butte at the same location of the 2012 project.

To help ensure that the gravel did not put spring Chinook at risk by washing away in winter, ODFW initiated a project to monitor gravel transport in Big Butte Creek to help evaluate the benefits of gravel augmentation in this unique subbasin. During spring and summer of 2013, ODFW inserted PIT tags into Chinook-sized spawning gravels. Approximately 275 rocks were tagged in all. These rocks were distributed at six different sites in Big Butte Creek, including the

gravel placement site. Rocks were placed individually and in groups and a GPS waypoint was taken at each site. All sites where tagged rocks were placed are either sites where Chinook are known to spawn or are candidate areas for future gravel augmentation projects (pending access for equipment, landowner approval, etc.). This information will help determine whether future, larger scale gravel placement in Big Butte Creek will be cost effective.

In 2014, 92% of tagged rocks were recovered across all gravel monitoring sites. It appeared that these particles moved very little, if at all. Some of the smaller sized particles (40-64mm max diameter) were located toward the periphery of the creek and some were even recovered on the creek's floodplain. However, the majority of the recovered particles were still in the summer wetted channel and were usable for spawning. The winter of 2013-2014 developed into a drought year in southwest Oregon, but Big Butte did reach a peak flow of 3000 cfs at the USGS gauging station in February 2014. Monitoring since 2014 has documented very little movement of tagged rocks.

Spring Chinook Salmon have spawned at the gravel placement site each year since completion. Coho adults were observed spawning on the gravel in addition to spring Chinook in 2017. Gravel augmentation in mainstem Big Butte Creek will successfully produce NPCHS (and Coho) and will be implemented.

5C. Planned actions

- ODFW will place 1,000 m^3 of spawning gravel in Big Butte Creek pending funding.

6. MANAGEMENT STRATEGY 9.3

Management Strategy 9.3 has not yet been implemented but is intended to decrease rates of predation on naturally produced spring Chinook salmon through a program designed to encourage fishing related mortality for non-native Umpqua pikeminnows. A pilot project was proposed to a local angling group soon after Plan adoption but did not receive support at the time.

Although this program has not been implemented, ODFW has taken other action to reduce the risk of new introductions into the Rogue watershed. Rogue District staff organized a meeting of boat ramp managers from a variety of agencies and the State of California to discuss illegal fish introductions and aquatic invasive species. The group agreed on a common approach to signage at boat ramps that has been implemented.

The 2009 Oregon Legislature established the Aquatic Invasive Species Prevention Program to keep aquatic invasive species out of Oregon's waters. The program targets quagga and zebra mussels, New Zealand mudsnails and aquatic invasive plants and is funded by sales of Aquatic Invasive Species Prevention Permits and some Federal funds. A boat inspection station is operated on Interstate 5 near Ashland. A full time watercraft inspection technician is stationed in the Rogue Watershed District.

Finally, mainstem dam removal not only improved conditions for fish passage but also removes preferred habitat for pikeminnow from the river. Reservoirs in the Columbia basin support very large populations of Northern Pikeminnow. Umpqua Pikeminnow are present in the Rogue but will not be able to grow unnaturally large populations behind Gold Ray and Savage Rapids dams.

6A. Planned action

- ODFW will develop a pilot project to encourage fishing related mortality on non-native pikeminnows in the Grants Pass area.

7. MANAGEMENT STRATEGY 9.4

Management strategy 9.4 is about managing fisheries to sustain productivity for all segments of the population of NPCHS, with a secondary objective of increasing harvest opportunities for hatchery fish produced to mitigate for blocked habitat.

7A. Action 4.1

With adoption of the Plan, early run NPCHS were protected from direct harvest through changes in freshwater angling regulations. Early run NPCHS are the segment of the run most affected by construction and operation of William Jess Dam/Lost Creek Reservoir. These fish migrated the farthest upstream prior to dam construction but are now blocked from their preferred spawning habitat.

Early run NPCHS are also the most desired fish in the run for harvest. Early run fish tend to be older and larger spring Chinook and are prized by anglers. Early run spring Chinook migrate earlier in the lower river when conditions are better for fishing, and are present in holding pools of the upper Rogue for the longest time—both are best for angling success. These factors, and the fact that habitat related threats are difficult to resolve, contributed to freshwater harvest being considered a primary limiting factor for early run spring Chinook in the plan. The angling framework in the Plan, which was implemented starting in 2008, is intended to ensure harvest rates on early run, mid-run and late run NPCHS do not exceed 40% until the attainment of desired status. These angling regulations were meant to ensure sustainability of the historical life history characteristics of NPCHS, and also match well with recent genetic findings highlighting the importance of protecting early run NPCHS (see **MONITORING, EVALUATION AND RESEARCH NEEDS** section below for further explanation).

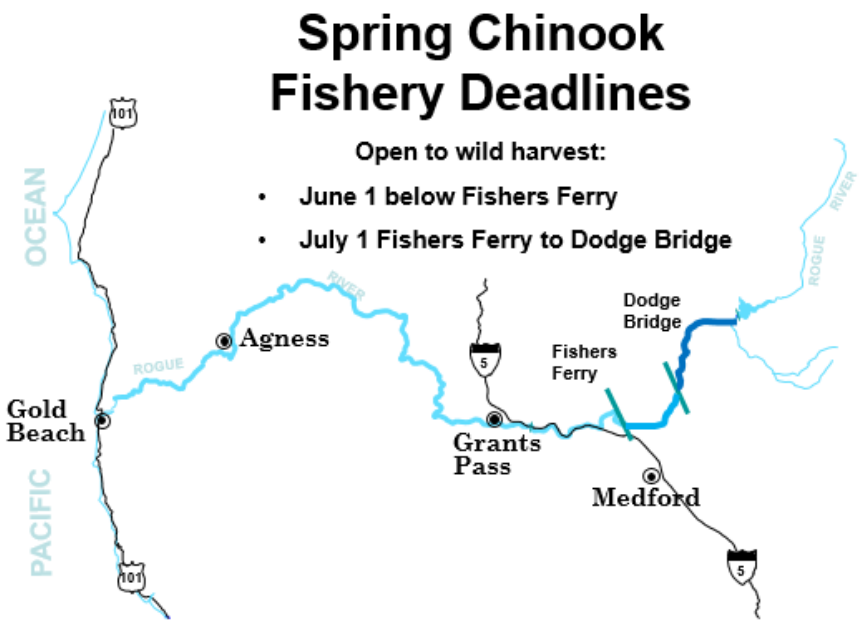

Figure 19. Map of key angling regulation deadlines for the Spring Chinook fishery.

From January 1 through May 31 each year, anglers may only keep adipose fin-clipped hatchery spring Chinook Salmon (HCHS) on the Rogue. Angling opens to wild harvest at various sections of the river after the early run fish have passed. In the river downstream of Fishers Ferry Boat Ramp (Figure 19), anglers may harvest wild spring Chinook beginning June 1 ***after early run fish have moved upstream***. Between Fishers Ferry Boat Ramp and the Dodge Bridge boat ramp, anglers may harvest wild spring Chinook beginning July 1 ***after early run fish have moved upstream***. Upstream of Dodge Bridge the fishery does not open to wild harvest. Early run fish are holding throughout spring and summer in the deep pools located upstream of Dodge Bridge.

7B. Action 4.2

ODFW plans to expand harvest opportunities for NPCHS in freshwater when returns are predicted to exceed 15,000 NPCHS and disease losses are predicted to be less than 10%. This opportunity is based on a preseason forecast, the first of which was completed for 2018. A framework for expanding harvest opportunity on NPCHS, including years when the preseason forecast is high, is provided below under 6E.

7C. Action 4.3 and 4.4.

Angling regulations elicit an extensive amount of public discourse and ideas for improvement. This action specifically states that ODFW will support only those special regulations for freshwater fisheries that are critical to conservation needs for CHS. The purpose of this action is to increase the complexity of angling regulations only if warranted. In addition, ODFW continues to work with the Oregon State Police (OSP) for increased enforcement of regulations

that target CHS. The purpose of this action is to ensure appropriate protection for NPCHS. This is especially important for snagging, an activity that is illegal and a citable offense.

7D. Actions 4.6 and 4.7

ODFW has implemented actions 4.6 (same as 5.2) and 4.7. ODFW revised spawning practices at Cole M. Rivers Hatchery to produce HCHS similar in age structure to that portion of the natural population that historically spawned upstream of Lost Creek Dam. This action is also intended to reduce the proportion of hatchery fish among natural spawners by increasing the harvest rates of HCHS. Size goals in the broodstock have not yet been fully met. In addition, ODFW traded hatchery Coho production (decreased from 200,000 smolts to 75,000 smolts) for more spring Chinook production (increased from 1,622,000 smolts to 1,703,260 smolts). The exchange was completed in brood year 2013. The first four year old adults following the exchange returned in 2017.

To increase production of HCHS, the October release was increased from 162,000 smolts to 193,250 smolts, and a yearling release in March was restored in 2015. The yearling release matches the pre-dam life history of Rogue spring Chinook and is a response to increasingly chaotic swings in environmental conditions and ocean productivity. The March release ensures that some HCHS are migrating to sea during spring conditions of ocean productivity.

Ongoing work to improve hatchery performance and returns

ODFW is continuing an extensive review of the HCHS program to increase returns and harvest of hatchery fish. Several changes have already been implemented to produce more HCHS salmon for anglers to harvest. Returns are just starting to come in for some changes and, for other changes, adults will not come back until 2019/2020. More information on the HCHS program is available in Appendix A. Necessary and completed changes include:

- **Hatchery Infrastructure:** Upgrade or replace hatchhouse water supply and treatment system to improve water quality and ensure that release goals can be met.
- **Yearling release:** The first returns of adult four year olds from the March yearling release began in 2017. The March fish survived at a higher rate than the fish released in August and September from that same brood year (2013).
- **Rearing densities:** Rearing densities were reduced beginning with the 2017 releases to ensure the highest quality smolt is released and has the best chance to survive.
- **Hatchery return monitoring**: All four hatchery spring Chinook smolt release groups have a coded wire tag group to monitor performance beginning with the 2017 release.
- **August smolt survival**: In response to public concern, a portion of the August smolt group will be released directly into the estuary in Gold Beach for five years (beginning with the 2017 release). Coded wire tags will be part of this new release, along with coded wire tags in a companion group released at the hatchery in August. The objective is to compare survival rates in returns to the hatchery, and to determine whether smolts released in August at the hatchery are surviving their migration to the ocean..

- **Larger smolts**: Larger smolts were released in 2017. The hatchery did not meet the production goal because of the low return of adults in 2016. To compensate, the hatchery released fewer fish in August and September and more of the larger fish in October and March. ODFW would like to reallocate spring Chinook production to release more of the larger fish in October and March in the future. The proposal is expected to increase returns on average by sending hatchery fish to sea in different periods of ocean cycles. This proposal will require a contract modification with USACE.

7E. Management Changes

ODFW proposes additional opportunity for wild harvest as the population builds. Opportunity will be based on and tiered to abundance as displayed in the framework below. Wild harvest addbacks would take place through in-season regulation changes when criteria are met, and may include collection of genetic and/or scale samples.

Table 4. Inseason openers to add wild harvest seasonally

Abundance trigger	Below Fishers Ferry	Fishers Ferry to Dodge Br
12,000*	Wild opens May 21 1 per day/3 per yr	Wild opens June 21 1 per day/3 per yr
13,500** Preseason over 17,500***	Wild opens May 11 2 per day/10 per yr	Wild opens June 11 2 per day/10 per yr
Desired status****	Wild opens April 1 2 per day/10 per yr	Wild opens May 1 2 per day/10 per yr

*Average of count over last two years and preseason forecast

** Average of count over last two years and preseason forecast

***Preseason forecast over 17,500

****10 year average exceeds 15,000; forecast over 15,000

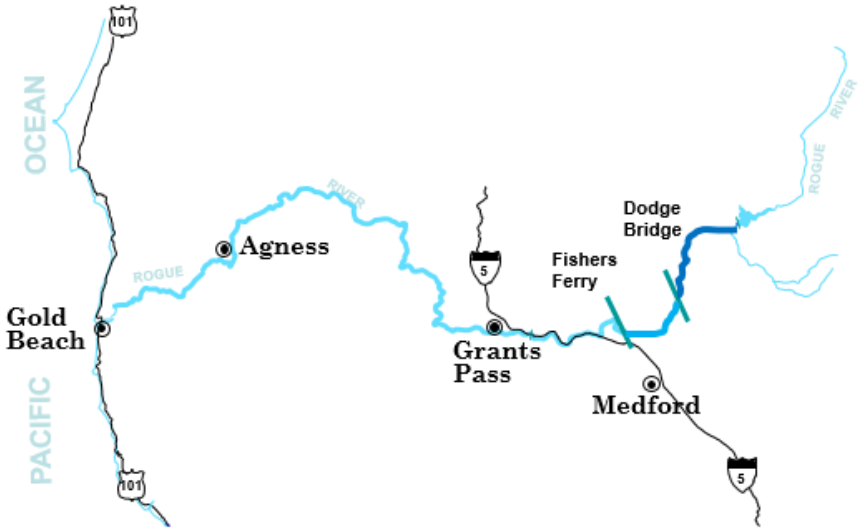

Figure 20. Map of key angling regulation deadlines for the Spring Chinook fishery.

ODFW believes the NPCHS population is improving and adding back opportunity tiered to abundance can be accomplished in a way that continues to build the population towards the desired status for abundance without setting back the early run component. The fishery takes place in two primary fisheries—a lower Rogue fishery based in Gold Beach, and an upper river fishery upstream of Fishers Ferry boat ramp (Figure 20). The spring Chinook fishery in the middle Rogue has historically not been significant compared to the other two areas.

Using a recent UC Davis genetic probablility analysis for fish passing Gold Ray Dam in 2004 (Thompson et al. 2018; see **MONITORING, EVALUATION AND RESEARCH NEEDS** section below for further explanation), it is possible to estimate the genetic composition of the portion of the Chinook Salmon population that would be affected by various fishery scenarios. Genetic research has identified a specific gene associated with run timing in Chinook Salmon in the Rogue River and elsewhere (Prince et al. 2017). Chinook salmon that return early are homozygous for the spring-run version of the gene, meaning they have two identical copies of the gene. Chinook that return later are homozygous for the fall-run version of the gene. In addition, many Chinook salmon in the Rogue have both the spring and fall Chinook versions of this gene. These fish are referred to as heterozygous, and have intermediate run timing (Thompson et al. 2018). ODFW used the genetic probability analysis at Gold Ray Dam in 2004 and an average migration rate of 3.6 miles per day for spring Chinook Salmon below Gold Ray Dam (from tagging studies in the 1970s and radio-tagged fish in 2008) to estimate the timing and genetic composition of the run at river entry in Gold Beach (Figure 21).

Under current regulations, the lower river fishery (upstream to Fishers Ferry boat ramp) opens to wild harvest on June 1. The presence of homozygous spring Chinook Salmon is dropping significantly by this date, and heterozygous Chinook Salmon are becoming more prevalent

Opening to harvest in May will put more early run spring Chinook Salmon at risk of harvest, but the abundance-based triggers will minimize potential impact on spawner escapement.

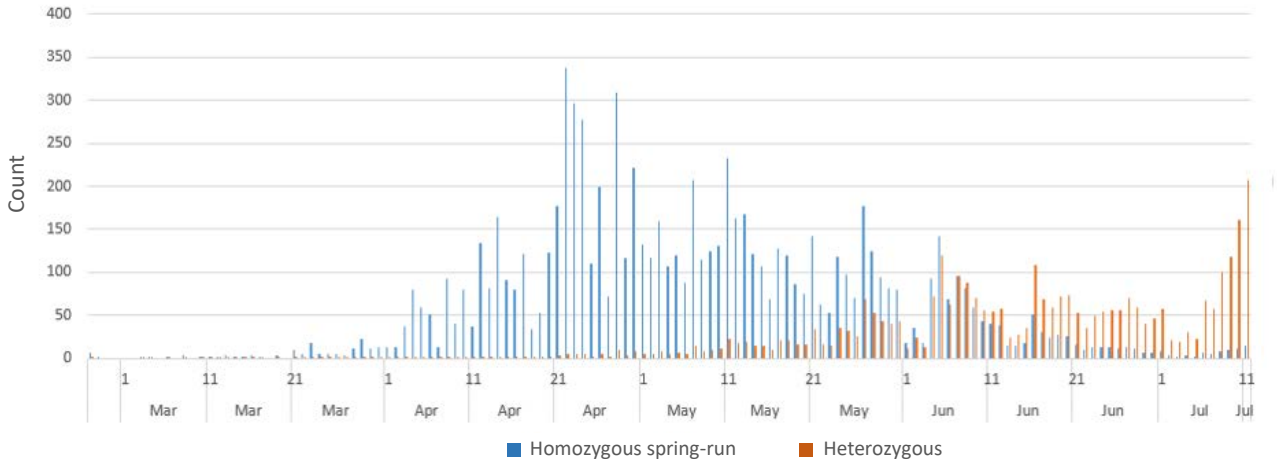

Figure 21. Estimated run timing and genetic composition of naturally produced Rogue River Chinook Salmon at river entry in Gold Beach in 2004. Data courtesy UC Davis.

Under current regulations, the upper river fishery from Fishers Ferry Boat Ramp (near the historical Gold Ray Dam site) to Dodge Bridge opens to wild harvest on July 1. The presence of homozygous spring Chinook is dropping by this date, and heterozygous Chinook are becoming more prevalent (Figure 22). As noted above, opening the fishery in June will put more early run spring Chinook Salmon at risk of harvest, but the abundance-based triggers will minimize potential impact on spawner escapement.

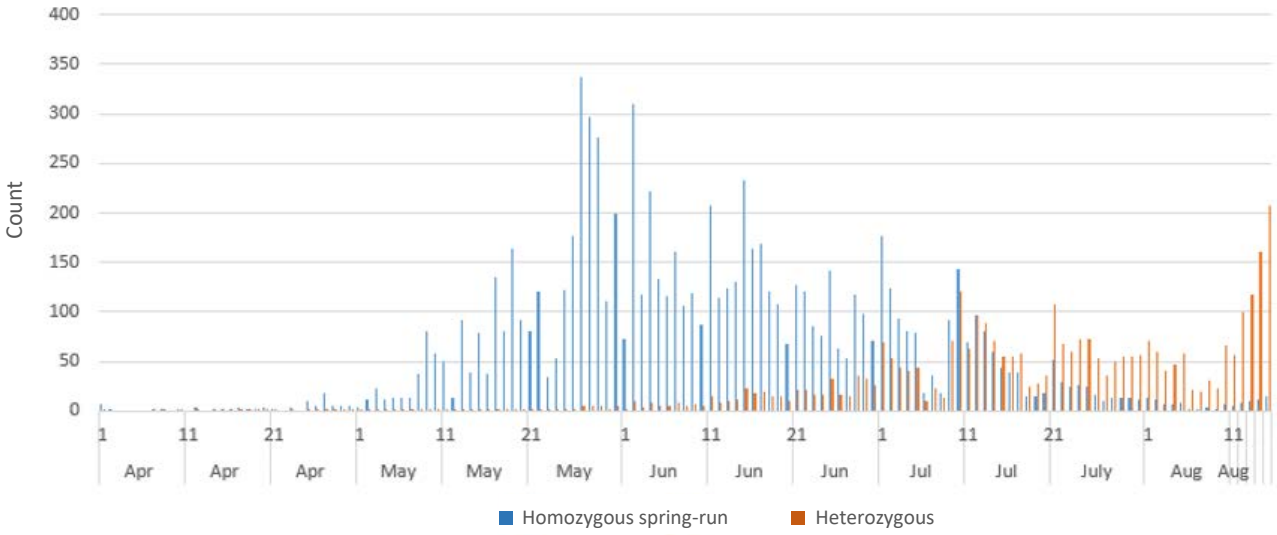

Figure 22. Estimated genetic composition of naturally produced Rogue River Chinook Salmon at Gold Ray Dam in 2004. Data courtesy UC Davis.

While the preseason forecast is new as of 2018, past run data for NPCHS can be used to give an indication of how frequently additional harvest on wild fish will be provided. Below is a graph of the three-year moving average count of wild fish for each year since 1998 (Figure 23). The three-year average count exceeded 12,000 in four of the last 20 years; years that were mostly returns that came in before Plan implementation. Using the first preseason forecast from 2018 and the last two counts of NPCHS, the average count going into the 2018 fishery was 10,176. Management actions that have been implemented since adoption of the Plan are expected to increase NPCHS abundance in the future and provide more consistent harvest opportunities.

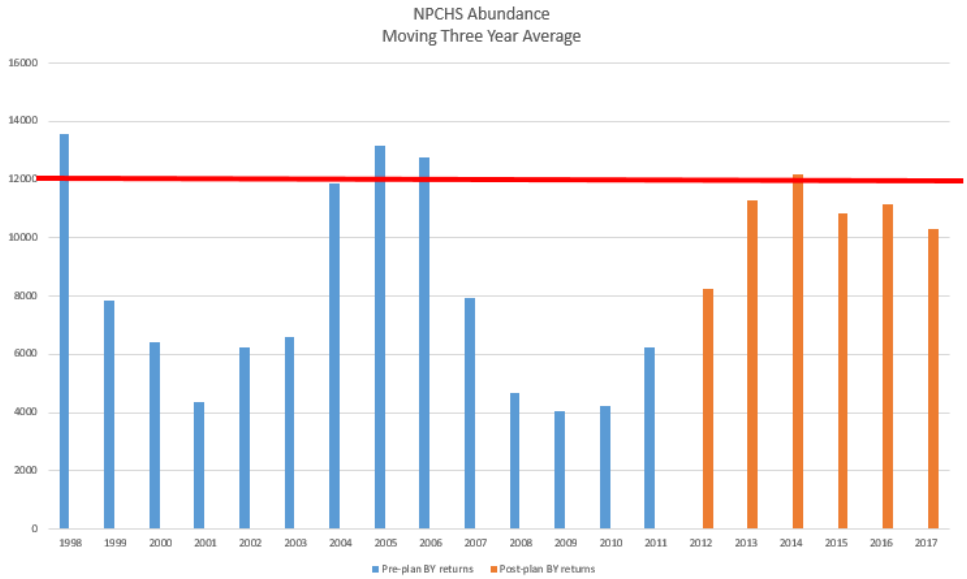

Figure 23. Most recent history of three-year average abundance over 12,000.

ODFW believes that adding additional harvest opportunity on wild fish that is not tiered to the abundance of the population risks impeding the restoration of early run NPCHS. The proposed fishery takes into account the current status of NPCHS in the Rogue River, as well as emerging genetic information.

In December 2017, the OFWC reviewed a public petition for a five-year experimental spring Chinook fishery as an amendment to the Plan. The petition called for opening NPCHS harvest one month earlier than allowed in current regulations to improve estimates of fishery impact rates and test for significant impacts to metrics reflecting status criteria. The Commission denied the petition, but directed the agency to consider the merits of the petition during development and finalization of this Plan review. ODFW considered the petition when devising the fishery management changes described above. The experimental fishery proposed in the petition was not incorporated as a management action modification in this document because it was determined to be inconsistent with achieving desired status criteria for NPCHS identified in the Plan.

7F. Planned actions

- ODFW will explore options for the use of premium tags as part of adding back wild harvest opportunity, and collecting genetic samples from NPCHS harvested when additional opportunity is provided.

- ODFW will continue to request flexibility in the hatchery contract from USACE to release larger but fewer HPCHS smolts to improve returns, while staying within contract poundage. ODFW is investigating an adaptive approach to spring Chinook smolt production to respond to increasingly chaotic environmental extremes. This request has been denied as of March 2018.

- ODFW has collected genetic samples from Cole Rivers HCHS broodstock to test for the spring migration allele over the collection period. Results are expected to be included in the 2019 annual report.

8. MANAGEMENT STRATEGY 9.5

In Management Strategy 9.5 ODFW listed actions to reduce the potential risk of hatchery fish to NPCHS. These actions are mostly complete or in process.

8A. Action 5.1

To complete action 5.1, a temporary weir was constructed in a return flow channel leading to the outfall from Cole Rivers Hatchery (Figure 24). A portion of the hatchery run enters this channel every year, instead of remaining in the main channel of the river and entering the hatchery at the collection pond. ODFW believes that many of these hatchery fish spawn in the river and add to hatchery stray rates. Unfortunately, the weir did not prove effective and did not work when smolts were released. In 2017, a trap constructed at the outfall (Figure 25) proved effective in capturing HCHS. Trapping will continue at this location.

Figure 24. Temporary barrier weir below hatchery outfall

Figure 25. Trap at hatchery outfall

8B. Action 5.2

A revision to broodstock management (same as Action 4.6) was designed in 2007. The objective is to ensure that the age structure of broodstock spawned at the hatchery mimics more closely the age structure of older NPCHS that spawned upstream of the Lost Creek dam site, while also increasing harvest rates on hatchery spring Chinook. Effort to fully implement the broodstock change continues.

8C. Action 5.3

Management action 5.3 specifies that in the event that hatchery fish compose more than 25% of the CHS that spawn between Cole M. Rivers Hatchery and Rogue Elk Park, additional measures will be employed to reduce the proportion of hatchery fish among natural spawners. The purpose of this action is to decrease the risk of potential negative impacts of hatchery fish on early-run NPCHS in their most important spawning area. Stray rates are very low on the Rogue, likely because imprinting is maximized. Fish produced at Cole Rivers are spawned, incubated, reared and release in the same water that adults return to each year. For Rogue spring Chinook, as the abundance of NPCHS has increased since plan adoption, the proportion of hatchery fish counted on the spawning grounds has decreased dramatically. Implementation of action 5.3 has not been needed.

8D. Planned Action

- ODFW STEP and hatchery staff will annually trap the hatchery outfall channel to maintain low stray rates with the new trap developed in 2017.

9. OTHER MANAGEMENT ACTIONS

9A. Carcass placement: Coastal Conservation Association and guides

Hatchery carcasses, a resource byproduct of hatchery production, are often used for nutrient enrichment in streams. The idea is to mimic the large run size that spawned in target streams historically, and replace the nutrients provided by the historic runs.

Carcass placement on the Rogue is implemented as a Salmon Trout Enhancement Program (STEP) activity. These activities are made possible through the help and coordination of lead STEP volunteers. Carcasses have been placed to benefit NPCHS production since 2014 in a project prompted by interest from the local chapter of the Coastal Conservation Association. A brigade of volunteers disperses HCHS carcasses via drift boat. Volunteers from the guiding community, local fishing groups, and the public participate in this activity. The primary site for enrichment is the mainstem between Cole Rivers Hatchery and Shady Cove, along with Big Butte Creek. Table 5 shows the pounds of carcasses released each year by treatment site.

Table 5. Spring Chinook Carcass Placement in Mainstem Rogue River and Big Butte Creek

Brood Year	Month/Year of Placement	Water Body	# ChS Carcasses	Poundage	Miles Treated
2012	Feb-13	Big Butte	80	560	1.5
2013	Nov-13	Big Butte	255	3023	1.5
2014	Nov-14	Rogue	2272	26,056	11.0
2015	Nov-15	Rogue	2042	22,462	11.0
2016	Nov-16	Rogue	1396	15,356	11.0
	Dec-16	Big Butte	318	3,498	1.5
2017	Nov-17	Rogue	1582	17,402	11.0

10. MONITORING, EVALUATION AND RESEARCH NEEDS

The Plan acknowledged that not all the tasks identified in this section would be completed and that prioritization would be needed. In addition, adaptive management is likely to identify additional monitoring, evaluation and research needs.

10A. Monitoring Needs

All annual monitoring that can take place is taking place. All weekly monitoring is being done as part of weekly coordination calls with USACE. Two out of three intermittent monitoring projects are underway.

Genetic Assessment

Historically, spawning habitat for Chinook Salmon in the mainstem Rogue River had a fairly distinct separation of spring and fall Chinook Salmon. Spring Chinook spawning habitat ranged from Gold Ray, at river mile 126, up into the middle and south forks of the Rogue. A few anecdotes about NPCHS spawning below Gold Ray are available, but it is impossible to tease out whether poor passage at the mainstem dams (very bad at times) contributed to this rare occurrence. The bulk of fall Chinook spawning took place below Gold Hill at river mile 120, with relatively few passing Gold Ray Dam.

Spawning distribution changed when Lost Creek Reservoir was constructed and flow augmentation allowed early run fall Chinook (and probably late run spring Chinook) to survive the river migration in summer. Fall Chinook abundance in the upper Rogue has increased since dam construction, while spring Chinook decreased in abundance (ODFW 2000).

Advances in genetic science are coming quickly and are likely to provide significant benefits in the stewardship of Rogue NPCHS. In 2014, ODFW was contacted by a geneticist from the UC Davis asking for samples from Rogue Chinook Salmon. The samples were needed to complement samples being collected elsewhere in Washington, Oregon, and northern California. ODFW provided samples from known naturally produced fall Chinook seined at Huntley Park, known NPCHS from spawning ground surveys, and early returning fish to Cole Rivers Hatchery.

Results from Rogue samples were consistent with the hypothesis from UC Davis that run timing is associated with a single gene. For instance, Chinook that return early are homozygous for the spring-run version of the gene (allele), whereas Chinook that return later are homozygous for the fall-run allele. The research also indicates that there are substantial numbers of Chinook that have one copy of the gene associated with spring run timing and one copy of the gene associated with fall run timing (Thompson et al. 2018). These fish generally have intermediate run timing and are referred to as heterozygous, the technical term for an individual having two different versions of a particular gene.

Researchers from UC Davis completed additional analyses on the genetics of Rogue Chinook Salmon using archived genetic samples collected in 2004 (Thompson et al. 2018). Samples were collected at Gold Ray Dam at river mile 126 in three time periods: the last week of May; the first week of August; and the first week of October. Data from the UC Davis analysis are presented in Figure 26 below. Fish passing Gold Ray Dam the last week of May were almost all spring Chinook with two copies of the gene associated with early run timing (homozygous spring-run). By the first week of August, most fish passing Gold Ray Dam were Chinook salmon with both spring-run and fall-run versions of the gene associated with run timing (heterozygous). Fish passing Gold Ray Dam the first week of October were almost all fall Chinook with two copies of the gene associated with late run timing (homozygous fall-run). Based on these results, researchers from UC Davis also estimated genotype frequencies across the entire run year for Chinook Salmon passing Gold Ray Dam in 2004 (Figure 27).

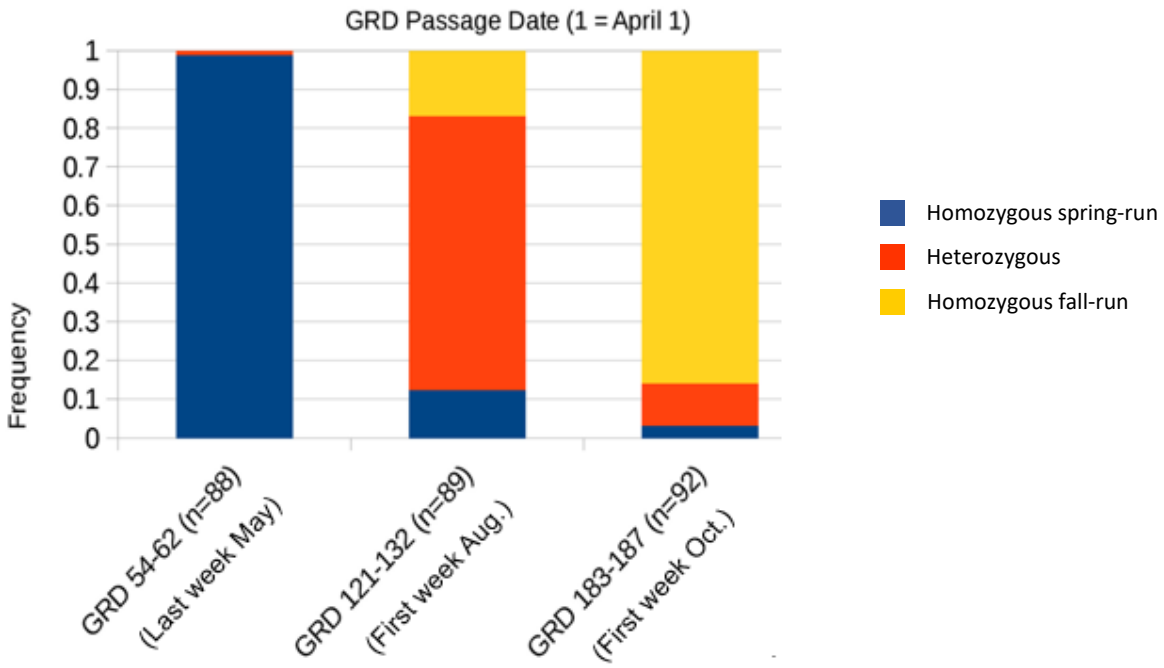

Figure 26. Genetic composition of Chinook passing Gold Ray Dam at three time periods in 2004. Fish are grouped based on their genotype at one location associated with run timing.

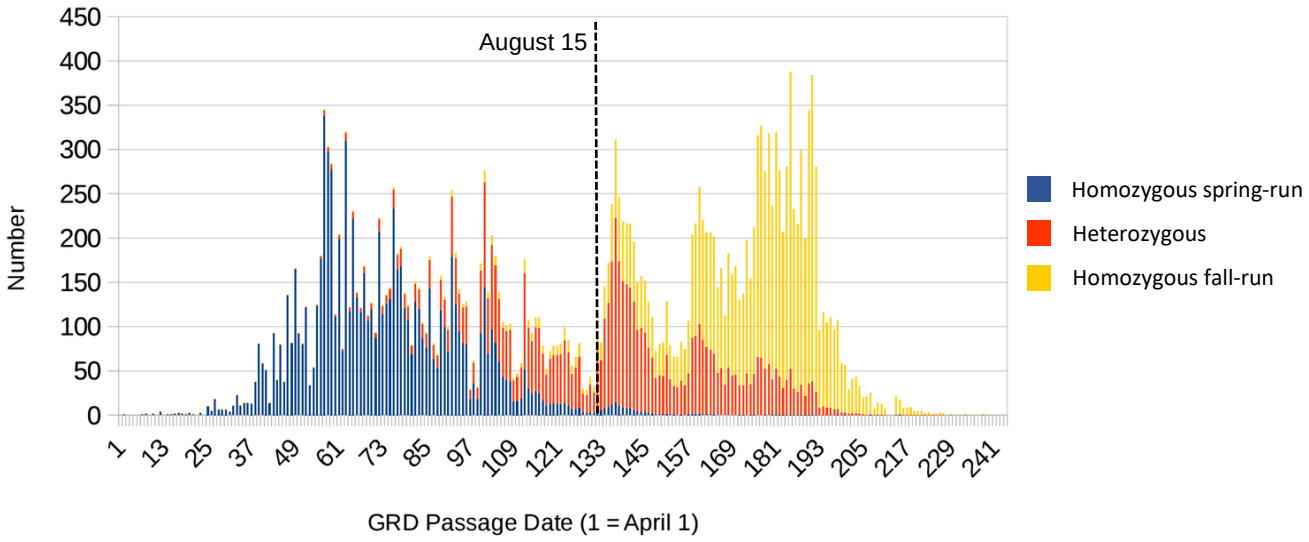

Figure 27. Estimated genetic composition of Chinook passing Gold Ray Dam in 2004. Fish are grouped based on their genotype at one location associated with run timing.

Spring Chinook Salmon counts at Gold Ray Dam conventionally ended on August 15th, and fish passing Gold Ray Dam from August 16th on were counted as fall Chinook (ODFW 2000). Dam counts by necessity are estimated using discrete time periods. In a river like the Rogue where fish migration occurs every day of the year, some error is inherent in having a specific cut-off date between runs. The UC Davis genetic analysis of samples from 2004 indicates that Spring Chinook counts at Gold Ray Dam included many heterozygous Chinook salmon with intermediate run timing.

With a new tool available for determining fall versus spring Chinook Salmon, ODFW initiated a study in 2016 to collect genetic information from carcasses of naturally produced Chinook Salmon during carcass surveys. The primary objective of the study is to quantify by date and location the genotypes of Chinook spawning in the upper Rogue River. This information may provide managers the ability to adjust monitoring and management of NPCHS. Two years of data have been collected and the final year of data collection will be in 2018. These data will help meet a need identified in the Plan (Intermitting Monitoring Need 1; Research Need 4).

For ODFW, the emerging genetic information underscores the requirement for cautious stewardship of NPCHS. According to the researchers at UC Davis, the viability of NPCHS is under direct threat from interbreeding with fall Chinook Salmon and loss of the early migration gene (Thompson et al. 2018). Some of the assumptions underlying this conclusion still need to be tested, however, and ongoing research will likely provide further insight in coming years. For now, the current state of knowledge supports the focus of the Plan on protecting early run NPCHS.

Assessment of gravel between Cole Rivers Hatchery and Shady Cove
Biologists with USACE conducted a survey of gravel in the upper Rogue in 2012 and reported some coarsening below Jess Dam.

10B. Evaluation needs
This comprehensive assessment addresses one of the evaluation needs identified in the Plan, which was to evaluate the efficacy of management strategies adopted in the Plan. Four other evaluation needs identified in the Plan have not yet been completed.

10C. Research needs
Out of 8 research needs, one has been completed, one is in progress, and two are no longer applicable following the removal of Gold Ray Dam.

Preseason Forecast
The first pre-season forecast of abundance for Rogue NPCHS has been completed (Research Need 1). The ability to model a pre-season forecast is possible because the ages of spawning fish have been obtained for the last seven years. While the ability to create the forecast is possible, model accuracy will improve with successive years of additional spawner age data and environmental co-variate data.

Three modeling techniques were used that fit Rogue NPCHS data: 1) Traditional sibling regression, 2) ARIMAX, and 3) NARX. Sibling regression is a forecasting technique used to predict the number of fish returning based on the abundance and age distribution of returning adults over some time period up to the most recent year. ARIMAX is an autoregressive moving average model which works well for time series data. The NARX model is a neural network that is a proven predictor and performs well with the modeling of nonlinear dynamic systems. All three models produced estimates and an ensemble prediction was used for the final estimate. The results of the models are shown below and ODFW's pre-season forecast for returns in 2018 is 10,716.

Table 6. Model data that make up the 2018 forecast of abundance.

Technique	2018 Prediction	MAPE	1/MAPE	weight
Sibling Regression	13192	0.24028	4.161811	0.395127
ARIMAX	7576	0.2451	4.079967	0.387357
NARX	11809	0.43648	2.291056	0.217516
Ensemble Prediction	10,716			

It is the goal of ODFW to provide a pre-season forecast using models that are designed to use all information available in the data, including the number of adults returned and their respective age distributions as well as any environmental covariates found to be useful in predicting these

parameters. Input variables into the models utilizing environmental co-variates will be updated over time as necessary.

Develop method to monitor (index) spawner abundance and spawner composition.
With the removal of Gold Ray Dam in 2010, ODFW switched to a hindcast estimate of the Gold Ray count based on an annual carcass count as described previously. ODFW is currently working on refining abundance estimation techniques for NPCHS within budgetary constraints. Consideration is being given to an approach that will provide a spawning escapement in lieu of the current "hindcast" technique. This approach would use a "superpopulation" modification to the Cormack-Jolly-Seber mark/recapture technique. This technique has been utilized in the Central Valley of California to estimate Chinook escapement. ODFW statisticians are currently evaluating the efficacy for use in estimating the Rogue spring Chinook spawning escapement.

10D. Planned actions

- ODFW is working to refine abundance estimation techniques for NPCHS within budgetary constraints. Consideration is being given to an approach that will provide a spawning escapement in lieu of the current "hindcast" technique.

- ODFW will complete an analysis of genetic samples collected from carcasses on the spawning grounds (2016-2018). The objective is to quantify by date and location the genotypes of Chinook spawning in the upper Rogue River. Results are expected to be included in the 2019 annual report.

- ODFW will follow emerging findings from genetic research and implement changes needed to continue to restore early run NPCHS. The new agency geneticist will assist with this effort.

- ODFW STEP will conduct an annual redd count in early September to verify the presence of early spawning NPCHS.

11. CONCLUSION

The Rogue Spring Chinook Salmon Conservation Plan began to be fully implemented in 2008, and has guided fish management for NPCHS for 10 years as of 2017. ODFW believes that in the context of environmental conditions experienced during Plan implementation, progress has been achieved, with positive signs observed in abundance and indications of a rebuilding early run component of the population. Full post-plan returns began in 2012, so only one complete brood has returned to date. More returns are needed to evaluate the effectiveness of management strategies to achieve desired status. **In fact, in the Plan it was stated there was a reasonable chance that desired status can be attained between 2019 and 2025.**

Because progress has been made, ODFW does not propose to modify management strategies or key elements in the Plan. Instead ODFW proposes to increase habitat restoration, add additional harvest opportunity while building toward desired status, and continue to improve the harvest of HCHS. ODFW believes this approach will provide the best strategy to achieve desired status and conserve the early run life history of the population.

As indicated in Oregon Administrative Rule 635-500-6525(6)(b), most of the management strategies in the Plan are long term strategies to be implemented for 25 years. Moving forward, additional changes to individual management actions may take place as new information becomes available or future needs are identified, under the principle of adaptive management. Completion of additional, full, post-plan life cycles will help determine progress toward achieving desired status, and the need for additional adaptive management. ODFW will continue to provide updates on Plan implementation and progress through reports and assessments. Given the amount of effort involved, ODFW will likely seek reporting and assessment efficiencies by aligning requirements under this Plan with those in other conservation plans that have been adopted and are under development for the Rogue basin. However, after the completion of the next life cycle in 2023, ODFW does plan to review the likelihood of achieving desired status for NPCHS by 2028 and describe any Plan changes or adaptive management that may be necessary to achieve it by this time.

12. REFERENCES

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Appendix A. Hatchery Program Overview

Background:
Cole Rivers Fish Hatchery was built by the Corps of Engineers to replace the fish and fishery that were lost due to dam construction and operation. William Jess Dam on the Rogue River was completed in 1977, blocking salmon and steelhead from using 10 miles of the mainstem and portions of both the Middle Fork and South Fork of the Rogue River. Applegate Dam was completed in 1982, blocking steelhead and some salmon from using the Middle Fork Applegate River, Carberry Creek and numerous tributaries.

What fish does Cole Rivers Hatchery produce for the Rogue River?
Cole Rivers produces fish to meet the mitigation obligation for the Corps. The primary purpose of the hatchery is production of Spring Chinook salmon. Jess Dam/Lost Creek Reservoir stopped production of about 1/3 of the spawning population of Rogue spring Chinook. The mitigation goal is 13,020 adult spring Chinook. Cole Rivers also has mitigation goals for Coho Salmon, summer Steelhead, winter Steelhead, and Rainbow Trout.

- Spring Chinook salmon 1,703,250 smolts* Aug., Sept., Oct., Mar**
- Coho salmon 75,000 smolts Late April/early May
- Summer Steelhead 220,0000 smolts Late April/early May***
- Rogue Winter Steelhead 152,000 smolts Late April/early May****
- Applegate W Steelhead 111,040 smolts Mid-April****

**numbers may decrease if larger smolts released*
***off station release to minimize risk of predation on naturally produced Spring Chinook fry*
****includes off station release to minimize risk of predation on naturally produced Spring Chinook fry*
*****two year smolt*

How many hatchery Spring Chinook has Cole Rivers released in recent years?
Below is a table showing the releases of Spring Chinook smolts from Cole Rivers Hatchery over the past five years.

Table 1: Spring Chinook smolt releases from Cole Rivers Hatchery.

Release Year	August Release	September Release	October Release	March Release	Total Release
2013	623,090	733,799	163,576	0	1,520,465
2014	735,620	732,039	193,000	50,388	1,711,047
2015	729,980	750,960	196,550	50,323	1,727,813
2016	766,418	766,382	205,872	51,025	1,789,697
2017	467,189/31,356**	574,164	360,900	91,500	1,525,109

***estuary release*

How many hatchery Spring Chinook have been released in nearby rivers in recent years?
Hatchery releases of spring Chinook salmon also takes place in the Klamath and Umpqua watersheds. Trinity River Hatchery in the Klamath releases spring Chinook in June and in the

fall (occasionally into winter). Cole Rivers Hatchery on the Rogue releases spring Chinook in August, September, October and March. Releases from Rock Creek Hatchery in the Umpqua are completed in October and February.

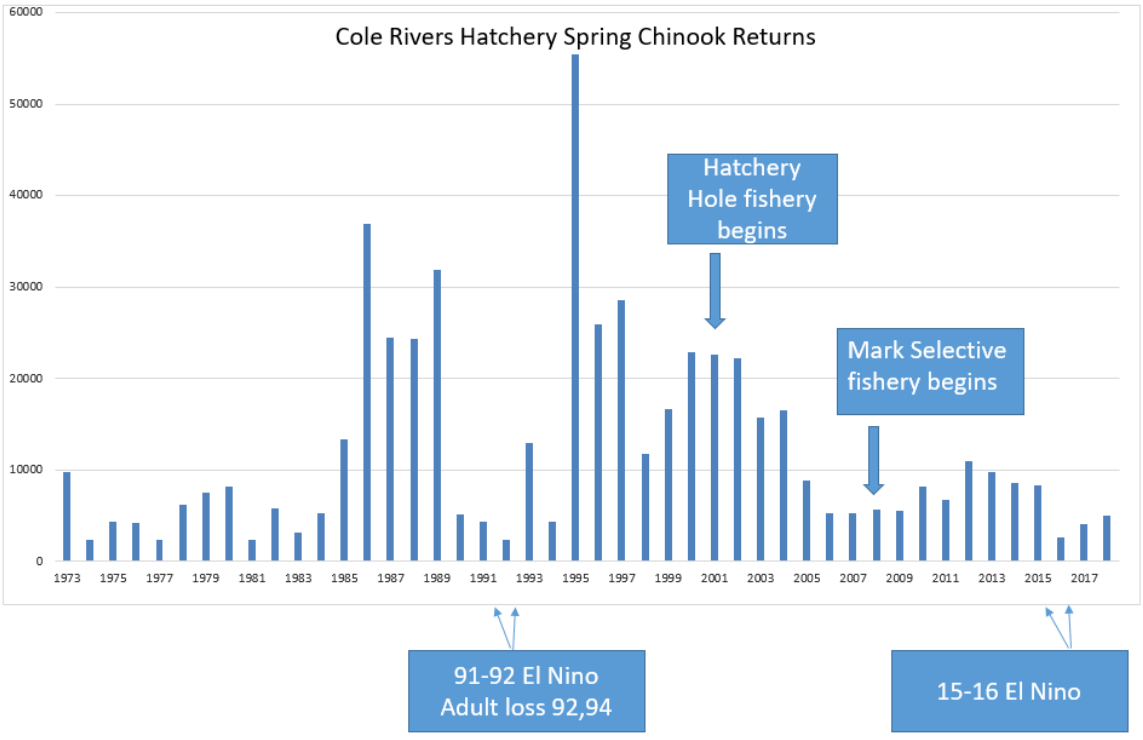
Table 2: Spring Chinook smolt releases from Cole Rivers Hatchery and neighboring hatcheries.

Brood Year	Release Year	Rock Creek Hatchery	Trinity River Hatchery*	Cole Rivers Hatchery	Expected Return Year
2013	2014	369,576	1,442,424	1,711,047	2016-2018
2014	2015	552,677	1,403,161	1,727,813	2017-2019
2015	2016	3,525	1,461,465	1,789,697	2018-2020
2016	2017	211,313	1,473,612	1,525,109	2019-2021

** Trinity River Hatchery and CDFW data*

Does Cole Rivers Hatchery mark all the hatchery Spring Chinook with a fin clip?
Beginning with the smolt release in 2007, the spring Chinook produced at Cole Rivers Hatchery have been all been released with an adipose fin clip. The fin clipping is accomplished using an automated process in a marking trailer that moves around the state. The hatchery goal is for a 100% fin clip rate. Recently, the fin clipping has taken place in March at Cole Rivers.

How many hatchery Spring Chinook have returned to Cole Rivers over time?
Below is a graph of the collection pond tally of Spring Chinook salmon at Cole Rivers Hatchery. The returns do not include the number caught in ocean and river fisheries. Key environmental and management events over time are included.



How many hatchery spring Chinook have returned to nearby rivers in recent years?
Tallies of spring Chinook returning to the three hatcheries in recent years is shown below. These data are simply totals from the collection pond and include some unmarked wild fish. This tally shows what has returned to the hatchery after the fish have passed ocean and in-river fisheries.

Table 3: Spring Chinook returns from neighboring river hatcheries.

Return Year	Rock Creek Hatchery	Trinity River Hatchery	Cole Rivers Hatchery
2013	768	3,035	9,763
2014	875	4,530	8,609
2015	658	2,076	8,301
2016	1,087	2,104	2,698
2017	613	1,393	4,059

When will the Spring Chinook released in 2018 return to the river?
One challenge with fish management of salmon and steelhead is the length of time these fish spend at sea. Most fish returning to the Rogue River come back four years after the year the bulk of the parents spawned (the brood year). The spring Chinook released in 2018 come from the 2017 brood year. Most of these fish released in 2018 will return in 2021 as four year old adults. Some will return in 2019, some in 2020, and some in 2022.

Why do I see empty raceways at the hatchery?
As the fish grow, the hatchery needs space to expand each group into more ponds. The hatchery is constantly splitting ponds of fish as pounds of fish in the raceways go up. During an entire year, the hatchery uses every raceway on the facility.

For example, the spring Chinook to be released in 2018/2019 were ponded into five raceways in mid-December 2017. In March the spring Chinook are marked with an adipose fin clip and placed into the raceways where they stay until they are released.Spring Chinook rearing takes place in at least 26 out of 87 raceways available at the hatchery. In mid-August the first group will be released and these raceways will be empty. In mid-September another group is released, followed by mid-October and mid-March. The next brood year of spring Chinook will be placed into five raceways in mid-December 2018 to repeat the cycle.

How can I find out how many fish are returning to Cole Rivers?
Check the ODFW website at https://myodfw.com/cole-rivers-hatchery-fish-counts, ODFW's weekly recreation report, and the USACE dam report at 1-800-472-2434.

How can I found out more about Rogue fish?
Research reports and a variety of other information specific to the Rogue watershed is available on the Rogue web page at http://www.dfw.state.or.us/fish/local_fisheries/rogue_river/index.asp.

The page includes a link to sign up for periodic district updates sent via email. Finally, district staff can be contacted at 541-826-8774.