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Annual Report

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Executive Summary

This progress report describes work performed by the Confederated Tribes of Warm Springs' (CTWSRO) portion of the Hood River Production Program Monitoring and Evaluation Project (HRPP) during the 2008 fiscal year. A total of 64,736 hatchery winter steelhead, 12,108 hatchery summer steelhead, and 68,426 hatchery spring Chinook salmon smolts were acclimated and released in the Hood River basin during the spring. The HRPP exceeded program goals for a release of and 50,000 winter steelhead but fell short of the steelhead release goals of 30,000 summer steelhead and 75,000 spring Chinook in 2008. Passive Integrated Transponders (PIT) tags were implanted in 6,652 hatchery winter steelhead, and 1,196 hatchery summer steelhead, to compare migratory attributes and survival rates of hatchery fish released into the Hood River. Water temperatures were recorded at six locations within the Hood River subbasin to monitor for compliance with Oregon Department of Environmental Quality water quality standards. A pre-season spring Chinook salmon adult run forecast was generated, which predicted an abundant return adequate to meet escapement goal and brood stock needs. As a result the tribal and sport fisheries were opened. A tribal creel was conducted from May 22 to July 18 during which an estimated 172 spring Chinook were harvested. One hundred sixteen Spring Chinook salmon redds were observed and 72 carcasses were inspected on 19.4 miles of spawning grounds throughout the Hood River Basin during 2008. Annual salvage operations were completed in two irrigation canals resulting in the liberation of 1,641 fish back to the Hood River.

Program Introduction

The Hood River subbasin supports four species of endemic anadromous salmonids: Chinook salmon (*Oncorhynchus tshawytscha*), coho salmon (*Oncorhynchus kisutch*), steelhead (*Oncorhynchus mykiss*), and sea run cutthroat trout (*Oncorhynchus clarki*). Indigenous spring Chinook salmon were extirpated in the late 1960s. The naturally spawning spring Chinook salmon currently present in the subbasin are progeny of Deschutes River stock. Prior to implementation of the HRPP, the Hood River subbasin hatchery steelhead program utilized out-of-basin stocks. The current steelhead hatchery stocks are progeny of the indigenous Hood River steelhead beginning in brood year 1997 for summer steelhead and 1994 for winter steelhead. Indigenous Hood River stocks of summer and winter steelhead were listed as a Threatened Species in March 1998 by National Marine Fisheries Service (NMFS) under the Endangered Species Act (ESA).

The Hood River Production Program (HRPP) is a Bonneville Power Administration (BPA) funded program initiated as a mitigation measure for Columbia River hydrosystem effects on anadromous fish. The Confederated Tribes of the Warm Springs Reservation and the Oregon Department of Fish and Wildlife drafted the Hood River Production Master Plan (O'Toole and ODFW 1991a; O'Toole and ODFW 1991b) and the Pelton Ladder Master Plan (Smith and CTWSRO 1991). Both guiding documents were completed in 1991 and subsequently approved by the Northwest Power and Conservation Council in 1992 and authorized through a BPA lead Environmental Impact Statement in 1996. The implementation of the HRPP began in 1993 with the first release of Deschutes origin spring Chinook salmon into the Hood River. Steelhead releases began in 1996 for the winter race and 1999 for the summer race. Recommendations from subsequent program reviews and the scheduled removal of Powerdale dam in 2010 led to the completion of the Revised Hood River Master Plan (HDR/Fish Pro, 2008).

The HRPP is jointly implemented by the CTWS and ODFW. The primary goals of the HRPP are to: (1) re-establish naturally sustaining spring Chinook salmon using Deschutes River stock in the Hood River subbasin, (2) rebuild wild runs of summer and winter steelhead in the Hood River subbasin, (3) maintain the genetic characteristics of the populations, (4) protect high quality habitat and restore degraded fish habitat, and (5) provide consistent harvest opportunities for tribal and sport fishers. Monitoring and evaluation is conducted by both the CTWS and ODFW as BPA projects 1988-053-04 and 1988-053-03 respectively. Data collected by the HRPP has been

summarized annually in the reports submitted by ODFW and CTWS since 1996. Annual progress reports are available online at <http://www.efw.bpa.gov/> Publications.

This report summarizes the results for the fiscal year 2008 (FY08). Work implemented during this period under BPA contract included: (1) acclimating and releasing hatchery winter steelhead smolts and spring Chinook salmon smolts, (2) Oak Springs Hatchery (OSH) and Round Butte Hatchery (RBH) mark rate evaluation, (3) PIT tagging hatchery origin winter steelhead, and spring Chinook salmon smolts (4) Hood River basin water temperature monitoring, (5) spring Chinook salmon run size forecasts, (6) Tribal fishery creel survey and harvest estimate, (7) spring Chinook salmon spawning ground surveys, (8) irrigation ditch fish salvages.

Hatchery spring Chinook and steelhead smolt acclimation

Background and Introduction

Transportation of salmonid smolts has been shown to increase physiological stress responses in coho salmon (Schreck et al., 1989) and steelhead (Whitesel et al., 1994). Schreck et al. (1989) also found that fish not allowed to recover adequately from transport were less capable of surviving in a natural environment. An experiment published by Rhine et al. (1996) suggested that volitional release was effective for sorting residual and precocial summer steelhead from hatchery releases. Acclimation and volitional release procedures are utilized by the HRPP to reduce transportation stress, straying, mortality, and residualism in addition to allow for imprinting of the fish to the Hood River subbasin. Fish that do not migrate from the acclimation ponds are collected and transported to the mouth of the Hood River where they are released. Transporting non-migrants from the acclimation sites to the river mouth is theorized to reduce the number of residual hatchery fish and prevent these fish from competing for resources (Miller 1958, Bachman 1984, Vincent 1987) with native Hood River steelhead and Coho salmon that are listed as "threatened under the Endangered Species Act. ODFW biologists have observed a substantial increase in the proportion of hatchery released steelhead migrating out of the Hood River when managers changed from direct release to acclimated release of steelhead smolts (Robert Reagan, ODFW, personal communication)

The HRPP has acclimated and volitionally released all spring Chinook salmon and steelhead smolts since 1996. Prior to the acclimation and volitional release strategy, all steelhead and spring Chinook salmon smolts were direct released into the Hood River subbasin. The Hood River hatchery winter and summer steelhead and spring Chinook salmon are acclimated and released at sites located near primary spawning habitat with the intent that they will imprint and home back to targeted spawning areas.

Methods

East Fork Irrigation District Sandtrap

Hatchery winter steelhead smolts have been acclimated and volitionally released into the East Fork Hood River at East Fork Irrigation District (EFID) sand trap at river kilometer 11 since 1996. The fish are delivered by ODFW transport trucks from Oak Springs Hatchery (OSH). They are liberated and allowed to acclimate in two concrete cells that act as sand settling basins during irrigation season. Cell dimensions are 12' x 60' with a bottom sloping from six to twelve feet in depth. Aluminum screens are installed within the cells to prevent fish from leaving the cells during the acclimation period. The smolts are delivered from OSH in mid-April. The fish are bio-sampled and inspected for fin mark quality onsite during delivery. After a seven day acclimation period the screens are removed from the cells and smolts are allowed to volitionally migrate out of the EFID sand trap and into the East Fork Hood River. A stop log system is used to adjust the water levels in the cells after the screens are removed and the water levels are gradually reduced during the volitional release period to encourage out migration. PIT tag detectors are in place at the outflow to detect and record outmigration tagged smolts. At the end of acclimation in mid-May the remaining non-migratory steelhead are collected from the cells, biosampled and scanned for PIT

tags, before loading into ODFW and CTWS fish liberation trucks. They are transported and released into the Columbia River near the mouth of the Hood River. The condition factor of non-migrants is compared to the original population of fish delivered to the acclimation site.

Parkdale Fish Facility

In the fall of 1998, the Parkdale Fish Facility (PFF) was completed near RM 4.0 on the Middle Fork Hood River. The Parkdale Fish Facility is owned by BPA and is operated by the Confederated Tribes of Warm Springs. The facility is used for brood holding, adult spawning, and egg incubation and smolt release. The water source for the facility is from the Rogers Spring Creek and the Middle Fork Hood River. Winter steelhead and spring Chinook salmon smolts are acclimated and released from two painted concrete acclimation ponds with dimensions of 80 ft x 8 ft x 4 ft. Recycled Christmas tree conifers are suspended in the ponds to increase cover and provide semi-natural habitat features for fish acclimating in the concrete ponds. Unlike the other Hood River acclimation sites fish held at the PFF are fed a maintenance diet. Hatchery staff at the PFF monitors water quality in the acclimation ponds and remove mortalities. A stop log system is used at the outlet of the acclimation ponds to control pond levels and release fish. The outlet is equipped with a PIT detector. Fish that leave the ponds exit the hatchery into Rogers Spring Creek, a small tributary that enters the Middle Fork Hood River at RM 4.0.

Winter Steelhead smolts are delivered to the PFF mid March (Table 1). The fish are acclimated in the pond for ten days and then allowed to volitionally out-migrate from the facility. In mid-May any remaining non-migrants are collected, bio-sampled, checked for PIT tags, and trucked to the Columbia River near the mouth of the Hood River.

Blackberry Creek

Hatchery spring Chinook salmon have been acclimated and volitionally released on the West Fork Hood River (RM 9.0) at the Blackberry Creek acclimation site since 1996. An additional tank was added to the Blackberry acclimation site in 1999 to acclimate summer steelhead smolts. The two portable acclimation ponds are located high in the West Fork drainage to imprint smolts to the upper West Fork which contains quality spawning and rearing habitat for both species.

Two ponds are assembled at Blackberry with dimensions of 4'9" x 11'9" x 90'7" for the summer steelhead pond and 4'9" x 11'9" x 60'7" for the spring Chinook salmon pond. The ponds were purchased from ModuTank, Inc. and are comprised of four foot galvanized steel panels, supporting frames and cables; a 3.6 mm reinforced polypropylene liner, and a six inch PVC bulkhead. Assembly of the ponds and piping occurs in March when the snow has melted sufficiently from the site to allow installation. Water for the Blackberry ponds is diverted from Blackberry Creek through a screened intake box and a 930 ft gravity flow pipeline of 8 ft diameter pipe. There is approximately 38 ft. of head differential between the intake box and the ponds. The return flow back to the West Fork Hood River consists of 360 ft. of 8" pipe. Control valves regulate water at the intake box, the junction of the two ponds, and at each pond outlet. A bracing and support system is constructed for the pipeline. Once the ponds are constructed, a four-foot high, six-inch diameter PVC standpipe is connected to the outlet bulkhead of each pond to control the water level. Fish exit the ponds via the standpipes that are also used to drain the ponds when needed. The ponds are covered with a fine mesh net at both ends of the pond to prevent fish from jumping out, protect them from predators, and create shade refuge. A battery operated flotation alarm system is attached to each pond during acclimation. The alarm can be adjusted to trigger at various water depths so the alarm system will sound when the water level increases or decreases from a fixed level. In addition, 200 gpm pumps and an aerating system are set up for each pond to re-circulate and aerate the pond water in the event of a water supply failure. The total water needed to sustain acclimating summer steelhead and spring Chinook in both ponds at Blackberry is calculated to be 760 gpm based upon hatchery guidelines. Smolts are volitionally released from the portable ponds utilizing an aluminum hopper. The release hopper was constructed with a rectangular "V" shaped bottom, three vertical sides, one open side and the "V" bottom connected to a six-inch diameter pipe.

Each acclimation site is manned twenty four hours a day. Water temperatures, dissolved oxygen, and fish mortalities are recorded regularly during the acclimation period. After holding for a number of days (usually a week), the screens are removed and the fish are allowed to emigrate on their own volition. If another group of fish is to be received, the screens are replaced for approximately a week and the process is repeated. Spring Chinook that remained in the acclimation ponds at the end of the volitional release period were forced out of the tanks and into the West Fork Hood River. Steelhead that remained in the ponds after the volitional release period were collected, counted, bio-sampled, and hauled in a 500 gallon liberation truck and released near the mouth of the Hood River.

During the first 24-48 hours of volitional release ODFW de-activates the juvenile rotary screw traps on the West, East, and Middle forks so that the traps are not overwhelmed with out migrating hatchery smolts. ODFW continues to fish the mainstem screw trap during smolt releases. Thereafter out migrating smolts are sampled on the mainstem, East Fork, West Fork, and Middle Fork Hood River. Out migration timing is monitored and smolt survival estimated by ODFW.

Results and Discussion

Summer Steelhead

Wild summer steelhead broodstock were collected in 2006 and 2007 at the Powerdale Trap on the Hood River at RM 4.5 and were transported, held, and spawned at the Parkdale Fish Facility in 2007. They were reared at OSH until spring 2008. At OSH Hood River stock summer steelhead were marked with adipose fin and right maxillary clips.

On March 25, 2008, 12,219 summer steelhead hatchery smolts were received at the Blackberry Creek acclimation site (Table 1). It should be noted that number of smolts delivered by ODFW OHS was significantly less than the target release goal of 40,000. Volitional release of this group into the West Fork Hood River began on April 1 after ten days of acclimation. Of these fish, 11,525 emigrated volitionally into the West Fork Hood River, 49 mortalities were observed, and 583 did not migrate.

The mean fork length of the hatchery summer steelhead smolts delivered from OSH was 200 mm, ± 30 mm. The mean condition factor was 1.03, ± 0.06 . The mean length of the non-migrant fish was 189 mm, ± 34 mm. The mean condition factor was 0.95 ± 0.06 . A length frequency histogram of the relative distribution of lengths observed displays a very similar distribution of lengths for the pre-release and non-migrant samples (Figure 1). We performed a Mann-Whitney test to compare the samples and in fact there was no significant difference between the two groups ($P=0.818$). The adipose and left maxillary clips were evaluated similarly to the methods used for winter steelhead mark evaluation. Out of a sub-sample of 439 summer steelhead, <0.5% were missing maxillary clips (Appendix G).

Figure 1. Length frequency histogram of pre-release and non-migrant sample groups of summer steelhead released into the Hood River in 2008.

Winter Steelhead

Wild winter steelhead broodstock were collected in 2007 at the Powerdale Trap on the Hood River at Rm 4.5 and were transported, held, and spawned at the Parkdale Fish Facility in 2007. They were reared at OSH until spring 2008. At OSH Hood River stock winter steelhead were marked with adipose and left ventral fin clips

On April 15, 16 and 17, 2008 37,845 Hood River stock hatchery winter steelhead smolts were delivered from OSH to the EFID sandtrap. They were acclimated for 30 days and volitionally released (Table 1). Of these fish, 37,649 emigrated volitionally into the East Fork Hood River, 8 were mortalities, and the remaining 188 non-migrants were trucked and released into the Columbia River near the mouth of the Hood River on May 15, 2008.

In the Middle Fork Hood River, 26,918 smolts were received at the Parkdale Fish Facility on April 14 (Table 1). They were acclimated ten days prior to volitional release. There were 19 mortalities during acclimation. The remaining 26,843 emigrated volitionally to the Middle Fork Hood River. The remaining 56 non-migrants were trucked and released into the Columbia River near the mouth of the Hood River on May 16.

The winter steelhead delivered to PFF from OSH were 4.8 fish/pound, at the East Fork sand trap winter steelhead were 4.9 fish per pound at delivery. The mean fork length of the hatchery winter steelhead smolts was 202 mm $\pm$ 21 mm. The mean condition factor was 1.13, $\pm$ 0.08. The mean length of the non-migrant winter steelhead was 197 mm $\pm$ 38 mm. The mean condition factor was 1.09 $\pm$ 0.08. The mean size of these two groups of fish is very close. However a length frequency histogram appears to display a bimodal distribution in the non-migrant fish (Figure 2). This supports the theory that non-migrant fish are those that are either too small to smolt that year and thus residualize, or that they are large fast growing fish that may adopt a precocial spawning life history. A Mann-Whitney test was performed to compare these groups that yielded a non-statistically significant difference ($P=0.348$). The inability to measure statistically significant

differences may be due to confounding effects in the acclimation and release methods or that volitional release is only partially capable of sorting smolting from residual steelhead. The fact that the summer steelhead did not display a similar pattern is interesting but could be an artifact of the unusually early acclimation and release timing of summer steelhead in 2008.

At OSH hatchery winter steelhead were marked with an adipose and left ventral fin clip. The fin clips were evaluated for a sub-sample of 428 winter steelhead. The marks were defined as missing if half or more of the targeted fin remained in tact. None of the winter steelhead sampled were missing adipose clips or ventral clips.

Figure 2. Length frequency histogram of pre-release and non-migrant groups of winter steelhead released into the Hood River in 2008.

Spring Chinook

A total of 68,772 hatchery spring Chinook salmon smolts were produced in the Pelton ladder cells at Round Butte Hatchery for release to the Hood River. It should be noted that the number delivered from Round Butte Hatchery were just over half of the target production level of 125,000. Additionally the fish were delivered nearly one month later than normal. This was due to a BKD outbreak and subsequent erythromycin treatment period.

All of these fish were transferred to the Blackberry acclimation site on the West Fork Hood River on April 16 and 17 (Table 1). They were held for seven days before volitional release began. These fish were allowed to volitionally emigrate out of the ponds until May 9 when the remaining fish were forced out of the ponds.

Fin mark quality and coded wire tag retention was sampled for 435 West Fork acclimated spring Chinook. The spring Chinook sampled had a 100% coded wire tag retention. 37 or 8.5% of West Fork hatchery spring Chinook had poor or missing adipose fin clips. Poor clips were defined as retaining 50% of the targeted fin tissue. All the secondary marks (maxillary) were present on sampled fish.

Spring Chinook smolts reared in the Pelton Ladder and delivered to West Fork acclimation sites were 10.0 fish per pound when delivered on April 16. The mean fork length of the West Fork hatchery spring Chinook salmon smolts was 153mm +/- 19mm (Figure 3). The mean condition factor was 1.13 +/- 0.07.

Figure 3. Length frequencies of spring Chinook salmon smolt released into the West Fork Hood River in 2008.

Smolt Condition Factor

Condition factors were calculated for all pre-acclimation and non-migrant smolts for all release years (Figures 4-6). Condition factor is a metric intended to measure the overall fitness of the fish. Ideal condition factor for a smolt is considered to be 1.0. Condition factor significantly greater than 1.0 could be due to accelerated growth or fat reserves, which could lead to increased residualism in steelhead (Rhine et al. 1996) or precocity in Chinook (Beckman and Larsen 2005). Condition factors significantly lower than 1.0 could indicate lower growth rates or malnourishment that could lead to decreased fitness of smolts. General trends show that in nearly every instance the pre-acclimation smolts had a greater mean condition factor than the non-migrants. Both winter and summer steelhead matched that general trend observed in previous years. The non-volitional released Chinook were forced out of the acclimation ponds instead of being collected and trucked to the mouth in 2008. Thus there was no non-migrant group for spring Chinook in 2008.

Table 1. Summary of HRPP summer steelhead, winter steelhead, and spring Chinook hatchery smolt releases in 2008

Sub-basin, Location, Species, Release group	Date transferred to acclimation pond	Number transferred to raceway	Fish/lb at transfer	Number of days acclimated	Mortalities in acclimation raceway	Number volitionally released	Number liberated to Columbia	Total released
West Fork, Blackberry, Summer Steelhead,	Mar 25	12,219	5	8	54	11,525	583	12,108
West Fork, Blackberry, Spring Chinook,	Apr 16-17	68,772	10	7-8	346	68,426	NA	68,426
East Fork, Sandtrap, Winter Steelhead,	Apr 15-17	37,845	4.9	8-10	8	37,649	188	37,837
Middle Fork, Parkdale, Winter Steelhead,	Apr 14	26,918	4.8	10	19	26,843	56	26,899

Figure 4. Condition factors of non-migrant and pre-acclimation Chinook salmon smolts at the Blackberry acclimation site on the West Fork Hood River, 1998-2008.

Figure 5. Condition factors of pre-acclimation and non-migrant winter steelhead smolts at the East Fork acclimation sites and Parkdale Fish Facility, 1996-2008.

Figure 6. Condition factors of pre-acclimation and non-migrant summer steelhead smolts at the Blackberry acclimation site on the West Fork Hood River, 1999-2008.

Investigations of Hood River migration attributes, and adult returns and precocial maturation using PIT tags

Introduction

Managers in the HRPP are keenly interested in the life history expression and migration behaviors of hatchery smolts in order to assess: the effectiveness of hatchery rearing and release strategies; the performance of hatchery fish, and their potential interactions with native fish in the basin. Hood River native steelhead are listed as “threatened” under the Endangered Species Act as part of the Mid Columbia Steelhead ESU. Since one of the goals of the HRPP is to rebuild native steelhead runs while maintaining genetic characteristics of the native fish populations HRPP managers are investigating the possible interactions of the hatchery production program on wild runs in the Hood River (O’Toole 1991a).

Following the HRPP Program review (Underwood et al, 2003) the Independent Scientific Review Panel (ISRP) suggested that Passive Integrated Transponder (PIT) tags could be an effective method to investigate wild and hatchery fish populations in the Hood River. One issue HRPP managers were concerned with was the potential that hatchery fish releases could provide a significant source of competition with wild fish during juvenile rearing and migration. Studies in many other river systems have indicated that hatchery fish (especially steelhead) can residualize at a high rate and could potentially consume resources that would otherwise be available to native fish (Rhine et al. 1996, Vincent and Schuck 1995). The use of PIT tags will enable HRPP biologists to study the migration characteristics of hatchery and wild fish to identify overlaps in time and space which may result in negative competitive interactions.

Hood River hatchery spring Chinook salmon express much higher rates of jacks and mini-jacks than occur in natural or even other hatchery populations in some years. By implanting PIT tags in

juvenile spring Chinook we seek to better understand the life history traits, more accurately measure precocity rates and assess rearing and release practices for hatchery Spring Chinook salmon in the Hood River.

HRPP CTWS personnel began PIT tagging in 2005 when 4,979 non-migrant winter steelhead smolts were tagged before being trucked to the mouth of the Hood River. The goal was to gain insight on the fate of these potential residual fish after they were released at the mouth of the Hood River. In 2006 the PIT tagging project was expanded from tagging only non-migrant fish to tagging 35% of all hatchery winter steelhead delivered to Hood River acclimation sites. In 2007 this project was expanded again to include hatchery spring Chinook smolts. It was planned to PIT tag spring Chinook again in 2008 however low production levels and an outbreak of bacterial kidney disease (BKD) in the Pelton ladder cells prompted HRPP managers to cancel Chinook tagging. Spring Chinook PIT tagging is planned to resume for 2009 releases. The goal is for approximately ten percent of all steelhead and spring Chinook production released into the Hood River to receive PIT tags. The objectives of this multi-year study are listed below.

The co managers (ODFW) M&E project also utilizes PIT tags in cooperation with CTWS in their monitoring program. ODFW M&E primarily PIT marks hatchery and wild fish at the 5 rotary screw traps they operate in the Hood Basin. To date nearly all wild salmonids PIT tagged by the HRPP and used for hatchery–wild juvenile migration and survival comparisons have been marked at the ODFW operated screw traps. Fish tagged at the screw traps are used for the mark recapture methodology to generate downstream migrant estimates at the traps sites. ODFW also PIT tags a group of ~2,000 hatchery winter steelhead at Oak Spring Hatchery. These fish are part of an experimental group that is direct released in upper reaches of the East Fork Hood River. Additionally ODFW staff monitors PIT detections at downstream interrogation sites such as Bonneville Dam and the estuary trawl. ODFW also scans all adult fish captured in the Powerdale trap for PIT tags. Further detail on ODFW's PIT tag methods and analysis can be found in the Hood River and Pelton Ladder annual report to BPA (Olsen 2007).

Objectives

1. Compare behavior and performance of wild and hatchery smolts
2. Investigate differences in migrant and non-migrant hatchery smolt
3. Investigate the effect of hatchery rearing practices on precocial maturation and freshwater residualism
4. Estimate adult exploitation in Columbia River Zone 6 and Hood River sport fisheries
5. Document and estimate straying of Hood River adult salmon and steelhead.
6. Monitor adult run strength and timing at Bonneville Dam.

Methods

Approximately 6,652 juvenile winter steelhead, destined for release into the East Fork and Middle Fork of the Hood River, and 1,196 summer steelhead to be released in the West Fork Hood River were PIT tagged at Oak Springs Hatchery. Tagged steelhead juveniles were approximately 20 fish per pound and 128mm fork length at the time of tagging. Tagging was conducted in an ODFW marking trailer from January 7 through January 16, 2008 by a crew of five. On average 1,100 fish were tagged per day.

Our methods for marking fish with PIT tags was based on the protocols outlined in the PIT Tag Marking Procedures Manual provided by the PIT Tag Steering Committee (Columbia Basin Fish and Wildlife Authority 1999). Fish tagged Oak Springs Hatchery were collected by seining or crowding and held unfed for at least 48 hours prior to tagging. Fish were then anesthetized in a tricaine methane sulfonate (MS 222) bath (20g/l stock solution) and examined for overall condition. The fish were not tagged if they exhibited signs of disease; were less than 70 mm in length; or had observable physical anomalies. We used the TX1400SST PIT tags for this project

(12.5 mm in length by 2.07 mm in diameter). Tags were injected by hand using a 12 gauge veterinary syringe that was sterilized in a 70% ethyl alcohol solution. Fish were then scanned with a Destron Fearing PIT tag reader to record the unique tag code for each fish. Individual tag code, fork length (mm), weight (g), and any other pertinent information was recorded for each fish. PIT tags were inserted in the pelvic girdle region on the ventral side posterior of the pectoral fin. After tagging the fish were held in a separate pond to estimate tag loss and delayed mortality. A sub sample of approximately 15% of the tagged fish was sampled for tag retention after 24 hours. For both summer and winter steelhead tag retention was greater than 99%. All tagged fish were then released into the original pond with the population-at-large. Hatchery staff monitored the ponds for mortalities and collected them as they occurred. Mortalities were scanned for PIT tag numbers and those tag codes were deleted from the database. Post tagging mortality for winter steelhead tagged at OSH was less than 0.05 percent.

In addition to the hatchery salmonids tagged ODFW tags wild salmonids captured in rotary screw traps that are operated in the Hood River. This provides an opportunity to compare the life history expression, migration attributes, and survival rates between hatchery release groups and wild Hood River fish, which is one of the objectives of this PIT tagging project. Fish captured and PIT tagged in ODFW operated screw traps in the Hood River Basin provides a suitable number of wild Steelhead for comparison.

In March and April, winter and summer steelhead smolts were transported from Oak Springs Hatchery to Hood River acclimation sites. We assumed a random distribution of tagged fish among the release sites since they had several months to mix with the release group. A PIT tag detector was installed at the release outflow of each acclimation pond to detect volitional migrants and record emigration date. The transceivers were downloaded to a lap top computer daily during volitional release periods. Following the volitional release, non-migrants were scanned with a PIT reader to record tag codes. Non-migrants were anesthetized and bio-sampled to measure size and condition factor and then released at the confluence of the Hood River and Columbia River.

Separate tag files were produced for volitional migrants detected at acclimation pond outflows, volitional migrants that were not detected leaving the ponds and non-migrants that were trucked to the mouth of the Hood River. These tag files were then uploaded to the PTAGIS database. Throughout the year the PTAGIS database was queried to monitor migration from the acclimation sites to Bonneville Dam, and the Columbia River estuary trawl.

Survival estimates were generated from capture histories for each fish based on data downloaded from the PTAGIS database by the Columbia River DART real time data access tool (http://www.cbr.washington.edu/dart/help/pit_def.html, 2008).

The Columbia River DART tool also provides detection information on fish ascending the adult passage facilities at Bonneville Dam. This information can be used to gauge the incoming run strength and migration timing of PIT marked cohorts. Total run to Bonneville Dam for a cohort is calculated by the equation below.

$$\hat{N} = \left(\frac{1}{M} \right) \times R$$

where,

$\hat{N}$ = estimated number of fish passing adult ladder

M = proportion of fish in release group marked with a PIT

R = number of fish from a release group detected at the adult passage facility

Results and Discussion

Compare behavior and performance of wild and hatchery smolts

The survival rate for the hatchery winter steelhead releases was estimated to be 0.7005. By comparison the survival rate of wild Hood River steelhead smolts¹ tagged at ODFW screw traps was 0.8698 (Table 4). These were the highest measured survival rates for both of these groups since the HRPP began PIT tagging Hood River Steelhead. Two tailed t-tests were performed to determine whether there was a statistically significant difference in survival rates and mean migration dates between the hatchery and wild PIT tag groups. The P-value from a t-test comparing survival was 0.5578 indicating there was not a statistically significant survival difference between these groups to Bonneville dam. Hatchery summer steelhead had a survival rate of 0.2952 to Bonneville dam which was much lower than either the hatchery winter steelhead or wild steelhead group. A t-test between survival rates of hatchery summer steelhead and wild steelhead also failed to identify a statistically significant difference ($P=0.165$). We attribute the failure to identify significant survival differences between wild and hatchery fish in this instance to be an artifact of the relatively low sample size and high standard error for the wild steelhead tag group.

We compared the mean migration date between hatchery winter steelhead and wild PIT tagged steelhead released in 2008 and found a statistically significant difference ($P = 0.001$). The P-value for a t-test between hatchery summer steelhead and wild steelhead was not quite statistically significant ($P=0.057$). The wild steelhead out-migration timing appeared to be shifted slightly later than both groups of hatchery steelhead in 2008 (Figure 3). Interestingly the mean migration date for summer steelhead was 3 days later than the mean migration date of winter steelhead (Table 4) despite the fact they were released from the acclimation ponds approximately two weeks earlier. It could be that migration timing for all groups was more strongly influenced by the pulse of spring runoff than the date of release.

Insufficient numbers of naturally produced spring Chinook were captured in 2008 years to conduct a comparative analysis. To address the shortage in the wild Chinook tag group and improve the quality of analysis the HRPP CTWS is investigating additional juvenile sampling to capture and tag more spring Chinook. Beginning in fall of 2009 CTWS will conduct test sampling with baited minnow traps, as well as snorkelers and beach seines. The objective will be to boost the number of tagged Chinook juveniles for PIT tag analysis and to determine whether it is feasible to capture enough wild Chinook to comprise a sufficiently large tag group in upcoming years.

Investigate differences in migrant and non-migrant hatchery smolt

Another objective for PIT tagging juvenile salmonids in 2008 was to investigate whether the volitional release strategies used in our acclimation protocols were effective at reducing residuals in the Hood River. The practice during juvenile acclimation is to allow fish to volitionally leave the ponds for a period of several weeks. This allows fish that are undergoing the physiological changes of smoltification suitable time to initiate migration. At the end of the volitional migration period the remaining fish are gathered from the acclimation ponds and trucked to the mouth of the Hood River and directly released. Prior to liberation the fish are scanned for PIT tags. Fish are sorted into separate tag groups of fish that volitionally left the ponds and those that did not. We then compared the migration attributes of these two groups. We determined: 1.) the rate fish

¹ Wild steelhead PIT tagged in the Hood River are a combination of summer and winter runs as the race cannot be determined reliably during the juvenile phase when they are captured in screw traps.

from the respective tag groups that were detected at Bonneville dam; 2.) the migration timing and survival differences among tag groups to Bonneville Dam ; and 3.) smolt to adult survival of tag groups

Table 2. Estimated downstream migrants to Bonneville dam and adult detections at Bonneville and Powerdale adult ladders for 2005-2008 hatchery winter steelhead PIT tag releases.

Release Year	Group	# tagged	Estimated migrants to Bonneville				Adults detected	
			Year 1	Year 2	Year 3	Year 4	Bonneville	Powerdale
2005	Non- migrant	4,944	839	18	0	3	9	2
2006	Migrant	12,737	3,775	28	0	-	58	14
2006	Non- migrant	390	67	0	0	-	1	1
2007	Migrant	3,813	2,594	22	-	-	7*	2*
2007	Non- migrant	14	0	0	-	-	0	0
2008	Migrant	6,635	4,651	-	-	-	-	-
2008	Non- migrant	17	3	-	-	-	-	-

* 1-salt returns only

We observe fish making delayed downstream migrations in post-release years from both migrant and non-migrant groups of PIT tagged hatchery steelhead (Table 2). Thus it appears that the volitional release strategy as it is practiced now is not completely effective at removing residuals from the hatchery population. Since there is such a variation in number of steelhead that do not volitionally release from year to year (it ranges from a couple hundred to several thousand) in some years there have been very few PIT tags in the non-migrant group. This contributes to a small number of second year observations to date, which limits our ability to measure statistically valid differences between fish that smolt upon release and those that residualize for a year before outmigration. To remedy this sample size shortfall we intend to reserve PIT tags to mark additional non-migrants at the end of the volitional release period in the coming years.

Investigate the effect of hatchery rearing practices on precocial maturation and freshwater residualism

PIT tagging sufficient numbers of allow us to test whether there are any relationships among rearing / release strategies and survival rates, precocity/residualism, and migration timing. With other marking techniques, like a coded wire tag, this sort of analysis is restricted to large release groups. However PIT tags give us the ability to identify individual fish and segregate fish within a larger release group into more specific categories. For instance we can identify the fish that volitionally emigrated from acclimations ponds from those that were force released or trucked to mouth of the Hood River. In 2006 when PIT tagging of winter steelhead began in earnest there were enough tags in each group to calculate survival rates for migrant and non-migrant group smolts (Appendix A). However in the years since fewer fish have been remaining in the ponds and not enough of these non-migrant fish had PIT tags to comprise a large enough group to calculate outmigration survival rates. To remedy this we recommend reserving some PIT tags to implant in all non-migrant fish at the time of collection and transport to the Columbia River release site, thus ensuring a suitable sample size for comparing the volitional and non-volitional migrant groups. Chinook mini-jack data was collected and investigated using PIT tag detections in 2007 however since Chinook tagging was canceled we were unable to collect similar data in 2008. We intend to resume this component of the investigation in 2009.

Figure 7. Out migration timing of PIT tagged wild and hatchery steelhead smolts in the Hood River during 2008.

Estimate adult exploitation in Columbia River Zone 6 and Hood River sport fisheries

The ability to detect nearly all PIT tags in adult fish ascending Bonneville Dam on the Columbia River and Powerdale Dam on the Hood River offer us an excellent opportunity to estimate the exploitation of Hood River fish in Columbia River Zone 6 tribal, commercial, and sport fisheries and the Hood River sport fishery. Tags detected at Bonneville dam adult ladders and subsequently detected at Powerdale Trap on the Hood River will identify fish that survived the Zone 6 and Hood River fisheries (Table 3). Fish with tags detected at Bonneville Dam but not detected at Powerdale Trap could have three potential fates. They could have been pre-spawn mortalities below Powerdale Trap, stray to other rivers, or be harvested in the fisheries between Bonneville and Powerdale dams. We cannot estimate natural mortality for Hood River fish in the Bonneville pool but we suspect it is low relative to harvest. Radio telemetry research conducted by the University of Idaho estimated a loss of 12-17% to causes other than straying and harvest of mixed salmon and steelhead stocks in the Columbia River hydro system (Keefer et al 2005). Hood River fish are exposed to only one dam and a relatively small portion of the hydrosystem so we expect the loss rates are likely lower than those measured in Keefer et al's analysis. Thus we hypothesize that the vast majority of winter steelhead lost between Bonneville dam and the Powerdale trap are taken in fisheries.

Document and estimate straying of Hood River adult salmonids

Some of the fish that go missing between Bonneville Dam and The Hood River could be strays as opposed to being mortalities or harvested. Straying of hatchery fish from the Hood River is of interest to fisheries managers and quantifying strays has been identified as an important objective for M&E biologists. PIT tags have the potential to be quite useful in estimating stray rates if the necessary infrastructure is in place. We expect that most Hood River strays would be bound for the Deschutes River, as this is where the hatchery rearing occurs. Currently there is no PIT tag detection capability at The Dalles Dam, which would effectively identify fish homing to the Deschutes. The next mainstream Columbia Dam with adult PIT tag detection is John Day Dam which is well above the Deschutes River. To date there has never been a Hood River PIT tag logged at John Day. An in-channel PIT tag array has been proposed to be installed near the Mouth of the Deschutes River (personnel communication with Jen Graham, Confederated Tribes of Warm Springs). If and when this comes to pass such a site would prove invaluable for determining rates of Hood River released fish straying to the Deschutes River. The majority of steelhead strays the Hood River produces are likely a by-product of the practice of recycling excess hatchery steelhead captured at the Powerdale trap to the mouth of the Hood River. Numerous anecdotal reports of anglers catching steelhead with Powerdale trap floy tags in the White Salmon River (a nearby stream entering the Columbia on the Washington side ~1 mile downstream of the Hood River) further confirms the phenomenon of recycled Hood River fish straying. Other nearby streams that Hood River fish could be straying to is the Klickitat River and 15 Mile Creek. The Klickitat River has an adult fish trap operated by the Yakima Nation (YN) and Washington Department of Fish and Wildlife (WDFW) at Lyle Falls, which is located at RM 2.2. HRPP biologists maintain contact with the YN biologists and to date no Hood River PIT tags have been detected at Lyle Falls. An adult steelhead weir with PIT tag detection capabilities has recently been installed by ODFW near the mouth of 15 Mile Creek. In coming years this will provide a means of detecting Hood River fish that may be straying to that stream.

Measure incoming adult run strength and timing with tag detections at the Bonneville Dam adult ladders

Using the equation described in the methods section for estimating escapement from Bonneville Dam PIT tag detections we estimated the total passage of Hood River Chinook jacks in 2008. The tag ratio of hatchery Chinook smolt was 9.6% (0.096) in the Middle Fork, and 7.8% (0.078) in the West Fork for 2007 releases. There were 8 Middle Fork Chinook and 33 West Fork Chinook detected at Bonneville yielding an estimate of 506 jack Chinook past Bonneville Dam. A total of 404 jacks were caught at the Powerdale trap in 2008. Sport creel data estimated 88 hatchery jack Chinook taken in the Hood River sport fishery below Powerdale Dam. Thus the sport harvest nearly entirely accounts for the difference in fish numbers between the Bonneville Dam estimate

and the Powerdale Dam counts. We will replicate this run estimation methodology for upcoming Chinook and steelhead runs to confirm its accuracy. If the method proves to be as accurate and effective for future cohorts it could become instrumental in estimating escapement to the Hood River after Powerdale Dam, and the associated fish trap, is removed in summer of 2010.

Table 3. Adult detections and estimated exploitation/mortality rate for PIT tagged hatchery fish released into the Hood River.

Adult run year, Species,	Bonneville Detections	Powerdale Detections	Exploitation Rate
2006, STW,	1	0	100.0%
2007, STW,	24	4	83.3%
2008, STW,	44	15	65.9%
CHS,	42	27	35.7%

Table 4. Interrogation rates, survival rates and mean migration dates to Columbia River detection sites for PIT tagged steelhead released into the Hood River in 2008.

Release Group	Tag Group	Bonneville Dam			Mean Migration Date	Travel Time (SE)
		Detected	Capture Probability (SE)	Survival Probability (SE)		
Hatchery STW	6,652	1498	0.3219 (0.0382)	0.7005 (0.082)	5/8/2008	12.57 (0.25)
Hatchery STS	1,196	91	0.2521 (0.1539)	0.2952 (0.1787)	5/11/2008	36.56 (2.31)
Wild Steelhead*	617	154	0.1429 (0.0764)	0.8698 (0.4602)	5/16/2008	7.55 (0.55)

*Includes both winter and summer steelhead.

Water Temperature Monitoring

Introduction

CTWS began monitoring water temperature at sites throughout the Hood River basin beginning in 1990. Originally the goal was to ascertain whether the temperature regime in the Hood River was suitable to support a spring Chinook population. After the HRPP began spring Chinook reintroduction CTWS continued to monitor water temperature at seven sites in the Hood River watershed to monitor temperature trends and gain a better understanding of the thermal regime in the Hood River. This knowledge of the thermal regime gives HRPP managers' insights to fish behavior and ecological responses, such as anticipating spawning periods and emergence timing of fish populations in the Hood River. Also the HRPP is interested in whether water quality standards are being met (Table 5), as well as measuring temperature response to management and/or restoration activities occurring in the basin. An eighth thermograph was deployed at Moving Falls on the West Fork Hood River in late 2008. The Moving Falls thermograph was installed to begin monitoring and gathering baseline temperature data at the location for a proposed smolt rearing and acclimation site. Data for this new site will be compiled and reported starting in 2009. Additionally temperature data collected by CTWS is frequently shared with other agencies and groups operating in the Hood River watershed such as the Oregon Department of Environmental Quality (ODEQ), the U.S. Forest Service, irrigation districts, and the Hood River Watershed Group.

Figure 8. Locations of thermograph sites monitored by CTWS in the Hood River subbasin

Methods

Water temperatures are monitored continuously at one hour increments using thermographs at sites on the mainstem Hood River, Middle Fork, East Fork, West Fork, Lake Branch, Neal Creek, and Baldwin Creek. We use Onset U22 Water Temp Pro v2 thermographs at all sites. Before deployment to the field a hot bath and cold bath accuracy check is performed for each thermograph. Thermographs are downloaded periodically during the year. At the time of downloads a field audit of thermograph accuracy is performed with a National Institute of Standards and Technology (NIST) certified digital thermometer. Data is processed through the Eel River Water Temperature Analysis Program version 97.8, to produce summations and to compare data to ODEQ water temperature standards. Charts of temperatures at all sites are included in Appendix C.

Table 5. Temperature criteria for streams in the Hood River subbasin supporting salmonids

Temperature Standard	Area	Time Period
13°C standard for salmon and steelhead spawning use	West Fork Hood	August 15 – June 15
	Lake Branch	August 15 – June 15
	East Fork Hood	October 15 – May 15
	Neal Creek	October 15 – May 15
	Baldwin Creek	October 15 – May 15
	Mainstem Hood River	October 1 – June 15
16°C standard for core cold water habitat use	West Fork Hood	Year Round
	Lake Branch	Year Round
	Mainstem Hood River	Year Round
18°C standard for salmon and trout rearing and migration	Neal Creek	Year Round
	Baldwin Creek	Year Round
	East Fork Hood	Year Round
12°C standard for bull trout spawning and juvenile rearing	Middle Fork Hood	August 15 – May 15

Results

The overwhelming temperature trend observed in 2008 was for cooler than average stream temperatures in the spring and summer (Table 6, Appendix C). This was undoubtedly due to the tremendous snowpack the basin received in the winter of 2007/2008. For instance the Natural Resource Conservation Service (NRCS) reports the Hood River Basin SNOTEL sites had 242% of average snow water equivalent on May 1, 2008. (<http://www.wcc.nrcs.usda.gov/snotel>) Consequently the cool trend was especially strong in the streams which drain the high elevation slopes of Mt. Hood, such as the West Fork and Lake Branch. The West Fork thermograph recorded summer water temperatures so low as to arouse suspicion that the thermograph could be malfunctioning. Upon comparing the measurements taken with the NIST thermometer at the time of thermograph downloads the West Fork Thermograph was determined to exceed the 0.5 °C range quality standard on 2 of the 3 checks (thermograph measured up to 2 °C low). The thermograph at the Lost Lake Road site on the West Fork will be removed from service and replaced in 2009. The other thermographs deployed in the Hood River subbasin passed validation in 2008.

After analysis of the available temperature data two of seven of the streams monitored exceeded ODEQ standards (Table 7), in 2008. Baldwin Creek and Neal Creek were found to exceed the 13°C standard for salmonid spawning, for 8 days and 3 days respectively. Average daily water temperatures for 2008 remained at or below ODEQ standards for all other criteria. The incidence of exceeding ODEQ stream temperature standards was the lowest ever for the period the HRPP has been monitoring stream temperature in the Hood River. We don't believe this is due to any watershed management actions but simply attribute it to the high and protracted snowmelt.

Unfortunately thermograph data was unavailable for Middle Fork Hood River and sporadic for the East Fork site in 2008. The original site for the Middle Fork temperature logger was destroyed in a catastrophic glacial outburst flood event in November 2006. Since then the Middle Fork has been extremely unstable and each time a thermograph is deployed it is buried or dewatered as the stream channel migrates. The East Fork site has also been fraught with frequent sedimentation issues. We will attempt to improve the thermograph deployments at these sites in 2009 to achieve consistent data collection.

Table 6. Average monthly temperatures (Celsius) recorded in 2008, by site and month. Average monthly temperatures for period of record at each site are in parenthesis.

	Mainstem Hood 2000-2008	West Fork 1990-2008	Baldwin Creek 2000-2008	Neal Creek 2001-2008	Lake Branch 1999-2008	Middle Fork 1994-2006	East Fork 1990-2008
January	2.9 (3.8)	2.4 (3.3)	3.3 (3.6)	3.9 (4.5)	2.6 (3.4)	(3.2)	(3.2)
February	4.7 (4.2)	3.6 (3.6)	4.5 (4.0)	5.4 (4.8)	3.7 (3.5)	(3.4)	(3.6)
March	5.3 (5.8)	4.0 (4.5)	5.8 (6.2)	6.0 (6.6)	4.0 (4.4)	(4.5)	5.6 (5.3)
April	6.4 (7.3)	4.5 (5.6)	7.3 (8.2)	7.1 (8.3)	4.5 (5.3)	(6.1)	(7.0)
May	7.6 (9.6)	5.3 (7.5)	10.5 (10.9)	10.1 (11.1)	5.0 (7.1)	(8.1)	(8.8)
June	9.2 (12.2)	5.3 (9.2)	11.5 (12.8)	11.5 (13.1)	6.7 (8.8)	(9.4)	7.8 (11.1)
July	12.9 (15.1)	4.1 (11.1)	13.8 (14.7)	14.5 (15.4)	10.4 (10.8)	(10.1)	(14.3)
August	13.6 (15.0)	5.0 (11.2)	14.1 (14.5)	14.5 (14.9)	10.4 (10.6)	(10.2)	(14.3)
September	11.6 (12.3)	5.8 (9.7)	11.9 (12.4)	11.8 (12.3)	8.6 (8.9)	(10.0)	(11.9)
October	8.1 (9.0)	6.2 (7.5)	8.3 (9.2)	8.8 (9.5)	6.9 (7.2)	(7.7)	7.7 (8.0)
November	6.7 (5.4)	6.2 (5.3)	7.0 (5.7)	7.6 (6.5)	6.3 (5.2)	(5.1)	5.8 (4.8)
December	2.9 (3.4)	2.7 (3.6)	2.5 (3.9)	3.3 (4.6)	3.1 (3.7)	(3.1)	2.3 (2.9)

Table 7. Number of days that recorded seven day average temperature exceeded ODEQ temperature standards at each thermograph site in 2008.

	Mainstem Hood	West Fork	Baldwin Creek	Neal Creek	Lake Branch	Middle Fork	East Fork
18° C Salmonid rearing	na	na	0	0	na	na	0
16° C Cold water habitat	0	0	na	na	0	na	na
13° C Salmonid spawning	0	0	8	3	0	na	0
12° C Bull Trout	na	na	na	na	na	-	na

Spring Chinook Run Size Forecast

Background

The Hood River Production Program has generated adult spring Chinook salmon run to the river estimates annually since 2001. Run forecasts are used to guide various management strategies such as sport and tribal fishery regulation and brood stock collection. Several different models have been evaluated to estimate spring Chinook run predictions in the Hood River.

The two types of run forecast models have been used: 1.) the cohort age ratio model and; 2.) the age class regression model. Both these models rely on the previous year's number of jacks (3 year olds) to predict following year's return of 4 year old adults. Similarly the run of 5 year old adults is estimated based on the previous years run of 4 year olds.

Methods

The cohort age ratio model uses the previous year's return of the preceding age class as an estimator. The age structure for each cohort has been monitored by collecting and reading scales from all spring Chinook adults handled at the Powerdale Fish Trap. For each cohort since brood year 1991 we have calculated an age 3 (jack) to age 4 ratio, and a age 4 to age 5 ratio (Appendix B). The mean over all available brood years of these ratios is multiplied by the jack and age 4 adult counts to produce the estimate of the incoming age class as described by the equations below. Summing the output of these equations gives the total adult estimate

$$\text{Forecasted Adults}_{(\text{age } 4)} = \text{Mean Age 4/3 ratio} * \text{Powerdale Jack Count}_{(t-1)}$$

$$\text{Forecasted Adults}_{(\text{age } 5)} = \text{Mean Age 5/4 ratio} * \text{Powerdale Age 4 Count}_{(t-1)}$$

The Regression Model method uses the preceding age class to estimate the incoming age class. A regression is constructed between the Age 4 and 3 returns and the Age 5 and 4 returns for each cohort data. We apply the Intercept coefficient and X variable coefficient to the preceding age class count to estimate the following age class as shown by the equations below. Summing the results of the equations yields the total adult estimate.

$$\text{Adult}_{(\text{age } 4)} = Y \text{ Intercept} + (X \text{ variable} * \text{Jack count}_{(t-1)})$$

$$\text{Adult}_{(\text{age } 5)} = Y \text{ Intercept} + (X \text{ variable} * \text{Age 4 count}_{(t-1)})$$

Hatchery Adult Spring Chinook Forecast

Ratio and Regression models yielded similar outputs for hatchery escapement and either model gives a reasonably accurate forecast during 8 out of the last 12 years. However in years with high jack ratios the age ratio model generates vastly inflated adult estimates, as was the case in 2002 and 2005. Given an unusually high jack return in 2007 it appeared this would be the case during 2008 (Table 8). In order to quantify the relative accuracy of the forecast models we calculated the absolute difference between the actual run number and the forecasted run for the age ratio and regression model techniques. Then we calculated the mean of these values from 1997 to present. The mean absolute difference for the Age Ratio Model was 817.8 adult Chinook whereas the mean was 133.6 adults for the Regression Model. Thus, over the period of record the regression

method has produced substantially more accurate estimates, especially during high jack years. Thus we felt the Regression Model based estimate of 872 adult spring Chinook to be more realistic than the age ratio based estimate of 3,783 adult spring Chinook in 2008 (Table 8).

Wild Adult Spring Chinook Forecast

Both forecasting methods are similarly effective for estimating natural produced Chinook. We calculated the absolute difference between the forecast and actual run number as described above for the hatchery Chinook run. The mean absolute difference for the Age Ratio Model was 77.5, compared to 41.9 for the regression model. Thus the regression model does appear to have an advantage in forecasting closer to actual returns over the period of record (Table 9). The age ratio model for wild Hood River spring Chinook estimates 158 adults in 2008. The regression model yields an estimate of 102 wild adults for 2008. For management purposes HRPP managers adopted the regression model estimate and confidence interval (Table 10).

Table 8. Run estimates generated for hatchery produced spring Chinook by the various methods used by the HRPP and actual returns to the Powerdale adult trap from 1997 to 2008. The absolute difference from the actual adult return is shown in parentheses.

Run Year	<u>Hatchery Run Estimates</u>		Published	Actual
	Ratio	Regression		
1997	162 (118)	213 (67)	-	280
1998	26 (26)	216 (201)	-	15
1999	22 (66)	186 (98)	-	88
2000	58 (38)	201 (181)	-	20
2001	1372 (812)	425 (135)	1388	560
2002	5343 (4314)	1183 (154)	1006	1029
2003	313 (20)	343 (10)	346	333
2004	172 (20)	233 (81)	168	152
2005	1957 (1370)	541 (46)	600	587
2006	846 (75)	392 (529)	280	921
2007	422 (118)	346 (42)	431	304
2008	3783 (2852)	872 (59)	872	931

Table 9. Run estimates generated for naturally produced spring Chinook by the various methods used by the HRPP and actual returns to the Powerdale adult trap from 1997 to 2008. The absolute difference from the actual adult return is shown in parentheses.

Run Year	Ratio	Natural Run Estimates			Actual
		Regression	Published		
1997	104 (32)	87 (15)	-		72
1998	30 (50)	52 (28)	-		80
1999	187 (166)	111 (90)	-		21
2000	73 (7)	66 (0)	-		66
2001	111 (69)	86 (44)	105		42
2002	118 (47)	85 (14)	45		71
2003	54 (46)	63 (37)	97		100
2004	222 (91)	126 (5)	189		131
2005	245 (135)	143 (33)	120		110
2006	163 (134)	105 (192)	70		297
2007	197 (54)	141 (2)	202		143
2008	158 (99)	102 (43)	102		59

Table 10. Hood River spring Chinook run estimates with upper and lower 95% confidence intervals and actual returns to Powerdale fish trap for 2008.

	Estimate	Lower 95% C.I.	Upper 95% C.I.	Actual return
Natural	102	58	268	59
Hatchery	872	627	1117	931
Total	974	685	1385	990

Development of Non-Cohort Based Multiple Regression Run Forecast Models

As outlined above, traditional Chinook run forecast methods rely on the previous years return of 3 year old jack's as an indicator for older age class adults returning in succeeding years. These forecasting methods require accurate and complete age data of the population. Powerdale dam and its associated fish trap provided an excellent means to acquire that data. In 2010 Powerdale dam is scheduled to be decommissioned along with the adult fish trap. After the dam is removed managers will not have equivalent adult collection capabilities. Beyond the age data needs Chinook run prediction is hindered by highly inconsistent jack ratios for the Hood River's hatchery produced fish. As a result run forecasts have high levels of variance. In anticipation of this scenario managers sought alternative methods of forecasting Chinook and steelhead returns that provide greater accuracy and do not require complete age structure data.

In order to attain the desired run forecasting precision in the absence of Powerdale fish trap data the CTWS contracted a biometrician, Jim Griswold of Western EcoSystems Technology (WEST, Inc.), to develop and test various statistical forecast models that may be used for Hood River run size forecasting. The statistical forecast models produced by West, Inc. are one season ahead multiple regression models. A model based bootstrap procedure was used to provide 90% confidence limits on the prediction. These models use biological and environmental variables as predictors that influence or cause a response in the target population. For instance snow water equivalent values measured on Mt. Hood can be indicators for stream flow and temperature conditions that influence juvenile salmonid production and survival in the Hood River. When selecting the predictor variables the objective was to utilize the fewest number of variables to keep the models as simple as possible while providing fairly high accuracy and precision.

Additionally the predictor variables had to be obtained from sources that are published and readily available annually.

The suite of predictor variables selected for the natural Chinook prediction model were: Bonneville Dam Chinook counts five years prior; the square of Bonneville Dam spring Chinook counts five years prior; annual October Mt. Hood mean snow depth six years prior; and November Mt. Hood Mean snow depth six years prior to the return year being predicted. The Bonneville Dam spring Chinook counts are an indicator for the parent stock producing the predicted cohort. The Mt. Hood snow depth variables are thought to influence rearing conditions for juvenile Chinook produced in the Hood River. The R^2 for the natural adult Chinook multiple regression model produced by WEST, Inc. is 0.90. Conversely the age cohort regression model used by the HRPP and described above to estimate 4 year old adult returns has an R^2 of 0.15. Based upon the high correlation of the non-cohort model, the WEST, Inc model should provide more precise results compared to existing models.

The best predictor variables identified for the hatchery Chinook prediction model were: Bonneville Dam annual spring Chinook jack counts two years prior to the Hood River adult hatchery spring Chinook return; average of spring transition dates² three and four years prior to the hatchery spring Chinook return; annual median Columbia River turbidity measured at Bonneville Dam over the period 4/15-6/30 three years prior to return; and median annual Bonneville Dam screen water temperature over the period 4/15-6/30, three years prior to return. The Bonneville jack count is a surrogate cohort strength indicator. Spring transition dates are indicators for ocean conditions and productivity. Columbia River temperature and turbidity values measured at Bonneville Dam are indicators for smolt outmigration conditions and survival in the Columbia River. The R^2 for the hatchery adult Chinook multiple regression model was 0.90. Comparatively the age cohort regression model has an R^2 of 0.66

The multiple regression models produced by WEST, Inc. for forecasting adult Chinook runs appear very promising as they have far greater statistical fit than the previous models. We will utilize these new multiple regression models alongside the existing Age Cohort Ratio and Age Class Regression ratio models during the 2009 and 2010 run years while Powerdale Dam trap data is still available. WEST, Inc. will also be producing multiple regression models to estimate adult wild winter steelhead, adult hatchery winter steelhead, adult wild summer steelhead, and juvenile steelhead smolt. These models will be completed and submitted to the HRPP in 2009.

Hood River Tribal Spring Chinook Fishery Creel Survey

Pre-season run forecasts generated by HRPP staff indicated a surplus of spring Chinook salmon adults in excess of broodstock and escapement needs. As a result a spring Chinook subsistence fishery for Warm Springs tribal members was opened on the Hood River from April 15 to July 31, 2008 by Tribal Council Resolution # 10,875. The entire Hood River subbasin was opened to harvest of adipose marked hatchery Chinook. To monitor tribal harvest and determine exploitation of the 2008 spring Chinook run the HRPP conducted creel surveys of tribal fishers at Punchbowl Falls. Some tribal fishing did occur below Powerdale dam. However all fishing below the dam is monitored by ODFW which conducts a year round creel survey in this area.

The vast majority of tribal fishing effort occurs in the vicinity of Punchbowl falls, near the mouth of the West Fork Hood River. Punchbowl falls is a natural concentration point for holding Chinook salmon. The area is well suited to both hook and line angling and dip net fishing methods. Past roving creel surveys in 2001 and 2002 have revealed that tribal members seldom fish at locations other than Punchbowl Falls. During 2008 we utilized a single access point creel design as

² Spring Transition Date is the date when predominately southerly coastal winds of the winter switch to the predominately northerly winds of summer. The northerly summer winds contribute to ocean current conditions that promote upwelling of nutrient rich waters to the near shore ocean surface. The near shore upwelling phenomenon fosters favorable conditions for salmonid growth and survival.

described by Pollock et al (1994) focusing on the Punchbowl Falls fishery. Tribal harvest effort in the mainstem Hood River has been minimal in recent years primarily due to the non-crowded nature of and high success rate at Punchbowl falls. To monitor potential mainstem harvest we placed sign boards with floy tag deposit boxes at major access points.

Methods

The Chinook season official opened on April 15, however the run was late throughout the Columbia Basin in 2008 and no Chinook arrived to the fish trap at Powerdale dam until early May. Creel surveys began on May 22. No tribal anglers were observed at Punchbowl falls until June 3.

HRPP managers desired a complete picture of the distribution of fishing effort in this developing tribal fishery in 2008. An intensive creel schedule was designed in which creel surveyors checked Punchbowl Falls fishing sites from 7:00 AM to 9:00 PM, 7 days a week, from May 22 until July 18. Creel surveyors were present at the access point and recorded when tribal fishers entered and exited the fishing area as well as what gear they were using. When fishers left the fishing area creel surveyors would approach and interview them as well as check any fish they had caught. Fishers were asked to fill out a questionnaire form. Creelers identified the species, life history form (jack, adult), and sex of fish harvested as well as measured the fork length, and record all marks and tags the fish possessed. If the fish had a coded wire tag (CWT) the creelers were instructed to ask the fisher if they could remove the snout.

Some creel shifts were missed due to sick days and other circumstances. Also creel surveys were not conducted after July 18 due to staffing constraints and lack of harvest effort. To enumerate effort and harvest during non-surveyed periods expanded estimates were made for weekday and weekend strata as described in Pollock et al (1994) for a stratified random sample design.

Results and Discussion

Creel surveyors recorded 40 fishing trips, totaling 474.23 hours of effort and inspected 141 harvested jack and adult spring Chinook salmon (Table 11). When expanded estimates were generated from the creel data we estimate that there were 590 hours expended and 172 fish harvested in the Punchbowl Falls tribal fishery during 2008 (Table 12). Floy tag deposit boxes were in place to supplement collection of fish harvest information when creel surveyors were absent. We collected 21 tags from these boxes indicating that at least 21 fish were harvested that were not checked by a creel surveyor. Thus we have direct evidence of 162 fish that we can account for being harvested in the tribal fishery near Punchbowl Falls. Some tags may have been shed before fish were caught and some floy tags from harvested fish might not have been turned in. However the tag loss rate is quite low (<4% in fish observed by creelers) and tribal members are generally well informed and vigilant about returning in floy tags. As a result we believe that we accounted for most harvested fish.

Most of the tribal fishing effort was with hook and line methods. However a scaffold was constructed at the base of Punchbowl Falls and some fishing was done with dip nets and jump nets. 2008 was the first time in the history of the HRPP that fishing from a scaffold was observed in the Hood River. Fish were successfully taken with nets however we could not quantify the amount of harvest for each method as fishers generally used both netting and hook and line methods during the same fishing trip. Creel surveyors were instructed to record other species besides spring Chinook that were caught or taken by fishers. Creelers did not record observing any steelhead or other non-target species (i.e. bull trout) as being captured or taken. As the fishery progressed into July tribal fishermen began releasing a portion of the fish captured, many without being inspected by creel surveyors. These released fish may have included some unmarked wild fish but mostly this appears to be an artifact of the fish becoming too old and dark to be considered good quality meat.

Figure 9. Estimates of fishing effort and spring Chinook harvest for Warm Springs tribal subsistence fisheries in the Hood River.

The tribal fishery in the Hood River appears to be gaining momentum and popularity as the Chinook run and fishery becomes more consistently available and as knowledge of the fishery increases among the tribal membership (Figure 9). We expect that the popularity of this fishery will be influenced by the opportunities and success rates at other tribal fisheries such as Sherars Falls on the Deschutes River and the Columbia River zone 6 fisheries. Several tribal fishers interviewed by creelers commented that they liked the Hood River fishery because it was less crowded than Sherars Falls (Deschutes River, Oregon) and more ascetically pleasing. The Hood River fishery also provide more convenient fishing opportunities for tribal members who live outside the Warm Springs Reservation, such as the Columbia River Gorge and Portland metropolitan area.

Presently the majority of tribal fishing effort is concentrated around Punchbowl falls area. This is a prime fishing location and provides enough fishing spots with the current tribal effort level. If and when the number of tribal fishers increases harvest may expand to other locations in the Hood River Basin. We will continue to monitor the fishery and adjust creel methods to collect valid harvest data as the fishery continues to develop.

Table 11. Weekly observations of effort, harvest, and catch per unit effort (CPUE) for the 2008 tribal spring Chinook fishery at Punchbowl Falls.

Week	Recorded Effort (hrs)	Recorded Harvest	CPUE (hr/fish)
June 2-8	18.08	0	-
June 9-15	37.48	1	37.48
June 16-22	167.80	29	5.79
June 23-29	66.32	23	2.88
June 30 - July 6	84.20	27	3.12
July 7-13	87.60	53	1.65
July 14-20	12.75	8	1.59
Total	474.23	141	52.51

Table 12. Expanded estimates with standard errors (SE) of fisher effort and harvest for the 2008 Punchbowl Falls tribal spring Chinook fishery calculated by weekday and weekend stratum.

Stratum	Sample Days	Sample Mean	Fishery Days	Total	SE
Weekday					
Effort	33.5	6.34	40	253.51	63.42
Harvest	33.5	2.46	40	98.29	46.31
Weekend					
Effort	10.5	21.03	16	336.55	134.61
Harvest	10.5	4.58	16	73.33	54.43
Total Effort (hrs)				590	148.80
Total Harvest				172	71.47
CPUE (Hrs/Fish)				3.44	

Spring Chinook Salmon Spawning Ground Surveys

Introduction

Spawning surveys are conducted during the spring Chinook spawning period to assess whether the reintroduced population of spring Chinook is colonizing habitat in the Hood River. The HRPP has been conducting Spring Chinook spawning surveys on the West Fork since 1997, and Rogers Creek (Middle Fork) since 2000. The Middle Fork was surveyed in 2000 from Laurence Lake Dam (RM 10.8) to its confluence with the East Fork, however the glacial nature of this stream typically reduces visibility to near zero and future surveys were abandoned. The primary objectives of these surveys are too:

1. Determine spawning distribution and habitat use of reintroduced spring Chinook
2. Measure spawner demographics, disease frequency, and spawning success

The West Fork Hood River is considered the primary spawning stream for the Hood River spring Chinook population. However Chinook have been observed in other tributaries within the Hood River basin as well. So in addition to the West Fork Hood River sections of Rogers Creek, Greenpoint Creek, Dog River, Tony Creek, and McGee Creek were surveyed as well. 2008 was the first year CTWS conducted official surveys in Greenpoint Creek, Dog River, and Tony Creek.

Methods

HRPP staff conducted basin wide surveys of the West Fork and sub-reach surveys on other streams. The West Fork was surveyed on foot proceeding downstream in nine reaches. Three passes were made in each reach from early August to the end of October. A standard data sheet was used to record survey date, surveyors, start/end time of survey, water temperature (°C), and water visibility. Redds, carcasses, and live fish were counted and recorded along with the accompanying river mile. Redds were flagged on the adjacent stream bank with the date, surveyors initials, and river mile. When possible GPS locations were recorded for each redd. Carcasses were examined for fin marks, sexed, and checked for bacterial kidney disease (BKD) and spawning success. Snouts were removed from suitably intact carcasses in order to recover coded wire tags. MEPS (middle eye-posterior scale) lengths were measured. Finally, the caudal peduncle was severed from carcasses to prevent double-counting on subsequent surveys.

Results and Discussion

Determine spawning distribution and habitat use of reintroduced spring Chinook

Chinook redds were counted in the Hood River basin from August 11th to October 23th, 2008. Consistent with previous years spawning peaked occurred during the first two weeks of September. There were 116 Spring Chinook salmon redds documented in the surveyed areas (Table 13). The greatest number of redds and fish were observed in the West Fork (Figure 10), with the greatest concentration of spawning found in the upper portion of the West Fork upstream of Ladd Creek (Figure 11). However Chinook spawning was observed in most the other surveyed streams as well (Table 13). Rogers Creek was the only stream surveyed where spawning was not observed. This is likely an artifact of a flood event in November 2006 that formed two new waterfalls on the Middle Fork. The status of these falls as barriers is not completely determined as of yet but these potential barriers are likely limiting anadromous fish access to the upper Middle Fork and Rogers Creek to some degree. The barriers may also be increasing the use of Tony Creek as a spawning tributary. Tony Creek enters the Middle Fork a short distance below the more difficult of the two falls and could be used as alternative spawning habitat for fish deterred by the barrier falls. In the West Fork spawning distribution in 2008 was similar to previous years. The highest density of spawning (44 redds/mile) occurred above Ladd Creek (RM 13) with another aggregation of spawning occurring between Moving Falls (RM 2.5) and Lake Branch (RM 5.5) (Table 14). The first redds were observed in the upstream most section of the West Fork in early August. This phenomenon has been observed in previous years and is likely related to cooler water temperatures higher in the basin facilitating earlier spawning.

Table 13. Summary of redds, carcasses, and live fish observed during spring Chinook spawning surveys in the Hood River basin in 2008.

Stream	Redds	Carcasses	Live Fish	Miles Surveyed	Redd Density (redds/mile)
West Fork Hood River	78	56	126	14.0	5.6
McGee Creek	10	2	2	1.0	10.0
Green point Creek	1	0	2	1.35	0.7
Tony Creek	10	2	15	1.0	10.0
Lake Branch	7	4	1	0.8	8.8
Dog River	10	8	6	1.0	10.0
Rogers Creek	0	0	0*	0.25	0.0
Basin Total	116	72	152	19.4	6.0

*No fish were observed during spawning surveys however Parkdale Fish Facility staff photographed a single adult Chinook at the hatchery weir on Rogers Creek.

Figure 10. Distribution of spring Chinook redds observed in the Hood River Subbasin,

Figure 11. Distribution of spring Chinook redds in the West Fork Hood River

Table 14. Spring Chinook salmon redd counts by river mile in the West Fork Hood River 1997-2008.

River Mile	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
1	5	4	2	4	6	9	5	7	5	3	9	2
2	-	1	1	4	5	2	0	3	1	2	5	2
3	-	0	1	0	3	1	1	1	1	9	6	1
4	0	0	0	1	1	0	1	0	1	6	0	0
5	2	4	2	2	2	7	7	2	4	10	2	4
6	4	1	0	2	8	1	1	2	2	11	7	8
7	0	1	0	0	2	0	-	-	-	2	2	4
8	1	0	0	3	5	7	-	-	-	0	3	4
9	2	2	1	0	2	1	-	-	-	2	1	1
10	1	0	0	0	5	3	-	-	-	2	0	2
11	2	0	0	0	1	2	-	-	-	5	1	2
12	0	0	0	1	1	0	-	-	-	1	1	2
13	0	2	1	-	0	0	-	-	-	0	0	2
14	13	2	1	5	34	54	3	4	13	43	16	44
15 (McGee)	1	0	0	0	5	10	0	0	6	6	5	10
Lake Branch	6	0	2	1	2	0	0	1	1	11	2	7
Totals	37	17	11	23	82	97	18	20	34	113	60	95

Measure spawner demographics, disease frequency, and spawning success

A total of 70 Spring Chinook salmon carcasses were recovered during 2008 spawning surveys. Of the 70 carcasses 43 were female, 22 were male, and five were unidentifiable. Of the total 64 of the carcasses were intact enough for necropsies. From the necropsies one out of 64 carcasses appeared to show signs of bacterial kidney disease (BKD). Fifty seven spawned completely, six partially spawned, and one was a pre-spawn mortality. Sixty four snouts were collected from carcasses and a total of 49 CWTs were recovered. The CWT codes were queried in the Regional Mark Processing Center (RMPC) website (<http://www.rmhc.org/>) to determine hatchery and release origins. Thirty of the tags identified as Round Butte hatchery reared Chinook released in the Hood River. Eighteen of the tags were Round Butte hatchery fish intended for release in the Deschutes. One tag was reported as a fish reared at the Siletz hatchery and released in the East Fork Hood River. Although this is likely simply an erroneous database error as to our knowledge no tribal or state agency has ever transported Chinook from the Siletz to the Hood River Basin, nor ever released Chinook into the East Fork. It is unknown whether or not the reported Deschutes origin fish were true strays as there was some documented mixing of Deschutes and Hood River bound fish in the ladder cells at Round Butte Hatchery. Therefore some fish marked as Deschutes fish may have in fact been released into the West Fork of the Hood River.

Recommendations

The barriers that appeared on the Middle Fork Hood River during the November 2006 flood event appear to be unstable and should be monitored in coming years to assess whether they remain a barrier to migration. If these barriers become passable spawning surveys in Middle Fork tributaries should be resumed. In September 2007 spring Chinook were reported to be concentrated below the East Fork Irrigation Diversion push-up dam. It was previously thought that spring Chinook did not use the East Fork Hood River. The push up dam at the irrigation diversion was modified to facilitate passage for the 2008 Chinook run. Spawning surveys documented Chinook presence in Dog River and confirmed that fish successfully passed the East Fork pushup dam and are colonizing the East Fork portion of the basin. We recommend that Dog River continue to be surveyed in coming years and that other potential East Fork spawning areas are investigated. Radio telemetry tracking of adult spring Chinook implies that some fish may be remaining in the mainstem Hood River through the spawning period. Quantifying the presence

and contribution of main stem spawners is critical in evaluating spawning distribution and carrying capacity for natural production in the Hood River. Thus in the future we plan to conduct exploratory spawning surveys on the mainstem of the Hood River during the time period between summer glacial flow and fall high water events to document spawning activity.

Additional justification for conducting basin wide spawning surveys is related to major changes oncoming in the Hood River. In 2010 Powerdale dam located at river mile 4.5 is scheduled to be removed. Thus far Powerdale Dam and fish trap has provided a location to enumerate all Chinook migrating to the spawning grounds. When the dam is removed adult collection facilities will be located much higher in the basin and above some of the habitat available to spawning fish. Thus it is important to increase survey effort outside the West Fork to gain a clearer picture of Chinook spawning distribution and to assess the impact on adult counts from moving the trapping location.

Table 15. Number of spring Chinook salmon carcasses collected during spawning ground surveys in the West Fork Hood River 1997-2008.

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Index 1	9	1	2	1	2	19	2	7	3	3	9	0
Index 2	-	0	2	0	9	0	2	3	3	10	2	2
Index 3	5	0	3	0	9	5	13	7	5	22	5	8
Index 4	7	0	0	0	1	1	-	5	-	8	0	4
Index 5	5	0	2	1	8	4	-	-	-	-	0	5
Index 6	2	1	1	1	6	4	-	-	-	1	1	2
Index 7	0	0	0	0	0	1	-	-	-	-	0	5
Index 8	11	4	1	0	21	29	0	3	5	44	0	32
Index 9	1	0	0	0	2	2	0	0	5	0	0	2
Total	40	6	11	3	58	65	17	25	21	88	17	60

^a Index area 2 was not surveyed in 1997.

^b Index areas 4, 5, 6, and 7 were not surveyed in 2003

^c Index areas 5, 6, and 7 were not surveyed in 2004, 2005

Irrigation Ditch Fish Salvage

Introduction

With the help of ODFW, irrigation districts, and volunteers, CTWS conducts annual fish salvages in some of the irrigation canals within the Hood River subbasin. The purposes of the salvage are to collect fish from irrigation canals that would otherwise be stranded when the ditches are dewatered for the winter, and to monitor and evaluate the effectiveness of particular fish screens. In 2008, salvages were conducted in the East Fork Irrigation District (EFID) Irrigation canals. An exploratory survey was conducted in the Dee Irrigation District's (DID) canal to determine the extent of anadromous fish presence in the ditch. Salvage was conducted using backpack electrofishing units and portable fish tanks. Fish were identified to species and tallied by length class prior to release into the Hood River. All required sampling permits were secured prior to fish collection operations.

East Fork Irrigation District

The East Fork Irrigation District (EFID) fish salvage occurred October 2 and 31. A total of 1,575 fish were salvaged from the EFID canals in 2008 (Table 16). Of the fish salvaged 1,497 were identified as juvenile steelhead/rainbow trout. Data taken in the salvage activities do not distinguish between winter steelhead, summer steelhead, and rainbow trout because there is no reliable physical differentiation between them. However, due to known distributions, it is expected that these fish would either be winter steelhead or resident rainbow trout. There were a total of 15 cutthroat trout and 1 cutthroat/rainbow hybrid salvaged. Salmonids comprised 96% (N=1,575) of the fish salvaged from the EFID canals in 2008.

All fish were collected using Smith-Root Model 12-B backpack electrofishers and held in a fish liberation truck until the end of the day. Following the collection, all the fish were transported to the nearest appropriate free-flowing water body and released. Fish salvaged from the Main Canal (both above and below the fish screen) were released into the East Fork Hood River below the main diversion. Fish salvaged from the Neal Creek lateral canal were liberated to Neal Creek. During the EFID salvage there was a direct mortality of 82 steelhead/rainbow trout.

Table 16. Fish captured in salvage efforts at East Fork Irrigation District canals in 2008.

Site	Date	St/Rb	Cutthroat	Rb/Ct hybrid	Sculpin	Total
Neal Creek Lateral	10/2/2008	1,058	15	1	30	1,104
Headgate to Sandtrap	10/31/2008	411			29	440
Select main canal sites	10/31/2008	28			3	31
Total		1,497	15	1	62	1,575

Figure 12. Number of salmonids salvaged from EFID and canals, 1999-2008.

The Neal Creek fish screen is scheduled to be replaced with an invert siphon by 2009. This mechanism will separate Neal Creek from irrigation water, thereby blocking fish access into the canal. Salvage will be continued to monitor the effectiveness of the diversion change. There has been a decreasing trend in numbers of fish in the Main Canal below the fish screen (Figure 12). However, the main canal has areas of refuge where fish can over winter, thus it would be difficult

to completely remove all fish from this part of the canal. Fish captured in recent years are likely residuals missed in previous salvage operations or a result of natural production in the ditch. As a result of extremely low catch rates in the Main Canal in recent years it was determined that the fish screen at the sand trap is functioning well and it was not necessary to salvage the entire Main Canal.

There was a relatively large number of fish salvaged above the Sand Trap in 2008 compared to most previous years but the data show no clear trend in abundance of fish in this unscreened section of ditch. Stream flow, diversion set-up, East Fork fish population trends, and other environmental conditions likely contribute to the variability seen in these data above the fish screen. The section of the Main Canal above the fish screen is an area that will need to be salvaged annually unless there is a change to the diversion and screen set up for the Main Canal. The CTWS is working with EFID to reconfigure the head gate structure, which should reduce the number of fish entrained in of the portion of the canal from the headwork to the main fish screen.

Dee Irrigation District

CTWS crews conducted a reconnaissance survey of the ~1.5 mile open canal operated by the Dee Irrigation District. A fish screen located near the intake is equipped with a bypass enabling fish entering the ditch to return to the West Fork. Several unscreened headwater tributaries flow into the ditch. The CTWS is working with DID to convert the open ditch to pipe. Methods and equipment for collecting fish in the canal was the same as the EFID ditch salvage. Following the collection, all the fish were transported and released into the West Fork Hood River. During the DID salvage there was a direct mortality of 13 steelhead/rainbow trout. Branding or other marking observed during salvage was minimal. The fish that were marked recuperated and showed no other outward signs of stress.

Fish salvage at the Dee Irrigation District Ditch occurred on October 7. A total of 66 fish were salvaged from the DID canal in 2008 (Table 17). There were a total of 62 steelhead/rainbow trout salvaged. There was no hatchery marked fish observed. One cutthroat trout was salvaged. Two fish were identified as a rainbow and cutthroat trout hybrid.

It was noted by the salvage crew that all the fish captured below the screen appeared to be resident forms, and that the screen appeared to be functioning properly. Thus it is unlikely that CTWS will repeat fish salvage in the DID canal.

Table 17. Species composition of fish salvaged from Dee Irrigation District canals in 2008.

Location	Date	St/Rbt ^a	Cutthroat	Hybrid ^b	Chinook	Total
Above Fish Screen	10/1/2007	23	0	0	1	24
Below Fish Screen	10/2/2007	39	1	2	0	42
Total		62	1	2	1	66

^a St/Rbt: steelhead/rainbow trout

^b Hybrid: rainbow trout/cutthroat trout hybrid

Status of HRPP program objectives

Background and Introduction

From the inception of the HRPP monitoring and evaluation has been essential to provide data in order to address the scientific uncertainties and to collect and build a body of quantitative and qualitative knowledge required for the program's adaptive management strategies. The original Hood River Production Program Master Plan (O'Toole and ODFW 1991a) outlined a set of objectives, several of which the monitoring and evaluating program would be directly tasked with addressing. These are as follows;

- 1) Re-establish naturally sustaining spring Chinook runs in the Hood River Subbasin.
- 2) Rebuild naturally sustaining summer steelhead runs in the Hood River Subbasin.
- 3) Rebuild naturally sustaining winter steelhead runs in the Hood River Subbasin.
- 4) Maintain the genetic character of naturally producing population of salmonids native to, and re-established in, the Hood River Subbasin.
- 5) Contribute to Columbia River tribal and non-tribal fisheries, ocean fisheries, and increasing Columbia Basin salmon runs.
- 6) Achieve goals set for adult returns to the mouth of the Hood River (Table 17).
- 7) Provide sustainable Indian and non-Indian harvest of salmon and steelhead.

A 10-year programmatic review of the HRPP (Underwood et al. 2003) and a revision of the Master Plan for the HRPP (HDR FishPro 2008) revisited the goals and performance criteria of the HRPP. Original and updated numerical objectives for the program are shown in Table 18. In this segment of the M&E annual report we seek to summarize some key M&E findings, assess whether goals and objectives are being met, and make determine how the M&E component should proceed in the changing landscape of the HRPP.

Discussion

Re-establish naturally reproducing Spring Chinook salmon

As described in previous segments of this document and in the various guiding documents for the Hood River Production Program (O'Toole and ODFW 1991a; Underwood et al, 2003; HDR FishPro 2008) the natural spring Chinook population was to be re-introduced by stocking Deschutes River, Oregon, stock hatchery smolts in the basin and allowing the returning adults from those releases to spawn in the wild. To this end the HRPP has been successful. Spring Chinook redds and spawning adults have been observed in the West Fork and other spawning grounds since CTWS began conducting spawning ground surveys in 1997 (Table 19). Naturally produced adults have been observed at the Powerdale fish trap annually since the program was initiated as well. Over the course of the program the naturally produced Chinook run has shown a generally positive trend, peaking at a return of 297 adults in 2006 (Figure 12). While the presence of a naturally produced component of the spring Chinook run is encouraging it has not been productive enough in most years to achieve spawner escapement goals (125 adults) while contributing to the hatchery broodstock or supporting tribal harvest. Nor have wild Hood River Chinook reached an escapement level that would assure an effective population size (widely considered in the literature to be at least 500 individuals for most salmonid stocks) that would maintain sufficient genetic variation in the long term (Allendorf et al. 1997). Thus we feel spring Chinook reintroduction in the Hood River Basin cannot yet be considered complete.

Table 18. Numerical Fish Objectives and biological performance criteria for the Proposed Program, Showing Comparison to 1991 Objectives and Observed Averages for Each HRPP Stock

	Original Goal		Observed Average		Revised Goal by 2018	
Spring Chinook	Wild	Hatchery	Wild	Hatchery	Wild	Hatchery
Adult Escape to Mouth of Hood R.	1,700		99	399	300	600
Adult Escape to Natural Production	400		98 ¹	148 ¹	205	8
Broodstock Collection	220		1	108	20	180
Harvest (Tribal & Sport)	1,080		U	83	30	318
Pre-spawning Mortality	NA		U	60	45	90
Smolt production	24,000	250,000	U	120,380	15,000	150,000
	1991 Objective		10 Year		Revised Objective	
Egg-to-Smolt Survival	U	U	U	U	4.4%	78%
Smolt-to-Adult Survival	0.68%	0.68%	U	0.24%	2.0%	0.40%
Pre-Spawn Mortality	10%	10%	15% ²	15% ²	15%	15%
Tribal & Sport / Incidental Harvest	63%	63%	1% ¹	21% ¹	10%	53%
HOR Natural Spawn (<5%)	NA	NA	NA	151% ¹	NA	4%
HSRG Rules (>0.70)	NA	NA	NA	0.02 ¹	NA	0.73
Summer Steelhead	Wild	Hatchery	Wild	Hatchery	Wild	Hatchery
Adult Escape to Mouth of Hood R. ³	8,000		300	852	510	NA
Adult Escape to Natural Production	2,400		210	175	408	NA
Broodstock Collection	160		35	3	0	NA
In-Basin Harvest (Tribal & Sport)	5,440		1	110	51	NA
Pre-Spawning Mortality	NA	NA	27 ¹	22 ¹	51	NA
Smolt Production		40,000	3,921	38,585 ⁴	7,500	NA
Egg-to-Smolt Survival	NA	NA	0.58% ¹	71.0%	1.0%	NA
Smolt-to-Adult Survival	NA	NA	7.5%	2.1% ⁵	5%	NA
Pre-Spawn Mortality	NA	NA	10% ²	10% ²	10%	NA
Tribal & Sport / Incidental Harvest	NA	NA	0% ¹	10% ¹	10%	NA
HOR Natural Spawn (5%)	NA	NA	NA	5% ¹	NA	NA
HSRG Ratio (>0.7)	NA	NA	NA	0.67 ¹	NA	NA
Winter Steelhead	Wild	Hatchery	Wild	Hatchery	Wild	Hatchery
Adult Escape to Mouth of Hood R.	5,000		662	1,003	656	1,000
Adult Escape to Natural Production	2,400		515	370	465	24
Broodstock Collection	90		68	24	60	0
In-Basin Harvest (Tribal & Sport)	2,510		2	365	66	876
Pre-Spawning Mortality	NA		60 ¹	63 ¹	66	100
Smolt Production		85,000	8,718	57,286	9,370	50,000
Egg-to-Smolt Survival	NA	NA	0.9%	66.4%	1.0%	75%
Smolt-to-Adult Survival	NA	NA	8.1%	1.1% ⁶	7.0%	2.0%
Pre-Spawn Mortality	NA	NA	10% ²	10% ²	10%	10%
Tribal & Sport / Incidental Harvest	NA	NA	0% ¹	58% ¹	10%	88%
HOR Natural Spawn (<5%)	NA	NA	NA	75% ¹	NA	5%
HSRG Ratio (>0.7)	NA	NA	NA	0.64 ¹	NA	0.95

Table 19. Spring Chinook redds, carcasses, and spawning fish observed on Hood River Basin spawning grounds annually, 1997-2008.

Year	Redds	Carcasses	Live Fish	Miles Surveyed	Redd Density (redds/mile)
1997	37	41	37	12.75	2.90
1998	17	6	3	15.8	1.08
1999	10	8	5	14	0.71
2000	26	1	9	14	1.86
2001	83	49	56	15.8	5.25
2002	113	68	83	16.8	6.73
2003	22	17	5	9	2.44
2004	28	22	36	9.8	2.86
2005	35	23	23	9.8	3.57
2006	111	88	81	12.9	8.60
2007	60	18	48	16.8	3.57
2008	116	70	77	20.15	5.76
Average	55	34	39	13.97	3.78

Figure 13. Adult returns of naturally produced and hatchery produced adult spring Chinook salmon to the Powerdale fish trap, 1992-2008.

Rebuild naturally sustaining summer steelhead runs

During the initial period of the HRPP wild summer steelhead appeared to be in severe decline in the Hood River. A supplementation strategy using hatchery reared fish from wild broodstock was employed in order to boost the number of returning spawners while maintaining the genetic characteristics of the native stock. Hatchery summer steelhead releases into the West Fork Hood River are shown in appendix Table D5. There were significant improvement to returns in 2000 and 2001 (years when virtually every anadromous fish stock in the Columbia Basin flourished) there was little if any positive wild adult return response from the hatchery supplementation (Figure 14). Another assumption of the wild broodstock supplementation strategy was that smolts

reared from wild origin parents should be better adapted to the basin and experience better survival than the “domesticated” out-of-basin origin fish stocked to provide angling opportunities. In fact the opposite was the case and ODFW reported that the Hood stock hatchery steelhead consistently had lower smolt to adult ratio’s than Skamania stock steelhead of the same brood year (1999-2005) (Olsen 2007). Thus it appears that summer steelhead supplementation was ineffective at rebuilding the wild run. As a result Hood River managers decided to end the Hood River wild broodstock hatchery supplementation. The last release of Hood River stock summer steelhead is to occur in spring 2009. The final release of out-of-basin Skamania stock steelhead occurred in 2008. HRPP M&E will continue to monitor the wild summer steelhead population as hatchery origin fish phase out.

Figure 14. Adult returns of naturally produced and hatchery produced adult summer steelhead to the Powerdale fish trap, 1992-2007.

Figure 15. Adult returns of naturally produced and hatchery produced adult winter steelhead to the Powerdale fish trap, 1992-2007.

Rebuild naturally sustaining winter steelhead runs

The Hood River wild winter steelhead run was also at low population levels and experiencing decline when the HRPP was implemented. To address these trends Hood River fish managers decided to phase out the planting of out-of-basin Big Creek stock hatchery winter steelhead in favor of releasing a Hood River stock derived from a wild broodstock supplementation strategy. In the period from 1992-1999, before the offspring of supplementation fish began to return the wild winter steelhead run averaged 332 adults. In the period from 2000-2007, after returns from the supplemented population began returning the wild winter steelhead run averaged 676 adults, virtually doubling the abundance. Granted the post supplementation period includes a couple overall high return years for all salmonids (2000, 2001) there still appears to be a positive response after those high return years (Figure 14). While we hesitate to describe the wild population as “rebuilt” it does seem that supplementation has contributed to increasing the numbers of wild winter steelhead returning to the Hood River. Fisheries managers have decided to continue the winter steelhead supplementation program in its current configuration as published in the Revised Master Plan for the Hood River Production Program (HDR FishPro 2008).

Maintain the genetic character of naturally producing population of salmonids native to, and re-established in, the Hood River Subbasin.

The HRPP has taken efforts to meet the objective of maintaining the genetic character of the Hood River’s salmonid populations. For instance out-of-basin stocks were phased out in favor of wild broodstock for steelhead hatchery releases. The potential for inadvertently interbreeding winter and summer steelhead in the hatchery has been addressed by “rapid read” genetic sampling to verify the race of broodstock fish before they are spawned. When possible brood for Chinook production are taken from Hood River returning adults to facilitate the positive adaptation of the Deschutes founder stock to the Hood River. Smolt acclimation practices attempt to remove residual and precocially maturing steelhead. As the HRPP continues with the Revised Master Plan we will continue to seek to operate and monitor production to minimize negative impacts on wild populations. In addition the HRPP is partnering in research opportunities to support our objectives. This includes a relative reproductive success study sponsored by CRITFC to attempt to measure adaptation or naturalization of the reintroduced spring Chinook in the Hood River Basin. Another research opportunity we are pursuing is a partnership with NOAA Fisheries to study smolt physiology and precocial maturation in our spring Chinook production to determine best long term hatchery rearing strategies.

Contribute to Columbia River tribal and non-tribal fisheries, ocean fisheries, and increasing Columbia Basin salmon runs. Provide sustainable Indian and non-Indian harvest

The HRPP has certainly provided fisheries in the Subbasin and contributed to Columbia River and Pacific Ocean fisheries. A sport fishery occurs annually for summer and winter steelhead and returns of spring Chinook have been sufficient to open tribal and sport Chinook fisheries in 5 of the last 8 years. Annual harvest estimates for sport and tribal fisheries are provided in appendix Table F1. In addition to the fisheries in the Hood River spring Chinook coded wire tags have been recovered in numerous tribal, sport and commercial fisheries in the Columbia River and Pacific Ocean (Appendix Table F2).

Achieve goals set for adult returns to the mouth of the Hood River

The HRPP has yet to realize any of the adult return goals outlined in the original Master Plan (Table 18) for any of the stocks managed in the Hood River. It appears survival rates simply have not been as high as HRPP planners originally anticipated. In the Revised Master Plan adult return goals were reduced (Table 18) for all stocks. The revised adult goal should be more feasible to attain, and in fact hatchery Chinook goals have been met in 2 of the last 3 run years. In order to consistently meet adult return goals there must be an increase in survival rates, an increase in production, or a combination thereof. A component of the Revised Master Plan will be a slight

increase in hatchery Chinook production (125k-150k). As well as a comparative rearing evaluation, where Chinook smolts will be reared at 3 different hatchery locations and compared to determine which rearing location and regime best fits HRPP goals. Reductions of straying and precocial maturation are other factors that could increase the adult recruitment to the basin, which the Hood River M&E program intends to investigate.

Appendix A. Salmonid PIT tagging

Table A 1. Juvenile detection rates, survival probabilities, capture probabilities, and migration estimates to Bonneville Dam for Hood River hatchery steelhead and spring Chinook PIT tagged populations

Release year, species, release group,	Number Released	Number Tagged	Detections		Survival		Capture		Total Migration Estimate		
			Bonneville	TWX	Probability	SE	Probability	SE	Bonneville	SE	
2008,											
Winter Steelhead,											
Volitional	64,763	6,635	1,497	150	0.7005	0.082	0.3236	0.039	45,366	5,311	
Non-migrants	188	17	1	0	-	-	-	-	-	-	
Total STW	64,951	6,652	1,498	150	0.7005	0.082	0.3219	0.0382	45,498	5,326	
Summer Steelhead,											
Volitional	12,108	1,139	88	8	0.2952	0.1787	0.2521	0.1539	3,574	2,164	
Non-migrants	583	57	3	1	-	-	-	-	-	-	
Total STS	12,691	1,196	91	9	0.2952	0.1787	0.2521	0.1539	3,746	2,268	
2007,											
Winter Steelhead,											
Volitional	36,523	3,813	550	56	0.5245	0.133	0.212	0.0543	19,156	4,858	
Non-migrants	494	14	0	0	-	-	-	-	-	-	
Total STW	37,017	3,827	550	56	0.5088	0.1287	0.2158	0.0551	18,834	4,764	
Spring Chinook,											
Middle Fork	31,681	3,970	223	40	0.617	0.2886	0.107	0.0504	19,547	9,143	
West Fork	96,148	7,515	575	93	0.3911	0.0783	0.2117	0.043	37,603	7,528	
Total CHS	127,829	11,485	798	133	0.3551	0.0724	0.1864	0.0384	45,392	9,255	
2006											
Winter Steelhead,											
Volitional	34,191	12,949	744	87	0.2837	0.061	0.1971	0.0428	9,700	2,086	
Non-migrants	628	390	19	7	0.1755	0.1011	0.2857	0.1707	110	63	
Total STW	34,819	13,339	763	94	0.2836	0.061	0.1971	0.0428	9,875	2,124	
2005											
Winter Steelhead,											
Non-migrants	4,943	4,943	105	47	0.1725	0.0695	0.1262	0.0519	853	344	

Appendix B. Spring Chinook returns to the Powerdale Fish Trap

Table B 1. Hood River hatchery spring Chinook returns to Powerdale trap and return ratios by age class for brood years 1991 -2005. Values used for 2008 run estimates in bold.

BROOD YEAR	RETURN AGE			ADULT RETURN	TOTAL RETURN	RETURN RATIOS	
	JACK	FOUR	FIVE			4/3	5/4
1991	5	27	2	29	34	5.40	0.07
1993	15	280	3	283	298	18.67	0.01
1994	1	12	0	12	13	12.00	0.00
1995	2	88	2	90	92	44.00	0.02
1996	5	18	0	18	23	3.60	0.00
1997	128	560	20	580	708	4.38	0.04
1998	496	1,009	133	1142	1,638	2.03	0.13
1999	24	199	14	213	237	8.29	0.07
2000	15	138	8	146	161	9.20	0.06
2001	182	578	66	644	826	3.18	0.11
2002	76	854	75	929	1,005	11.24	0.09
2003	35	229	12	241	276	6.54	0.05
2004	352	919	-	919	-	2.61	-
2005	301	-	-	-	-	-	-
Mean	117	378	28	404	443	10.09	0.05

Table B 2. Hood River wild spring Chinook returns to Powerdale trap and return ratios by age class for brood years 1989 -2005. Values used for 2008 run estimates in bold.

BROOD YEAR	RETURN AGE			ADULT RETURN	TOTAL RETURN	RETURN RATIOS	
	JACK	FOUR	FIVE			4/3	5/4
1989	1	23	11	34	35	23.00	0.48
1990	1	19	13	32	33	19.00	0.68
1991	2	3	2	5	7	1.50	0.67
1992	4	91	42	133	137	22.75	0.46
1993	4	30	38	68	72	7.50	1.27
1994	1	29	5	34	35	29.00	0.17
1995	13	14	3	17	30	1.08	0.21
1996	5	57	12	69	74	11.40	0.21
1997	6	24	21	45	51	4.00	0.88
1998	8	49	51	100	108	6.13	1.04
1999	2	45	17	62	64	22.50	0.38
2000	15	109	47	156	171	7.27	0.43
2001	14	57	39	96	110	4.07	0.68
2002	10	255	89	344	354	25.50	0.35
2003	4	47	23	70	74	11.75	0.49
2004	10	25	-	25	-	2.50	-
2005	1	-	-	-	-	-	-
Mean	6	55	28	81	90	12.43	0.56

Appendix C. Stream temperature

Figure C 1. Water temperature (°C) recorded in the Hood River at Powerdale Dam, river mile 4.5

Figure C 2. Water temperature (°C) recorded in the West Fork Hood River at Lost Lake Road, river mile 4.6, UTM 10T; N 0601338; E 5044637

Figure C 3. Water temperature (°C) recorded in Baldwin Creek near its mouth, river mile 0.1, UTM 10T; N 0610283; E 5046528

Figure C 4. Water temperature (°C) recorded in Neal Creek near its mouth, river mile 0.1, UTM 10T; N 0614858; E 5057667

Figure C 5. Water temperature (°C) recorded in Lake Branch near its mouth, river mile 0.1, UTM, 10T; N 0601338; E 5044637

Figure C 6. Water temperature (°C) recorded in the East Fork Hood River at the County Gravel Pit, river mile, 0.7, UTM 10T; N 0607988; E 5047377

Appendix D. Hatchery Salmonid Releases

Table D 1. Deschutes and Hood River stock spring Chinook salmon acclimated in the West Fork Hood River drainage, 1996-2008.

Drainage, Release Location, Release year, Release group,	Date(s) Delivered to Site	Number delivered to site	Fish/lb at Delivery	Marks	CWT #	Number of days acclimated	Mortalities at acclimation site	Number volitionally released	Number of non- migrants	Total released
West Fork, Blackberry Creek,										
1996,										
Group 1	Apr 8-10	85,080	10.1	Ad-RV	07-11-30	6-8	180	84,900		
Group 2	Apr 22-23	44,838	9.5	Ad-RV	07-11-30	7-8	527	44,311	0	129,211
1997,										
Group 1	Apr 7-8	46,446	8	Ad-LV	09-17-47	6-7	679	45,767		
Group 2	Apr 16-17	56,380	8.4	Ad-LV	09-18-06	4-5	1,054	55,326	0	101,093
1998,										
Group 1	Apr 1-2	63,130	9.8	Ad-RV	09-22-26	8-9	1,073	62,057		
Group 2	Apr 15-16	55,485	9.7	Ad-RV	09-22-27	7-8	944	54,541	0	116,598
1999,										
Group 1	Mar 30- Apr 1	25,474	7.5	Ad-LV	09-25-55	7-9	155	22,232	3,087	
Group 2	13-Apr	26,837	6.7	Ad-LV	09-25-56	7	334	23,415	3,088	51,822
2000,										
Group 1	Apr 4-5	33,343	7.6	AD-LM	09-28-55	5-6	61	30,277	3,005	
Group 2	Apr 18-19	31,410	6.4	AD-LM	09-28-56	5-6	358	28,222	2,830	64,334
2001,										
Group 1	29-Mar	22,018	9.6	Ad-LV	09-31-21	6	32	20,451	1,535	
Group 2	17-Apr	26,445	10.5	Ad-LV	09-31-20	6	47	24,554	1,844	48,382
2002,										
Group 1	28-Mar	23,520	14.7	Ad-LM	09-33-20	8	92	18,579		
Group 2	16-Apr	25,632	14.4	Ad-LM	09-33-20	9	565	20,218	9,698	48,495
2003,										
Group 1	1-Apr	27,474	11.4	Ad-RM	09-35-54	6	139	25,322		
Group 2	15-Apr	28,504	11.2	Ad-RM	09-35-55	7	212	26,278	4,027	55,627
2004,										
Group 1	29-Mar	29,112	13.2	Ad-LM		8	96	28,991		
Group 2	17-Apr	28,215	13.5	Ad-LM		7	334	27,855	51	56,897

Table D1. Continued

Drainage, Release Location, Release year, Release group,	Date(s) Delivered to Site	Number delivered to site	Fish/lb at Delivery	Marks	CWT #	Number of days acclimated	Mortalities at acclimation site	Number volitionally released	Number of non- migrants	Total released
West Fork, Blackberry Creek, (Cont.)										
2005,										
Group 1	17-Mar	24,480	13.6	Ad-RM	09-40-46	0	0	0	0	
Group 2	7-Apr	18,788	12.2	Ad-RM	09-40-47	8	10	18,664	91	43,215
2006,										
Group 1	4-Apr	30,635	12.8	Ad-LM	09-42-33; 09-42-30	13				
Group 2	18-Apr	34,809	11	Ad-LM	09-42-32; 09-42-31	20	86	63,622	1,822	65,444
2007,										
Group 1	3-Apr	29,016	11.7	Ad-RM	09-44-44	7	100			
Group 2	17-Apr	26,864	10.4	Ad-RM	09-44-45	7	145	52,666	2,904	55,570
2008,										
Group 1	Apr 16-17	68,772	10	AD-LM	09-46-22	7-8	346	68,426	0	68,426
2009,										
Group 1	25-Mar	59,086	15.5			11				
Group 2	15-Apr	37,800	14			8	112	96,774	0	96,774
Jones Creek,										
1998,										
Group 2	16-Apr	8,245	9.7	Ad-RV	09-22-27	6	60	8,185	0	8,185
1999,										
	Mar 30-									
Group 1	Apr 1	19,982	7.6	Ad-LV	09-25-55	7-9	462	12,937	6,583	
Group 2	13-Apr	19,991	6.7	Ad-LV	09-25-56	7	309	13,104	6,578	39,188
2000,										
Group 1	Apr 4-5	20,085	8	AD-LM	09-28-55	5-6	216	17,420	2,449	
Group 2	Apr 18-19	19,529	6.3	AD-LM	09-28-56	5-6	959	16,189	2,381	38,431
2001,										
Group 1	29-Mar	20,037	9.8	Ad-LV	09-31-21	6	35	20,002		
Group 2	17-Apr	17,940	9	Ad-LV	09-31-20	6	69	17,871	0	37,873
2002,										
Group 1	28-Mar	16,170	14.7	Ad-LM	09-33-20	8	2,080	14,090	0	14,090

Table D1. Continued

Drainage, Release Location, Release year, Release group,	Date(s) Delivered to Site	Number delivered to site	Fish/lb at Delivery	Marks	CWT #	Number of days acclimated	Mortalities at acclimation site	Number volitionally released	Number of non- migrants	Total released
West Fork, Jones Creek,										
2003,										
Group 1	29-Mar	20,235	11.4	Ad-RM	09-35-54	6	67	15,650		
Group 2	17-Apr	19,996	11.4	Ad-RM	09-35-55	7	91	15,386	9,037	40,073
2004,										
Group 1	29-Mar	19,575	13.2	Ad-LM		8	6	18,496		
Group 2	17-Apr	19,696	13.5	Ad-LM		7	38	18,585	2,146	39,227
2005,										
Group 1	17-Mar	20,060	13.6	Ad-RM	09-40-46	10	70	19,975	0	
Group 2	7-Apr	20,130	12.2	Ad-RM	09-40-47	8	43	20,007	65	40,047
2006,										
Group 1	4-Apr	19,259	12.8	Ad-LM	09-42-33	13		18,907		
Group 2	18-Apr	24,905	11	Ad-LM	09-42-32	20	90	22,731	2,526	41,638
2007,										
Group 1	3-Apr	20,684	11.7	Ad-RM	09-44-44	7	143			
Group 2	17-Apr	20,384	10.4	Ad-RM	09-44-45	7	246	39,123	1,455	40,578

Table D 2. Deschutes and Hood River stock spring Chinook salmon acclimated in the Middle Fork Hood River drainage, 1999-2008.

Drainage, Release Location, Release year, Release group,	Date Delivered to Site	Number delivered to site	Fish/lb at Delivery	Marks	CWT #	Number of days acclimated	Mortalities at acclimation site	Number volitionally released	Number of non- migrants	Total released
Middle Fork, Parkdale Fish Facility,										
1999, Group 1	29-Mar	30,600	6.4	Ad-RM	09-25-54	14	191	30,195	214	30,409
2000, Group 1A	3-Apr	15,334	6.7	Ad-RV	09-28-57	7	12	15,293	29	
Group 1B	20-Apr	15,176	5.7	Ad-RV	09-28-57	5	12	15,136	28	
Group 2	20-Mar	4,170	14.9	Ad-LV	09-17-04; 07-11-23,24	na	10	4,126	34	34,646
2001, Group 1	29-Mar	31,362	9.6	Ad-RM	09-31-22	28	20	31,319	23	
Group 2	17-Apr	7,082	14.2	Ad-RV	09-32-09	na	0	7,066	16	38,424
2002, Group 1	Mar 5- 6	31,293	13.2	Ad-RV	09-33-22	29-30	50	30,941	302	31,243
2003, Group 1	3-Mar	30,720	12.9	Ad-LV	09-35-56	33	67	30,638	15	30,653
2004, Group 1	Mar 1- 2	32,180	13.4	Ad-RV	09-38-53	31-32	48	31,932	200	32,132
2005, Group 1	1-Mar	29,796	13.7	Ad-LV	09-40-10	31	76	29,669	37	29,706
2006, Group 1	6-Mar	33,160	12	Ad-RV	09-42-34	15	207	32,933	0	32,933
2007, Group 1	6-Mar	31,784	13.7	Ad-LV	09-44-46	14	91	31,681	0	31,681
2008, -	-	-	-	-	-	-	-	-	-	-

Table D 3. Hood River stock winter steelhead acclimated in the Middle Fork Hood River drainage, 1996-2008.

Drainage, Location, Release year, Release group	Date Delivered to Site	Number delivered to site	Fish/lb at Delivery	Marks	Number of days acclimated	Mortalities at acclimation site	Number volitionally released	Number of non- migrants	Total released
Middle Fork Hood River, Parkdale Fish Facility,									
1999,									
Group 1	Apr 6-7	10,012	5.5	Ad-RV	8-9	2	9,857	153	19,978
Group 2	28-Apr	9,975	6	Ad-RV	7	7	9,816	152	
2000,									
Group 1	Apr 11	15,912	7.3	Ad-LV-CWT	6	8	15,279	625	32,019
Group 2	25-Apr	16,235	7.7	Ad-LV-CWT	6	20	15,578	637	
2001,									
Group 1	26-Apr	14,696	5.6	Ad-RV	4	13	14,535	148	25,275
Group 2	8-May	10,648	5.9	Ad-RV	6	56	10,484	108	
2002,									
Group 1	5-Apr	14,142	6.3	Ad-LV-CWT	7	75	13,809	516	31,750
Group 2	23-Apr	17,758	5.5	Ad-LV-CWT	6	75	17,425		
2003,									
Group 1	3-Apr	11,256	6.5	Ad-LV, Ad-RV	7	53	11,103	200	26,343
Group 2	Apr 22-23	15,193	5	Ad-LV, Ad-RV	7-8	53	15,040		
2004,									
Group 1	Apr 1-2	15,014	6	Ad-LV	7-8	5	14,904	210	30,156
Group 2	20-Apr	15,175	4.6	Ad-LV	7	28	15,042		
2005,									
Group 1	Mar 30-31	20,000	7.7	Ad-RV	8-9	30	33,052	4,481	37,517
Group 2	Apr 14-15	17,605	6.7	Ad-RV	8-Jul	29			
2006,									
Group 1	8-Mar	9,000	10	Ad-LV	14	15	16,835	0	16,826
Group 2	29-Mar	7,875	7.5	Ad-LV	8	25			
2007,									
Group 1	12-Mar	9,760	6.4	Ad-RV	8	15	16,742	348	17,090
Group 2	27-Apr	7,368	5.8	Ad-RV	7	14			
2008,									
Group 1	Apr 14	26,918	4.8	Ad-LV	10	19	26,843	56	26899

Table D 4. Hood River stock winter steelhead acclimated in the East Fork Hood River drainage, 1996-2008.

Drainage, Location, Release year, Release group	Date Delivered to Site	Number delivered to site	Fish/lb at Delivery	Marks	Number of days acclimated	Mortalities at acclimation site	Number volitionally released	Number of non- migrants	Total released
East Fork, Toll Bridge Park,									
1996, Group 1	1-Apr	24,057	5.7	Ad-LV-RM-CWT, AD-RM	9-12	26	24,031		
Group 2	22-Apr	26,965	5	Ad-LV-RM-CWT, AD-RM	8-10	92	20,885	5,988	50,904
EFID Sand Trap,									
1997, Group 1	11-Apr	27,740	5.7	Ad-LM	6-10	29	27,711	0	
Group 2	29-Apr	32,578	8.3	Ad-LM	6	452	32,126	0	59,837
1998, Group 1	7-Apr	29,510	5.2	Ad-RM	7	0	29,510		
Group 2	21-Apr	32,626	7.5	Ad-RM	7	0	31,707	919	62,135
1999, Group 1	6-Apr	13,439	5.6	Ad-RV	9	4	12,430	1,005	
Group 2	29-Apr	13,630	5.8	Ad-RV	6	2,052	10,572	1,006	27,011
2000, Group 1	12-Apr	14,599	7.3	Ad-LV-CWT	5	1	13,852	746	
Group 2	25-Apr	16,558	7.8	Ad-LV-CWT	5-6	20	15,694	844	31,136
2001, Group 1A	24-Apr	13,265	5.3	Ad-RV	5-6	0	0	0	
Group 1B	7-May	3,782	4.4	Ad-RV	7	0	0	0	
Group 2	7-May	8,557	6.4	Ad-RV	7	0	0	0	25,604
2002, Group 1	4-Apr	14,659	6.1	Ad-LV-CWT	8	54	14,436		
Group 2	22-Apr	16,572	5.4	Ad-LV-CWT	7	6	16,396	339	31,171
2003, Group 1	4-Apr	11,255	5.7	Ad-LV, Ad-RV	6	5	10,372		
Group 2	21-Apr	13,865	5.9	Ad-LV, Ad-RV	8	25	12,962	1,756	25,090
2004, Group 1	5-Apr	29,482	5.5	Ad-LV	15	17	28,914	551	29,465

Table D4. Continued.

Drainage, Location, Release year, Release group	Date Delivered to Site	Number delivered to site	Fish/lb at Delivery	Marks	Number of days acclimated	Mortalities at acclimation site	Number volitionally released	Number of non- migrants	Total released
East Fork, EFID Sand Trap,									
2005, Group 1	29-Mar	39,000	7.6	Ad-RV	10	56	38,385	559	38,935
2006, Group 1	7-Mar	18,000	9.9	Ad-LV	20	16	17,356	628	17,984
2007, Group 1	12-Apr	8,493	5.9	Ad-RV	8				
Group 2	13-Apr	10,944	6.4	Ad-RV	7	4	19,287	146	19,433
2008, Group 1	15-Apr	37,845	4.9	Ad-LV	8-10	8	37,649	188	37,837
2009, Group 1	5-May	33,699	6.28	Ad-RV	7	6	33,693	0	33,693

Table D 5. Hood River stock summer steelhead acclimated in the West Fork Hood River drainage, 1999-2008.

Drainage, Location, Release year, Release group	Date Delivered to Site	Number delivered to site	Fish/lb at Delivery	Mark(s)	Number of days acclimated	Mortalities at acclimation site	Number volitionally released	Number of non- migrants	Total released
West Fork, Blackberry Creek,									
1999, Group 1	2-Apr	19,532	5.5	LM or RM	13	19	15,616	3,897	19,513
2000, Group 1	6-Apr	18,165	6.2	LM, Ad-LM	7	19	15,611	2,535	
Group 2	21-Apr	15,775	5.2	LM, Ad-LM	3-6	31	13,541	2,203	33,890
2001, Group 1	5-Apr	15,046	7.2	LM, Ad-LM	7	3	11,517	3,526	
Group 2	13-Apr	15,126	6.8	LM, Ad-LM	5	8	11,575	3,543	
Group 3	24-Apr	7,516	6.4	LM, Ad-LM	6	12	5,745	1,759	37,665
2002, Group 1	2-Apr	21,000	5.1	Ad-RM	7-8	20	19,047		
Group 2	18-Apr	19,372	4.3	Ad-RM	8	21	17,418		
Group 3	29-Apr	5,395	4.7	Ad-RM	3	18	3,444	5,799	45,708
2003, Group 1	27-Mar	15,893	5.1	Ad-LM	5-6	49	14,295		
Group 2	10-Apr	15,895	5.2	Ad-LM	2-7	76	14,270		
Group 3	24-Apr	15,833	5.3	Ad-LM	6-7	24	14,260	4,647	47,472
2004, Group 1	31-Mar	20,299	4.9	Ad-RM	8-9	18	17,840		
Group 2	15-Apr	20,277	5	Ad-RM	7-8	128	17,707	4,883	40,430
2005, Group 1	15-Mar	17,368	5.2	Ad-LM	8-9	23			
Group 2	31-Mar	18,993	5.7	Ad-LM	8-9	50			
Group 3	18-Apr	20,333	5	Ad-LM	8-9	12	50,653	5,876	56,529
2006, Group 1	5-Apr	18,464	4.8	Ad-RM	8-9	25			
Group 2	19-Apr	15,632	4.9	Ad-RM	8-9	42	28,441	5,541	33,982
2008, Group 1	Mar 25	12,219	5	Ad-RM	8	54	11,525	583	12,108

Appendix E. Adult Escapement

Table E 1. Escapement of natural and hatchery produced spring Chinook salmon, summer steelhead, and winter steelhead to the Hood River Basin, measured at the Powerdale Fish Trap, 1992-2008.

Run Year	Spring Chinook				Summer Steelhead			Winter Steelhead		
	Wild Adult	Wild Jack	Hatchery Adult	Hatchery Jack	Wild	Hatchery (Hood)	Hatchery (Skamania)	Wild	Hatchery (Big Creek)	Hatchery (Hood)
1992	35	0	414	3	490	-	1,726	662	298	-
1993	42	0	446	15	245	-	1,098	396	215	-
1994	33	1	261	5	218	-	1,624	370	151	1
1995	20	0	63	0	132	-	546	190	18	83
1996	96	1	2	15	184	-	1,344	269	-	259
1997	72	1	280	1	81	-	594	274	-	611
1998	80	1	15	2	132	-	556	207	-	365
1999	21	3	88	5	188	-	485	285	-	304
2000	66	0	20	128	221	7	1,176	901	-	290
2001	42	3	560	496	495	417	1,879	998	-	897
2002	71	2	1,029	24	707	910	1,655	1,023	-	922
2003	10	11	333	15	266	656	1,327	712	-	468
2004	131	13	152	182	233	995	1,834	570	-	920
2005	110	7	587	76	206	645	608	331	-	451
2006	297	4	923	36	197	526	456	431	-	813
2007	150	4	355	302	176	484	300	442	-	395
2008	59	1	931	301	-	-	-	-	-	-

Appendix F. Sport and Tribal salmonid harvest estimates

Table F 1. Harvest estimates for sport and tribal subsistence fisheries for spring Chinook, summer steelhead and winter steelhead in the Hood River Basin, 1995-2008.

Run Year	Fishery	Spring Chinook		Summer Steelhead			Winter Steelhead	
		Unmarked	Hatchery	Wild	Hood Hatchery	Skamania Hatchery	Wild	Hatchery
1995	Sport	-	-	0	0	31	-	-
1996	Sport	53	5	4	0	749	0	314
1997	Sport	40	15	0	0	343	0	319
1998	Sport	16	11	0	0	355	5	231
1999	Sport	0	0	0	0	224	0	172
2000	Sport	8	22	0	1	438	0	217
2001	Sport	0	54	4	9	771	0	351
2001	Tribal	0	130	-	-	-	-	-
2002	Sport	9	287	0	19	814	5	841
2002	Tribal	0	112	-	-	-	-	-
2003	Sport	4	13	0	70	591	5	411
2004	Sport	3	0	0	145	650	0	475
2005	Sport	0	60	2	205	166	0	182
2005	Tribal	0	65	-	-	-	-	-
2006	Sport	0	0	0	125	178	2	457
2007	Sport	0	182	0	94	88	0	170
2007	Tribal	0	51	-	-	-	-	-
2008	Sport	0	222	5	208	345	0	110
2008	Tribal	0	172	-	-	-	-	-

Table F 2. Coded wire tag (CWT) recoveries and harvest estimates of spring Chinook released into the Hood River from 1991-2003 in Columbia River and Pacific Ocean fisheries, as reported by the Regional Mark Processing Center (<http://www.rmhc.org/>).

Fishery	Recoveries	Estimated Catch
Columbia R. Gillnet	162	382
Columbia R. Sport	72	215
Columbia Tributary Sport	135	215
High Seas	6	9
Ocean Sport	1	1
Ocean Troll	3	10
Sport (charter)	1	2
Sport (Private)	1	4
Treaty Ceremonial	8	13
Treaty Subsistence	1	1
Totals	390	852

Appendix G. Hatchery salmonid mark rates

Table G1. Assigned marks and proportions of missing marks for HRPP hatchery salmonid production, 2003-2008

Year	Species	Release Site	Assigned Marks	Missing CWT	Poor/missing primary mark	Poor/missing secondary Mark
2008	STS	Blackberry	Ad-RM	NA	9.10%	1.14%
	STW	Oak Springs	Ad-LV	NA	0.00%	0.00%
	CHS	Blackberry	Ad-LM, CWT	0.00%	9.43%	0.00%
2007	STW	Oak Springs	Ad-RV	NA	0.00%	0.46%
	CHS	West Fork	Ad-RM	3.31%	0.57%	5.77%
	CHS	PFF	AD-LV	2.99%	0.60%	17.96%
2005	CHS	PFF	Ad-LV, CWT	0.47%	11.22%	20.49%
	CHS	West Fork	Ad-RM, CWT	4.27%	9.86%	11.45%
	STS	West Fork	Ad-RM	NA	9.91%	1.67%
	STW	East/Middle Forks	Ad-RV	NA	1.14%	45.37%
2004	CHS	PFF	Ad-RV, CWT	1.91%	1.44%	13.88%
	CHS	West Fork	Ad-LM, CWT	1.41%	5.28%	1.41%
	STS	West Fork	Ad-RM	NA	30.38%	2.11%
	STW	East/Middle Forks	Ad-RM	NA	5.14%	24.05%
2003	CHS	PFF	Ad-LV	17.87%	0.74%	12.66%
	CHS	West Fork	Ad-RM	1.23%	10.74%	0.37%
	STS	West Fork	Ad-LM	NA	9.92%	2.01%
	STW	East/Middle Forks	Ad-LV, Ad-RV	NA	4.58%	42.11%

Appendix H. References

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