1998 to 1999 Horse Linto Creek Anadromous Monitoring Spawning and Downstream Migrant Trap Report

Funded by: Senate Bill-271
Department of Fish and Game
Contract #FG 7350 IF

Prepared by Lower Trinity Ranger District
Six Rivers National Forest
October 1999

Contract:	#FG7350IF
Location of work:	The coordinates of the trap site are T7N, R5E, Section 4. The trap can be accessed from the town of Willow Creek by taking Country Club Road north and turning left on Patterson Road. Take road 8N03 to the Horse Linto Creek Campground. The trap site is at the Horse Linto campground, approximately 210 meters downstream from the Cedar Creek confluence and approximately 1650 meters upstream of the Horse Linto confluence with the Trinity River. See Figure 1 of downstream migrant trap report.
Dates of Work:	Spawning surveys were conducted from late October 1998 through early January 1999 on Cedar and Horse Linto Creek. The downstream migrant trap was installed in Horse Linto Creek and operating by March 23, 1999. Fish were counted from March 24, 1999 through August 9, 1999. Data preparation and report writing extended to 10/8/99.
Hours:	Approximately 830 hours were charged to CDFG, but over 2000 additional hours were donated to the project by USFS.
Costs:	$9,900 was spent
Project Objectives:	This project seeks to monitor the success of past enhancement work in the Horse Linto watershed. Also, we are conducting both spawning surveys and downstream migrant trapping to get a better idea of the variability in juvenile production, presumably due to natural variables such as flooding and bedload movement.

Executive Summary

This report ties together two related, but separate tasks: fall/winter salmon spawning surveys and spring/summer juvenile salmonid down-stream-migrant (DSM) trapping. Both tasks are discussed in chronological detail on the following pages. This work could not continue without financial assistance, such as the CDFG grant we received that will fund work up to winter 2001. Conducting both tasks provides us with much better information and a more complete picture of what's going on with anadromous fish than only conducting one task or the other. Many of our cooperators are interested in Horse Linto, since it was the site of a hatchery supplementation project and numerous stream and watershed restoration projects. Unfortunately, as this report is being finalized, a very large wildfire is continuing to burn in the Horse Linto watershed; we anticipate detrimental effects to water quality and fish habitat.

Spawning surveys in our established survey reaches found only 89 chinook redds in 1998/99, which is the lowest number of redds seen since 1993. The average of 1991 to 1997 was 179 redds. However, 1999 DSM trapping work estimated 51,602 chinook outmigrants, the highest number documented this decade and more than double the average of the previous five years. Chinook outmigration peaked in late June this year and while most juvenile chinook appeared to have emigrated by the time the trap was closed in mid-August, we believe that many thousands emigrated after we closed the trap.

The dichotomy of low adult chinook numbers resulting in record high numbers of outmigrants cannot be precisely explained, but the following facts are relevant to the discussion: Some redds were certainly missed since we only survey a representative portion of the watershed, and high flows and turbidity are always factors in missing redds. We also noted that chinook continued spawning in Horse Linto into late January, after our regular surveys are normally complete.

Several factors may have resulted in better egg to alevin survival. Spawning peaked about 3 weeks later than usual in Horse Linto, basically after the stream flow rose, so redds were generally constructed in better (safer from erosive flooding) locations than many redds were in previous years. Large woody debris enhancement projects and natural wood recruitment have increased stream complexity and improved spawning. Storm events from 1998 to 1999 did not seem to create as much stream scour in 1998 to 1999 as we have seen in recent years.

Several coho spawners were positively identified in Horse Linto, and the DSM trapping found 1 young of the year (YOY) coho. Both adult and juvenile coho have been at very low levels since 1995.

Our spawning surveys cannot reliably document steelhead spawning, but DSM trapping found 480 1+ (one year or older) steelhead. That number is below the average from the previous 5 years which was 599 1+ steelhead. There was insufficient data to make population estimates for 1+ steelhead. DSM trapping also documented 11,990 YOY steelhead. This is the greatest number of YOY steelhead documented in Horse Linto to date. This abundance makes it appear that we had good recruitment of steelhead in 1999.

1998-99 CHINOOK AND COHO SPAWNING REPORT
LOWER TRINITY RANGER DISTRICT
SIX RIVERS NATIONAL FOREST
HORSE LINTO CREEK WATERSHED

Prepared By: Becky L. Dutra and Sean A. Thomas,
AmeriCorps Watershed Stewards Project

Edited By: Lee Morgan, USFS

Materials and Methods

Spawning surveys were conducted from late October 1998 through early January 1999 on Horse Linto Creek and Cedar Creek (Horse Linto's largest anadromous tributary). The survey reaches comprise about 6 stream miles of habitat. Horse Linto Creek surveys are broken into two reaches, Index and Extended. The reaches we survey were where the bulk of spawning was documented to occur a decade ago, but about 10 miles of additional habitat is available upstream to spawners. The Horse Linto Extended reach is downstream of the Horse Linto Campground and our down stream migrant (DSM) trapping efforts.

Appendix A shows the survey reaches and results by date. Occasionally, surveys were prevented or shortened due to inclement weather, turbidity and subsequent high flows; they commenced again when water levels allowed surveyors to work safely and accurately. AmeriCorps Watershed Stewards Project (WSP) members Becky L. Dutra and Sean A. Thomas were the primary surveyors and received assistance from experienced fisheries personnel and volunteers, and other WSP members. Horse Linto Index reach, was surveyed through the first week of February 1999 due to high numbers of fish continuing to spawn in these waters combined with flows allowing surveys. Data from the surveys outside of the reaches or time frame that are normally surveyed have been segregated to allow comparison of past work with similar effort.

Spawning survey effort has been relatively constant over the last eight years. However, 1998-99 surveys on Horse Linto Index reach extended past the time scope of past surveys. Also, an extra survey was performed on upper Horse Linto Creek to check for spawning activity above where surveys are normally conducted. This extra effort would have skewed comparisons with other years. Accordingly, this data is not included in the table totals, or most discussions within this report, but is shown in Appendix A as additional information. Survey reaches have been consistent and unaltered since 1991, with only a few exceptions. Please refer to Appendix B for dates and additional information on surveys conducted from 1991 to 1998. The total number of redds recorded from 1991 to 1998 on each survey stream are shown in Appendix C.

The primary species of anadromous fish observed in Horse Linto and Cedar Creek, was chinook salmon (*Oncorhynchus tshawytscha*). Fish habitat has been augmented in many places to enhance/mimic natural spawning sites. Redds found near an enhanced site are referred to as artificial, whereas redds found where no augmentation has occurred are said to be natural. Numbers of live fish were recorded for informational purposes only, as an indicator of fish activity.

LTRD spawning crews collected heads from carcasses that possessed an adipose-fin-clip in order to recover CWTs. The 1998-99 sample size of CWTs was very small. Only fifteen CWTs were recovered out of seventeen adipose-fin-clipped fish found district-wide. One CWT was lost during recovery lowering the total number of CWTs to fourteen. The heads were processed by LTRD personnel at the Hoopa Valley Tribal Fisheries office in Hoopa, CA. All CWTs were read by B. Dutra with assistance by S. Thomas and Hoopa Tribal Fisheries staff and were double-checked by Bill Jong at the CDFG office in Arcata, CA.

Scales were collected from the carcasses retrieved from all survey streams. B. Dutra and S. Thomas mounted all the readable scales at the Hoopa Tribal Fisheries Office. These scales were then aged by readers in the Yurok Tribal Fisheries Program and in part by readers at the Hoopa Tribal Fisheries Department. The age class components were calculated as a percentage of the total carcass sample size for each watershed and are presented in Figure 1 on page five. Aging accuracy was an issue with all LTRD scale samples. Based on a sample size of thirteen fish with both a CWT (known age) and scales, Yurok readers aged eleven fish correctly (at least two of three readers aged correctly) and two incorrectly (two or more readers aged incorrectly) for an accuracy of 85%. Scale sample sizes from fish of unknown ages for each watershed were small; there were only thirty-four samples from Horse Linto. These small sample sizes should serve as a caution when viewing and making assumptions about the given age classes shown in Figure 1; this data is for general information purposes only.

Results and Discussion

Coho

Four redds presumed to be coho redds were located in Cedar Creek in early January. Our surveyors observed two coho working one redd in Horse Linto (Index reach) during the second week in January, however this data fell outside the established survey time window and is shown only in Appendix A. The determination of a coho redd, if live fish were absent, was based on the combination of when the redd was found (i.e. late in season) and redd geometry (i.e. deep pit, tall tail and relatively small area for a coho) (*note, Table 1). Admittedly, the accuracy of this distinction is debatable, but our surveys have located more than 100 confirmed coho redds in the last 4 years and noted that those coho redds always had a different geometry than confirmed chinook redds.

Table 1
1998-99 Lower Trinity Ranger District spawning survey totals for coho salmon (*Oncorhynchus kisutch*).

CREEK	LIVE FISH	CARCASSES				REDDS		
		F♀	M♂	U	TOTAL	NAT	ART	TOTAL
Cedar	2	0	0	0	0	2*	2*	4
HL Extended	0	0	0	0	0	0	0	0
HL Index	0	0	0	0	0	0	0	0

*Believed to be coho salmon redds; however no fish were observed at site to verify.

Chinook

Table 2 shows that Horse Linto watershed spawning activity, which includes both Cedar and Horse Linto creeks, produced 89 redds, the lowest number since 1993 (refer to Appendices B and C). Using the CDFG recommended expansion of 2.25 fish per redd, the total number of fish in the Horse Linto Creek watershed within our regular survey reaches was calculated as 200 fish.

Table 2
1998-99 Lower Trinity Ranger District spawning survey totals for chinook salmon (*Oncorhynchus tshawytscha*) for comparison with previous years.

CREEK	LIVE FISH	CARCASSES				REDDS		
		F♀	M♂	U	TOTAL	NAT	ART	TOTAL
Cedar	57	16	1	3	20	32	4	36
HL Extended	28	8	3	2	13*	18	5	23
HL Index	28	1	2	1	4	22	8	30

*Three carcasses could not be identified to species - assumed to be chinook.

As shown in Appendix A, on January 12, 1999 an additional survey on Horse Linto Creek was performed from the confluence with North Fork Horse Linto Creek downstream to station marker 14655 (terminus of the Index reach/14655 feet up from mouth), in order to count redds, collect carcass data and assess fish passage. This reach encompasses approximately 4.5 miles of fish habitat. Since this survey was performed after a two-week period of high flows in early December 1998, only spawning activity that occurred from mid-December on could be detected. In total, ten redds were seen and no carcasses were found; this data is shown only in Appendix A, because it is not comparable with previous years. The redds were located in two separate areas: five were seen in a section of the creek within T8N, R6E, Sec 31 and the remaining five in Sec 35. We have no credible way to estimate how many additional redds were outside of our regular survey reaches, but it is safe to assume that there were more than the 10 we located in one day.

Hatchery Component of Spawners

All the CWTs recovered in Horse Linto and Cedar Creek during the 1998-99 season were from Horse Linto Hatchery fish (see Table 3). As stated before, Horse Linto Hatchery fish were 100% ad-clipped/tagged when possible. A total of ten CWTs were recovered in the Horse Linto watershed from five-year-old, 1993 brood year, Horse Linto Hatchery chinook (#062928). One additional chinook from the Horse Linto Hatchery was found in Willow Creek.

This was the final year returns were expected from the Horse Linto Hatchery. The five-year-old, 1993 brood year chinook were the last batch of fish released from the hatchery before its closure in 1994. The facility appears to have been successful at rebuilding fall chinook salmon returns in the short term. Future monitoring will help evaluate whether chinook populations can be maintained by natural production alone.

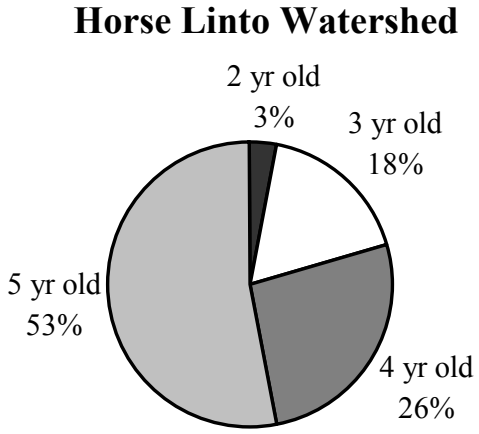
Table 3
1998-99 Horse Linto Creek Hatchery Coded Wire Tag recoveries on the Lower Trinity Ranger District

CREEK	CODED WIRE TAGS
	#062928
Cedar	8
HL Extended	1
HL Index	1
Willow	1

Age Component of Spawners

Scales recovered from 34 Horse Linto Watershed carcasses and the known age of fish with CWTs suggested that Horse Linto watershed had the age classes shown in Figure 1. The scale data showed varying growth realized for each of the age classes recovered. In some cases as much as a ten-inch difference in fork-length per age class was noted. Also, we saw a noticeably high percentage of five-year-olds returns (Figure 1). It is not known why a greater number of fish held over in the ocean an additional year before returning to spawn. These growth and migration observations may be attributed to the El Nino event that occurred in 1998.

Figure 1
1998-99 age class percentages of spawning salmon in Horse Linto and Cedar Creek on the Lower Trinity Ranger District as calculated from scale samples



We did not expect to see a large number of returning four-year-old chinook. This was because DSM numbers in 1995 for YOY chinook in the Horse Linto Watershed were very low, apparently due to the flooding that occurred that winter in this and other watersheds. As cited in the LTRD 1995 DSM final report, 103 salmon redds were counted in the Horse Linto watershed in the fall of 1994, which is not a low number. Subsequent DSM trapping in the spring of 1995 and direct observation dives found extremely low numbers of young of the year (YOY) chinook. A total of 113 YOY chinook were captured in the trap, and the trap was closed early due to a general lack of chinook in the watershed. Either most redds were damaged by the extreme high flows or most of the chinook left the stream before the trap was operational. Based on the 1995 DSM data and the subsequent low returns, it seems likely that the flooding of 94-95 impacted juvenile production and thus the number of four-year-old salmon returning to the Horse Linto watershed during the 1998-99 spawning.

Appendix A

1998-99 Spawning Survey Summaries on the Lower Trinity Ranger District

Cedar Creek

REACH	DATE	LIVE FISH	CARCASSES	REDDS
0 - 15000	11/03/98	4	0	3
0 - 15000	11/10/98	7	0	2
0 - 15000	12/07/98	23/2*	0	8
0 - 15000	12/15/98	13	1	10
0 - 15000	12/23/98	5	11	4
0 - 15000	12/30/98	5	6	7
0 - 15000	01/06/99	0	2	2/4*
TOTALS	**7 Survey Days**	**57/2***	**20**	**36/4***

*Coho salmon

Horse Linto Creek (Extended)

REACH	DATE	LIVE FISH	CARCASSES	REDDS
0 - 4500	10/29/98	0	0	1
0 - 4500	11/09/98	3	0	1
0 - 4500	11/16/98	0	0	0
0 - 4500	12/09/98	15	2	5
0 - 4500	12/17/98	7	2	8
0 - 4500	12/22/98	0	5	3
0 - 4500	12/29/98	2	0	2
0 - 4500	01/05/99	1	4	3
TOTALS	**8 Survey Days**	**28**	**13**	**23**

Horse Linto Creek (Index)

REACH	DATE	LIVE FISH	CARCASSES	REDDS
4500 – 14700	11/03/98	0	0	2
4500 – 14700	11/10/98	0	0	3
4500 - 14700	11/16/98	1	0	2
4500 - 14700	12/07/98	13	1	2
4500 - 12600	12/15/98	2	1	2
4500 - 11000	12/21/98	0	1	1
4500 - 14000	12/28/98	5	1	5
4500 - 14700	01/04/99	7	0	13
TOTALS	**8 Survey Days**	**28**	**4**	**30**
--Data below is outside the time scope of past surveys--				
4500 – 14100	01/12/99	5/2*	1	8/1*
4500 – 12000	02/04/99	0	0	0
TOTALS	10 Survey Days	33/2*	5	38/1*

*Coho salmon

Horse Linto Creek (North Fork to Index)

REACH	DATE	LIVE FISH	CARCASSES	REDDS
14655 – NF	01/12/98	0	0	10
TOTALS	**1 Survey Day**	**0**	**0**	**10**

Appendix B

Spawning Survey Totals from 1991 to 1998 on the Lower Trinity Ranger District

1991

CREEK	SURVEY DAYS	LIVE FISH	CARCASSES	REDDS		TOTAL REDDS
				NAT	ART	
Cedar	4	42	5	25	2	27
HL Extended	3	32	12	3	27	30
HL Index	4	25	7	8	7	15

1992

CREEK	SURVEY DAYS	LIVE FISH	CARCASSES	REDDS		TOTAL REDDS
				NAT	ART	
Cedar	4	56	14	54	11	65
HL Extended	8	21	5	16	40	56
HL Index	8	91	2	51	27	78

1993

CREEK	SURVEY DAYS	LIVE FISH	CARCASSES	REDDS		TOTAL REDDS
				NAT	ART	
Cedar	9	22	2	16	7	23
HL Extended	6	19	3	20	9	29
HL Index	8	32	9	14	14	28

1994

CREEK	SURVEY DAYS	LIVE FISH	CARCASSES	REDDS		TOTAL REDDS
				NAT	ART	
Cedar	10	28	8	11	3	14
HL Extended	9	70	21	23	16	39
HL Index	8	117	27	12	38	50

1995

CREEK	SURVEY DAYS	LIVE FISH	CARCASSES	REDDS		TOTAL REDDS
				NAT	ART	
Cedar	6	99	5	35	8	43
HL Extended	6	128	15	11	34	45
HL Index	5	176	9	45	22	67

1996

CREEK	SURVEY DAYS	LIVE FISH	CARCASSES	REDDS		TOTAL REDDS
				NAT	ART	
Cedar	7	131	14	70	29	99
HL Extended	6	57	27	9	47	56
HL Index	8	197	17	44	64	108

1997

CREEK	SURVEY DAYS	LIVE FISH	CARCASSES	REDDS		TOTAL REDDS
				NAT	ART	
Cedar	10	336	138	235	16	251
HL Extended	10	29	8	22	11	33
HL Index	10	129	82	70/1*	26	96/1*

*Coho salmon

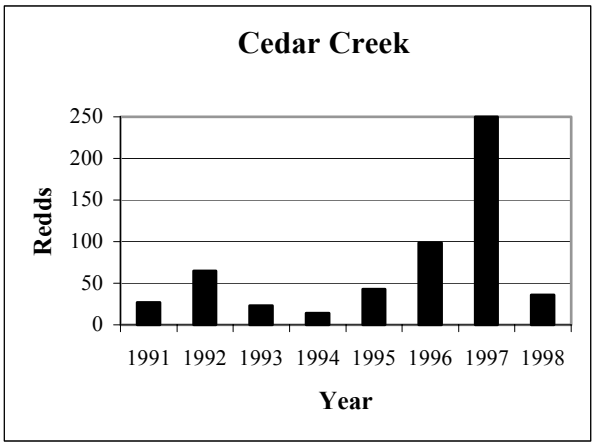
1998

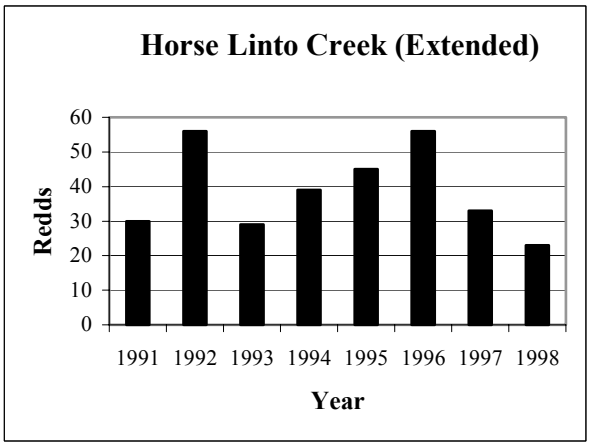
CREEK	SURVEY DAYS	LIVE FISH	CARCASSES	REDDS		TOTAL REDDS
				NAT	ART	
Cedar	7	57/2*	20	32/2*	4/2*	36/4*
HL Extended	8	28	13	18	5	23
HL Index	8	28	4	22	8	30

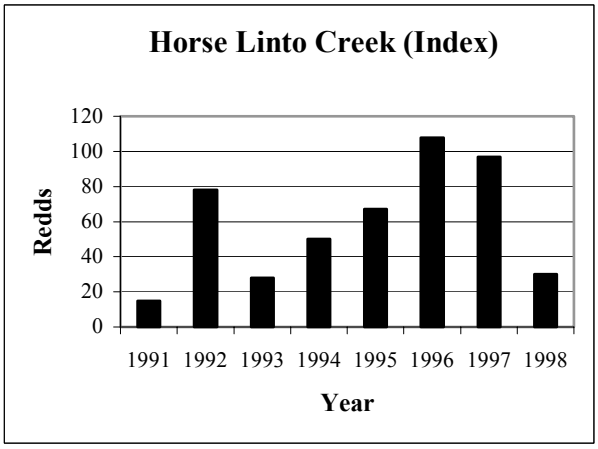
*Coho salmon

Appendix C

Redd Totals per Creek from 1991 to 1998 for the Lower Trinity Ranger District







1999 DOWNSTREAM (DSM) TRAPPING REPORT

LOWER TRINITY RANGER DISTRICT
SIX RIVERS NATIONAL FOREST
Horse Linto Creek Watershed

Prepared By: Cindy A. Walker, USFS

DSM Trapping Executive Summary

The downstream migrant trap was installed in Horse Linto Creek and operating by March 23, 1999. This is the fifth year of DSM rotary screw trapping in Horse Linto Creek. Fish were counted from March 24, 1999 through August 9, 1999.

A total of 12,165 chinook salmon (*Oncorhynchus tshawytscha*), 1 coho salmon (*O. kisutch*) and 12,470 steelhead (*O. mykiss*) were captured and counted. 11,990 steelhead were YOY (young of the year), and 480 steelhead were 1+ (one year old or older). The overall catch per unit effort, or CPUE (number of fish captured per trapping day) was 102.23 for chinook, and 104.79 for steelhead. Other fish species caught in the trap were 379 dace (*Rhinichthys spp.*), 83 sculpin (*Cottus spp.*), 30 lamprey (*Entosphenus spp.*) and 5 suckers (*Catostomus spp.*).

The expanded population estimates of total outmigration during the period of trapping for chinook salmon was 51,602. This is the largest number of outmigrants estimated per year in this decade. Our trap efficiencies have only varied within a few percentage points in the five different years that we marked and recaptured. Chinook outmigration peaked in late June this year. It should be noted that we caught 473 chinook from August 1 to August 9, 1999; the trap was not closed due to lack of fish, but rather to get the report completed.

There was insufficient data to make population estimates for steelhead. This year, the spring/summer peak emigration of 1+ steelhead occurred in May. An unknown number of 1+ steelhead emigrated in the winter, when we were unable to trap. We plan to install the trap by the end of March to best monitor the 1+ steelhead and YOY chinook in 2000.

Introduction

In 1999, a downstream migrant fish trap was placed in Horse Linto Creek for the ninth consecutive year in order to monitor the out migration of juvenile salmon and steelhead. In 1991 through 1993 pipe traps had been used to monitor fish migration on Horse Linto Creek. In 1994 through 1999, a rotary screw trap was used. The downstream migrant trap was installed in Horse Linto Creek and operating by March 23, 1999. Fish were counted from March 24, 1999 through August 13 1999, for a total of 113 trapping days. There were two rotary screw traps operated this year, one in Horse Linto Creek and the other in Willow Creek.

Horse Linto Creek is a tributary of the Trinity River located in Humboldt County, California. Horse Linto Creek drains approximately 186 square kilometers of the Klamath Mountains. The creek originates at an elevation of 1660 meters and travels in a southerly direction for approximately eight kilometers, then turns west for about 24 kilometers and meets the Trinity River at an elevation of 120 meters. Cedar Creek is Horse Linto's largest anadromous tributary.

Since 1978, a considerable amount of restoration work has been completed within the Horse Linto Creek basin. More than 200 instream habitat improvement structures have been constructed to create spawning and rearing habitat for salmonids, as well as stabilization of a large landslide to reduce sedimentation. From 1985 through 1994, a fall chinook salmon hatchery was in operation on Horse Linto Creek as a cooperative effort between California Department of Fish and Game (CDF&G), Pacific Coast Federation of Fishermen's Association (PCFFA) and Six Rivers National Forest (SRNF). The last release of chinook salmon by the hatchery was in 1994. The Age-5 fish from that release returned the fall and winter of 1998. The hatchery has been discontinued in order to evaluate the long-term benefit to the natural population. More than $1,000,000 has been invested in instream and upslope restoration projects within the Horse Linto Creek basin. In 1987, a basin-wide habitat classification and fish abundance survey was conducted.

During the past eight field seasons, 1991 through 1998, regular weekly surveys were conducted within Horse Linto Creek index reaches to gather information on adult chinook returns and redds, and annual reports were prepared. These surveys were conducted when the stream flows were at levels that the surveyors could cross the creek, and when the water was clear enough to see the redds. When flows were too high, or rain made water too cloudy, surveys were not done. For further information on studies and restoration work conducted on Horse Linto Creek see the 1991 stream report (Fuller 1991).

This study of juvenile migration was conducted to provide an annual index of the production of chinook salmon, coho salmon and steelhead. In addition, it provides an indication of the effectiveness of the previously noted habitat improvement work and hatchery supplementation.

Materials and Methods

A rotary screw fish trap manufactured by E. G. Solutions, Inc. was used in 1999. The trap is powered by water entering a 1.5-meter diameter cone. Moving water enters the perforated cone and impinges upon an internal auger screw assembly causing the cone to turn. Fish entering the cone are forced into and retained in a live box. Mop heads are used in the live well to provide escape for smaller fish. The trap was emptied daily when it was in use. The cone was elevated out of the water by a winch when it was not in use.

When comparing data with downstream migrant traps on the Klamath and Trinity River, as well as previous years in Horse Linto, there have been significant numbers of fish moving downstream in March and April (Craig 1990). We have set a goal for getting the trap in the water in March and to be trapping by April 1st. This year

we were able to achieve our goal. We feel that we were trapping when the majority of the fish were migrating this year.

The coordinates of the trap site are T7N, R5E, Section 4. The trap can be accessed from the town of Willow Creek by taking Country Club Road north and turning left on Patterson Road. Take road 8N03 to the Horse Linto Creek Campground. The trap site is at the Horse Linto campground, approximately 210 meters downstream from the Cedar Creek confluence and approximately 1650 meters upstream of the Horse Linto confluence with the Trinity River (Figure 1). The trap was placed in the thalweg of the creek, except when high flows prevented it.

Fish were counted seven days a week when the weather permitted, and personnel were available to operate the trap. We closed the trap in windy and stormy conditions or on weekends when no personnel were available. The trap was closed for six days in April, five days in May, one day in June, five days in July, and one day in August, for a total of 18 days during the trapping period. See the comments section of the Appendices for days when the trap was closed.

When large numbers of fish were present, species would be grouped into size classes by species. The size classifications of fork lengths of fish started at 25-40 mm, then were recorded in increments of 10 mm, e.g., 41-50, 51-60, and 61-70 etc., up to >160 mm. When there were more than 10 fish of the same species and size, they would be scooped into a pan and a subset measured. For example, 10 fish estimated to be in the 25-40 mm class size would be grouped together and two of them measured. The data collector would then enter 10 fish in the 25-40 mm class. All of the fish with fork lengths greater than 100 mm were measured individually.

The fish were immediately returned to the creek unless they were to be used for mark and recapture efforts to measure for trap efficiency. Over 90% of the recaptured fish were caught the following day. A few more would trickle in the second day, and rarely one or two the third day. Fish used to test trapping efficiency were taken approximately 400 meters upstream in buckets and dyed with Bismark Brown Y dye. Two grams of dye were used per 25 gallons of water. The dye was effective for a maximum or three or four days. Fish were placed in the dye solution for approximately 20 minutes, and then they were counted and released. The dyed fish that were recaptured in the trap were used for gauging the efficiency of the trap. Trap efficiency was calculated as the percentage of the dyed fish that were trapped again.

For the days during which the trap was closed, an estimated capture was calculated by averaging the previous four days' catch, or the following four days' catch. These numbers were added to the totals of fish actually caught to estimate the total migration out of the stream during the trapping period. To determine the expanded population estimate, we took the total chinook caught that week, and added in the estimated capture for the days the trap was closed; that number was divided by the trap efficiency determined for that time period (Table 1). Nine tests were done with chinook to determine the trap efficiencies (Table 2). Trap efficiency test results varied slightly throughout the season, yielding a mean of 35.52%, with a standard error of 4.68 for chinook. Previous years' mean trap efficiencies have been similar, all within a few percentage points (Table 3).

We had insufficient data to try to estimate an expanded population of 1+ steelhead. Separating juvenile steelhead into 1+ (one year old and older) and 2+ (two years old and older) classes was problematic due to differential growth rates, so it was not attempted. However, separating YOYs (young of the year) from 1+ was relatively easy. Steelhead with fork lengths 51 mm and longer were called 1+ in March through June 5. Steelhead with fork lengths 61 mm and longer were called 1+ from June 6 through June 19. Steelhead with fork lengths 71 mm and longer were called 1+ from June 20 through July 3. From July 4 on, only steelhead with fork lengths 81 mm and longer were called 1+.

Results

Chinook

A total of 12,165 chinook were caught during the 1999 trapping season. When we added the estimated the number of fish that might have been caught on the days the trap was closed we came up with 13,868 chinook during the trapping season. Using the trap efficiency data, and estimated captures for when the trap was closed, we estimated that 51,602 chinook salmon outmigrated during the trapping period. The catch per unit effort or CPUE (number of fish captured per trapping day), for the season was 102.23 chinook per day. The weekly peak (week when the most chinook were caught in the trap) occurred during the week of June 20 through June 26 (Figure 2). A total of 1735 chinook were caught during that week. The CPUE for that week was 247.86 fish. The highest numbers of chinook caught on any one day was June 25, when 372 chinook were caught in the trap.

Chinook fork lengths were separated into size classes and graphed to demonstrate how the frequency of each size class shifted throughout the season (Figures 3-8). During the months of April, and May, the dominant size class was <40 mm. In June, the 41-50 mm size class chinook were the most frequently caught. By July, the most frequently captured size class was the 51-60 mm size. In August, the dominant size class was 71-80 mm chinook. Chinook trap mortalities were low, at less than 1% for the entire trapping period.

Steelhead

A total of 12,470 steelhead were captured in the trap. Of those, 480 steelhead were in the 1+ age class, and 11,990 were in the 0 age class. The CPUE for the season was 104.79 steelhead per day. The weekly peak occurred during the week of August 1 through August 7 (Figure 9). 3007 steelhead were caught in the trap that week. The CPUE for that week was 429.57 steelhead per day. The highest numbers of steelhead caught on any one day was August 7, when 1232 steelhead were caught in the trap. Of those caught during the peak week, 555 steelhead were in the 25-40 mm size class fresh out of the gravel. The weekly peak for 1+ steelhead occurred during the week of May 16 through May 22 (Figure 10). A total of 82 1+ steelhead were caught in that week. The CPUE for the 1+ class was 4.3 steelhead per day.

Steelhead fork lengths were separated into size classes and graphed to demonstrate how the frequency of fish found in each size class shifted throughout the season (Figures 11-16). In March, 81 - 90 mm steelhead were the most frequently caught. In April, 71 – 80 mm steelhead were the most frequently caught. In May, June

and July, 25-40 mm young of the year steelhead emerging from the gravel were the most dominant size class. In August, 41-50 mm steelhead were the most dominant size class. Reported trap mortalities were low, averaging less than 1% for steelhead during the entire trapping period.

Coho

One YOY coho salmon was caught this year in the Horse Linto Creek trap. Horse Linto habitat should well support coho growing to their normal yearling outmigration size. Unfortunately coho yearling outmigration is expected to be about complete by the time we start trapping.

Miscellaneous Fish

Total numbers of non-salmonid fish caught included 379 dace, 83 sculpin, 30 pacific lamprey, and 5 suckers.

More chinook and steelhead were trapped this season in Horse Linto Creek than in any previous year. The CPUE for Chinook and steelhead were also higher than in previous years. (Table 4).

Discussion

The purpose of the downstream migrant traps is to monitor the effectiveness of the Horse Linto Creek Hatchery and stream restoration projects in increasing salmon production and to allow the comparison of the relationship between redd counts, downstream migrant production, and subsequent adult return. The trapping should be a long-term program in order to compare annual variation in production. It should be noted that the trapping location is at the juncture of the Horse Linto Index and Extended reaches, so that YOYs produced in the Extended reach (from the Horse Linto hatchery to the Trinity River) will not be trapped. Comparisons between numbers of redds and resultant YOY salmon production should focus on redds in Cedar and Horse Linto Index reaches.

As can be seen when comparing Table 4 and Table 5, increases in chinook redds do not always result in increases in downstream migrant Chinook, and conversely, lower numbers of redds counted do not mean that there will be fewer fish in the trap the following year. Redds counted in 1998-1999 spawning season were lower than the previous five years, and yet fish caught in the trap was higher than ever. See Table 5 for the increase in CPUE in the 1999 trapping season.

Many different factors could be responsible for high survivorship in relation to the redds that were counted. There was a noticeably high percentage of five year old chinook spawning this year; bigger and older females have more eggs. Some redds were certainly missed as they are every year due to high flows, turbidity, and the fact that we only survey a subset of the watershed. Another possible explanation is that a number of fish spawned after our surveys ended; we did observe that chinook spawning in several other watersheds including Horse Linto continued into late January. This thought is consistent with the fact that we saw many late-emerging fry in Horse Linto.

However, we believe that probably the most significant reason that numbers of outmigrants in Horse Linto have varied annually, has been in response to egg to alevin

survival. Several factors may have resulted in better egg to alevin survival. Spawning began later than usual in Horse Linto Creek, basically after the stream flow rose, so redds were generally constructed in better (safer from erosive flooding) locations than many redds were in previous years. Large woody debris enhancement projects in Horse Linto Creek have increased stream complexity and improved spawning. Storm events from 1998 to 1999 in Horse Linto Creek did not seem to create as much stream scour in 1998 to 1999 as we have seen in recent years. The weekly peak outmigration came late this year. Late spawning and late emergence might have been advantageous to survival. The stream flows were down in June by the time our peak emigration out of the stream came. DSM trapping appears to be the best way to get an index of the actual results from the prior years spawning.

We want to stress that our 1+ steelhead data is a production index, rather than a population estimate, since we only trap in spring and summer. Recently emerged steelhead fry that are trapped are most likely just moving downstream in search of a territory in the creek. Those fry that are displaced to the river are likely to have very poor survival to adulthood. For this reason the only meaningful index for steelhead production is the 1+ and older age class.

Our DSM data on 1+ steelhead should only be used as a comparative annual index, but our YOY data appears to give a good indication of how well seeded the stream is in a given year. Table 3 shows the variability in steelhead caught from 1994 to 1999. It appears that 1999 found Horse Linto exceptionally well seeded with YOYs, but the 1999 index of 480 1+ steelhead was below the average of 599 1+ steelhead from the previous 5 years.

Based on the last few years' data, generally not enough 1+ steelhead were trapped weekly to conduct mark and recapture efforts. For this reason, trap efficiency tests for 1+ steelhead cannot be performed over the whole season.

Minimizing detrimental effects to fish while DSM trapping requires that the crew pays special attention to the weather. When storms cause water levels to rise quickly, large amounts of detritus are picked up and sucked into the trap at a much faster rate than the debris screen on the back is capable of removing it. Size of debris is an issue as well, since the debris screen will only carry away leaves and small woody debris. Large debris can build up and crush the fish in the live box. Sticks and debris that accompany a sudden high water event can pile up in the cone and clog the entrance. Windy conditions have also caused large amounts of wood to be blown down into the stream and carried into the trap. This can also cause the live box or the cone to fill up with debris and kill fish. We continue to monitor the weather and to anticipate when the wind or storms will cause the trap to become inundated with debris, and close the trap.

Recommendations

Install the trap as early as possible. Ideally the trap should be installed by the end of March with trapping beginning as soon as stream flows will permit. When storm events occur during the trapping season, the trap should be monitored carefully and the cone should be elevated out of the water when the stream carries more debris than the trap screen can remove. Windy conditions should also be monitored, and the trap closed if large amounts of debris are moving into the creek. Mark and recapture

efficiency tests need to be conducted frequently, once a week if numbers of fish are available. Future mark and recapture efforts should focus on chinook in the future unless sufficient numbers of 1+ and older steelhead are trapped. We plan to mark 1+ steelhead early in the year, and YOY chinook after they're 50+mm (probably in late May).