California Hatchery Review Project

Appendix VIII

Trinity River Hatchery Fall Chinook Program Report

June 2012

Introductory Statement from the California Hatchery Scientific Review Group

This program report was developed by contractor staff tasked with providing background information to the California Hatchery Scientific Review Group (HSRG) on hatchery programs, natural population status and fisheries goals in California. The resulting report is one of many sources of information used by the California HSRG in their review process.

Information provided in this program report was developed through interviews with hatchery staff, and regional, state and tribal biologists working in the basins, and a review and summarization of the pertinent scientific literature. The draft program report was then provided to interview participants for review and comment on multiple occasions. Comments received were incorporated into the report and the report was finalized.

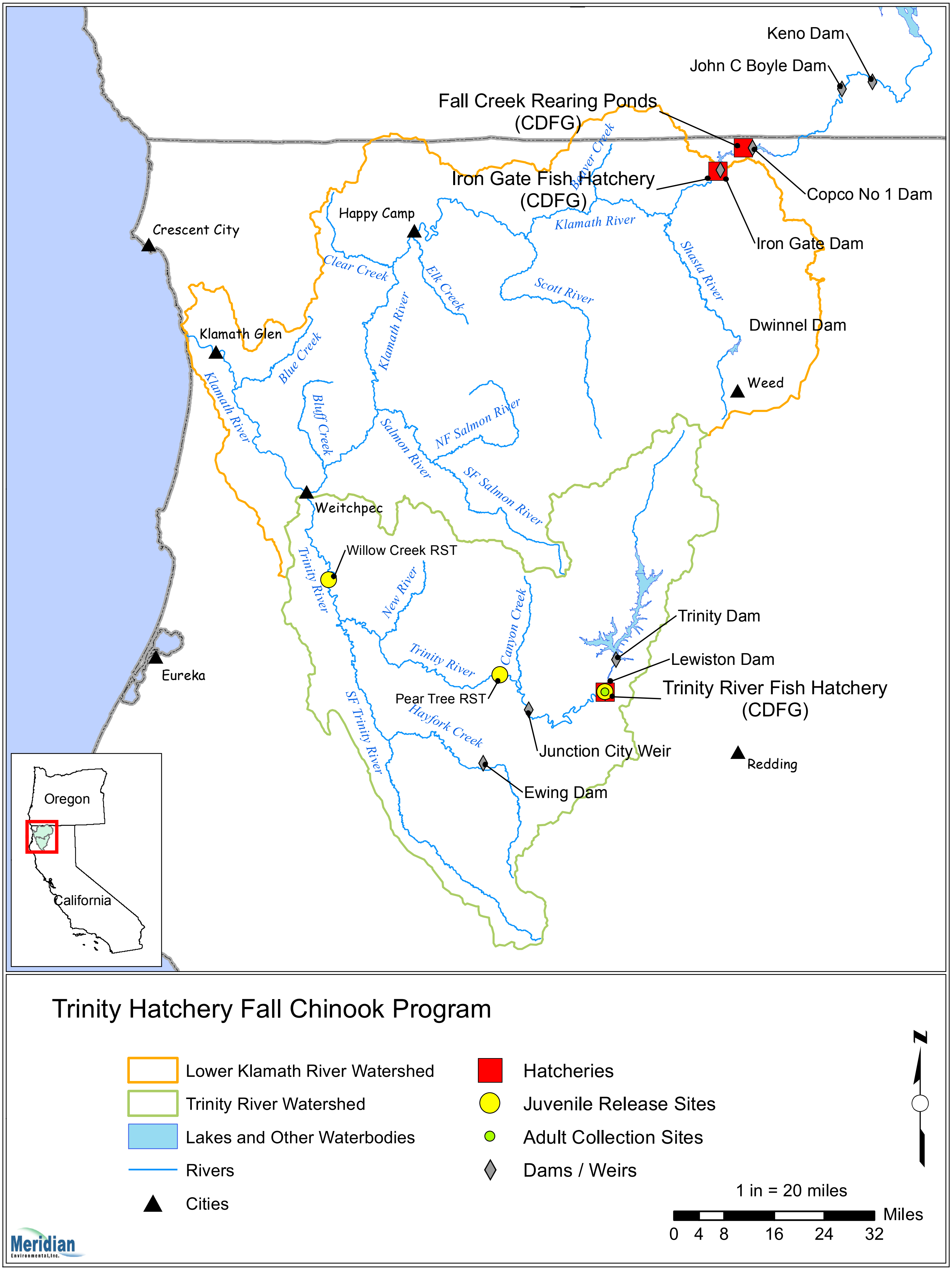
Because of the review process, it is believed the report represents an accurate snapshot in time of hatchery operations, natural salmon population status and fisheries goals in California as of 2012. This program report may or may not be consistent with the consensus positions of the California HSRG expressed in the main report, as their primary involvement was in the preparation of Section 4.3, "Programmatic Strategies", which compares existing program practices to the statewide Standards and Guidelines developed by the California HSRG.

Table of Contents

List of Figures

List of Tables

Appendices


Keno Dam
John C Boyle Dam
Fall Creek Rearing Ponds
(CDFG)
Beaver Creek
Iron Gate Fish Hatchery
(CDFG)
Copco No 1 Dam
Iron Gate Dam
Happy Camp
Crescent City
Klamath River
Clear Creek
Elk Creek
Scott River
Shasta River
Dwinnel Dam
Klamath Glen
Blue Creek
Klamath River
Weed
Klamath River
Bluff Creek
NF Salmon River
Salmon River
SF Salmon River
Weitchpec
Willow Creek RST
Trinity River
New River
Canyon Creek
Trinity Dam
Lewiston Dam
Trinity River Fish Hatchery
(CDFG)
Eureka
Trinity River
Pear Tree RST
Hayfork Creek
SF Trinity River
Junction City Weir
Redding
Ewing Dam
Oregon
California
Trinity Hatchery Fall Chinook Program
Lower Klamath River Watershed
Trinity River Watershed
Lakes and Other Waterbodies
Rivers
Cities
Hatcheries
Juvenile Release Sites
Adult Collection Sites
Dams / Weirs
N
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1 Description of Current Hatchery Program

The Trinity River Division of the Central Valley Project in California included construction of the Trinity and Lewiston dams that divert a substantial portion of the river's flow to the Central Valley of California for agricultural, and municipal and industrial uses. Lewiston Dam, completed in 1963, is the upstream limit of anadromy, blocking access to 109 miles of salmon and trout spawning and rearing habitat in the upper river (including most of the spring Chinook habitat). The Trinity River Hatchery (TRH) was constructed at the base of Lewiston Dam to mitigate for the loss of anadromous fish habitat. The TRH is located at river mile (RM) 110 near the town of Lewiston in Trinity County.

The Bureau of Reclamation, Northern California Area Office, funds operation and maintenance of the TRH by the California Department of Fish and Game (CDFG). Typical hatchery operations and maintenance costs (excluding fish food) are approximately $887,000 (based on 2007 data). The TRH crew consists of six fish and wildlife technicians, two managers, two fish and wildlife seasonal aides, and one half-time secretary.

The fall Chinook program has a release goal of 2 million smolts and 900,000 yearlings.

1.1 Programmatic Components

Trinity River Hatchery spring Chinook salmon broodstock originated from an in-river weir when hatchery operations began in 1964. No eggs or fish have been used to supplement this program in at least the last 10 years.

Mitigation goals for lost adult production were determined from pre-project studies of anadromous fish populations in the basin. The USFWS and CDFG (1956) estimated that 3,000 spring, 8,000 summer, and 24,000 fall Chinook; 10,000 steelhead (no run timing was designated); and 5,000 coho passed above the Lewiston Dam site.

Total annual adult production goals (catch plus escapement) for the Trinity River Hatchery were further defined in 1980 to be 6,000 spring Chinook, 70,000 fall Chinook, 7,500 coho and 22,000 steelhead (Frederickson et al. 1980). Escapement goals to the hatchery were described in 1983 as 3,000 spring Chinook, 9,000 fall Chinook, 2,100 coho and 10,000 steelhead (USFWS 1983). These production goals are based on the number of juveniles released, not adult returns.

1.1.1 Post-release Survival

For Brood Years 2000-2003, total survival (catch in all fisheries plus escapement) ranged from 0.03 to 0.98% (averaging 0.40%) for smolts, and 0.32 to 2.79% (averaging 1.65%) for yearling releases (Table 1). Since 2000, brood year survival rates have generally decreased.

Smolt-to-adult return (SAR) rates for fall Chinook released from TRH between 1986 and 2003 are presented in Table 2 (based on returns to areas above the Willow Creek weir, but not including ocean catch and in-river harvest below the weir). Yearling releases have an average survival rate that is just over five times greater than that of smolt releases (0.32 percent vs. 1.61 percent).

Table 1. Total percent survival (catch plus escapement) and average exploitation rate for TRH fall Chinook 2000-2003 brood years (including all age classes of recoveries).

Brood Year	Smolts[1]	Yearlings
2000	0.98	2.79
2001	0.11	2.59
2002	0.49	0.96
2003	0.03	0.32
Average	0.40	1.67
Average Total Exploitation Rate	35.0%	56.4%

[1] Some years' data are averages of multiple tag codes

1.1.2 Adult Returns

Trinity River Hatchery fall Chinook adult returns can be estimated by multiplying the average SAR for each release by the average number of fish released. Using the average SAR for the smolt release (Table 1) and the average smolt release numbers (from Table 5) provides an estimate of 6,499 fall Chinook (29% of the total adult return) from the smolt release. Using the data for the yearlings in the same manner, an estimated 15,461 fall Chinook (71% of the total adult return) would be expected to be produced (totaling 21,960 adults). While there is considerable annual variation in SARs for both smolt and yearling releases, and an average of more recent years would have higher SARs than the long-term average, this value compares reasonably well with the estimate of 25,923 of TRH fall Chinook from Table 3.

In a review of Iron Gate Hatchery (IGH) and Trinity River Chinook releases, Hankin and Logan (2010) concluded that the release of Chinook at a larger size at a later month leads to substantially improved survival to age 2, reduced size at ages 2 and 3, reduced maturation probabilities at these same ages and reduced age 3 ocean fishery exploitation rates.

1.1.3 Fishery Contributions

Both natural-origin (NOR) and hatchery-origin (HOR) fall Chinook contribute to sport and Tribal harvest in the Trinity River. For the years 2000-2008, anglers harvested an average of 1,008 fall Chinook from the area above the Junction City weir (Table 3). The harvest of TRH fall Chinook is believed to be in proportion to its contribution to the total run. TRH fall Chinook contributed significantly to an intense commercial troll and sport fishery off California. For brood years 2000-2003, the average total exploitation rate was 35.0% and 56.4% for smolts and yearling releases respectively (Table 1).

Table 2. Percent returns of Trinity River Hatchery fall Chinook from brood years 1986-2003.[1]

Brood Year	Smolts Released			Yearlings Released		
	Number released	Number of Returns	Percent Return	Number released	Number of Returns	Percent Return
1986	393,955	292	0.074	153,700	4,899	3.187
1987	172,980	129	0.075	92,300	418	0.453
1988	194,197	138	0.001	143,934	796	0.553
1989	201,622	21	0.010	143,978	174	0.121
1990				103,040	166	0.161
1991	206,416	937	0.454	115,300	517	0.448
1992	192,032	2,503	0.013	108,894	5,369	4.930
1993	201,032	158	0.001	110,336	798	0.723
1994	216,563	374	0.173	113,124	756	0.668
1995	216,051	285	0.132	110,327	3,106	2.815
1996	217,981	445	0.204	112,746	394	0.349
1997	216,772	1,707	0.787	313,080	11,396	3.640
1998	184,781	292	0.158	334,726	7,173	2.143
1999	181,301	693	0.382	296,892	5,833	1.965
2000	522,316	3,909	0.748	216,593	5,245	2.422
2001	499,919	476	0.095	230,055	5,894	2.562
2002	508,963	3,563	0.700	236,319	3,561	1.507
2003	534,219	289	0.054	225,798	944	0.418
Mean	285,947	954	0.320	175,619	3,191	1.610

[1] Based on estimated returns upstream of Willow Creek weir. Does not include ocean harvest or in-river harvest below Willow Creek weir.
Source: Sinnen et al. 2010

1.1.4 Stray Rates

Between 2000 and 2008, the proportion of hatchery-origin fish spawning naturally (pHOS) upstream of the Junction City weir (JCW) was 46%. In other words, hatchery-origin fish made up 46% of the total natural spawning population (NOR + HOR) in this portion of the river. PHOS ranged from a low of 0.20 in 2002 and 2007 to a high of 0.86 in 2004. (Table 3)

Table 3. Estimated contributions of Trinity River Hatchery-produced fall-run Chinook salmon to total estimated run-size and spawners in natural areas.

Year	Run-Size	TRH Component	Natural Component	Percent TRH Composition	Harvest[a]	TRH Returns[b]	Hatchery-Origin Spawners[c]	Natural-Origin Spawners[d]	Proportion of Hatchery-Origin Spawners (pHOS)
2000	55,473	38,881	46,592	70.1%	1,412	27,046	13,555	13,460	0.50
2001	57,109	33,984	23,125	59.5%	1,772	18,175	16,568	20,594	0.45
2002	18,156	6,884	11,272	37.9%	559	4,553	2,572	10,472	0.20
2003	64,362	52,944	11,418	82.3%	1,867	30,386	24,086	8,023	0.75
2004	29,534	25,956	3,578	87.9%	381	13,443	13,527	2,183	0.86
2005	28,231	19,674	8,557	69.7%	856	13,806	6,655	6,914	0.49
2006	34,912	21,768	13,144	62.4%	ND	11,994	10,990	11,928	0.48
2007	58,873	24,633	34,240	41.8%	939	18,114	7,914	31,906	0.20
2008	22,997	8,585	14,412	37.3%	281	5,252	3,746	13,718	0.21
Average	41,072	25,923	18,482	61.0%	1,008	15,863	11,068	13,244	0.46

[a] Assumed equal harvest on hatchery- and natural-origin fish.
[b] Assume 10 percent natural-origin fish used in broodstock.
[c] Hatchery-origin spawners = [(run size – harvest) x (% TRH composition)] – (TRH returns x 0.90)
[d] Natural-origin spawners = [(run size – harvest) x (% natural composition)] – (TRH returns x 0.1)
Source: Sinnen et al. 2010
ND- No data

1.2 Operational Components

Water is supplied to the TRH from Lewiston Reservoir, located approximately 100 feet upstream. Hatchery water is withdrawn from a 12-foot strata between 9 and 20 feet below the surface of the lake in volumes ranging from 20 cubic feet per second (cfs) to 125 cfs depending on hatchery needs at any given time. Temperature control curtains within the lake allow the hatchery to adjust the temperature of water diverted to the hatchery. Flow enters the hatchery by way of an intake structure and an aeration facility capable of processing 130 cfs.

The hatchery building encloses 60 incubator stacks, 148 standard California troughs, and 26 deep tanks. TRH uses all of the incubator stacks during spawning season between the months of October and December. Only 80 of the standard California troughs are in use at any given time. All 26 deep tanks are used.

Exterior facilities at the TRH include 40 concrete raceways, each 10 feet wide by 3.5 feet deep by 200 feet long. Approximately 2.5 cfs is supplied to each raceway for single pass use then discharge. If all the raceways are in use, the total water demand is100 cfs.

1.2.1 Broodstock

All adult collections are taken at the fish ladder and gathering tank (the trap), located directly below Lewiston Dam. Fish arriving at the beginning of the run are typically held for several weeks until the size of the run can be estimated. Limited adult holding space (up to about 1,000 adults) requires fish to either be spawned or killed on any given day. Eggs taken each spawning day are usually from adults removed from the trap that are ready to spawn, known as “trap run”. Operational guidelines for broodstock include a break in trapping and spawning between the spring and fall Chinook spawning periods (the trap is closed). This break lasts about 14 days according the historic spawning period (approximately October 12-25). The hatchery receives coded-wire tag (CWT) information to determine overlap between the two races of Chinook that guides decisions to cull eggs if needed. Following the 14 day closure, the trap is reopened and recruited fish are classified as spring or fall Chinook based on appearance. An average of 2,142 females are spawned each year to allow for culling and to provide juveniles to meet smolt and yearling production goals. A recent history of the number of adults collected and spawned is provided in Table 4.

Table 4. Number of fall Chinook salmon returns to Trinity River Hatchery by sex, age, females spawned, eggs taken, fecundity and egg size for Brood Year (BY) 2000 through BY 2009.

Year	Females	Males	Jacks	Females Spawned	Number of Eggs	Fecundity (# eggs per female)	Egg Size (eggs per oz)
2000	11,676	14,339	1,013	1,983	6,003,740	3,028	90.00
2001	9,093	8,904	703	1,809	5,936,774	3,281	83.00
2002	1,412	2,342	746	1,331	4,597,470	3,454	82.00
2003	14,395	15,443	671	1,996	6,926,371	3,470	76.00
2004	6,139	6,195	1,055	2,067	6,112,168	2,957	96.70
2005	6,463	6,675	242	2,988	5,764,316	2,459	80.40
2006	4,061	4,052	4,128	2,502	7,068,473	2,825	76.90
2007	9,543	8,537	34	2,474	6,549,618	2,647	88.70
2008	2,584	1,901	750	2,026	5,873,110	2,899	72.60
2009	3,338	4,066	155	2,241	6,495,999	2,898	96.20
Average	6,870	7,245	950	2,142	6,132,804	2,992	84.25

Source: Trinity River Hatchery Annual Reports 2000-2010 cited as Marshall and as Ramsden.

1.2.2 Spawning

The spawning matrix is made up of a random selection of ripe fish that either enter the facility ripe or are held until they are ripe. Spawning is conducted by pooling gametes from 6 males and 4-5 females in a common container. No jacks are used in spawning. It is estimated that 10% natural-origin fish are incorporated into the broodstock annually, ranging from 5 to 15%. This is based on CWT recoveries and expansions of marked fish. Fish in excess of estimates derived by CWT expansion are presumed to have been natural-origin fish. Only CWT tagged fish can be positively identified as hatchery origin.

1.2.3 Incubation

Temperature monitoring occurs daily. Water temperatures for incubation are kept between 46 and 54° Fahrenheit based on inflows from Lewiston Lake. Gravity-fed Lewiston lake water is supersaturated with dissolved oxygen, and, thus, no monitoring occurs on a daily basis. Inflow silt is minimal, and no other parameters are regularly monitored as inflow water quality is excellent. Eggs are incubated at a rate of approximately 10,000 eggs per incubator tray without substrate.

Eggs are culled to the level needed for production during the "eyed" stage after removal of unfertilized or dead eggs. Culling is required to reduce total egg numbers to be representative of spawn timing. Culling based on level of Bacterial Kidney Disease (BKD) in the parents is not done for fall Chinook. CWT analysis may provide a basis for culling incidental crosses between tagged spring and fall Chinook.

1.2.4 Rearing

All fall Chinook are ponded at swim-up stage (based on visual inspection). Ponding is not volitional; fry are ponded directly to outdoor ponds. Winter water temperatures vary from year to year and may affect exact dates of ponding. Cumulative temperature units are not calculated at the TRH.

An estimated 3.0 million fall Chinook fry are ponded annually (the program goal). Both smolt and yearling release groups are initially ponded together as part of the general population. Twenty-five percent of the population receives a CWT. Prior to CWT tagging, a group of 990,000 fish is selected, segregated from the general population, and held until the fall to be released as yearlings. Yearling production is taken from the middle of the spawn timing curve (peak) and does not represent the very early or very late egg take timing. This selection method has occurred for three years. The prior practice was to select yearlings from the latest egg takes of the fall Chinook, which resulted in a run-timing shift to later in the year.

A recent history of the number of eggs, fry and fish released is provided in Table 5.

Table 5. Number of fall Chinook eggs taken, fry ponded, and fish released from Trinity River Hatchery (BY 2005-2009).

Brood Year [a]	Eggs Taken [a]	Number Eyed [a]	Fert % [a]	Eggs Culled [a]	Number at Hatch [a]	Number Fry Ponded [a,b]	Eyed Egg to Fry Ponded Survival	Total Fish Released [c,d]	Fry Ponding to Smolt Release Survival [e]	Eyed Egg to Release Survival
2005	5,764,316	3,085,768			3,019,382	3,019,382	98%	3,064,593	101%	99%
2006	7,068,450	3,969,340	85.00%	4,491,630	3,007,930	3,003,500	76%	2,986,572	99%	75%
2007	6,549,618	3,753,980	85.40%	2,908,308	3,001,630	3,001,600	80%	2,641,049	88%	70%
2008	5,873,090	3,356,490	82.80%	2,174,500	3,003,490	3,001,900	89%	3,063,237	102%	91%
2009	6,495,999	3,620,373	95.80%	3,283,400	3,053,019	3,053,015				

[a] Numbers provided by TRH staff.
[b] This is a calculated estimate based on the average size counts of eggs and the number of eggs in ounces measured into each incubator tray after the final pick.
[c] The total number of fish released is obtained by inventorying the fish during the tagging process, conducted by the Hoopa Valley Tribal Fisheries marking crews. These are considered to be the final numbers released after observed mortalities are subtracted.
[d] Calculated from Trinity River Hatchery Annual Reports.
[e] Some numbers may appear incorrect due to the estimation of the Number of Fry Ponded versus the inventory of Total Fish Released.

Fish are reared to achieve a target size of 90 fish per pound (fpp) for smolts and 10 fpp for yearlings (fall release). Feed conversions for individual raceways are not calculated. Generally, fry-to-smolt survival is high (>90 percent), but it is not possible to separate out the effects of the yearling component on total fry to release survival (yearlings suffer higher mortality due to predation) (Table 5).

California hatcheries use biweekly standard weight counts (defined by fpp) to determine growth rate and prevent overcrowding. The hatchery tracks average weight, in conjunction with mortality counts, by species for each pond series. Fish are dispersed into more ponds as necessary to prevent exceeding pond density limits and to meet release standards. The TRH sets maximum rearing pond densities at one pound fish per cubic foot of raceway area.

1.2.5 Release

Fall Chinook smolts (subyearlings) are released between June 1 and 15 and yearlings are released between October 1 and 15. These dates are intended to reduce competition with natural juveniles. A period of volitional outmigration is provided. The average size of fish released has been 108 and 15 fpp for smolts and yearlings, respectively. These number show that the program is not achieving the target release size of 90 fpp and 10 fpp for smolts and yearlings, respectively.

The release goal for the program is 2 million smolts and 900,000 yearling fall Chinook. Data in Table 6 show that on average the fish release goals are achieved. Small groups of fish are released off-station near the Willow Creek and North Fork Pear Tree screw traps (on the mainstem Trinity River) to provide juveniles for trap calibration. These release numbers are 85,000 fall Chinook (25% marked) and 50,000 spring Chinook (not marked). This release is expected to continue for the next two years. A recent history of the fish releases is provided in Table 6.

1.2.6 Fish Health Maintenance and Monitoring.

Sanitation procedures are a continuous part of standard hatchery operations. Overall fish health maintenance and sanitation procedures include biweekly pond cleaning to remove accumulated solids and fish wastes to maintain a healthy rearing environment.

Incubation egg control is accomplished through daily iodine flushes until eggs reach hatch stage. Incidence of yolk-sac malfunction is unusual and as such, these occurrences are not recorded in a hatchery database. Egg mortalities are removed by pipette and bulb or by salt immersion when going from green- to eyed-egg stage. Dissolved oxygen, pH, and turbidity are monitored quarterly or as needed. TRH water temperatures range between 46 and 54° Fahrenheit based on Lewiston Lake flows and season. Previous gas-bubble disease problems were resolved by installing a vent on pond inflow pipes.

Fish culturists inventory, rotate, and discard feed to maintain fish health. Pond stocking density is continuously monitored and adjusted to prevent overcrowding. Hatchery personnel generally assess health conditions on a daily basis. If a severe disease outbreak occurs, CDFG pathology staff is available to assist in pathogen identification. Depending on the cause of the outbreak, treatments may vary. Any pathologist-recommended treatments are implemented by TRH personnel. Chemical treatments for external parasites are limited to the use of salt, copper sulphate, and potassium permanganate. Additional treatments for bacterial pathogens may be accomplished by the use of terrimyicin-treated feed. Carcasses from juvenile fish mortalities are minimal and are frozen for disposal at the local landfill.

Fish are sampled prior to release (Pre-release Fish Pathology Reports) for disease certification. A disease diagnostic and health assessment is conducted prior to release to document internal fat levels, condition index, smolt status and measured blood parameters (Rogers and Chapman 1991)

A summary of the recent findings of the pre-release sampling reports for yearling fall Chinook is provided in Table 7.

Table 6. Actual dates, number, and average size of fall Chinook salmon releases from the Trinity River fall Chinook, 2000-2010.

Release Year	Release Date Sub-yearlings	Release Date Yearlings	Release Location	Release Method	Purpose	Total Smolts Released	Average Weight (FPP)	Total Yearlings Released	Average Weight (FPP)	Marks or Tags Applied
2000	--	10/3 to 10/6	TRH	Volitional	Mitigation	--	--	863,267	15.77	25% AD/CWT
2001	6/6 to 6/13	10/4 to 10/10	TRH	Volitional	Mitigation	2,113,804	69.33	872,666	12.70	25% AD/CWT
2002	6/3 to 6/12	10/10 to 10/15	TRH	Volitional	Mitigation	2,084,069	94.33	940,049	13.40	25% AD/CWT
2003	6/3 to 6/9	10/1 to 10/7	TRH	Volitional	Mitigation	2,078,192	88.67	954,286	16.00	25% AD/CWT
2004	6/4 to 6/10	10/1 to 10/7	TRH	Volitional	Mitigation	2,105,708	111.33	908,913	16.00	25% AD/CWT
2005	6/4 to 6/10	10/3 to 10/11	TRH	Volitional	Mitigation	2,006,066	74.75	956,688	14.30	25% AD/CWT
2006	6/1 to 6/7	10/2 to 10/16	TRH	Volitional	Mitigation	2,099,237	122.3	965,356	19.80	25% AD/CWT
2007	6/1 to 6/8	10/1 to 10/17	TRH	Volitional	Mitigation	2,021,056	122	965,516	19.50	25% AD/CWT
2008	6/2 to 6/17	10/1 to 10/16	TRH	Volitional	Mitigation	1,808,904	176.6	832,145	17.20	25% AD/CWT
2009	6/1 to 6/8	10/1 to 10/15	TRH	Volitional	Mitigation	2,018,580	90.6	1,044,657	11.68	25% AD/CWT
2010	6/1 to 6/8	--	TRH	Volitional	Mitigation	1,975,162	128.5	--	--	25% AD/CWT
					Average	2,031,078	107.8	960,354	15.4	

Source: Trinity River Hatchery Annual Reports 2000-2010.

Table 7. Results of fish pathologist reports for Trinity River Hatchery fall Chinook yearling release, 2007-2009. (*additional data requested but not provided*)

Date	Weight (g)	Length (mm)	Hematocrit (%)	Internal Assessment	External Assessment	Pathogens
9/2007	40.7	160.3	43.6	Good	Excellent	None
9/2008	36.8	140.25	48.8	Excellent	Excellent	None
9/2009	48.9	168.3				

2 Populations Affected by the Hatchery Program

NMFS considers fall Chinook salmon present downstream of the Trinity River-Klamath River confluence to belong to the Southern Oregon and Northern California Coastal (SONCC) Chinook salmon ESU. Fall and spring Chinook salmon upstream of the Trinity confluence are both considered to be part of the Upper Klamath-Trinity Rivers Chinook salmon ESU. Neither ESU is currently listed under the ESA. NMFS is currently considering listing Upper Klamath spring Chinook as threatened (decision pending at the time this document was being completed).

Historically, both fall and spring Chinook salmon were abundant in the Klamath-Trinity River basin. Between 1915 and 1928, the total estimated catch and escapement of all Chinook salmon in the Klamath River and its tributaries averaged between 300,000 and 400,000 fish annually. Concern about the depletion of anadromous salmonid resources and associated habitat in the basin emerged around the turn of the 20th Century and has accelerated in recent decades, coincident with expanded logging and fishing operations, construction of dams, road construction, agricultural use, and other development. As in other river systems of the Pacific Northwest, Chinook in the Klamath-Trinity River Basin are susceptible to habitat degradation and over-exploitation, as reflected by declining runs in recent decades. Despite these impacts, Chinook salmon continue to be the most abundant anadromous salmonid species present in the basin and they support important commercial, recreational, and tribal fisheries (NMFS 2010a).

Naturally spawning populations of fall Chinook in Klamath River Basin that may be incidentally affected by the TRH fall Chinook program are delineated as follows for purposes of this report: mainstem Klamath River, Salmon River subbasin, Scott River subbasin, Shasta River subbasin, Bogus Creek subbasin, miscellaneous Klamath River tributaries (above the Yurok Reservation)[1], Yurok Reservation tributaries, mainstem Trinity River[2], miscellaneous Trinity River tributaries (above the Hoopa Reservation)[3], and Hoopa Reservation tributaries[4]. These population groupings are consistent with how data are presented in CDFG's megatable for Klamath River Chinook management. It is important to note that the number of spawners included within each of these population groups are naturally spawning Chinook, which may be of either natural- or hatchery-origin.

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[1] These miscellaneous tributaries are all located upstream of the Klamath-Trinity confluence.
[2] This grouping includes all fish that spawn naturally upstream of the Willow Creek weir (WCW), a monitoring site located at RM 22.6 on the mainstem Trinity River. The group is comprised of fish that spawn in all tributaries and in the mainstem Trinity River upstream of WCW. In addition, the grouping includes fish that spawn in the mainstem Trinity River downstream of WCW.
[3] This grouping is comprised of fish that spawn in tributaries to the Trinity River downstream of the Willow Creek weir (WCW) (RM 22.6) but upstream of the Hoopa Valley Indian Reservation, which is located roughly seven miles downstream of WCW.
[4] This grouping is comprised of fish that spawn in tributaries to the Trinity River on the Hoopa Valley Indian Reservation.

2.1 Current Conditions of Affected Natural Populations

Adult fall Chinook begin entering the Klamath River in July (Barnhart 1994). The run peaks in early September and continues through late October. Spawning normally peaks during mid-October, and is complete by the middle of November. In general, fall Chinook salmon in the upper basin spawn earlier than the lower basin populations. Some late-run fall Chinook have been observed at the mouth of the Scott River as late as mid-December (USFWS 1998).

Time of emergence depends upon the water temperature regime. In the mainstem Klamath River, fry can emerge from early February through early April, but peak times vary from year to year. After they emerge, fry disperse downstream, and many then take up residence in shallow water on the stream edges, often in flooded vegetation, where they may remain for various periods. As they grow larger, they move into faster water. Some fry, however, keep moving after emergence and reach the estuary for rearing (FERC 2007). The majority of the naturally produced fall Chinook in the Klamath-Trinity River Basin spend less than a year in freshwater, a life history strategy that allows them to take advantage of streams in which temperature conditions may become unfavorable by late summer (Moyle 2002).

Adult spawners are primarily age 3 and 4; 5-year-old fish make up a relatively small percentage of the returns. About 5 to 30% of each annual run is comprised of age two fish ("jacks" or "grilse") (Barnhart 1994).

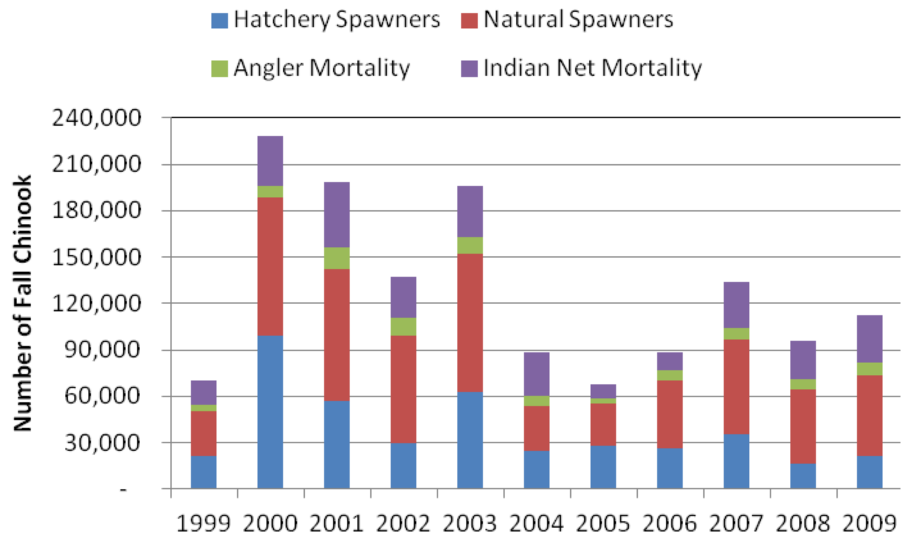
Between 1978 and 2009, the total estimated in-river run of fall Chinook in the Klamath River Basin, including fish produced at the Iron Gate and Trinity hatcheries, averaged 120,910 fish (Figure 1). Approximately 22% of these returned to the hatcheries; the remaining 78% were either natural spawners (including stray fish from hatchery releases) or were harvested (including incidental mortalities) in the in-river tribal and recreational fisheries (CDFG unpublished data 2011). Figure 4 displays total annual in-river run sizes of Klamath Basin fall Chinook, broken out by harvest mortality (both angler and Indian harvest) and spawning escapements for 1999-2009.[5]

Under existing operations, the TRH releases approximately 1 to 3 million juvenile fall Chinook salmon each year. Releases usually occur in late May to early June, with fish reaching the estuary 1 to 2 months later. The annual Trinity River run of up to several thousand adult fall Chinook salmon consists primarily of returning TRH fish (FERC 2007).

Fall Chinook are released from the Trinity River Hatchery at a time when discharge from Iron Gate Dam is in steep decline and water temperatures are rapidly rising, which may create competition between hatchery and natural fish for food and limited resources, especially limited space and resources in thermal refugia. Hatchery operations may have a suppressive effect on naturally produced Chinook salmon through predation and competition, and it should not be assumed that hatchery operations are beneficial to salmonids or to Chinook salmon in particular (NRC 2004, NMFS 2010b). When released into the freshwater, hatchery fish may compete with naturally produced fish for food and habitat (McMichael et al. 1997; Fleming et al. 2000; Kostow et al. 2003; Kostow and Zhou 2006, as cited in NMFS 2010b). The exact effects on naturally produced juvenile Chinook salmon from competition and displacement in the Klamath River are

[5] All run size components are included in the figure, except for the number of fall Chinook estimated to have died during a fish kill in 2002. The fish kill was estimated to be 32,553 (adults and jacks). Source for all run size component values is CDFG megatable.

not known. In addition, it is believed that spring and fall Chinook returning to the Trinity River were once reproductively isolated -- spring-run fish spawned upstream in early fall while fall-run fish spawned further downstream in late fall.



Source: CDFG megatable.
Note: Hatchery spawners are the number of fish that returned to hatcheries. Natural spawners include both hatchery- and natural-origin fish spawning in nature.

Figure 1. Total in-river run sizes (adults and jacks combined) of Klamath River fall Chinook shown broken out into in-river harvest mortality (Angler and Indian Net) and spawning escapement.

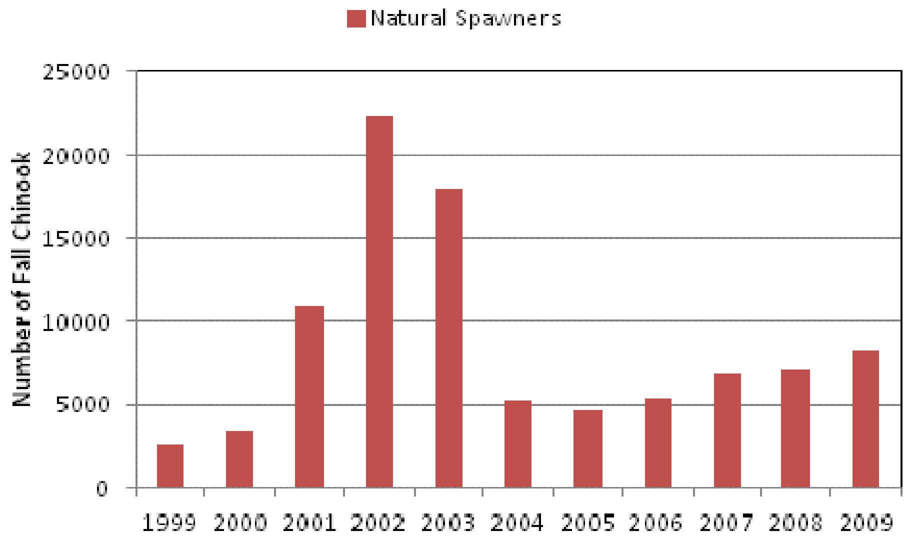
Construction of the Lewiston Dam and the Trinity River Hatchery in 1964 resulted in extensive compression of spawning habitat and the potential for inadvertent interbreeding of the two runs. Recent genetic research conducted by Kinziger et al. (2008) assessed the degree to which spring and fall Chinook salmon returning to Trinity River Hatchery were genetically distinct and determined the extent of hybridization between the runs. Results of their evaluation suggested the occurrence of hybridization between spring and fall Chinook salmon returning to TRH, particularly during the transition or overlap period between fish from the two phenotypic groups. However, the extent to which hybridization was caused by hatchery operations or occurred prior to Lewiston Dam construction was unclear (Kinziger et al. 2008).

2.1.1 Mainstem Klamath River

This population group consists of all naturally spawning Chinook that spawn in the mainstem Klamath River between the head of tidewater to the base of Iron Gate Dam (RM 190). Prior to the development of Iron Gate and Copco dams in the 1900s, this population had access to many more miles of mainstem river habitat; numerous tributaries were also blocked by those dams.

The abundance of naturally spawning fall Chinook in the mainstem Klamath River is highly variable across years. Since 1978, CDFG in cooperation with other entities has monitored fall Chinook spawner abundance within this population group, as well as for the other population groups (CDFG unpublished data). Between 1999 and 2009, mainstem Klamath River spawner abundance of fall Chinook (jacks and adults) has averaged 8,613 fish, ranging from 2,608 in

1999 to 22,308 in 2002 (Figure 2). These spawners were comprised of natural-origin fish as well as stray hatchery-origin fish.



Source: CDFG megatable.
Naturally spawning fish are shown, which include hatchery- and natural-origin fish.

Figure 2. Mainstem Klamath River fall Chinook salmon spawner escapements (adults and jacks combined), 1999 to 2009.

The USFWS conducted a series of fall Chinook carcass surveys in the mainstem Klamath River between Iron Gate Dam and the Shasta River from 2007 through 2010. During this period, surveyors counted an average of 2,381 fall Chinook carcasses annually (Table 8) (USFWS unpublished data). The percent hatchery fish ranged from 17.4% in 2007 to 36.9% in 2010, with a general increase in percent hatchery contribution in recent years (Table 8). Biologists who met in Yreka in February 2011 to provide information for this review stated that available observations suggest that relatively few hatchery-origin Chinook spawn naturally in the mainstem river downstream of the Shasta River. Similarly, few recoveries of marked and tagged Chinook in tributaries downstream of the Shasta River suggest low stray rates into those streams.

Table 8. Estimated contribution of hatchery-origin to naturally spawning abundance of fall Chinook in the mainstem Klamath River between Iron Gate Dam (RM 190) and Shasta River (RM 177).

Year	Total Carcasses Sampled (Hatchery + Wild)	Percent Hatchery	Peterson Estimate (Wild)	Hatchery Estimate
2007	2,991	17.4	5,523	960
2008	2,650	31.7	4,894	1,551
2009	2,572	35.0	4,427	1,549
2010	1,311	36.9	2,572	950
Average	2,381	30.3	4,354	1,253

Note: Only data for 2007-2010 are shown, though older data exists. Survey effort for older data was low and estimates of hatchery fish contribution are not considered to be reliable (Dave Hillemeier, personal communications).
Source: Carcass surveys compiled by Steve Gough, USFWS, Arcata, CA.

Information describing the distribution and abundance of juvenile fall Chinook in the mainstem Klamath River is not available.

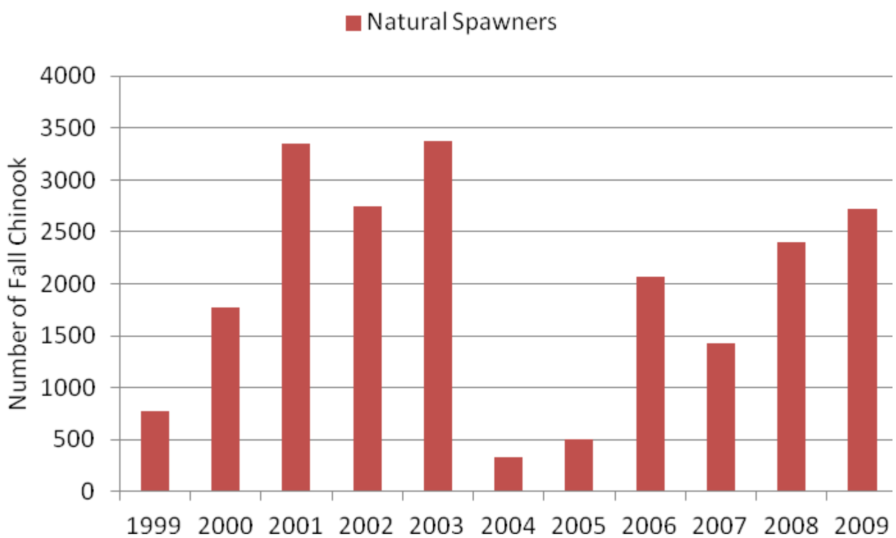
2.1.2 Salmon River Subbasin

The Salmon River watershed drains an area of 751 square miles that is primarily federal land (approximately 90%). Because of the absence of development, the Salmon River subbasin is sparsely populated and does not experience water quality and quantity issues to the same degree as the rest of the Klamath River Basin; however, the river is currently listed by the state as impaired due to high nutrient levels and water temperature (NMFS 2007).

The escapement of fall-run Chinook salmon has been monitored since 1978 in the Salmon River subbasin and reflects little hatchery influence. Between 1999 and 2009, fall Chinook spawner escapement to the Salmon River (natural spawners) averaged 1,953 fish, ranging from 333 in 2004 to 3,375 in 2003 (Figure 3).

Biologists who met in Yreka in February 2011 to provide information for this review stated that available recoveries of marked/tagged fish suggest that few hatchery-origin Chinook spawn naturally in the Salmon River system.

Information describing the distribution and abundance of juvenile fall Chinook in the Salmon River subbasin is not available.



Source: CDFG megatable.

Figure 3. Salmon River subbasin fall Chinook salmon natural spawner (HOR + NOR) escapement estimates from 1999 through 2009 (adult and jacks combined).

2.1.3 Scott River Subbasin

The Scott River enters the Klamath at RM 143 at an elevation of 1,580 feet and drains a watershed area of approximately 812 square miles. Major tributaries to the 58-mile-long Scott River include Shackleford-Mill, Kidder, Etna, French, and Moffett creeks and the South and East Forks of the Scott River (ESA 2009).

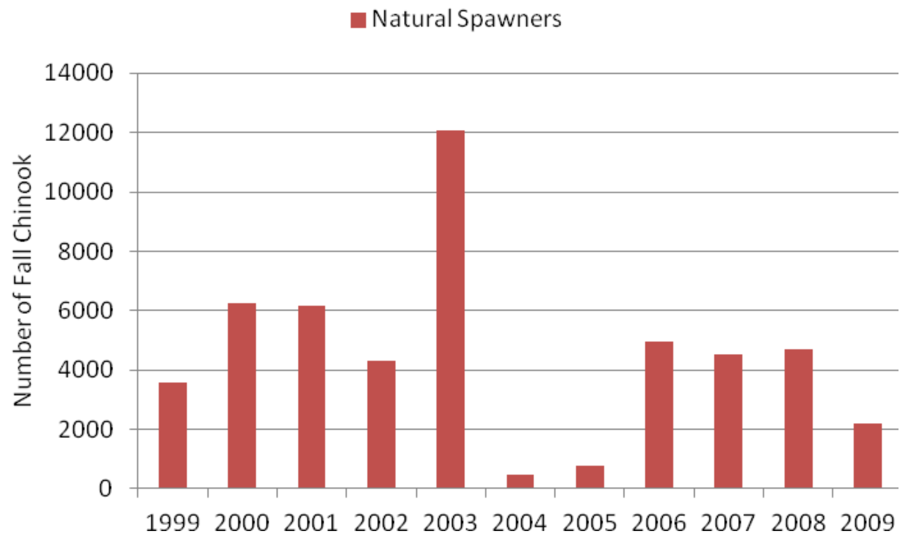
No estimates of Chinook salmon abundance prior to the 1950s are available for the Scott River subbasin. However, in the early 1960s, fall-run Chinook salmon run sizes in the Scott River were estimated at 8,000 to 10,000 (SRWC 2005, as cited in ESA 2009). Today, the Scott River remains a relatively major salmon spawning tributary. For example, during the 1996-98 spawning seasons, an average of 30.6% (8,914) of the total number of natural area adult Chinook salmon spawners above the Trinity River confluence were estimated to have entered the Scott River to spawn (Knechtle 2008).

The timing and distribution of fall Chinook salmon spawning within the Scott River subbasin has been documented annually during cooperative spawning surveys since 1978. Fall Chinook salmon primarily use the mainstem Scott River from its confluence with the Klamath River to approximately Faye Lane. Spawning distribution within the mainstem can be limited during periods of low flow as fish are unable to leave the Scott Canyon reach and ascend into the valley areas due to a lack of streamflow. Smolt outmigration from the Scott River typically occurs from April through June (SRWC 2005, as cited in ESA 2009).

The Scott River Fish Counting Facility (weir) is located at RM 18.2 near the downstream edge of Scott Valley between the Indian Scotty Campground and Jones Beach picnic area. Between 1999 and 2009, the Chinook salmon run (adults and jacks combined) in the Scott River ranged from 467 fish (in 2004) to 12,053 fish (in 2003) and averaged 4,537 fish (Figure 4) (CDFG unpublished data). Like the Salmon River subbasin, the escapement of fall Chinook salmon reflects little hatchery influence.

Biologists who met in Yreka in February 2011 to provide information for this review stated that available recoveries of marked/tagged fish suggest that few hatchery-origin Chinook spawn naturally in the Scott River system. It was reported that in two years of survey data prior to 2010 no adipose-clipped Chinook were found out of 2,400 carcasses sampled. In 2010, one adipose-clipped fish was reported but no CWT was recovered.

Information describing the distribution and abundance of juvenile fall Chinook in the Scott River subbasin is not available.



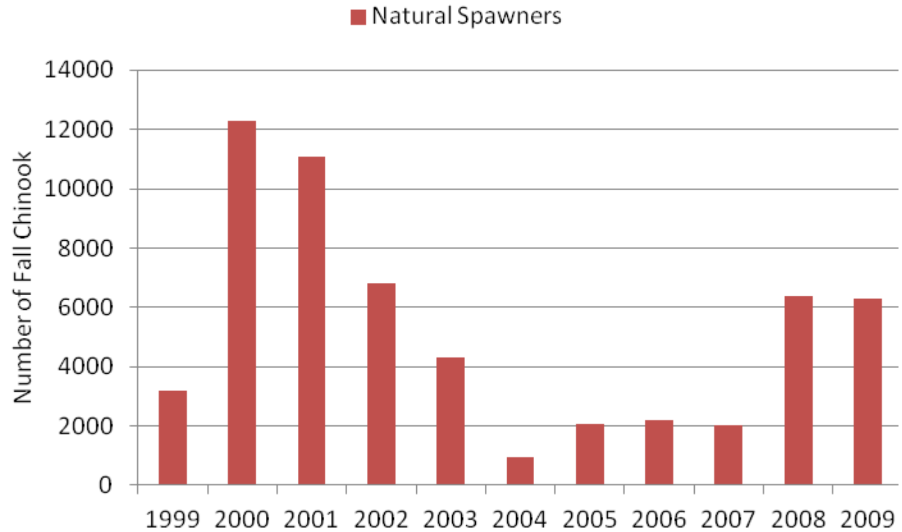
Source: CDFG megatable.

Figure 4. Scott River subbasin fall Chinook salmon natural spawner (HOR + NOR) escapement estimates from 1999 through 2009 (adult and jacks combined).

2.1.4 Shasta River Subbasin

The Shasta River subbasin drains a watershed area of approximately 793 square miles and enters the mainstem Klamath at RM 177 at an elevation of approximately 2,000 feet. Major tributaries to the 50-mile long Shasta River include Parks Creek, Big Springs Creek, Little Shasta River, and Yreka Creek. As relatively little precipitation falls in the Shasta Valley, the Shasta River receives the majority of its flow from glacial melting and mountain precipitation on Mount Shasta and the Eddy Mountains.

Historically, the Shasta River was one of the most productive salmon streams in California, with runs that sometimes exceeded 80,000 fish in the 1930s (NRC 2004). Since the 1940s, Chinook salmon numbers have decreased dramatically. Between 1999 and 2009, Chinook returns to the Shasta River subbasin (adults and jacks combined) averaged 5,235 per year with a high of 12,296 (in 2000) and a low of 962 (in 2004) (CDFG unpublished data) (Figure 5).



Source: CDFG megatable.

Figure 5. Shasta River subbasin fall Chinook salmon natural spawner (HOR + NOR) escapement estimates from 1999 through 2009 (adult and jacks combined).

Since 2002, the CDFG has estimated the number of hatchery-origin (HOR) fall Chinook that may have strayed into the Shasta River (Chesney and Knechtle 2009). These estimates have been based on sample expansions from tag recoveries obtained from the Shasta River, or have been based on the proportional distribution of CWT recoveries observed at Iron Gate Hatchery and applied to the number of adipose fin-clipped Chinook that were observed passing through the Shasta River fish collection facility during the season. This latter method was used to estimate the number of hatchery stays in the Shasta River during the 2002 through 2009 seasons. Since 2002, the percent estimated contribution of hatchery strays to the Shasta River has ranged from a low of 1.0% in 2008 to a high of 38.7% in 2004 (Chesney and Knechtle 2010) (Table 9).

Table 9. Estimates of hatchery strays as a percentage of fall Chinook entering the Shasta River, 2002 through 2009.

Year	Total Number of Chinook	Hatchery Stray Estimate	Percent Hatchery
2002	6,820	79	1.2
2003	4,289	436	10.2
2004	962	372	38.7
2005	2,129	469	22.0
2006	2,184	106	4.9
2007	2,035	69	3.4
2008	6,362	66	1.0
2009	6,287	131	2.1

Source: Chesney and Knechtle 2010

Construction of Dwinnell Dam in 1928 at approximately RM 40.6 precluded salmon from accessing the upper watershed and effectively eliminating an estimated 22% of the spawning habitat formerly available to salmon and steelhead (Wales 1951, as cited in ESA 2009). This reduction in stream size resulted in a considerable loss of spawning habitat in the reach from

Dwinnell Dam to Big Springs Creek. Historically, the Shasta River is believed to have been a major producer of spring Chinook (NRC 2004). Spring Chinook are no longer present in the river.

More recently, Chinook are known to spawn in the mainstem Shasta River (primarily in the Canyon reach and in the vicinity of Big Springs Creek), Parks Creek, and Big Springs Creek (CDFG 1997; Chesney et al. 2007). Spawning also occurs in two other tributaries, Yreka Creek and Little Shasta River, during years when there is a hydrologic connection between the tributaries and the mainstem at the time of Chinook spawning migration. The majority of juvenile fall-run Chinook salmon spend only a few months rearing in freshwater before outmigrating in the spring and early summer. Peak smolt outmigration from the Shasta River typically occurs in March and April (Chesney et al. 2007, as cited in ESA 2009).

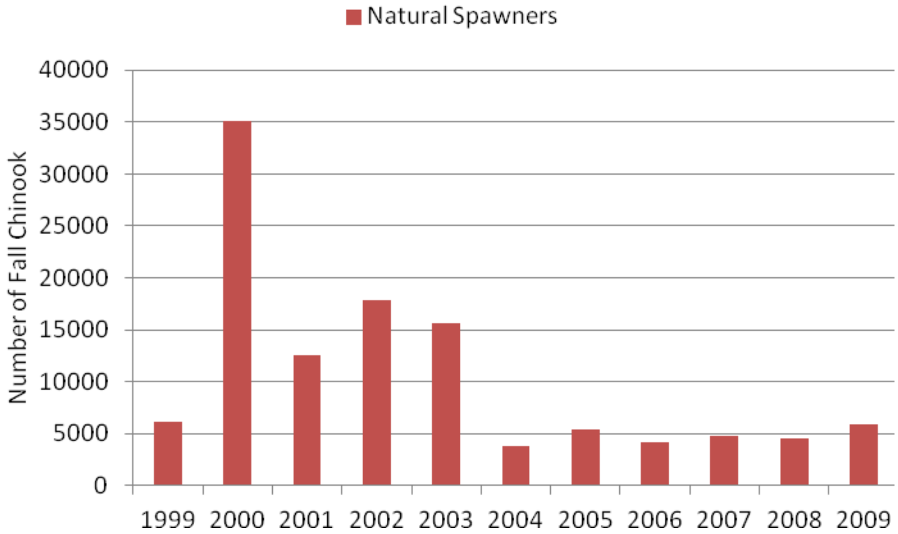
Information describing the distribution and abundance of juvenile fall Chinook in the Shasta River subbasin is not available.

2.1.5 Bogus Creek Subbasin

Bogus Creek is located on the southeast side of the Klamath River just downstream of Iron Gate Hatchery (between RM 189 and 190). Fall Chinook return to Bogus Creek to spawn from mid-September to early November (Knechtle 2008). Like the Scott and Shasta rivers, Bogus Creek is a relatively important Chinook salmon spawning tributary, despite its small size.

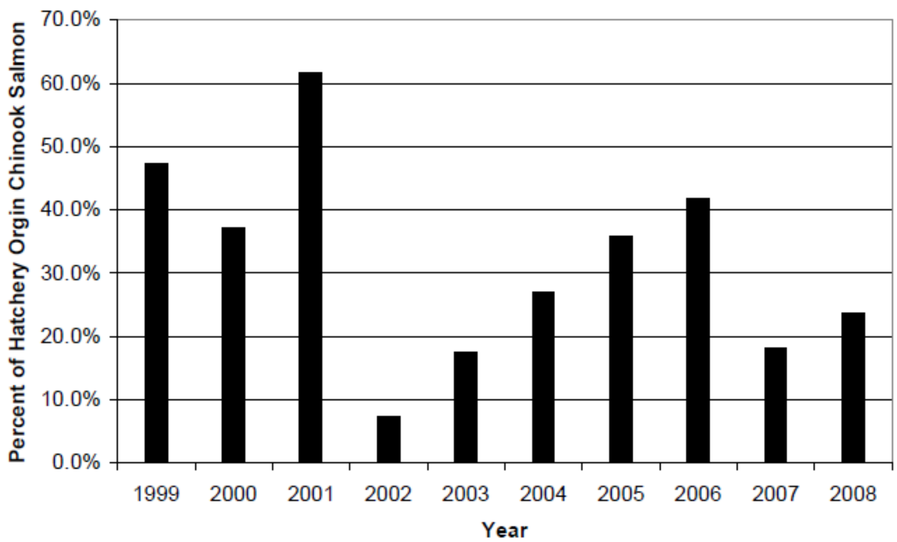
Between 1999 and 2009, adult and jack Chinook returns to Bogus Creek averaged 10,526 per year with a high of 35,051 (in 2000) and a low of 3,788 (in 2004) (CDFG unpublished data) (Figure 6).

Fish from Iron Gate Hatchery make up a significant portion of fall Chinook spawners in Bogus Creek. The CDFG has estimated the contribution of hatchery-origin Chinook salmon in Bogus Creek since 1999. Over a ten-year period, the contribution of hatchery Chinook salmon in relation to the total Chinook salmon run in Bogus Creek fluctuated greatly, ranging from 61.6 to 7.5%. An estimated 23.6% of the Chinook salmon that entered Bogus Creek during 2008 were hatchery origin (Figure 7) (Knechtle 2009).



Source: CDFG megatable.

Figure 6. Bogus Creek subbasin fall Chinook salmon natural spawner (HOR + NOR) escapement estimates from 1999 through 2009 (adult and jacks combined).



Source: Knechtle 2009

Figure 7. Estimated contribution of hatchery-origin (HOR) Chinook salmon observed in Bogus Creek from 1999 through 2008.

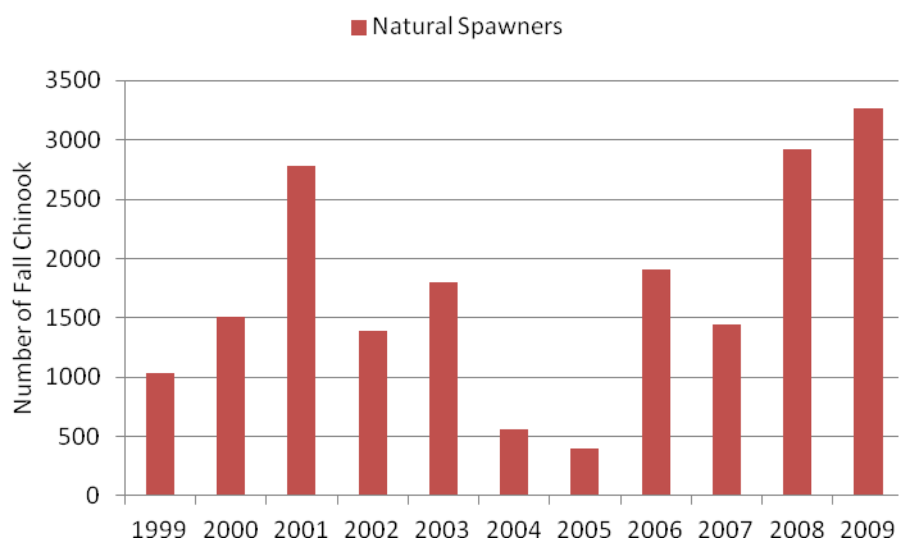
Information describing the distribution and abundance of juvenile fall Chinook in the Bogus Creek subbasin is not available.

2.1.6 Miscellaneous Klamath River Tributaries (above the Yurok Reservation)

Miscellaneous Klamath River Tributaries (above the Yurok Reservation) include the following:

- Aiken Creek
- Beaver Creek
- Bluff Creek
- Boise Creek
- Camp Creek
- Clear Creek
- Dillon Creek
- Elk Creek
- Grider Creek
- Horse Creek
- Independence Creek
- Indian Creek
- Irving Creek
- Perch Creek
- Red Cap Creek
- Rock Creek
- Slate Creek
- Seiad Creek
- Thompson Creek
- Ti Creek
- Pine Creek

Between 1999 and 2009, fall Chinook returns (adults and jacks combined) to these tributaries averaged 1,725 per year with a high of 3,269 (in 2009) and a low of 401 (in 2005) (CDFG unpublished data) (Figure 8).



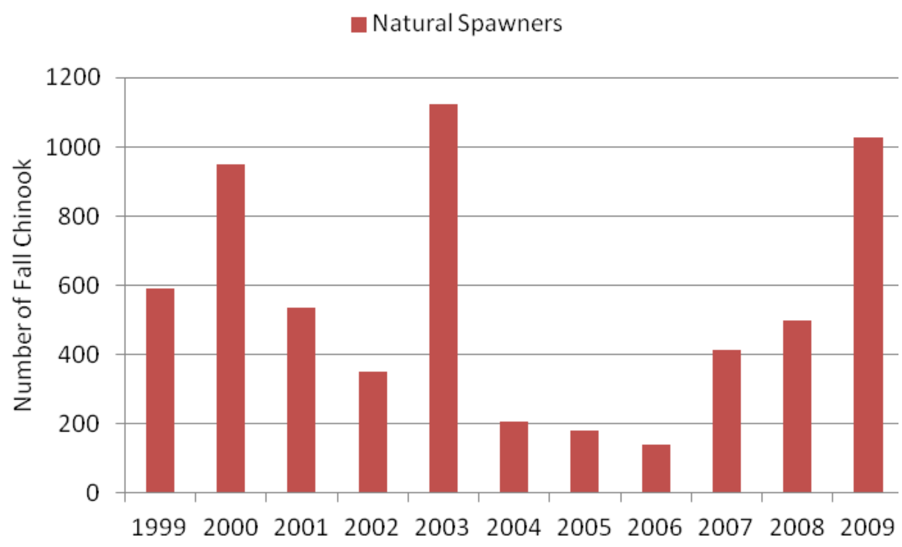
Source: CDFG megatable.

Figure 8. Miscellaneous Klamath River Tributaries (above the Yurok Reservation) fall Chinook salmon natural spawner escapement from 1999 through 2009 (adult and jacks combined).

2.1.7 Yurok Reservation Tributaries

The Yurok Indian Reservation is a 56,000-acre corridor extending one mile from each side of the Klamath River from the Trinity River confluence to the Pacific Ocean, including the river channel. There are approximately two dozen major anadromous tributaries within that area. Some of the most important Chinook salmon spawning tributaries include Turwar, McGarvey, Tectah, Blue, Tully, Hunter, and Johnson creeks. Blue Creek is the largest and most pristine tributary to the Lower Klamath and supports the largest proportion of anadromous fish in the subbasin.

Between 1999 and 2009, Chinook returns (adults and jacks combined) to the Yurok Reservation Tributaries (Blue Creek)[6] averaged 547 per year, with a high of 1,125 (in 2003) and a low of 139 (in 2006) (CDFG unpublished data) (Figure 9).



Source: CDFG megatable.

Figure 9. Yurok Reservation tributaries fall Chinook salmon natural spawner escapement estimates from 1999 through 2009 (adult and jacks combined).

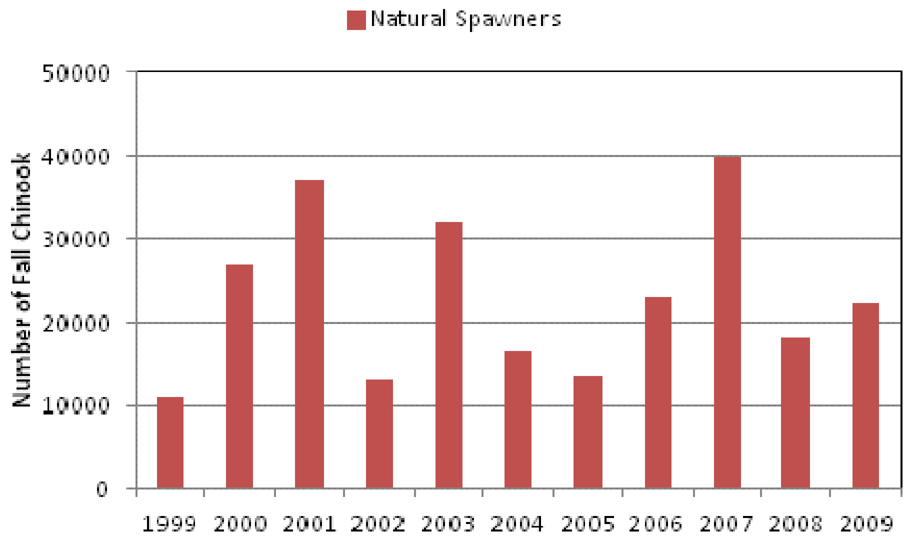
Information describing the distribution and abundance of juvenile fall Chinook in these tributaries is not available.

2.1.8 Mainstem Trinity River

The Trinity River is the largest tributary to the Klamath River, draining approximately 3,000 square miles; approximately one-quarter of which is above Lewiston Dam, an anadromous fish migration barrier located at RM 112. The terrain is predominantly mountainous and forested. Elevations in the basin range from 8,888 feet above sea level in the headwater areas to less than 300 feet at the confluence with the Klamath River (at RM 43). Major tributaries include the North Fork and South Fork Trinity and New rivers.

Since 1978, CDFG has operated sampling weirs within the mainstem Trinity River at RM 22.6 near Willow Creek (downstream of the South Fork Trinity River). This population group includes all fish that spawn naturally upstream of the Willow Creek weir (WCW), as well as fish that spawn in the mainstem Trinity River downstream of WCW. Between 1999 and 2009, spawner abundance (jacks and adults combined) in this geographic area averaged 23,096 fish, ranging from 10,907 in 1999 to 39,970 in 2007 (Figure 10).

[6] Only survey data from Blue Creek were provided in the CDFG data.



Source: CDFG megatable.

Figure 10. Fall Chinook spawner abundance (HOR + NOR) within the mainstem Trinity River population group from 1999 through 2009 (adult and jacks combined).

In addition to adult escapement monitoring, both wild and hatchery juvenile salmonid emigration from the mainstem Trinity River has been monitored at the Willow Creek trap since 1989 (Scheiff et al. 2001; Pinnix et al. 2007; Pinnix and Quinn 2009; Pinnix et al. 2010). The majority of juvenile Chinook captured during the spring/summer emigration period were age-0 fish, with the natural and hatchery emigration periods overlapping. Between 1997 and 2008, the number of hatchery Chinook (both spring- and fall-run) captured in the Willow Creek trap ranged from 67,078 (in 2002) to 11,153 (in 2000) (Table 10). Between 14 and 83% of these annual catches were thought to be Trinity River Hatchery fish.

Table 10. Hatchery and natural (age-0) Chinook salmon captured in screw traps located in the Lower Trinity River (RM 34) near Willow Creek (1997 through 2008).

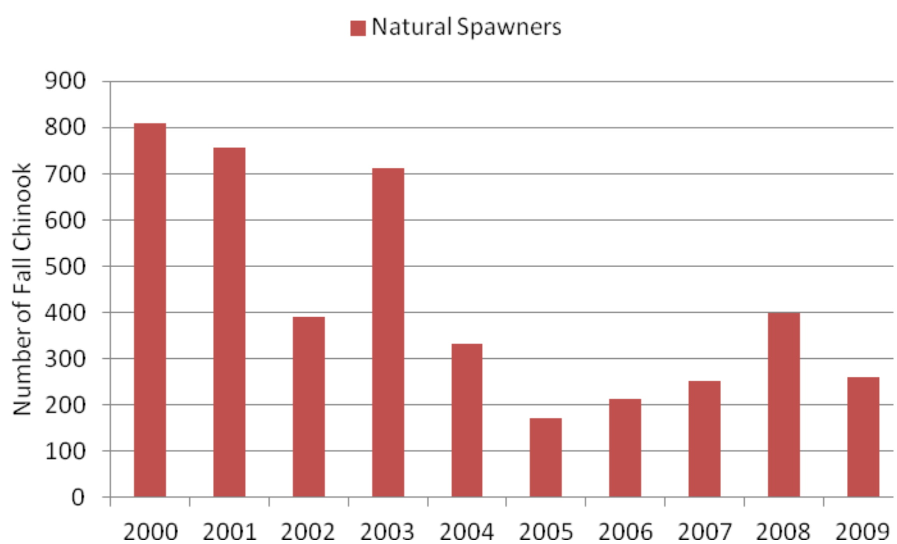
Year	Hatchery	Natural	Total	Percent Hatchery
1997	15,700	3,108	18,808	83
1998	14,359	12,708	27,067	53
1999	10,935	7,877	18,812	58
2000	4,962	6,191	11,153	44
2001	8,346	28,113	36,459	30
2002	20,194	46,884	67,078	43
2003	5,737	10,590	16,327	54
2004	3,963	15,952	19,915	25
2005	12,179	37,289	49,468	33
2006	12,328	3,765	16,093	77
2007	8,115	45,212	53,327	15
2008	13,204	77,994	91,198	14

Note: 2001 through 2007 data included fish captured during the fall sampling period.

Spring and fall Chinook spawning surveys conducted by CDFG during 2008 documented a total of 3,564 Chinook salmon in the mainstem Trinity River between the Klamath River and Lewiston Dam (excluding the reach from Cedar Flat to Hawkins Bar) (Sinnen et al. 2010). CWT recoveries from adipose fin-clipped Chinook indicated spring Chinook carcasses outnumbered fall Chinook carcasses until after Julian week 44 (ending November 3, 2008). With this Julian week separation, 993 spring Chinook carcasses were recovered and 2,571 fall Chinook carcasses were recovered. CWT recoveries also allowed separation of two-year-old jacks from adults (older than two years old), revealing that 78.9% of the spring Chinook and 83.6% of the fall Chinook were adults. The recovery of these adipose fin-clipped Chinook carcasses indicated 10.3% of the spring and 11.1% of the fall carcasses observed in the mainstem surveys were of hatchery origin (Sinnen et al. 2010). Of the 3,564 Chinook carcasses encountered, 1,775 (49.8%) were recovered in between Lewiston Dam (RM 112) and Bucktail Launch (RM 105). Biologists who met in Yreka in February 2011 to provide information for this review reported that the percent of hatchery-origin fish spawning naturally is highest in the reaches nearest the hatchery. The percent of hatchery-origin fish declines sharply as distance increases from the hatchery.

2.1.9 Miscellaneous Trinity River Tributaries (above the Hoopa Reservation)

Between 2000 and 2009, adult and jack fall Chinook naturally spawning Chinook within the Miscellaneous Trinity River tributaries above the Hoopa Reservation averaged 429 per year with a high of 809 (in 2000) and a low of 172 (in 2005) (CDFG unpublished data) (Figure 11).

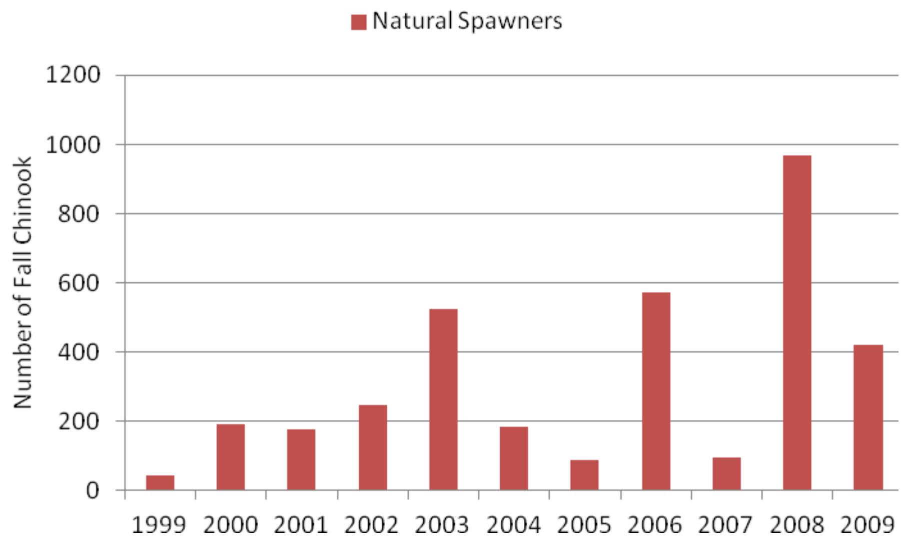


Source: CDFG megatable.

Figure 11. Miscellaneous Trinity River Tributaries (above the Hoopa Valley Reservation) fall Chinook salmon natural spawner escapement estimates from 2000 through 2009 (adult and jacks combined).

2.1.10 Hoopa Reservation Tributaries

Between 1999 and 2009, naturally spawning fall Chinook (jacks and adults combined) in Hoopa Reservation tributaries averaged 319, ranging from 44 (in 1999) to 969 (in 2008) (Figure 12) (CDFG unpublished data, Megatable).



Source: CDFG megatable.

Figure 12. Hoopa Valley Reservation tributaries fall Chinook salmon natural spawner escapement estimates from 1999 through 2009 (adult and jacks combined).

2.2 Long–term Goals for Natural Populations

The Trinity River fall Chinook populations identified and described above (Section 2.1) differ in their relationship to the Trinity River Hatchery program as a result of where and when spawning and rearing occurs. Whether the hatchery confers a benefit or a risk to a natural population depends on this relationship and on the status and goals for the natural population.

Each population unit has a unique role in the recovery and maintenance of its ESU. As a simple approach to identify this role, the Lower Columbia Fish Recovery Board (LCFRB), for example, defined three categories of populations: Primary, Contributing, or Stabilizing (LCFRB 2004). These definitions generally reflect the genetic identity of the population and/or its abundance potential (e.g., as a core population within the ESU).

NOAA defines four measures of viability for salmon populations: abundance, productivity, diversity, and population structure (McElhany et al. 2000). Natural production goals for each population component might then be expressed in terms of abundance, productivity and within population diversity. The viability pattern among the population units would then describe the population structure.

3 Fisheries Affected by the Hatchery Program

3.1 Current Status of Fisheries

Annual harvest management provisions for Klamath River fall Chinook are developed in concert with ocean harvest regimes formulated by the Pacific Fisheries Management Council (PFMC). The PFMC process as it concerns Klamath populations involvemes state and federal agencies (NMFS, USFWS, CDFG, and ODFW, among others), tribal governments (Yurok and Hoopa Valley), as well as commercial and recreational fishery interests. Prior to 2006, harvest provisions for Klamath Chinook populations were developed through the Klamath Fishery Management Council (KFMC), formed in 1985, which was a federal advisory committee made up of representatives from the aforementioned entities. The KFMC developed ocean and in-river management provisions in conjunction with the annual PFMC process. Authorization for the KFMC ended in 2006. Since then, ocean management provisions for Klamath River Chinook have been developed entirely through the PFMC process, which in practice then enables the development of management plans for marine nearshore and in-river fisheries. In-river regulations are promulgated by the relevant entities consistent with principles that were operative under the KFMC, while meeting currently accepted conservation objectives. The available harvest of this population is shared equally between non-tribal and tribal fisheries (tribes with Federally-recognized fishing rights).

The current conservation objective for Klamath River fall Chinook, and PFMC guidance for this stock, is described in recent annual PFMC reports (see annual review documents at PFMC website). The aggregate natural population is managed in accordance with PFMC guidance calling for a maximum adult natural spawner reduction rate of 67%, with a minimum spawner escapement of 40,700 adults in natural areas. The minimum spawner escapement was raised from 35,000 to 40,700 after 2007 in response to the triggering of an Overfishing Concern after failing to meet the 35,000 spawner escapement floor for three consecutive years (2004, 2005, and 2006). The population has also provided the basis for the NMFS ESA consultation standard for California coastal Chinook, which limits the ocean harvest rate on age-4 Klamath River fall Chinook to no more than 16.0%.

As noted earlier in this section, ocean escapements of Klamath River fall Chinook have fluctuated widely in past decades. There is no evidence for a long-term trend over the past 35 years—the ocean escapement pattern shows several periods of exceptionally high escapements with intervening years of much lower escapements (CDFG megatable). It is noteworthy that projected ocean run size for 2012, as developed for the preseason 2012 PFMC process, is much higher than any run size seen in the past 35 years (D. Hillemeier, Yurok Fisheries Program Manager, personal communication).

Estimated ocean[7] and in-river harvest rates (as proportions) of age-3 Klamath River fall Chinook (from 1999 through 2009) have averaged 0.19, ranging from 0.13 in 2003 and 2006 to 0.31 in 2009 (Table 11). Estimated harvest rates of age-4 fall Chinook during this same period averaged 0.34 , ranging from 0.18 in 2006 to 0.56 in 2007 (Table 11) (data summarized from Klamath River Technical Advisory Team (KRTAT) 2010.

[7] Ocean fisheries (Sept 1 through Aug 31) include KMZ troll and sport, north of KMZ, and south of KMZ. Ocean harvest rates are the fraction of Sept 1 ocean abundance harvested in these fisheries. River harvest rates are the fraction of the river run harvested in these fisheries.

Table 11. Estimated harvest rates (%) of age-3 and age-4 Klamath River fall Chinook.

Year	Harvest Rate			
	Ocean	Net	Sport	Total
Age-3				
1999	0.02	0.17	0.06	0.23
2000	0.06	0.12	0.03	0.15
2001	0.03	0.18	0.07	0.25
2002	0.02	0.12	0.07	0.19
2003	0.08	0.07	0.05	0.13
2004	0.12	0.14	0.06	0.20
2005	0.02	0.10	0.04	0.14
2006	0.01	0.13	0.00	0.13
2007	0.06	0.15	0.05	0.20
2008	0.00	0.17	0.03	0.21
2009	0.00	0.25	0.06	0.31
Average				0.19
Age-4				
1999	0.09	0.43	0.02	0.45
2000	0.10	0.22	0.02	0.25
2001	0.09	0.24	0.05	0.29
2002	0.15	0.19	0.06	0.26
2003	0.21	0.24	0.05	0.28
2004	0.34	0.43	0.04	0.48
2005	0.20	0.17	0.02	0.19
2006	0.10	0.18	0.00	0.18
2007	0.21	0.53	0.03	0.56
2008	0.10	0.36	0.03	0.38
2009	0.00	0.36	0.04	0.40
1999	0.09	0.43	0.02	0.45
Average				0.34

Source: KRTAT 2010

Estimated ocean and in-river harvests (in total numbers of fish) of age-3 Klamath River fall Chinook (from 1999 through 2009) averaged 14,187 fish, ranging from 2,401 in 2006 to 27,351 in 2000 (Table 12). Harvest of age-4 fall Chinook during this same period averaged 13,745 fish, ranging from 3,352 in 2005 to 27,346 in 2003 (Table 12) (KRTAT 2010).

Table 12. Estimated numbers of age-3 and age-4 Klamath River fall Chinook harvested in ocean and in-river fisheries, 1999-2009.

Year	Estimated number harvested			
	Ocean	Net	Sport	Total
Age-3				
1999	1,938	4,981	1,748	6,729
2000	37,491	22,458	4,893	27,351
2001	9,049	17,885	7,294	25,179
2002	12,415	11,734	6,258	17,992
2003	30,047	6,996	5,061	12,057
2004	18,423	4,679	2,051	6,730
2005	3,568	4,394	1,641	6,035
2006	850	2,388	13	2,401
2007	22,421	17,543	5,734	23,277
2008	0	3,225	608	3,833
2009	64	19,820	4,655	24,475
Average				14,187
Age-4				
1999	2,749	8,789	494	9,283
2000	4,415	6,733	756	7,489
2001	12,661	20,759	4,819	25,578
2002	14,992	11,929	4,063	15,992
2003	39,598	22,754	4,592	27,346
2004	36,089	17,623	1,751	19,374
2005	7,716	3,048	304	3,352
2006	6,098	7,569	42	7,611
2007	7,069	8,987	502	9,489
2008	8,142	17,891	1,260	19,151
2009	0	5,831	696	6,527
Average				13,745

Source: KRTAT 2010

3.2 Long-term Goals for Affected Fisheries

Long-term harvest goals for the fisheries affected by the program have not been established.

4 Programmatic and Operational Strategies to Address Issues Affecting Achievement of Goals

This section describes programmatic and operational hatchery strategies that can be used in the two Klamath Basin hatcheries to address issues that potentially affect achieving the goals for the fish populations. Issues to be considered in evaluating hatchery strategies are first identified, followed by brief descriptions of how possible strategies relate to those issues.

4.1 Issues Affecting Achievement of Goals

A host of issues exist that might affect fishery, fish production, and conservation goals for the Klamath Basin. Many of these issues are habitat-related and are outside the control of what can be done in the hatcheries. Patterns and magnitude of flow releases at Iron Gate Dam, for example, are beyond the control of hatchery management. But some issues can be addressed by specific programmatic and operational strategies employed at the hatcheries. A list of issues that can be addressed, at least in part, by the hatchery programs and their operations is given below. Important questions associated with the issues are also identified. These questions are not intended to be exhaustive—others will be identified during the course of the hatchery review.

4.1.1 Natural Production Issues

- Status of viable salmonid population (VSP) parameters for Trinity fall Chinook populations: What are the expected effects of the hatchery program on VSP parameters of Trinity fall Chinook? Can hatchery strategies be updated to enhance the VSP parameters for the natural populations, thereby improving the likelihood for recovery?

- Hatchery stock genetic management: What are the effects of current management on genetic diversity of the hatchery stock and possible effects of strays on natural-origin fish? Can hatchery strategies be updated to improve hatchery stock genetic diversity and adaptation to the natural environment (when fish leave the hatchery), both for fish that return to the hatchery and for those that spawn in nature?

- Natural population genetics: Is the hatchery program affecting the genetic integrity and productivity of the natural populations and, if so, can the program be modified to reduce, or even reverse, effects?

- Performance of the hatchery stock unrelated to genetic composition: Do hatchery fish released into nature exhibit behavioral traits that adversely affect their performance, unrelated to domestication effects on genetics, prior to returning to the hatchery or if they spawn in nature, and if so, can hatchery strategies be modified to ameliorate effects?

4.1.2 Ecological Interaction Issues Affected by or Affecting Other Species

- Predation effects: What are the predation effects of the hatchery fish released as part of this program on sensitive natural populations? What are the predation effects of other hatchery programs on fish released as part of this program? Can the hatchery strategies for this program be updated to ameliorate these effects?

- Competition: What are the competition effects of the hatchery fish released as part of this program on sensitive natural populations? What are the competition effects of other hatchery programs on fish released as part of this program? Can the hatchery strategies for this program be updated to ameliorate these effects?

- Disease: Does this program exacerbate effects of disease in the basin on other species or programs (including this program), and, if so, how can the hatchery strategies be updated to ameliorate effects?

4.2 Operational Issues

Operational issues at the hatchery were identified from answers to a set of questions dealing with all phases of hatchery operations. This questionnaire was initially developed as part the

Northwest Power and Conservation Council's Artificial Production Review and Evaluation (APRE) project for Columbia River hatcheries, and the scientific review process of Northwest salmon hatcheries. The California HSRG reviewed and updated the questions for the purpose of this review, and introduced a number of additional questions (see Appendix A-1). The questions were answered by the hatchery manager, M&E biologists and the regional manager(s) in workshops held in February 2011. Responses provided in the workshops (plus clarifying notes) can be found in Appendix A-1.

Most of the questions required simple "yes", "no" or "NA" replies. They are generally framed such that a "yes" answer implies consistency with Best Management Practices (BMPs) and a "no" answer implies a potential risk. The California HSRG requested five-year disease histories from resource managers as part of this questionnaire, but summaries were not provided for all years. This limited their ability to assess current disease status of the program, or to quantitatively assess the effectiveness of fish health management efforts. Data tables that were provided as follow up to the set of question/answers are presented in Appendix A-2, and a benefit-risk analysis of the Appendix A-1 information is provided in Appendix A-3.

4.3 Programmatic Strategies

The California HSRG identified a suite of issues that are applicable to hatchery programs statewide. These issues were organized under five topics (1) broodstock management; (2) program size and release strategies; (3) incubation, rearing and fish health management; (4) monitoring and evaluation; and (5) direct effects of hatchery operation on local habitat and aquatic or terrestrial organisms. For each topic, hatchery standards to be achieved were defined and in many cases, suggested implementation guidelines to meet the standard were developed. All standards and guidelines are listed in Chapter 4 of the California Hatchery Review Report. Standards that the California HSRG determined apply to this program are presented below. Where their evaluation determined that this program complies with a standard, this is noted. Where their evaluation determined that this program does not comply with a standard, "standard not met" is noted, and recommended guidelines to resolve the issue are identified. In many cases, the California HSRG provided program-specific comments as well.

4.3.1 Broodstock

Table 13. Broodstock Source.

Standard	Guideline
Standard 1.1: Broodstock is appropriate to the basin and the program goals and should encourage local adaptation. Standard met.	

Table 14. Broodstock Collection.

Standard	Guideline
Standard 1.2: Trapping is done in such a way as to minimize physical harm to both broodstock and non-broodstock fish. Standard met.	
Standard 1.3: Collection methods are appropriate for the program goals. Standard met.	
Standard 1.4: Trapping is designed to collect sufficient fish as potential broodstock to be representative of the entire run timing and life history distribution of the population or population component with which it is integrated. Standard NOT met.	Guideline 1.4.1. Fish traps should be operated for at least the entire temporal period of the run and should not exclude fish with any particular life history characteristics. An exception to this guideline is allowable when non-representative broodstock collection is necessary to achieve program goals, such as separating broodstock of differing eco-types.
Comment: The trap is closed for two weeks during the early fall return.	*Comment: Adult collection facilities should be operated throughout the entire temporal migration period of the run and should not exclude fish with particular life history characteristics, except when non-representative broodstock collection is necessary to achieve program goals. Currently, the trap is shut down for a period of approximately two weeks to minimize hybridization between separate spring and fall Chinook. Fish collected during this period should be euthanized without spawning.*
Standard 1.5: Hatcheries have effective facilities for the extended holding of unripe fish and males that will be used for multiple spawning. Standard NOT met.	Guideline 1.5.1. Holding facilities in hatcheries should provide adequate space, water flows, and temperature requirements to hold the expected number of unripe adult fish for extended periods of time with minimal hatchery-caused mortality (refer to Senn et al. 1984 for specific water quality, flow and temperature parameters).
Comment: Adult mortality in holding ponds is known to be high.	Guideline 1.5.2. Holding facilities in hatcheries should permit appropriate antibiotic and/or chemical treatments when deemed necessary to control adult mortality or prevent vertical transmission of diseases to progeny.
	Comment: Adult holding facilities in hatcheries should be upgraded/expanded to provide adequate space, water flows and temperature regimes to hold the number of adults required for broodstock at high rates of survival (more than 90 percent). Facilities need to be adequate to hold the expected number of unripe adults for extended periods with minimal hatchery-caused mortality.

Table 15. Broodstock Composition.

Standard	Guideline
Standard 1.6: Broodstock is primarily comprised of fish native to the hatchery location, with incorporation of fish from other locations not exceeding the rate of straying of natural-origin fish. Standard met.	
Standard 1.7: The levels of natural-origin broodstock are appropriate for program goals. Standard NOT met.	Guideline 1.7.2. For integrated programs, pNOB should be at least 10 percent to avoid run divergence. Higher pNOB may be applied to avoid/minimize domestication but should not be large enough to pose a demographic hazard to the natural population(s).
Comment: A range of 5-15 percent pNOB was reported. Numbers of NOR and HOR adult return data were not available.	*Comment: Natural-origin fish should be incorporated into broodstock at a minimum rate of 10 percent to prevent divergence of the hatchery and natural components of the integrated population. This may require auxiliary adult collection facilities or alternative collection methods (e.g., seining or trapping). Managers should investigate the feasibility of collecting natural-origin adult fish at alternate locations. The existing trapping location is very limited in its ability to capture fish representing the entire spectrum of life history diversity. Only fish that migrate to the furthest upstream reaches are susceptible to capture.*
Standard 1.8: Fish from different runs are not crossed. Standard NOT met.	Guideline 1.8.1. Hatcheries should employ effective methods to identify fish from different runs and avoid crossing them. Eggs produced by unintentionally crossing types should be culled.
Comment: Hatchery staff rely on phenotypic traits and spawn timing to separate spring and fall Chinook.	*Comment: Coded wire or genetic tag analysis should be used to determine the number of fall and spring Chinook spawned during the suspected period of run overlap (e.g., fish spawned in the last two weeks of spring Chinook spawning and the first two weeks of fall Chinook spawning). Tags should be read and egg lots tracked and eliminated from production as appropriate to reduce introgression of the two runs. Incubation techniques should therefore allow for separation of eggs from individual parents/families (no more than two families per tray).*
Standard 1.10: For Chinook and coho salmon, fish from all age classes and sizes are incorporated into broodstock at rates that are commensurate with their relative reproductive success in natural areas, when known. Standard NOT met.	Guideline 1.10.1. For Chinook salmon, the number of jacks to be incorporated into broodstock should not exceed the lesser of: 1) 50 percent of the total number of jacks encountered at the hatchery, and 2) 5 percent of the total males used for spawning. Guideline 1.10.4. For all programs, broodstock should

Standard	Guideline
Comment: Jacks are not included in the spawning matrix.	be selected so as to not induce changes in the maturation schedule of the natural population with which the hatchery population is integrated.
	Comment: Returning yearling-origin adults should not be used as broodstock (or if eggs are collected from or fertilized by such fish, they should be culled soon after spawning) unless inadequate returns of fingerling-origin adults require that some yearling-origin adults be included in the broodstock. *Jacks should be included in the broodstock at a rate that is not more than 50 percent of the total number of jacks encountered during spawning and in no case more than 5 percent of the total males spawned.*

Table 16. Mating Protocols.

Standard	Guideline
Standard 1.11: The program uses genetically conscious mating protocols to control or reduce inbreeding and genetic drift (random loss of alleles), to retain existing genetic variability and avoid domestication, while promoting local adaptation for integrated stocks. Standard NOT met.	Guideline 1.11.1. For broodstock numbers greater than or equal to 250 females, matings should be 1 male x 1 female, with each 1:1 spawn in a single spawning pan. Limit the reuse of males to unavoidable situations (e.g., where loss of eggs might result if males are not reused and loss of eggs threatens program goals).
Comment: A 1:1 spawning ratio (in single spawning pan) is not used.	Guideline 1.11.5. For integrated programs including conservation programs: • Maximize incorporation of natural-origin fish into broodstock to the extent that the number of natural-origin broodstock used in the hatchery program does not substantially reduce the population viability of the donor stock. • Hatchery-origin fish should be preferentially mated with natural-origin fish. Hatchery-origin x hatchery-origin matings should be considered least desirable. • In conservation-oriented programs, relatedness between mated pairs may be more important than hatchery vs. natural origin.
Standard 1.12: Inbreeding is avoided. Standard met.	
Standard 1.13: The proportion of natural-origin fish used as broodstock does not negatively affect the long-term viability of the donor population. For conservation-oriented programs, extinction risk of the ESU may take precedence. Standard met.	

4.3.2 Program Size and Release Strategies

Table 17. Program Size.

Standard	Guideline
Standard 2.1: Program size is established by a number of factors including mitigation responsibilities, societal benefits, and effects on natural fish populations. Standard NOT met.	Guideline 2.1.1. Program purpose should be identified and expressed in terms of measurable values such as harvest, conservation, hatchery broodstock, education, or research.
Standard 2.2: Program size is measured as adult production. Standard NOT met.	Guideline 2.2.1. Production goals (program size) should be expressed in terms of number of adult recruits just prior to harvest (age-3 ocean recruits for Chinook salmon in California) or at freshwater entry (age-3 adults returning to freshwater for coho; anadromous adults returning to freshwater for steelhead).
Standard 2.3: Annual assessments are made to determine if adult production goals are being met. Standard NOT met.	
Comment: Program size is based on a juvenile production goal, not adult production.	
Standard 2.4: Program size is based on consideration of ecological and genetic effects on naturally spawning populations, in addition to harvest goals or other community values. Consistency with Standard Unknown.	Guideline 2.4.1. If deleterious ecological or genetic effects result in substantial reduction of productivity for high-priority naturally spawning populations, and these effects cannot be alleviated by other changes, program size should be reduced. Under certain circumstances, conservation-oriented programs might increase program size to eliminate deleterious effects, for example to reduce inbreeding.
Standard 2.5: Natural spawning populations not integrated with a hatchery program should have less than five percent total hatchery-origin spawners (i.e., pHOS less than five percent). Spawners from segregated hatchery programs should be absent from all natural spawning populations (i.e., pHOS from segregated programs should be zero). Consistency with Standard Unknown	 *Comment: Populations have not been identified and population boundaries have not been delineated. This has been identified as an area of needed research (Chapter 6.2 of the California Hatchery Review Report).*

Table 18. Release Strategy.

Standard	Guideline
Standard 2.6: Size, age, and date at release for hatchery-origin fish produce adult returns that mimic adult attributes (size at age and age composition) of the natural population from which the hatchery broodstock originated (integrated program) or achieve some other desired size or condition at adult return (segregated programs). Standard NOT met.	Guideline 2.6.1. Size and date at release should generally mimic size and period of emigration of naturally migrating smolts in the river system on which a hatchery is located. Deviations from this guideline require substantial justification that addresses both the ecological and genetic consequences of such a strategy, particularly when extended rearing is proposed. Consider retaining some flexibility in release date to take advantage of beneficial flow, turbidity, or temperature conditions without increasing deleterious ecological effects on natural populations.
	Comment: The fingerling program achieves the guideline however, the fall Chinook release (yearlings) does not. Fall releases need to be uniquely marked and not included in broodstock.
Standard 2.7: Juveniles are released at or in the near vicinity of the hatchery. Standard met.	

4.3.3 Incubation, Rearing and Fish Health

Table 19. Fish Health Policy.

Standard	Guideline
Standard 3.1: Fishery resources are protected, including hatchery and natural fish populations, from the importation, dissemination, and amplification of fish pathogens and disease conditions by a statewide fish health policy. The fish health policy clearly defines roles and responsibilities, and what actions are required of fish health specialists, hatchery managers, and fish culture personnel to promote and maintain optimum health and survival of fishery resources under their care. The Fish Health Policy includes the California HSRG's Bacterial Kidney Disease (BKD) management strategy (see Appendix V). Standard NOT met.	Guideline 3.1.1. Develop and promulgate a formal, written fish health policy for operation of DFG anadromous fish hatcheries through the Fish and Game Commission policy review process. Such a policy may be formally identified in regulatory code, Fish and Game Commission policy, or in the Department of Fish and Game Operations Manual.
Comment: No formal fish health policies have been adopted by CDFG or Commission. The current "working" CDFG fish health policy is inadequate to protect fisheries resources.	*Comment: CDFG should develop and promulgate a formal, written fish health policy for operation of its anadromous hatcheries through the Fish and Game Commission policy review process. Hatchery compliance with this policy should be documented annually as part of a Fish Health Management Plan. The current CDFG fish health policy is inadequate to*

Standard	Guideline
	protect native stocks. *CDFG should develop an updated Hatchery Procedure Manual which includes performance criteria and culture techniques presented in IHOT (1995), Fish Hatchery Management (Wedemeyer 2001) or comparable publications. The fish culture manual (Leitritz and Lewis 1976) is outdated and does not reflect current research and advancements in fish culture.*

Table 20. Hatchery Monitoring by Fish Health Specialists.

Standard	Guideline
Standard 3.2: Fish health inspections are conducted annually on all broodstocks to prevent the transmission, dissemination or amplification of fish pathogens in the hatchery facility and the natural environment, as follows: a) Inspections are conducted by or under the supervision of an AFS certified fish health specialist or qualified equivalent. For state-operated anadromous fishery programs, specific standards and qualifications are to be defined during development of a fish health policy. b) Annual inspections follow AFS "Fish Health Bluebook" guidelines for hatchery inspections. c) Broodstocks are examined annually for the presence of BKD and where the causative bacterium *Renibacterium salmoninarum* recurs the California HSRG's control strategy will be implemented. Standard met.	
Standard 3.3: Frequent routine fish health monitoring is performed to provide early detection of fish culture, nutrition, or environmental problems, and diagnosis of fish pathogens, as follows: a) Monitoring is conducted by or under the supervision of an AFS certified fish health specialist or qualified equivalent. b) Monitoring is conducted on a monthly, or at least bi-monthly basis, for all anadromous species at each hatchery facility. c) A representative sample of healthy and moribund fish from each lot is examined. Results of fish necropsies and laboratory findings are reported on a standard fish health monitoring form. Standard NOT met.	Guideline 3.3.1. The frequency of monitoring should depend on the disease history of the facility, the importance of the species being reared, and the variable environmental conditions that occur in a particular rearing cycle (e.g., elevated water temperatures in spring and summer months).
	Guideline 3.3.2. Review fish culture practices with manager including nutrition, water flow and chemistry, loading and density indices, handling methods, disinfection procedures, and preventative treatments.
Comment: Diagnostic exams alone do not meet the standard of routine, preventative fish health monitoring.	Guideline 3.3.3. The number of fish examined is at the discretion of the fish health specialist.
Standard 3.4: All antibiotic or other treatments are pre-approved by the appropriate fish health specialist for each facility. If antibiotic therapy is advised, fish health personnel	Guideline 3.4.1. Re-occurring mortality, or repeated use of antibiotics or chemicals to control mortality, generally indicates that underlying fish culture,

Standard	Guideline
will culture bacterial pathogens to verify drug sensitivity. Post-treatment examinations of treated units are conducted to evaluate and document efficacy of antibiotic or chemical treatments. Consistency with Standard Unknown	nutritional or environmental problems are not being fully remediated and should be further investigated.
Comment: Unknown due to lack of fish health documentation.	
Standard 3.5: Examinations of fish are conducted prior to release or transfer to ensure fish are in optimum health condition, can tolerate the stress associated with handling and hauling during release, and can be expected to perform well in the natural environment after release. Consistency with Standard Unknown.	Guideline 3.5.1. Review transportation protocols with appropriate hatchery staff to ensure fish are handled and hauled in a manner that minimizes stress and provides the best opportunity for survival.
Comment: Unknown due to lack of fish health documentation.	*Comment: For state hatcheries, a more thorough assessment of smoltification is recommended prior to release.*
Standard 3.6: Annual reporting standards and guidelines will be followed for fish health reports, including results of adult inspections, juvenile monitoring and treatments administered, and pre-liberation examinations for each hatchery program. A cumulative five year disease history will be maintained for each program and reported in annual or other appropriate facility reports. Standard NOT met.	Guideline 3.6.1. Include an annual fish disease assessment for each program in the hatchery annual report (see Standard 3.14).
Comment: Unknown due to lack of fish health documentation.	
Standard 3.7: Fish health status of stock is summarized prior to release or transfer to another facility. Consistency with Standard Unknown.	Guideline 3.7.1. Written reports should include findings of monitoring and laboratory results. For fish transfers, feeding regime, and current growth rate, and any other information necessary to assist fish culturists at the receiving station, should be provided.
Comment: Unknown due to lack of fish health documentation.	

Table 21. Facility Requirements.

Standard	Guideline
Standard 3.8: Physical facilities and equipment are adequate, and operated in a manner that promotes quality fish production and optimum survival throughout the rearing period. If facilities are determined to be inadequate to meet all program needs, and improvements are not feasible, then the hatchery program(s) must be re-evaluated within the context of what the facility can support without compromising fish culture and/or fish health, or causing adverse interactions between hatchery and natural fish populations.	Guideline 3.8.1. Facilities and equipment should allow: effective capture and holding of adults, appropriate incubation and rearing units with adequate capacity to meet program size, equipment and/or methods for effective predator control, and release of fish without undue stress or harm. (see Section 4.1.1, Broodstock Management for additional adult holding requirements).
	Guideline 3.8.2. Hatchery managers, fish health specialists, biologists, and fish culturists should

Standard	Guideline
Standard NOT met.	identify facility/equipment deficiencies that constrain hatchery operations and/or prevent the facility from meeting program goals. Such facility deficiencies or constraints should be communicated to resource managers for remedy or redress.
	Guideline 3.8.3. When physical facility and/or equipment needs exist, resource managers and appropriate funding source(s) should actively pursue facility maintenance, upgrades or equipment needs through a prioritized budget process. In the interim, modifications should be made to program goals to minimize adverse impacts to fish culture and/or fish health.
	Comment: The adult spawning facility is inadequate to meet current needs for fish sorting, spawning and monitoring and should be upgraded.
Standard 3.9: Distinct separation of spawning operations, egg incubation, and rearing facilities is maintained through appropriate sanitation procedures and biosecurity measures at critical control points to prevent potential pathogen introduction and disease transmission to hatchery or natural fish populations, as follows: a) Disinfect/water harden eggs in iodophor prior to entering “clean” incubation areas. In high risk situations, disinfect eggs again after shocking and picking, or movement to another area of the hatchery. b) Foot baths containing appropriate disinfectant will be maintained at the incubation facility’s entrance and exit. Foot baths will be properly maintained (disinfectant concentration and volume) to ensure continual effectiveness. c) Sanitize equipment and rain gear utilized in broodstock handling or spawning after leaving adult area. d) Sanitize all rearing vessels after eggs or fish are removed and prior to introducing a new group. e) Disinfect equipment, including vehicles used to transfer eggs or fish between facilities, prior to use with any other fish lot or at any other location. Disinfecting water should be disposed of in properly designated areas. f) Sanitize equipment used to collect dead fish prior to use in another pond and/or fish lot. g) Properly dispose of dead adult or juvenile fish, ensuring carcasses do not come in contact with water supplies or pose a risk to hatchery or natural populations. Standard met.	
Standard 3.10: All hatchery water intake systems follow federal and state fish screening policies.	Guideline 3.10.1. Follow existing statutes, including NEPA, CEQA, ESA, CESA, and current court decisions.

Standard	Guideline
Standard NOT met.	
Comment: CDFG statewide fish screening policy provides that under the provisions of U.S. Fish & Wildlife Coordination Act the CDFG shall require the installation of fish screens on all unscreened diversions where fish are present (i.e., hatchery intake).	

Table 22. Fish Health Management Plans.

Standard	Guideline
Standard 3.11: Fish Health Management Plans (FHMP) similar to or incorporated within an HGMP have been developed. The FHMP will: a) Describe the disease problem in adequate detail, including assumptions and areas of uncertainty about contributing risk factors. b) Provide detailed remedial steps, or alternative approaches and expected outcomes. c) Define performance criteria to assess if remediation steps are successful and to quantify results when possible. d) Include scientific rationale, study design, and statistical analysis for proposed studies aimed at addressing disease problems or areas of uncertainty pertaining to disease risks. Standard NOT met.	Guideline 3.11.1. Compliance with the FHMP should be reviewed annually, through the hatchery coordination team, and include any new data or information that may inform actions or decisions to address disease concerns.
Comment: New standard to be initiated.	

Table 23. Water Quality.

Standard	Guideline
Standard 3.13: Existing facilities strive for suggested water chemistry and characteristics (IHOT 1995, Wedemeyer 2001) which may require water filtration and disinfection, additional heating or cooling, degassing and/or aeration, or other modifications to the quantity and quality of an existing water supply, as follows: a) Pathogen-free water supplies will be explored for each facility, particularly for egg incubation and early rearing. b) Water supplies must provide acceptable temperature regimes for egg incubation, juvenile rearing, and adult holding. c) Water supplies will have appropriate water chemistry profiles, including dissolved gases: near saturation for oxygen, and less than saturation for nitrogen. d) Water supplies for egg incubation must not contain excessive organic debris, unsettleable solids or other characteristics that negatively affect egg quality and survival. Standard met.	

Table 24. Best Management Practices.

Standard	Guideline
Standard 3.14: The rationale, benefits, risks, and expected outcomes of any deviations from established best management practices[8] for fish culture and fish health management are clearly articulated in the hatchery operational plan (including specific fish culture procedures), Hatchery and Genetic Management Plan (HGMP), Fish Health Management Plan, the hatchery coordination team process, and/or in annual written reports. Standard NOT met.	Guideline 3.14.1. Develop required plans.
	Comment: Deviations from BMPs are to be described and documented in a hatchery operational plan (specific Fish Culture Procedures), a Fish Health Management Plan, the hatchery coordination team process, and/or in annual written reports.
Standard 3.15: Information on hatchery operations is collected, reviewed, and reported in a timely, consistent, and scientifically rigorous manner (see requirements and list of reporting parameters in Section 4.4, Monitoring and Evaluation (M&E)). Standard NOT met.	Guideline 3.15.1. An annual report containing monitoring and evaluation information (see M&E standards), including pathogen prevalence, fish disease prevalence, and treatment efficacies, should be produced in a time such that the information can be used to inform hatchery actions during the following brood cycle.
Standard 3.16: Eggs are incubated using best management practices and in a manner that ensures the highest survival rate and genetic contribution to the hatchery population, as follows: a) Eggs are incubated at established temperatures, egg densities, and water flows for specific species. Appropriate egg incubation parameters are identified in Hatchery Performance Standards (IHOT 1995, Chapter 4) or Fish Hatchery Management (Wedemeyer 2001). b) Incubation techniques should allow for discrimination of individual parents/families where required for program goals (e.g., for conservation-oriented programs and steelhead programs, or to exclude families for genetic (hybridization) or disease culling purposes). c) Eggs in excess of program needs are discarded in a manner that is consistent with agency policies and does not pose disease risks to hatchery or natural populations. Standard NOT met.	Guideline 3.16.1. Culling should be done to minimize unintentional selection.
	Guideline 3.16.2. Excess eggs are culled in a manner that does not eliminate representative families or any temporal segment of the run; and culled in portions that are representative of the entire run. Culling may be done to change the variance in family size.
	Guideline 3.16.3. Non-representative culling may occur to achieve specific program goals, but must be justified based on genetic considerations of maintaining or rebuilding desired characteristics of the spawning stock.
	Guideline 3.16.4. Eggs, fry, or juvenile fish in excess of production needs are disposed of in a manner that is consistent with agency policies on egg culling and fish disposal and will not be released, and should have no effects on natural populations.
	Comment: Guideline 3.16.2 is not always followed.
Standard 3.17: Fish are reared using best management practices and in a manner that promotes optimum fish health to ensure a high survival rate to the time of release, and provides a level of survival after-release appropriate to achieve program goals, while minimizing adverse impacts to natural fish populations, as follows: a) Fish performance standards (i.e., species-specific metrics	Guideline 3.17.1. Feeding practices should supply feed at a rate that is quickly consumed by juvenile fish, and does not permit excess feed to accumulate in rearing units. Excess or uneaten food has a high potential to increase organic loads in the rearing unit that can lead to fish pathogen amplification and disease outbreaks.

[8] Best management practices are procedures for operating hatchery programs in a defensible scientific manner to: 1) utilize well established and accepted fish culture techniques and fish health methodologies to ensure hatchery populations have the greatest potential to achieve program goals and, 2) minimize adverse ecological interactions between hatchery and natural-origin fish.

Standard	Guideline
for size, weight, condition factor, and health status) will be established for all life stages (fry, fingerling, and yearling) at each facility. b) Fish nutrition and growth rates are maintained through the proper storage and use of high quality feeds. Appropriate feeding rates will be closely monitored and adjusted as needed to accommodate fish growth/biomass in rearing units. c) Juvenile fish will be reared at density and flow indices and temperature that promote optimum health. Appropriate density and flow requirements for anadromous fish are identified in Hatchery Performance Standards Policy (IHOT 1995, Chapter 4) or in a comparable reference such as Fish Hatchery Management (Wedemeyer 2001). d) Appropriate growth strategies will be developed, with particular attention to photoperiod, temperature units, and feeding rates to optimize parr-to-smolt transformation, to ensure juvenile fish reach target size-at-release and are physiologically ready to out-migrate and survive saltwater entry. Standard NOT met.	Guideline 3.17.2. Fish Health specialists should be promptly contacted when fish feeding behavior appears abnormal or when fish stop feeding. Guideline 3.17.3. Stress induced infections or diseases, related to crowding or high rearing densities, should be minimized to promote optimal growth, and to avoid excessive use of therapeutics (antibiotic medicated feed or chemical treatments). Guideline 3.17.4. Rearing strategies will optimize the physical layout and use of rearing units at the facility to minimize handling of juvenile fish for inventory, transfer between rearing units, or tagging purposes. Preferably, fish are placed in units that allow adequate space and flows to permit extended periods of growth with no handling.
Comment: No fish performance standards; growth strategies do not meet size at release goals.	*Comment: Performance standards for each phase of the fish culture process should be established and tracked annually. Summaries of data collected with comparisons to established targets must be included in annual hatchery reports.* *Fish growth trajectories need to be monitored more closely to achieve the identified release target of 90 fpp for sub-yearlings and 10 fpp for yearlings. Data supplied by the hatchery indicate that average release size for the two respective groups has been 108 fpp and 15.4 fpp from 2000-2010.*

4.3.4 Monitoring and Evaluation

Table 25. Hatchery and Genetic Management Plans.

Standard	Guideline
Standard 4.1: Each hatchery program is thoroughly described in a detailed operational plan such as an HGMP or Biological Assessment. Operational plans are regularly updated to reflect updated data, changes to goals and objectives, infrastructure modifications, and changing operational strategies. Standard NOT met.	

Table 26. Hatchery Evaluation Programs.

Standard	Guideline
Standard 4.2: For each hatchery, a Monitoring and Evaluation program dedicated to reviewing the hatchery's achievement of program goals and assessing impacts to naturally produced fish must be established. Each M&E program will describe and implement a transparent, efficient, and timely process to respond to requests for experimental fishes, samples, and data. Standard NOT met.	Guideline 4.2.1. Hatchery Monitoring and Evaluation programs should be outside the direct hatchery line-of-command so they have a large degree of independence and autonomy from decisions made at the hatchery level. Program member expertise should include fish biology, population ecology, genetics, field sampling methods, experimental design and survey sampling strategies, database creation and management, and statistical analysis. Descriptions of specific monitoring and evaluation programs may be included as part of HGMPs.
Comment: The program lacks an annually updated, written plan describing program goals, operations and results. An HGMP has not been developed for this program.	*Comment: A Monitoring and Evaluation Program should be developed and implemented and a Hatchery Coordination Team formed for the program. Implementation of these processes will inform hatchery decisions and document compliance with best management practices defined in this report.*

Table 27. Hatchery Coordination Teams.

Standard	Guideline
Standard 4.3. A Hatchery Coordination Team has been created for each hatchery. Standard NOT met.	Guideline 4.3.1. Hatchery Coordination Teams should be comprised of hatchery managers, hatchery biologists/fish culturists, monitoring and evaluation biologists, fish health specialists, regional fish biologists, and fishery managers.
Comment: The program lacks an annually updated, written plan describing program goals, operations and results. An HGMP has not been developed for this program.	*Comment: Current M&E program does not provide data to adaptively manage the program.*

Table 28. In-Hatchery Monitoring and Record Keeping.

Standard	Guideline
Standard 4.4: The monitoring and record keeping responsibilities listed below are carried out on an annual basis in-hatchery for each anadromous salmonid program. Summaries of data collected, with comparisons to established targets, are included in annual hatchery program reports, and individual measurements (unless otherwise indicated) are store in electronic data files. Sample sizes indicated are provisional pending further consideration (see Section 6.2). A complete list of required and recommended data collection and reporting is provided in Appendix IV. a) Record date, number, size, age (if available), gender, and origin (natural or hatchery; hatchery- and basin-specific when available) of (a) all hatchery returns and (b) fish actually used in spawning. (Summaries in annual reports; individual measurements in electronic files.) b) Record age composition of hatchery returns, as	

Standard	Guideline
determined by reading scales and/or tags, from a systematic sample of the hatchery returns (n>550, or all returns for programs with less than 550 returns). c) Record sex-specific age composition of the fish spawned, as determined by reading scales and/or tags, from a systematic sample of the fish spawned (n>550, or all spawned fish for programs with less than 550 spawned fish). d) Describe in detail the spawning protocols used for each program (by family group for conservation-oriented programs), including the number of times individual males were used. e) Describe in detail the culling protocols used for each program, including purpose. f) Calculate and record effective population size (in conservation-oriented programs). g) Measure and record mean egg size, fecundity, and fish length for each individual in a systematic sample of spawned females (n>50), to establish and monitor the relation between fecundity, egg size, and length in the broodstock. (Include a table of all measurements in annual report.) h) Record survival through the following life stages: green egg to eyed egg, eyed egg to hatch, hatch to ponding, ponding to marking/tagging, and marking/tagging to release. i) Record mean, standard deviation, and frequency distribution based on n>100 measurements of fish length, by raceway, at periodic intervals (no less than monthly) prior to release and at time of release for all release types, to assess trends and variability in size throughout the rearing process. (Report means and standard deviations in annual reports; individual measurements and frequency distributions in electronic files.) j) Maintain records of disease incidence and treatment, including monitoring of treatment efficacy. k) Report CWT releases and recoveries to relevant databases (i.e., RMIS) on a timely annual basis. Standard NOT met.	
Comment: In-hatchery data are generally lacking for a number of important biological criteria.	*Comment: Performance standards for each phase of the fish culture process should be established and tracked annually. Summaries of data collected with comparisons to established targets must be included in annual hatchery reports.* *CWT releases and recoveries of fall Chinook should be reported annually to RMIS in a timely manner.*

Table 29. Marking and Tagging Programs.

Standard	Guideline
Standard 4.5: Chinook salmon marking and tagging programs allow for: a)Estimation of ocean and freshwater fishery impacts, and natural area and hatchery escapement at the age-, stock- and release group-specific levels, b)Estimation of the proportion of hatchery-origin fish in natural spawning areas, c) Estimation of the proportion of natural-origin fish in hatchery broodstock, d) Real-time identification of hatchery-origin juveniles and adults (i.e., hatchery vs. non-hatchery origin), e) Identification of stock of origin for hatchery-origin fish, f) Real-time identification of yearling vs. fingerling release-type fish at the adult stage. Standard NOT met.	Guideline 4.5.1. For mitigation/harvest programs (fall-, late fall-, and spring-run), all releases should be 100 percent CWT and 25 percent adipose fin-clipped. Yearling releases should receive an additional distinguishing external mark or tag (e.g., a ventral fin-clip) allowing real-time discrimination from fingerling releases at the adult stage. Deviation from this guideline must be rigorously justified, and in no circumstance can marking and tagging programs fail to meet Standard ((a) through (f) above).
Comment: Currently only 25 percent of fish receive a coded wire tag.	*Comment: Program fish should be 100 percent coded wire tagged and 25 percent adipose fin-clipped. Yearlings should be marked or tagged in a manner that allows real-time discrimination from fingerling releases at the adult stage.*

Table 30. Post-Release Emigration Monitoring.

Standard	Guideline
Standard 4.8: The quantities listed below are monitored in the freshwater environment following release of juvenile Chinook and coho. Summaries of collected data and associated estimates, along with comparisons to established targets, are included in annual or periodic (every 5 to 10 years) reports produced by the monitoring agencies/entities. a) Annual: Document length (mean, standard deviation, and frequency distribution) of hatchery fish at release as compared to naturally produced smolts. b) Periodic: Document the number of days (mean, standard deviation, and frequency distribution) from release of hatchery fish to passage at a location near entry to salt water (e.g., using PIT tags/detectors or acoustic tags/arrays) and the degree of overlap with natural-origin fish. c) Periodic: Estimate the percent hatchery-origin fish among outmigrating juveniles and, where feasible, estimate total juvenile production. Standard NOT met.	
Comment: Post release information on juvenile NORs and HORs is unavailable.	

Table 31. Adult Monitoring Programs.

Standard	Guideline
Standard 4.10: Monitoring programs for Chinook salmon allow for estimation of the following on an annual basis. a) Total recreational and commercial ocean harvest, and harvest of hatchery-origin fish at the age-, stock-, and release group-specific (CWT) level, b) Total freshwater harvest, and harvest of hatchery-origin fish at the age-, stock-, and release group-specific (CWT) level, c) Total returns (hatchery- and natural-origin) to hatchery, and returns at the age-, stock-, and release group-specific (CWT) level, d) Age composition of hatchery returns, e) Total escapement by tributary and by species/run, f) Proportion of hatchery-origin fish among natural area spawners (pHOS) by tributary and at age-, stock-, and release group-specific (CWT) level, g) Age composition of individual tributaries important for natural production. Standard NOT met.	
Comment: Impacts of hatchery fish on NORs is not quantified. An estimated percent of first generation hatchery and natural fish on the spawning grounds is not known. Coded wire tag recovery data is not provided to Regional Mark Processing Center (RMIS) in a timely fashion, preventing total survival estimates. Hatchery has no genetic monitoring plan for this program.	

Table 32. Evaluation Programs.

Standard	Guideline
Standard 4.13: Evaluation programs for Chinook salmon assess the following fundamental issues on a brood-specific basis: a) Survival from release to pre-fishery recruitment, b) Age-specific maturation schedules, c) Straying (here defined as failure of hatchery-origin fish to return to the hatchery from which they originated or to the watershed in the immediate vicinity of the hatchery), d) Age-specific fishery contribution rates, e) Pre-fishery age-3 ocean recruitment. Evaluation programs for Chinook salmon assess the following fundamental issues on a periodic basis (e.g., every 5 to 10 years): f) The relationship of hatchery fish survival rates and maturation schedules to size and/or date of release; g) Long-term trends in phenotypic traits (age, maturity, fecundity at size, run/spawn timing, size distribution) and	Guideline 4.13.1. Use tag recovery data and cohort reconstruction (cohort analysis) methods to estimate the following quantities. In the future, alternative technologies or analytical methods may generate other data suitable for estimating these quantities. • Brood survival from release to ocean age-2 at the release group-specific (CWT) level, • Brood maturation schedule (age-specific conditional maturation probabilities) at the release group-specific (CWT) level, • Straying and geographic distribution of stray hatchery-origin fish at the release group-specific (CWT) level, • Age-specific ocean and freshwater fishery contributions and exploitation rates at the release group-specific (CWT) level, • Pre-fishery ocean recruitment of hatchery-

Standard	Guideline
genetic traits (divergence among year classes, effective population size, divergence from natural populations) of hatchery populations; h) Spatial and temporal overlap and relative sizes of emigrating juvenile hatchery- and natural-origin fish and total (hatchery plus natural-origin) spawner distribution and densities to assess the likelihood or magnitude of deleterious effects of hatchery-origin fish on naturally spawning fish due to competition, predation, or behavioral effects. Standard NOT met.	origin fish at age-3 at the release group-specific (CWT) and program level.

4.3.5 *Direct Effects of Hatchery Operations on Local Habitats, Aquatic or Terrestrial Organisms.*

Table 33. Direct Effects of Hatchery Operations.

Standard	Guideline
Standard 5.1: Hatchery operations/infrastructure is integrated into local watershed restoration efforts to support local habitat restoration activities. Standard met.	
Comment: Hatchery is currently involved in general restoration efforts.	
Standard 5.2: Hatchery infrastructure is operated in a manner that facilitates program needs while reducing impacts to aquatic species, particularly listed anadromous salmonids. Standard NOT met.	Guideline 5.2.2. Consider screening needs of facility water supply intakes in non-anadromous waters to protect other ESA or CESA listed organisms. Design and operation of facility water diversion/supply structures also needs to consider operational flexibility to avoid catastrophic facility water loss due to debris loading or other failure.
Comment: The requirements for screening of the water supply is unknown for the protection of species in reservoir.	
Standard 5.3: Effluent treatment facilities are secure and operated to meet NPDES requirements. Standard met.	
Standard 5.4: Current facility infrastructure and construction of new facilities avoid creating an unsafe environment for the visiting public and staff and provide adequate precautions (e.g., fencing and signage) where unsafe conditions are noted. Standard met.	

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California Hatchery Review Project

Appendix VIII

Trinity River Hatchery Fall Chinook Program Report

Appendix A-1

June 2012

APPENDIX A-1

HATCHERY PROGRAM REVIEW QUESTIONS
TRINITY RIVER HATCHERY FALL CHINOOK

BACKGROUND INFORMATION

1 Trinity Hatchery: Trinity Fall Chinook Program

Hatchery:

Trinity Hatchery

Program:

Trinity River Fall Chinook

2 Species and Population (or stock) under Propagation and ESA Status

Species:

Fall Chinook

ESA Status:

N/a – not listed

3 Responsible Organization and Individuals

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4 Funding Source, Staffing Level, and Annual Hatchery Program Operational Costs

The Bureau of Reclamation, Northern California Area Office, provides funding for operation and monitoring of the TRH. Annual operations and monitoring costs are approximately $887,000 as of FY 2007for all programs combined (excluding fish food costs).

The CDFG operate and maintain the Trinity River Hatchery (TRH) under contract from Reclamation. The TRH crew consists of six fish and wildlife technicians, two managers, two fish and wildlife seasonal aides, and one half-time secretary.

5 Location(s) of Hatchery and Associated Facilities (weirs, etc.)

The TRH is located at RM 110 on the Trinity River at the base of the Lewiston Dam, near the town of Lewiston in Trinity County, California. Lewiston Dam is now the upstream limit of anadromy on the Trinity River. There are no acclimation facilities; juvenile fish are released volitionally into the Trinity River at the juvenile release outlet.

6 Type of Program

Integrated program for harvest.

7 Purpose (Goal) of Program

Mitigation for the loss of spawning habitat due to the development of Trinity and Lewiston Dams.

Hatchery operations compensate for lost spawning and rearing habitat resulting from damming the Trinity River by the Trinity River Project (Trinity and Lewiston Dams), completed in 1963.

8 Justification for the Program

A substantial portion of the Trinity's flow is diverted to the Central Valley for agricultural, municipal and industrial uses. Lewiston Dam blocks access to 109 miles of salmon and trout spawning and rearing habitat in the upper river. TRH was constructed at the base of Lewiston Dam to mitigate for the loss of anadromous fish habitat.

Additional: Please provide a summary of the program history.

This hatchery program was intended to compensate for the loss of salmon and steelhead caused by the Trinity River component of the Central Valley Project (specifically Trinity and Lewiston dams and flow diversions to Clear Creek). Hatchery program objectives were defined in 1956 by the USFWS and CDFG.

Trinity River Hatchery has operated continuously since 1960. The program maintains public and Tribal Trust resources affected by the lost habitat. Monitoring is conducted to reduce hatchery competition and interaction with natural stocks.

HATCHERY OPERATION PHASE: BROODSTOCK CHOICE

1 Do the broodstocks represent natural populations native to the watersheds in which hatchery fish will be released?

Clarification:

The watershed populations are those that will be evaluated by the Review Panel. Does broodstock represent a) one native population, b) a mixture of local native populations, or c) one or more nonnative populations?

Relationship to Outcomes/Goals:

This program uses a broodstock representing populations native to the watershed, which increases the likelihood of long-term survival of the stock, helps avoid loss of population diversity, and reduces the likelihood of unexpected ecological interactions.

Answer:

Yes.

2 Was the best available broodstock selected for this program?

Clarification:

This question applies to situations where the native populations are extirpated. The concern is that the best possible broodstock may not be the one selected.

Relationship to Outcomes/Goals:

Choice of a broodstock with a similar life history and evolutionary history to the extirpated stock improves the likelihood of successful reintroduction.

Answer:

N/A.

3 Does the broodstock display morphological and life history traits similar to the natural population?

Clarification:

The Review Panel will need to distinguish lineage of a population (that may be connected to an environment that no longer exists) from current environment and current fish performance.

Relationship to Outcomes/Goals:

Choice of a broodstock with similar morphological and life history traits improves the likelihood of the stock's adaptation to the natural environment.

Answer:

Yes.

4 Does the broodstock have a pathogen history that indicates no threat to other populations in the watershed?

Clarification:

Request a 5-year pathogen history.

Relationship to Outcomes/Goals:

The broodstock chosen poses no threat to other populations in the watershed from pathogen transmission.

Answer:

Yes. There is an annual Fish Pathogen test. It is assumed that the pathogens present in the basin are similar to the NOR and HOR populations. A summary of the results of the Fish Pathologist test is provided in Appendix A-3.

5 Does the broodstock have the desired life history traits to meet harvest goals (e.g., timing and migration patterns that result in full recruitment to target fisheries)?

Clarification:

This question applies only to segregated programs with the sole purpose of providing fish for harvest. (This question is not relevant to the K-T. It may be relevant in the Central Valley to capture the intent of program(s) specifically for harvest.)

Relationship to Outcomes/Goals:

The broodstock chosen is likely to have the life history traits to meet harvest goals for the target stock without adversely affecting other stocks.

Answer:

N/a.

10 Is the percent natural-origin fish used as broodstock for this program estimated?

Clarification:

[This question is out of order based on ID number, but should go before the next question.]

Relationship to Outcomes/Goals:

Estimating the proportion of natural fish used for broodstock makes it possible to determine whether composition targets have been met and prevents masking of the status of both the hatchery and natural populations.

Answer:

Yes. This number can be estimated after spawning based on CWT.

6 What is the percent natural-origin fish in the hatchery broodstock?

Clarification:

Relationship to Outcomes/Goals:

Estimating the proportion of natural fish used for broodstock makes it possible to determine whether composition targets have been met and prevents masking of the status of both the hatchery and natural populations.

Answer:

Ranges annually, typically between 5 and 15%.

7 Do natural-origin fish make up less than 5% of the broodstock for this program?

Clarification:

This question does not apply to integrated programs. [It it may be relevant in the Central Valley.]

Relationship to Outcomes/Goals:

Maintaining a segregated hatchery population composed of less than 5% natural fish reduces the risk of loss of population diversity.

Answer:

No.

HATCHERY OPERATION PHASE: BROODSTOCK COLLECTION

11 Are adults returned to the river?

Clarification:

If the answer is YES, then describe the purpose of returning fish to the river. For example, fish returned to river may be subject to additional harvest. Alternatively, fish may be returned to river to supplement the natural population (a conservation purpose).

Relationship to Outcomes/Goals:

Not returning adults to the lower river to provide additional harvest reduces the likelihood of straying and unintended contribution to natural spawning.

Answer:

No.

12 Are representative samples of natural and hatchery population components collected with respect to size, age, sex ratio, run and spawn timing, and other traits important to long-term fitness?

Clarification:

For integrated populations, consider both natural and hatchery components.
For segregated populations, consider only the hatchery component.

Ask the following questions twice: first about hatchery fish; second about wild fish being incorporated into hatchery stock:

How many males and females are collected for broodstock? Are adults collected over entire migration/spawn period? How many females and males are collected, and does the hatchery program attempt to equalize the number of males and females?

Relationship to Outcomes/Goals:

Collecting representative samples of both the natural and hatchery populations reduces the risk of domestication and loss of within-population diversity.

Answer:

No.

Hatchery Fish: Sex, length, ad clip, age (from CWT and scale analysis), run timing, spring/fall overlap, (No condition factor) for all fish used in broodstock. Wild fish used in brood can't be differentiated from hatchery fish.

Wild Fish: Sex, length, run timing, spring/fall overlap, (No condition factor) for wild fish at the hatchery. A basin wide estimate for wild fish in the wild for run timing, length, sex ratio,

13 Does the proportion of the spawners brought into the hatchery follow a "spread-the-risk" strategy that attempts to improve the probability of survival for the entire population (hatchery and natural components)?

Clarification:

The Review Panel will also consider timing of run and collection over all components of the run. [This question is particularly relevant to the coho programs in the Klamath/Trinity.]

Relationship to Outcomes/Goals:

The proportion of spawners brought into the hatchery improves the likelihood that the population will survive a catastrophic loss from natural events or hatchery failure.

Answer:

Yes.

14 Is the effective population size being estimated each year?

Clarification:

How many fish are mated each year? What is the age of fish mated, the family size variation, and how many total parents were used to produce offspring released? The Review Panel will use this information to evaluate program's effective population size.

Relationship to Outcomes/Goals:

Sufficient broodstock are collected to maintain genetic variation in the population.

Answer:

No. The data needed to calculate effective population size is being collected, but the estimate is not made each year.

15 Within the last 10 years, has the program used only eggs or fish from within the watershed?

Clarification:

If YES, is there a fish health policy that is in place for egg/fish transfers? If so, please provide a copy.

If the answer is NO, how many years and how many fish? Have fish been exported from this program in the last 10 years?

If the answer is NO, were transfers into this population extensive in the more distant past? (This question may be especially important in a segregated program where few natural fish are included in broodstock but large number of hatchery fish stray and spawn naturally.)

Relationship to Outcomes/Goals:

Avoiding stock transfers from outside of the watershed promotes local adaptation and reduces the risk of pathogen transmission.

Answer:

Yes, the program has not used fish from out of the basin.

Yes, there is a fish health policy in place (Dr. Cox memo).

16 Is the broodstock collected and held in a manner that results in less than 10% pre-spawning mortality?

Clarification:

If NO, ask questions to help the Review Panel evaluate the cause and consequences of pre-spawning mortality. What is the pre-spawning mortality in the program? Why does it exceed 10%? Are there any issues with bias in pre-spawning mortality? Are there facility needs that would reduce mortality?

Relationship to Outcomes/Goals:

Maintaining pre-spawning survival higher than 90% maintains an effective population size and reduces domestication selection.

Answer:

Yes. The spawning matrix is made up of ripe fish that either enter the facility or are held until they are ripe. Fish at the beginning of the run are typically held for several weeks until the size of the run can be estimated. Fish in excess of broodstock needs are destroyed on each spawning day. Limited adult holding (up to about 1,000 adults) requires fish to be either spawned or killed on any given day.

17 Does the program have guidelines for acceptable contribution of hatchery-origin fish to natural spawning?

Clarification:

If YES, describe your guidelines.

Relationship to Outcomes/Goals:

Having established guidelines for acceptable contribution of hatchery-origin fish to natural spawning provides a clear performance standard for evaluating the program.

Answer:

No, there is no numerical target, however qualitatively the hatchery attempts to reduce the impacts of hatchery fish on natural spawning. Adults are not returned to the river to contribute to natural spawning. Policy says hatchery ladder will be open unless there are logistical constraints to opening it.

18 Are guidelines for the hatchery contribution to natural spawning met for all affected naturally spawning populations?

Clarification:

Request a table of the estimated hatchery contribution to the spawning population.

Relationship to Outcomes/Goals:

The rate of hatchery contribution to natural spawning populations maintains population diversity and promotes adaptation to the natural environment.

Answer:

N/A.

Qualitative targets are being met through hatchery operations.

HATCHERY OPERATION PHASE: ADULT HOLDING

19 Is the water source [for adult holding] pathogen free?

Clarification:

If NO, what specific pathogens are in the water supply?

Relationship to Outcomes/Goals:

Fish health is promoted by the absence of specific pathogens during adult holding.

Answer:

No, surface water is used. *Saprolignia* fungus and *Aeromonas* and *Psuedomonas* bacteria may be present.

20 Does the water used [for adult holding] result in natural water temperature profiles that provide optimum maturation and gamete development?

Clarification:

Are there any issues with egg quality (fertilization, soft-shell, coagulated yolk, etc.) at the facility?

Relationship to Outcomes/Goals:

Use of water resulting in natural water temperature profiles for adult holding ensures maturation and gamete development synchronous with natural stocks.

Answer:

Yes. Currently, the temperature profile is significantly modified during summer months due to dam developments.

River flow modifications have led to change in egg size and gamete development (2000 Record of Decision – flows changed in 2004).

21 Is the water supply [for adult holding] protected by flow alarms?

Clarification:

Relationship to Outcomes/Goals:

Broodstock security is maintained by flow and/or level alarms at the holding ponds.

Answer:

Yes.

22 Is the water supply [for adult holding] protected by back-up power generation or a fail-safe back-up water supply?

Clarification:

Relationship to Outcomes/Goals:

Broodstock security is maintained by back-up power generation for the pumped water supply.

Answer:

Yes. All gravity flow. Gravity flow is considered a fail-safe suppy.

HATCHERY OPERATION PHASE: SPAWNING

23 Does the program have a protocol for mating?

Clarification:

If yes, what is the protocol?

Relationship to Outcomes/Goals:

Random mating maintains within-population diversity.

Answer:

Yes, spawners are selected randomly from adults that are ripe that day.

24 Does the program conduct single-family pairing prior to fertilization?

Clarification:

Relationship to Outcomes/Goals:

Single family pairing increases the effective population size of the hatchery stock.

Answer:

No.

25 Are multiple males used in the spawning protocol?

Clarification:

Relationship to Outcomes/Goals:

Use of back-up males in the spawning protocol increases the likelihood of fertilization of eggs from each female.

Answer:

N/A.

26 Are precocious fish (jacks and jills) used for spawning according to a set protocol?

Clarification:

Is the rate of juvenile male precocity tracked near release time? If so, provide the rate for the past 5 years (if available).

Relationship to Outcomes/Goals:

Use of precocious males for spawning as a set percentage or in proportion to their contribution to the adult run promotes within population diversity.

Answer:

No, no jacks are used.

26A Additional Question: Does the program have guidelines or policies for ensuring long-term phenotypic and genetic distinctions between populations/runs/species?

Clarification:

For example, is more than one run of a given species produced at your hatchery (e.g., spring and fall Chinook; fall and late fall Chinook; summer and winter steelhead)?

If YES, what are these guidelines or policies? If NO, please explain.

Answer:

Yes. Guidelines include a break in the spawning period between the spring and fall Chinook spawning periods. This break is approximately 14 days according the historic spawning period (approximately October 12-25 according to work week). Hatchery is provided information from CWT analysis to determine overlap between the two races in order to cull eggs if needed.

HATCHERY OPERATION PHASE: INCUBATION

27 Is the water source for incubation pathogen-free?

Clarification:

If NO, what specific pathogens are in the water supply?

Relationship to Outcomes/Goals:

Fish health is promoted by the use of pathogen-free water during incubation.

Answer:

No – *Saprolignia* fungus and *Aeromonas* and *Psuedomonas* bacteria may be present.

29 Does the water used for incubation provide natural water temperature profiles that result in hatching/emergence timing similar to that of the naturally produced stock?

Clarification:

Relationship to Outcomes/Goals:

Use of water resulting in natural water temperature profiles for incubation ensures hatching and emergence timing similar to naturally produced stocks with attendant survival benefits.

Answer:

Yes.

30 Can incubation water temperature be modified?

Clarification:

If YES, why is the temperature manipulated? This question will be asked for all programs to provide information about the facility use (e.g., otolith marking).

Relationship to Outcomes/Goals:

The ability to heat or chill incubation water to approximate natural water temperature profiles ensures hatching and emergence timing similar to naturally produced stocks with attendant survival benefits.

Answer:

Yes. There is a limited capability to heat water. TRH has the capability to heat water for approximately 1M eggs.

31 Is the incubation water supply protected by flow alarms?

Clarification:

Relationship to Outcomes/Goals:

Security during incubation is maintained by flow alarms at the incubation units.

Answer:

Yes.

32 Is the water supply for incubation protected by back-up power generation or a fail-safe back-up water supply?

Clarification:

Relationship to Outcomes/Goals:

Security during incubation is maintained by back-up power generation for the pumped water supply.

Answer:

Yes, gravity fed. Gravity flow is considered a fail-safe supply.

33 Are eggs incubated under conditions that result in equal survival of all segments of the population to ponding?

Clarification:

The Review Panel wants to know if any portion of the eggs derives a survival advantage or disadvantage from incubation procedures. Respond NO if there is a survival advantage.

Please describe the survival profile during incubation. How does the program go about ensuring representation throughout the run?

Relationship to Outcomes/Goals:

Incubation conditions that result in equal survival of all segments of the population reduce the likelihood of domestication selection and loss of genetic variability.

Answer:

Yes. Eggs are incubated the same. There is no survival advantage for any one lot.

A profile of incubation survival can be found in Appendix A-3.

34 Are families incubated individually? (Include both eyeing and hatching)

Clarification:

Request information about when families are combined and what protocols are used. This question will be asked for all programs.

Are progeny from *R. salmoninarum* (BKD+) adult segregation? If so, for how long?

Relationship to Outcomes/Goals:

Incubating families individually maintains genetic variability during incubation.

Answer:

No. Multiple individuals are spawned together and incubated together.

36 Are agency or tribal species-specific incubation recommendations followed for flow rates?

Clarification:

Request information about these incubation recommendations or protocols.

Relationship to Outcomes/Goals:

Use of flow recommendations/protocols during incubation promote survival of eggs and alevin and allow for optimum fry development.

Answer:

Yes, according to Leitritz Fish and Game Bulletin 164.

37 Are agency or tribal species-specific incubation recommendations followed for substrate?

Clarification:

Request information about substrate recommendations or protocols.

Relationship to Outcomes/Goals:

Use of substrate during incubation limits excess alevin movement and promotes energetic efficiency.

Answer:

No, there are no substrate recommendations, so no substrate is used.

38 Are agency or tribal species-specific incubation recommendations followed for density parameters?

Clarification:

Request information about density recommendations or protocols. What density index is targeted? Is the facility able to maintain the prescribed Density Index throughout the entire rearing period? Are there facility needs that would assist in meeting optimum rearing conditions?

Relationship to Outcomes/Goals:

Use of density recommendations/protocols during incubation promote survival of eggs and alevin and allow for optimum fry development.

Answer:

Yes. Densities are based on best professional judgment and site specific successes.

39 Are disinfection procedures implemented during spawning and/or incubation that prevent pathogen transmission within or between stocks of fish on site?

Clarification:

Are there written protocols for egg disinfection following spawning and during incubation for the program? If so, what are they?

Relationship to Outcomes/Goals:

Proper disinfection procedures increase the likelihood of preventing dissemination and amplification of pathogens in the hatchery.

Answer:

Yes, water hardened in iodophor. See Rogers and Chapman 1991 (Dr. Cox document) for protocols. Iodophor is also used for fungus control during incubation prior to hatch. Use of formalin is not allowed at the facility.

40 Are eggs culled and if so, how is culling done?

Clarification:

Are eggs from Reni bacterium salmoninarum (BKD +) adults culled?

If YES, what are the criteria for initial egg culling? How are progeny segregated (what disease levels), and for how long (what determines when segregated rearing can be discontinued)?

Relationship to Outcomes/Goals:

Random culling of eggs over all segments of the egg-take maintains genetic variability during incubation.

Answer:

No. Eggs are culled to be representative of spawn timing. BKD culling not done for fall Chinook.

40A Additional Question: Would the program benefit by having an ability to chill or heat incubation water supply?

Answer:

No – not for fall Chinook.

HATCHERY OPERATION PHASE: REARING

41 Is the water source [for rearing] pathogen free?

Clarification:

If NO, what specific pathogens are in the water supply? Are standards in place for "acceptable mortality rates" for each component of the production cycle (eggs, fry, fingerlings)? What mortality level initiates fish health intervention?

Relationship to Outcomes/Goals:

Fish health is promoted by the absence of specific pathogens during rearing.

Answer:

No – *Saprolignia* fungus and *Aeromonas* and *Psuedomonas* bacteria may be present.

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42 Does the water used [for rearing] provide natural water temperature profiles that result in fish similar in size to naturally produced fish of the same species?

Clarification:

Relationship to Outcomes/Goals:

Use of natural water temperature profiles for rearing promotes growth of fish and smoltification synchronous with naturally produced stocks.

Answer:

Yes.

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43 Does the hatchery operate to allow all migrating species of all ages to bypass or pass through hatchery related structures?

Clarification:

If NO, explain the reason(s) why not all species or ages are passed.

Relationship to Outcomes/Goals:

Providing upstream and downstream passage for juveniles and adults of the naturally produced stocks supports natural distribution and productivity.

Answer:

N/A. No bypass facility – terminal due to dam blockage of system and lack of suitable habitat upstream.

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44 Is the water supply [for rearing] protected by flow alarms?

Clarification:

Relationship to Outcomes/Goals:

Security during rearing is maintained by flow and/or level alarms at the rearing ponds.

Answer:

Yes.

45 Is the water supply [for rearing] protected by back-up power generation or a fail-safe back-up water supply?

Clarification:

Relationship to Outcomes/Goals:

Security during rearing is maintained by back-up power generation for the pumped water supply.

Answer:

Yes – gravity fed. Gravity flow is considered a fail-safe supply.

46 Are fish reared under conditions that result in equal survival of all segments of the population to release? (In other words, does any portion of the population derive a survival advantage or disadvantage from rearing procedures? If so, then mark NO.)

Clarification:

Request the survival profile during rearing.

What are the juvenile mortality rates for the past five years?

Relationship to Outcomes/Goals:

Rearing conditions that result in equal survival of all segments of the population reduce the likelihood of domestication selection and loss of genetic variability.

Answer:

Yes – all equal. See Appendix A-3 for survival rates.

47 Does this program avoid culling of juvenile fish? If fish are culled, how are they selected to be culled? In the response, make sure to capture the number culled, and the rational for culling.

Clarification:

Are Rs clinical juveniles culled? If so, what are the criteria for culling?

Relationship to Outcomes/Goals:

Avoiding culling of juveniles maintains genetic variability during rearing.

Answer:

Yes. No juveniles are culled.

48 Is there a growth rate pattern that this program is trying to achieve?

Clarification:

If YES, what is the pattern?

If NO, what are the constraints to achieving this pattern?

Relationship to Outcomes/Goals:

Following proper feeding rates to achieve the desired growth rate improves the likelihood of producing fish that are physiologically fit, properly smolted, and that maintain the age structure of natural populations.

Answer:

Yes, growth rates are targeted size at time of release and follow feed manufacturer guideline.

49 Is there a specified condition factor that this program is trying to achieve?

Clarification:

If YES, what is this condition factor?

If NO, what are the constraints to achieving this condition factor?

Relationship to Outcomes/Goals:

Feeding to achieve the desired condition factor is an indicator of proper fish health and physiological smolt quality.

Answer:

Yes. Data is collected, but there is no target. We were not supplied with a condition factor but it appears to be included in the fish pathologist report.

50 Does the program use a diet and growth regime that mimics natural seasonal growth patterns?

Clarification:

If NO, describe the diet and growth regime used in the program and how it may differ from more natural patterns.

Are there any problems with male precocity rates in juveniles? If known, please provide rates.

Relationship to Outcomes/Goals:

Use of diet and growth regimes that mimic natural seasonal growth patterns promote proper smoltification and should produce adults that maintain the age structure of the natural population.

Answer:

No. Growth is maximized to achieve target release size.

51 Does the program employ any NATURES-type rearing measures, e.g., by providing natural or artificial cover, feeding, structures in raceways, predator training, etc?

Clarification:

Is bird/wildlife predation a problem at this facility? If so, what proportion of juvenile production do you estimate may be lost to predation in a given production period?

Relationship to Outcomes/Goals:

Providing artificial cover increases the development of appropriate body camouflage and may improve behavioral fitness.

Answer:

No, but ponds do have a bird exclosure.

52 Are fish reared in multiple facilities or with redundant systems to reduce the risk of catastrophic loss?

Clarification:

This question applies to conservation programs.

Relationship to Outcomes/Goals:

Maintaining the stock in multiple facilities or with redundant systems reduces the risk of catastrophic loss from facility failure.

Answer:

No.

53 Are agency or tribal juvenile rearing standards followed for flow rates?

Clarification:

Request information about these standards.

Relationship to Outcomes/Goals:

Following standards for juvenile loading maintains proper dissolved oxygen levels. This promotes fish health, growth and survival, and increases the likelihood of preventing dissemination and amplification of fish pathogens.

Answer:

Yes, according to Leitritz. Flow rates are also managed based on best professional judgment, and site specific successes.

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54 Are agency or tribal juvenile rearing standards followed for density?

Clarification/Input:

Request information about density standards for juveniles.

Are there prescribed Density Indices for juvenile rearing? If so, please provide.

Relationship to Outcomes/Goals:

Following standards for juvenile density maintain fish health, growth, and survival, and increases the likelihood of preventing dissemination and amplification of fish pathogens.

Answer:

Yes, according to Leitritz. Densities are also managed based on best professional judgment, and site specific successes.

54A Additional Question How are fish selected for programming and release as subyearlings vs. yearlings?

Clarification:

Request information about how subyearling and yearling fish are selected.

Relationship to Outcomes/Goals:

Answer:

Both smolts and yearlings are initially ponded together as part of the general population. Prior to CWT tagging for smolts, yearlings are selected and ponded separately. Yearlings are pulled out of the middle of spawn timing and would not represent the very early or very late egg take timing. This program has occurred for two-three years. Prior to that, yearlings were selected from the latest egg takes of the fall Chinook and there was a shift in the run timing.

HATCHERY OPERATION PHASE: RELEASE

59 Is there a protocol to produce fish to a set size at release (fpp and length)?

Clarification:

If so, what is the protocol? What is the basis for the set size at release?

Relationship to Outcomes/Goals:

Producing fish that are qualitatively similar to natural fish in size may improve performance and reduce adverse ecological interactions.

Answer:

Yes. Smolt goal set to 90 fpp. Yearling release size target set to 10 fpp.

60 Are there protocols for fish morphology at release?

Clarification:

If so, what is the protocol?

Are standards in place for functional morphology characteristics at release (general fish health condition such as minimal fin and/or opercular erosion, degree of silver coloration scale loss, or any noted gross abnormalities)?

Relationship to Outcomes/Goals:

Producing fish that are qualitatively similar to natural fish in morphology may improve performance and reduce adverse ecological interactions.

Answer:

No, but fish health assessments are done – fat content, smoltification, virology, bacteria and parasites are assessed.

61 Are there protocols for fish behavior characteristics at release?

Clarification:

If so, what is the protocol?

Relationship to Outcomes/Goals:

Producing fish that are qualitatively similar to natural fish in behavior may improve performance and reduce adverse ecological interactions.

Answer:

No.

62 Are there protocols for fish growth rates up to release?

Clarification:

If so, what is the protocol?

Relationship to Outcomes/Goals:

Producing fish that are qualitatively similar to natural fish in behavior may improve performance and reduce adverse ecological interactions.

Answer:

Yes, based on target release size and feed manufacturers recommendations.

63 Are there protocols for physiological status of fish at release?

Clarification:

If so, what is the protocol? Are gill ATPase and blood chemistry tested prior to smolt releases?

Relationship to Outcomes/Goals:

Producing fish that are qualitatively similar to natural fish in behavior may improve performance and reduce adverse ecological interactions.

Answer:

No.

64 Are there protocols for fish size and life history stage at release?

Clarification:

If so, what is the protocol?

Relationship to Outcomes/Goals:

Releasing fish at sizes and life history stages similar to those of natural fish of the same species may improve performance and reduce adverse ecological interactions.

Answer:

Yes, target release size for smolts is 90 fpp; yearling target release size is 10 fpp.

65 Are volitional releases during natural out-migration practiced?

Clarification:

The Review Panel noted that in some cases, a non-volitional release may be the best practice.

Follow up with implementation questions (how long is the volitional release period, what occurs if fish remain, etc.).

Relationship to Outcomes/Goals:

Volitionally releasing smolts during the natural outmigration timing may improve homing, survival, and reduce adverse ecological interactions.

Answer:

No, but fish are volitionally released after natural migration to minimize impacts on the natural spawning population.

66 Are there protocols for fish release timing?

Clarification:

If so, what are the protocols? When are fish released? What are the natural out-migration characteristics?

Relationship to Outcomes/Goals:

Releasing fish in a manner that simulates natural seasonal migratory patterns improves the likelihood that harvest and conservation goals will be met and may reduce potential adverse ecological impacts.

Answer:

Yes, release dates are set to minimize competition with natural juveniles. Smolts are released between June 1 and June 15, yearlings released between October 1 and October 15.

67 Are all hatchery fish released at or adjacent to the hatchery facility (on-site)?

Clarification:

If NO, describe off-site release locations. Describe the extent to which off-site release locations are used, and explain why they are used.

Relationship to Outcomes/Goals:

Answer:

No, Screw trap studies (to continue for two more years)– 85,000 fall Chinook (25% marked), 50,000 spring (not marked) Chinook for calibration of mainstem Trinity rotary screw traps located at Willow Creek and North Fork Pear Tree. Fish released near these sites.

68 Are fish released in the same subbasin as rearing facility?

Clarification:

If YES, provide a table describing all releases for the last 10 years (including date, size, type, release method, location, number, purpose, and mark groups). The Review Panel has asked that the table include fish released for experimental purposes.

Are pre-release exams done? If so, are results provided to the hatchery manager or appropriate staff prior to release?

Relationship to Outcomes/Goals:

Answer:

Yes. See Appendix A-3 for the last 10 years of releases.

69 Has the current carrying capacity of the watershed used by migrating fish (i.e., lower river or estuary) been taken into consideration in sizing the number of releases from this program?

Clarification:

Relationship to Outcomes/Goals:

Considering the carrying capacity of the watershed when sizing the hatchery program increases the likelihood that stock productivity will be high and may limit the risk of adverse ecological and harvest interactions.

Answer:

No.

69A Additional Question: Are fish trucked to alternative release sites?

Clarification/Input:

If YES, what proportion of the release is trucked? Where are fish released and how are fish released?

Answer:

Yes, a portion are transported to areas near the rotary screw traps for testing purposes. No large off-site release program.

69B Additional Question: Is more than one release type (e.g., June and October releases) released from a typical brood year?

Clarification:

If YES, are all the fish used for each release type representative from throughout the hatchery's production (i.e., the same fraction of fish originating from each week's spawning are used for each release type so that releases originated from parents spawned throughout the spawning run)?

If YES, what is the basis for this allocation among release types?

If NO, please describe how fish used for each release type are selected.

Answer:

Yes. Release numbers are prescribed in the operating goals for each hatchery.

No, fish are not representative from throughout the hatchery's production (yearlings).

69C Additional Question: Does the hatchery have a method to estimate the number of fish released?

Clarification:

If YES, what are these inventory procedures?

If NO, does the hatchery estimate the numbers of fish released and how?

Answer:

Yes, an inventory is done at time of constant fractional tagging. Total population is weighed and 25% of that is transferred to the tagging trailer, which provides an estimate of total number of fish at time of tagging, within approximately 2 months of release. Following tagging, daily mortalities are tracked.

Starting with BY 2010, an automated tagging trailer will be used.

HATCHERY OPERATION PHASE: FACILITIES

71 Does hatchery intake screening comply with California State, National Marine Fisheries Service, and/or other agency facility standards?

Clarification:

Relationship to Outcomes/Goals:

Compliance with these standards reduces the likelihood that intake structures cause entrapment in hatchery facilities and impingement of migrating or rearing juveniles.

Answer:

No.

72 Does the facility operate within the limitations established in its National Pollution Discharge Elimination System (NPDES) permit?

Clarification:

Relationship to Outcomes/Goals:

Compliance with NPDES discharge limitations is designed to maintain water quality in downstream receiving habitat.

Answer:

Yes.

73 If the production from this facility falls below the minimum production requirement for an NPDES permit, does the facility operate in compliance with state and/or federal regulations for discharge?

Clarification:

Relationship to Outcomes/Goals:

Compliance with NPDES discharge limitations maintains water quality in downstream receiving habitat.

Answer:

N/A.

74 Is the facility sited so as to minimize the risk of catastrophic fish loss from flooding or other disasters?

Clarification:

Clarify the disposition of fish if the program manager anticipates a catastrophic loss.

Relationship to Outcomes/Goals:

Locating the facility where it is not susceptible to flooding decreases the likelihood of catastrophic loss.

Answer:

Yes.

75 Is staff notified of emergency situations at the facility through the use of alarms, autodialer, and/or pagers?

Clarification:

Relationship to Outcomes/Goals:

Notification to staff of emergency situations using alarms, autodialers, and/or pagers reduces the likelihood of catastrophic loss.

Answer:

Yes.

76 Is the facility continuously staffed to ensure the security of fish stocks on-site?

Clarification:

Relationship to Outcomes/Goals:

Continuous facility staffing reduces the likelihood of catastrophic fish loss.

Answer:

Yes

76A Additional Question: Does the hatchery have an emergency procedures manual?

Clarification:

How are fish handled under emergency scenarios?

Answer:

Yes, site safety procedure manual.

76B Additional Question: Does the hatchery have an emergency procedures plan in case of loss of water?

Clarification:

How are fish handled under emergency scenarios (addressed in the program HGMP)?

Answer:

Yes, there is an alarm system in place. There is no written protocol. No non-representatively marked fish are released.

76C Additional Question: Does the hatchery have the ability/procedures to protect fish on station from excessive predation/predators?

Clarification:

Is predator loss excessive (estimated loss)?

Are there ANS issues at this facility (snails, macrophytes, or other organisms in the water supply)? If so, what problems result and how do you address them?

Relationship to Outcome:

Limiting predator loss promotes accurate accounting of fish numbers. Limiting predator contact with fish and rearing units also reduces the risk of introducing predator-transmitted pathogens.

Answer:

Yes, the ponds have a bird exclosure and the round tanks are fenced.

HATCHERY OPERATION PHASE: MONITORING & EVALUATION

M&E – A Additional Question: Is there a formal fish health monitoring program?

Clarification:

Please provide information about the disease status of juveniles and returning adults.

If NO, does the facility have any of the following components of a fish health program:

- Fish health policy or guidelines
- Biosecurity plan
- Pathogen segregation program (BKD): prescribed prophylactic treatments/vaccination protocols for adults and/or juveniles?
- Juvenile monitoring program (prior to release)

Please provide guidance and protocols for each of above.

Relationship to Outcomes/Goals:

Answer

Yes.

The facility follows Rogers and Chapman 1991 (Dr. Cox fish health policy), the HACCP plan, takes ovarian fluid samples for pathogen segregation, and performs annual fish health assessments.

M&E – B Additional Question: Does the program monitor stock characteristics in relation to the population traits of the ESU?

Clarification:

Relationship to Outcomes/Goals:

Answer:

Yes, stock characteristics (size, time, age, length, sex ratio, incidence of hatchery fish in wild areas) are monitored within the Trinity River watershed and hatchery for adults and juveniles.

M&E – C Additional Question: Does this program have or is it developing an HGMP?

Clarification:

If YES, at what stage of the HGMP process is the program? When did this process start and is the program in compliance? If the program is not in compliance - why?

Answer:

No.

M&E – D Additional Question: Is there an ongoing genetic monitoring program? If so, please describe.

Clarification:

Answer:

No, but genetic information (PBT) has been collected for various research projects.

M&E – E Additional Question: Does the agency and/or hatchery program have staff dedicated to monitoring and evaluation of this program?

Clarification:

If YES, what data is collected?

Answer:

Yes, various biological data, scales for age/genetic analysis, meristical data. See data above. Results found in annual reports.

M&E – F Additional Question: Does the program have a consistent long-term marking or tagging program?

Clarification:

If YES, please describe the program and its recent 10-year history. Is continued funding reasonably secure for this program?

Answer:

Yes. CWT and marking (ad clip) for 25% since mid-1990s. Marking/tagging was approximately 10% since mid-1980s. Funding is secure through BOR.

M&E – G Additional Question: Are the fish selected for marking or tagging representative of all hatchery release and production groups?

Clarification:

Please provide information about how fish are selected for marking and/or tagging.

Answer:

Yes, for last decade. Unique tag codes for fingerling ponds based on size of fish. Yearlings all receive a single tag code.

M&E – H Additional Question: Are routine protocols followed annually to characterize attributes (e.g., run timing, age, size, sex structure, etc.) of hatchery fish trapped and fish actually used in broodstock?

Clarification:

If YES, what are the protocols and attributes?

Answer:

Yes, data is collected. See hatchery annual reports for protocols.

M&E – I Additional Question: Is there coordination in tagging and recovery of marks/tags among watersheds, hatcheries and/or other programs?

Answer:

Yes. There is coordination with IGH, but coordination with other agencies could be improved.

HATCHERY OPERATION PHASE: EFFECTIVENESS

81 What is the percent of hatchery-origin fish (first generation) in the natural spawning areas (for the same species/race) and how does this percent vary geographically within the watershed (e.g., reaches or tributaries adjacent to the hatchery often experience much greater straying than do more remote areas)?

Clarification:

If YES, please provide this information for the last 10 years. If available, ask for the distribution of natural spawners within the watershed to see if it matches or contrasts with the distribution of naturally spawning hatchery fish, even if only a qualitative comparison.

Relationship to Outcomes/Goals:

This question is used to evaluate the level of hatchery influence on the population.

Answer:

Yes, there is an estimate for the basin. For a geographic estimate, carcass surveys done from hatchery through mainstem. See Appendix A-3 for a 10 year history.

85 Is the percent hatchery-origin fish (first generation) in natural spawning areas estimated?

Clarification:

If YES, provide information about how the contribution to spawning is estimated (via weir counts, live counts, carcass recovery, etc.). Provide information on the relative reproductive success of hatchery fish on the spawning grounds.

Relationship to Outcomes/Goals:

Estimating the proportion of hatchery fish spawning in the wild allows evaluation of composition targets and prevents hatchery returns from masking the status of the natural population.

Answer:

Yes, via redd counts, carcass surveys, and expansions for fish counts. See Appendix A-3 for a 10 year history.

HATCHERY OPERATION PHASE: ACCOUNTABILITY

86 Are standards specified for in-culture performance of hatchery fish?

Clarification:

If YES, please describe these standards.

If NO, are there standards for some in-culture performance? These might include standards for overall health (free of clinical disease signs/behavior, free of gross abnormalities [i.e., gills and fins]); feed conversion and growth rates; or size and condition factor at release.

Relationship to Outcomes/Goals:

Explicit standards for survival, size, condition, etc., make it easier to detect culture problems before they become impossible to rectify.

Answer:

Yes, best professional judgment based on site specific historical performance, target size at release.

87 Are in-culture performance standards met? How often?

Relationship to Outcomes/Goals:

Meeting these standards is assumed to be the best management practice.

Answer:

Yes, target size and time standards are met.

88 Are standards specified for pre-release characteristics to meet post-release performance standards of hatchery fish and their offspring?

Clarification:

If YES, please describe these standards.

Relationship to Outcomes/Goals:

Explicit standards for post-release survival make it easier to detect culture problems before they become impossible to rectify.

Answer:

No.

89 Are post-release performance standards met?

Clarification:

How are myxozoan disease impacts on juveniles post release being addressed (*Ceratomyxa shasta* and *Parvicapsula minibicornis*)?

Are there alternative strategies for post-release performance when adverse disease or environmental conditions (e.g., elevated temperatures) occur at the scheduled time of release?

Relationship to Outcomes/Goals:

How often are standards met?

Answer:

N/A.

90 Are hatchery programming and operational decisions based on an Adaptive Management Plan? For example, is an annual report produced describing hatchery operations, results of studies, program changes, etc.? If a written plan does not exist, then the answer is No.

Relationship to Outcomes/Goals:

An Annual Report or review process that presents results of studies and that specifies responses to be taken ensures that the program managers can respond to adverse or unforeseen developments in a timely manner.

Answer:

No.

HATCHERY PROGRAM REVIEW ANSWERS

The Hatchery Program Review Questions were answered by regional managers, hatchery managers, and the M&E biologist associated with the hatchery program during ameeting held at Trinity River Hatchery, February 10, 2011.

Attendee	Affiliation
Andy Appleby	DJ Warren & Associates
Larry Glenn	CDFG
George Kautsky	Hoopa Valley Tribe – Fisheries
Kevin Malone	Malone Environmental
Laird Marshall, Jr.	CDFG
Mike Orcutt	Hoopa Valley Tribe
Shane Quinn	Yurok Tribe
Linda Radford	CDFG
Don Reck	US Bureau of Reclamation
Robyn Redekopp	Meridian Environmental, Inc.
Wade Sinnen	CDFG

California Hatchery Review Project

Appendix VIII

Trinity River Hatchery Fall Chinook Program Report

Appendix A-2

June 2012

Appendix A-2

Trinity River Hatchery Fall Chinook Program Data Tables

Table 1. Results of fish pathologist reports for Trinity River Hatchery fall Chinook, 2006-2010.

Date	Weight (g)	Length (mm)	Hematocrit (%)	Internal Assessment	External Assessment	Pathogens
2006[1]						
2007[1]						
9/2008	23.4	123.4	52.8	Excellent	Excellent	None
9/2009	35.2	153.0	46.3	Excellent	Excellent	None
2010[1]						

[1] This information has been requested but not provided.
Source: Annual Fish Pathologist Tests.

Table 2. Egg to release survival for fall Chinook reared at the Trinity River Hatchery, 2005-2009.

Brood Year [a]	Eggs Taken [a]	Number Eyed [a]	Fert % [a]	Eggs Culled [a]	Number at Hatch [a]	Number Fry Ponded [a,b]	Eyed Egg to Fry Ponded Survival	Total Fish Released[c,d]	Ponding to Release Survival[e]	Eyed Egg to Release Survival
2005	5,764,316	3,085,768			3,019,382	3,019,382	98%	3,064,593	101%	99%
2006	7,068,450	3,969,340	85.00%	4,491,630	3,007,930	3,003,500	76%	2,986,572	99%	75%
2007	6,549,618	3,753,980	85.40%	2,908,308	3,001,630	3,001,600	80%	2,641,049	88%	70%
2008	5,873,090	3,356,490	82.80%	2,174,500	3,003,490	3,001,900	89%	3,063,237	102%	91%
2009	6,495,999	3,620,373	95.80%	3,283,400	3,053,019	3,053,015				

[a] Numbers provided by TRH staff.
[b] This is a calculated estimate based on the average size counts of eggs and the number of eggs in ounces measured into each incubator tray after the final pick.
[c] The total number of fish released is obtained by inventorying the fish during the tagging process, conducted by the Hoopa Valley Tribal Fisheries marking crews. These are considered to be the final numbers released after observed mortalities are subtracted.
[d] Calculated from Trinity River Hatchery Annual Reports.
[e] Some numbers may appear incorrect due to the estimation of the Number of Fry Ponded versus the inventory of Total Fish Released.

Table 3. Release dates, number, and average size of fall Chinook salmon reared at the Trinity River Fall Chinook, 2000-2010.

Release Year	Release Date Sub-yearlings	Release Date Yearlings	Release Location	Release Method	Purpose	Total Smolts Released	Average Weight (fpp)	Total Yearlings Released	Average Weight (fpp)	Marks or Tags Applied
2000	--	10/3 to 10/6	TRH	Volitional	Mitigation	--	--	863,267	15.77	25% AD/CWT
2001	6/6 to 6/13	10/4 to 10/10	TRH	Volitional	Mitigation	2,113,804	69.33	872,666	12.70	25% AD/CWT
2002	6/3 to 6/12	10/10 to 10/15	TRH	Volitional	Mitigation	2,084,069	94.33	940,049	13.40	25% AD/CWT
2003	6/3 to 6/9	10/1 to 10/7	TRH	Volitional	Mitigation	2,078,192	88.67	954,286	16.00	25% AD/CWT
2004	6/4 to 6/10	10/1 to 10/7	TRH	Volitional	Mitigation	2,105,708	111.33	908,913	16.00	25% AD/CWT
2005	6/4 to 6/10	10/3 to 10/11	TRH	Volitional	Mitigation	2,006,066	74.75	956,688	14.30	25% AD/CWT
2006	6/1 to 6/7	10/2 to 10/16	TRH	Volitional	Mitigation	2,099,237	122.3	965,356	19.80	25% AD/CWT
2007	6/1 to 6/8	10/1 to 10/17	TRH	Volitional	Mitigation	2,021,056	122	965,516	19.50	25% AD/CWT
2008	6/2 to 6/17	10/1 to 10/16	TRH	Volitional	Mitigation	1,808,904	176.6	832,145	17.20	25% AD/CWT
2009	6/1 to 6/8	10/1 to 10/15	TRH	Volitional	Mitigation	2,018,580	90.6	1,044,657	11.68	25% AD/CWT
2010	6/1 to 6/8	--	TRH	Volitional	Mitigation	1,975,162	128.5	--	--	25% AD/CWT
					Average	2,031,078	107.8	960,354	15.4	

Source: Trinity River Hatchery Annual Reports 2000-2010.

Table 4. Number of fall Chinook salmon returns to the Trinity River Hatchery by sex, age, females spawned and eggs harvested for BY 2000 through BY 2009.

Year	Females	Males	Jacks	Females Spawned	# Of Eggs	Fecundity	Egg Size (eggs per oz)
2000	11,676	14,339	1,013	1,983	6,003,740	3,028	90.00
2001	9,093	8,904	703	1,809	5,936,774	3,281	83.00
2002	1,412	2,342	746	1,331	4,597,470	3,454	82.00
2003	14,395	15,443	671	1,996	6,926,371	3,470	76.00
2004	6,139	6,195	1,055	2,067	6,112,168	2,957	96.70
2005	6,463	6,675	242	2,988	5,764,316	2,459	80.40
2006	4,061	4,052	4,128	2,502	7,068,473	2,825	76.90
2007	9,543	8,537	34	2,474	6,549,618	2,647	88.70
2008	2,584	1,901	750	2,026	5,873,110	2,899	72.60
2009	3,338	4,066	155	2,241	6,495,999	2,898	96.20
Average	6,870	7,245	950	2,142	6,132,804	2,992	84.25

Source: Trinity River Hatchery Annual Reports 2000-2010.

Table 5. Estimated contributions of Trinity River Hatchery-produced spring-run Chinook salmon to total estimated run-size and spawners in natural areas.

Year	Run-size	TRH Component	Natural Component	Percent TRH Composition	Harvest [a]	TRH Returns [b]	Hatchery-Origin Spawners [c]	Natural-Origin Spawners [d]	Proportion of Hatchery-Origin Spawners (pHOS)
2000	55,473	38,881	46,592	70.1%	1,412	27,046	13,555	13,460	0.50
2001	57,109	33,984	23,125	59.5%	1,772	18,175	16,568	20,594	0.45
2002	18,156	6,884	11,272	37.9%	559	4,553	2,572	10,472	0.20
2003	64,362	52,944	11,418	82.3%	1,867	30,386	24,086	8,023	0.75
2004	29,534	25,956	3,578	87.9%	381	13,443	13,527	2,183	0.86
2005	28,231	19,674	8,557	69.7%	856	13,806	6,655	6,914	0.49
2006	34,912	21,768	13,144	62.4%	-	11,994	10,990	11,928	0.48
2007	58,873	24,633	34,240	41.8%	939	18,114	7,914	31,906	0.20
2008	22,997	8,585	14,412	37.3%	281	5,252	3,746	13,718	0.21
Average	41,072	25,923	18,482	61.0%	896	15,863	11,068	13,244	0.46

[a] Assumed equal harvest on Hatchery- and Natural-origin fish.

[b] Assume 10% natural-origin fish used in broodstock.

[c] hatchery origin spawners = [(run size – harvest) x(% TRH composition)] – (TRH returns x 0.90)

[d] natural origin spawners = [(run size – harvest) x (% Natural composition)] – (TRH returns x 0.1)

Source: Sinnen et al 2010.

California Hatchery Review Project

Appendix VIII

Trinity River Hatchery Fall Chinook Program Report

Appendix A-3

June 2012

Appendix A-3

Hatchery Program Review Analysis
Trinity River Hatchery Fall Chinook
Benefit-Risk Statements

Question ID	Category	Question	Correct Answer	**Benefit/Risk**	Benefit	Risk
1	Broodstock Choice	Does the broodstock chosen represent natural populations native or adapted to the watersheds in which hatchery fish will be released?	Y	Y	This program uses a broodstock representing populations native or adapted to the watershed, which increases the likelihood of long term survival of the stock, helps avoid loss of among population diversity, and reduces the likelihood of unexpected ecological interactions.	Selection of a broodstock not representing populations native or adapted to the watershed poses a risk of loss of among population diversity and may pose additional risks of adverse ecological interactions with non-target stocks.
2	Broodstock Choice	Was the best available broodstock selected for this program?	Y	NA	Choice of a broodstock with a similar life history and evolutionary history to the extirpated stock improves the likelihood of successful re-introduction.	Choice of a broodstock with a dissimilar life history and evolutionary history to the extirpated stock reduces the likelihood of successful re-introduction.

Question ID	Category	Question	Correct Answer	**Benefit/Risk**	Benefit	Risk
3	Broodstock Choice	Does the broodstock chosen display morphological and life history traits similar to the natural population?	Y	Y	Choice of a broodstock with similar morphological and life history traits improves the likelihood of the stock's adaptation to the natural environment.	Choice of a broodstock with dissimilar morphological and life history traits poses a risk that the stock will not adapt well to the natural environment.
4	Broodstock Choice	Does the broodstock chosen have a pathogen history that indicates no threat to other populations in the watershed?	Y	Y	The broodstock chosen poses no threat to other populations in the watershed from pathogen transmission	The broodstock chosen poses a risk to other populations in the watershed from pathogen transmission
5	Broodstock Choice	Does the broodstock chosen have the desired life history traits to meet harvest goals? (e.g. timing and migration patterns that result in full recruitment to target fisheries)?	Y	NA	The broodstock chosen is likely to have the life history traits to meet harvest goals for the target stocks without adversely impacting other stocks.	The broodstock chosen is unlikely to have the life history traits to successfully meet harvest goals and may contribute to overharvest of comingled stocks.
7	Broodstock Choice	Do natural origin fish make up less than 5% of the broodstock for this program?	Y		Maintaining a hatchery population composed of less than 5% natural fish reduces the risk of loss of among population diversity.	Maintaining a hatchery population composed of more than 5% natural fish increases the risk of loss of among population diversity.

Question ID	Category	Question	Correct Answer	**Benefit/Risk**	Benefit	Risk
10	Broodstock Choice	Is the percent natural origin fish used as broodstock for this program estimated?	Y	Y	Estimating the proportion of natural fish used for broodstock makes it possible to determine whether composition targets have been met and prevents masking of the status of both the hatchery and natural populations.	Percent wild fish used as broodstock for this program is not accurately estimated. Not estimating of the proportion of natural fish used for broodstock makes it impossible to determine whether composition targets have been met and it masks the status of both the hatchery and natural populations.
11	Broodstock Collection	Are adults returned to the river?	N	Y	Not recycling adults to the lower river to provide additional harvest reduces the likelihood of straying and unintended contribution to natural spawning	Recycling adults to provide additional harvest benefits can increase the likelihood of straying and increase the contribution of hatchery fish on the spawning grounds
12	Broodstock Collection	Are representative samples of natural and hatchery population components collected with respect to size, age, sex ratio, run and spawn timing, and other traits important to long-term fitness?	Y	N	Collection of representative samples of both the natural and hatchery populations reduces the risk of domestication and loss of within population diversity.	Failure to collect representative samples of both the natural and hatchery populations poses a risk of loss of within population diversity and viability.

Question ID	Category	Question	Correct Answer	**Benefit/Risk**	Benefit	Risk
13	Broodstock Collection	Does the proportion of the spawners brought into the hatchery follow a "spread-the-risk" strategy that attempts to improve the probability of survival for the entire population (hatchery and natural components)?	Y	Y	The proportion of spawners brought into the hatchery improves the likelihood that the population will survive a catastrophic loss from natural events or hatchery failure.	The proportion of spawners brought into the hatchery increases the risk that the population not will survive a catastrophic loss from natural events or hatchery failure.
14	Broodstock Collection	Is the effective population size being estimated each year?	Y	N	Sufficient broodstock are collected to maintain genetic variation in the population	Sufficient broodstock are not collected to maintain genetic variation in the population
15	Broodstock Collection	Within the last 10 years, has the program used only eggs or fish from within the watershed?	Y	Y	Avoidance of stock transfers from outside the watershed promotes local adaptation and reduces the risk of pathogen transmission.	Stock transfers from outside the watershed pose a risk to local adaptation and increases the risk of pathogen transmission.
16	Broodstock Collection	Is the broodstock collected and held in a manner that results in less than 10% prespawning mortality?	Y	Y	Maintaining pre-spawning survival higher than 90% maintains effective population size and reduces domestication selection.	Pre-spawning mortality greater than 10% poses a risk to maintaining effective population size and a risk of domestication selection
17	Broodstock Collection	Do you have guidelines for acceptable contribution of hatchery origin fish to natural spawning?	Y	N	Having established guidelines for acceptable contribution of hatchery origin fish to natural spawning provides a clear performance standard for evaluating the program.	Lack of established guidelines for acceptable contribution of hatchery origin fish to natural spawning makes program evaluation difficult.

Question ID	Category	Question	Correct Answer	**Benefit/Risk**	Benefit	Risk
18	Broodstock Collection	Are guidelines for hatchery contribution to natural spawning met for all affected naturally spawning populations?	Y	NA	The rate of hatchery contribution to natural spawning populations maintains among population diversity and promotes adaptation to the natural environment.	The rate of hatchery contribution to natural spawning populations poses a risk of loss of among population diversity and domestication selection.
19	Adult Holding	Is the water source [for adult holding] pathogen free?	Y	N	Fish health is promoted by the absence of specific pathogens during adult holding.	There is a risk to fish health due to the lack of specific-pathogen free water for adult holding.
20	Adult Holding	Does the water used [for adult holding] result in natural water temperature profiles that provide optimum maturation and gamete development?	Y	Y	Use of water resulting in natural water temperature profiles for adult holding ensures maturation and gamete development synchronous with natural stocks.	Lack of natural water temperature profiles may lead to domestication selection for adult maturation and gamete development.
21	Adult Holding	Is the water supply [for adult holding] protected by flow alarms?	Y	Y	Broodstock security is maintained by flow and/or level alarms at the holding ponds.	Absence of flow and/or level alarms at the holding pond may pose a risk to broodstock security.
22	Adult Holding	Is the water supply [for adult holding] protected by back-up power generation or a fail-safe back-up water supply?	Y	Y	Broodstock security is maintained by back-up power generation for the pumped water supply.	Lack of back-up power generation for the pumped water supply may pose a risk to broodstock security.
23	Spawning	Does the program have a protocol for mating?	Y	Y	Random mating maintains within population diversity.	Non-random mating increases the risk of loss of within population diversity.

Question ID	Category	Question	Correct Answer	**Benefit/Risk**	Benefit	Risk
24	Spawning	Does the program conduct single-family pairing prior to fertilization?	Y	N	Single family pairing increases the effective population size of the hatchery stock.	Pooling of gametes poses a risk to maintaining genetic diversity in the hatchery population.
25	Spawning	Are multiple males used in the spawning protocol?	Y	NA	Use of back-up males in the spawning protocol increases the likelihood of fertilization of eggs from each female.	Not using of back-up males in the spawning protocol increases the risk of unfertilized eggs and loss of genetic diversity in the broodstock.
26	Spawning	Are precocious fish (jacks and jills) used for spawning according to a set protocol?	Y	N	Use of precocious males for spawning as a set percentage or in proportion to their contribution to the adult run promotes within population diversity.	Not using precocious males for spawning as a set percentage or in proportion to their contribution to the adult run increases the risk of loss of within population diversity.
27	Incubation	Is the water source [for incubation] pathogen-free?	Y	N	Fish health is promoted by the use of pathogen-free water during incubation.	There is a risk to fish health due to the lack of pathogen-free water for incubation.
29	Incubation	Does the water used [for incubation] provide natural water temperature profiles that result in hatching/emergence timing similar to that of the naturally produced population?	Y	Y	Use of water resulting in natural water temperature profiles for incubation ensures hatching and emergence timing similar to naturally produced stocks with attendant survival benefits.	Lack of natural water temperature profiles may contribute to domestication selection during incubation.

Question ID	Category	Question	Correct Answer	**Benefit/Risk**	Benefit	Risk
30	Incubation	Can incubation water temperature be modified?	Y	Y	The ability to heat or chill incubation water to approximate natural water temperature profiles ensures hatching and emergence timing similar to naturally produced stocks with attendant survival benefits.	The inability to heat or chill incubation water to approximate natural water temperature profiles may contribute to domestication selection during incubation.
31	Incubation	Is the water supply [for incubation] protected by flow alarms?	Y	Y	Security during incubation is maintained by flow alarms at the incubation units.	Absence of flow alarms at the incubation units may pose a risk to the security of incubating eggs and alevin.
32	Incubation	Is the water supply [for incubation] protected by back-up power generation or a fail-safe back-up water supply?	Y	Y	Security during incubation is maintained by back-up power generation for the pumped water supply.	Absence of back-up power generation for the pumped water supply may pose a risk to the security of incubating eggs and alevin.
33	Incubation	Are eggs incubated under conditions that result in equal survival of all segments of the population to ponding?	Y	Y	Incubation conditions that result in equal survival of all segments of the population reduce the likelihood of domestication selection and loss of genetic variability.	Incubation conditions that result in unequal survival of all segments of the population pose a risk of domestication selection and loss of genetic variability.
34	Incubation	Are families incubated individually? (Includes both eying and hatching.)	Y	N	Incubating families individually maintains genetic variability during incubation.	Not incubating families individually poses a risk of loss of genetic variability.
36	Incubation	Are agency or tribal species-specific incubation recommendations followed for flow rates?	Y	Y	Use of IHOT flow recommendations during incubation promote survival of eggs and alevin and allow for optimum fry development.	Failing to meet IHOT flow recommendations during incubation poses a risk to the survival of eggs and alevin and may not allow for optimum fry development.

Question ID	Category	Question	Correct Answer	**Benefit/Risk**	Benefit	Risk
37	Incubation	Are agency or tribal species-specific incubation recommendations followed for substrate?	Y	N	Use of IHOT recommendations for use of substrate during incubation limits excess alevin movement and promotes energetic efficiency.	Failing to meet IHOT recommendations for using substrate during incubation may allow excess alevin movement and reduces energetic efficiency.
38	Incubation	Are agency or tribal species-specific incubation recommendations followed for density parameters?	Y	Y	Use of IHOT density recommendations during incubation promote survival of eggs and alevin and allow for optimum fry development.	Failing to meet IHOT density recommendations during incubation poses a risk to the survival of eggs and alevin and may not allow for optimum fry development.
39	Incubation	Are disinfection procedures implemented during spawning and/or incubation that prevent pathogen transmission within or between stocks of fish on site?	Y	Y	Proper disinfection procedures increase the likelihood of preventing dissemination and amplification of pathogens in the hatchery.	Lack of proper disinfection procedures increase the risk of dissemination and amplification of pathogens in the hatchery.
40	Incubation	Are eggs culled and if so, how is culling done?	Y	Y	Random culling of eggs over all segments of the egg-take maintains genetic variability during incubation.	Non-random culling of eggs increases the risk of loss of genetic variability during incubation.
41	Rearing	Is the water source [for rearing] pathogen free?	Y	N	Fish health is promoted by the absence of specific pathogens during rearing.	There is a risk to fish health due to the lack of specific-pathogen free water for rearing.
42	Rearing	Does the water used [for rearing] provide natural water temperature profiles that result in fish similar in size to naturally produced fish of the same species?	Y	Y	Use of water resulting in natural water temperature profiles for rearing promotes growth of fish and smoltification synchronous with naturally produced stocks.	Lack of natural water temperature profiles may lead to domestication selection during rearing.

Question ID	Category	Question	Correct Answer	**Benefit/Risk**	Benefit	Risk
43	Rearing	Does the hatchery operate to allow all migrating species of all ages to by-pass or pass through hatchery related structures?	Y	NA	Providing upstream and downstream passage of juveniles and adults supports natural distribution and productivity of naturally produced stocks.	Inhibiting upstream and downstream passage of juveniles and adults poses a risk to distribution and productivity of naturally produced stocks.
44	Rearing	Is the water supply [for rearing] protected by flow alarms?	Y	Y	Security during rearing is maintained by flow and/or level alarms at the rearing ponds.	Absence of flow and/or level alarms at rearing ponds may pose a risk to the security of the cultured fish.
45	Rearing	Is the water supply [for rearing] protected by back-up power generation or a fail-safe back-up water supply?	Y	Y	Security during rearing is maintained by back-up power generation for the pumped water supply.	Absence of back-up power generation for the pumped water supply may pose a risk to the security of the cultured fish.
46	Rearing	Are fish reared under conditions that result in equal survival of all segments of the population to release? (In other words, does any portion of the population derive a survival advantage or disadvantage from rearing procedures? If yes, then mark NO in box.)	Y	Y	Rearing conditions that result in equal survival of all segments of the population reduce the likelihood of domestication selection and loss of genetic variability.	Rearing conditions that result in unequal survival of all segments of the population pose a risk of domestication selection and loss of genetic variability.
47	Rearing	Does this program avoid culling of juvenile fish? If fish are culled, how are they selected to be culled? In the response, make sure to capture the number culled, and the rational for culling.	Y	Y	Random culling of juveniles over all segments of the population maintains genetic variability during rearing.	Non-random culling of juveniles increases the risk of loss of genetic variability during rearing.

Question ID	Category	Question	Correct Answer	**Benefit/Risk**	Benefit	Risk
48	Rearing	Is there a growth rate pattern that this program is trying to achieve?	Y	Y	Following proper feeding rates to achieve the desired growth rate improves the likelihood of producing fish that are physiologically fit, properly smolted, and that maintain the age structure of natural populations.	Improper feeding that does not achieve desired growth rate increases the risk of producing fish that are not physiologically fit, that are not properly smolted, and that exhibit an age structure not representative of natural populations.
49	Rearing	Is there a specified condition factor that this program is trying to achieve?	Y	Y	Feeding to achieve the desired condition factor is an indicator of proper fish health and physiological smolt quality.	Feeding that does not achieve the desired condition factor may be an indicator of poor fish health and physiological smolt quality.
50	Rearing	Does the program use a diet and growth regime that mimics natural seasonal growth patterns?	Y	N	Use of diet and growth regimes that mimic natural seasonal growth patterns promote proper smolitification and should produce adults that maintain the age structure of the natural population.	Use of diet and growth regimes that do not mimic natural seasonal growth patterns pose a risk to proper smolitification and may alter the age structure of the hatchery population.
51	Rearing	Does the program employ any NATURES-type rearing measures, e.g., by providing natural or artificial cover, feeding, structures in raceways, predator training, etc?	Y	N	Providing aritificial cover increases the development of appropriate body camouflage and may improve behavioral fitness.	Lack of overhead and in-pond structure does not produce fish with the same cryptic coloration or behavior as do using enhanced environments.
52	Rearing	Are fish reared in multiple facilities or with redundant systems to reduce the risk of catastrophic loss?	Y	N	Maintaining the stock in multiple facilities or with redundant systems reduces the risk of catastrophic loss from facility failure.	Not maintaining the stock in multiple facilities or with redundant systems increases the risk of catastrophic loss from facility failure.

Question ID	Category	Question	Correct Answer	**Benefit/Risk**	Benefit	Risk
53	Rearing	Are agency or tribal juvenile rearing standards followed for flow rates?	Y	Y	Following IHOT standards for juvenile loading maintains proper dissolved oxygen levels promoting fish health, growth and survival, and increases the likelihood of preventing dissemination and amplification of fish pathogens.	Not following IHOT standards for juvenile loading poses a risk to maintaining proper dissolved oxygen levels, compromising fish health and growth and increases the likelihood of dissemination and amplification of fish pathogens.
54	Rearing	Are agency or tribal juvenile rearing standards followed for density?	Y	Y	Following IHOT standards for juvenile density maintain fish health, growth, and survival, and increases the likelihood of preventing dissemination and amplification of fish pathogens.	Not following IHOT standards for juvenile density poses a risk to maintaining fish health, growth, and survival, and increases the likelihood of dissemination and amplification of fish pathogens.
59	Release	Is there a protocol to produce fish to a set size at release (fpp and length)?	Y	Y	Producing fish that are qualitatively similar to natural fish in size may improve performance and reduce adverse ecological interactions.	Producing fish that are not qualitatively similar to natural fish in size may adversely affect performance and increase adverse ecological interactions.
60	Release	Are there protocols for fish morphology at release?	Y	N	Producing fish that are qualitatively similar to natural fish in morphology may improve performance and reduce adverse ecological interactions.	Producing fish that are not qualitatively similar to natural fish in morphology may adversely affect performance.

Question ID	Category	Question	Correct Answer	**Benefit/Risk**	Benefit	Risk
61	Release	Are there protocols for fish behavior characteristics at release?	Y	N	Producing fish that are qualitatively similar to natural fish in behavior may improve performance and reduce adverse ecological interactions.	Producing fish that are not qualitatively similar to natural fish in behavior may adversely affect performance and increase adverse ecological interactions.
62	Release	Are there protocols for fish growth rates up to release?	Y	Y	Producing fish that are qualitatively similar to natural fish in growth rate may improve performance and reduce adverse ecological interactions.	Producing fish that are not qualitatively similar to natural fish in growth rate may adversely affect performance and increase adverse ecological interactions.
63	Release	Are there protocols for physiological status of fish at release?	Y	Y	Producing fish that are qualitatively similar to natural fish in physiological status may improve performance and reduce adverse ecological interactions.	Producing fish that are not qualitatively similar to natural fish in physiological status may adversely affect performance and increase adverse ecological interactions.
64	Release	Are there protocols for fish size and life history stage at release?	Y	Y	Releasing fish at sizes and life history stages similar to those of natural fish of the same species may improve performance and reduce adverse ecological interactions.	Releasing fish at sizes and life history stages dissimilar to those of natural fish of the same species may reduce performance and increase the risk of adverse ecological interaction.
65	Release	Are volitional releases during natural out-migration timing practiced?	Y	N	Volitionally releasing smolts during the natural outmigration timing may improve homing, survival, and reduce adverse ecological interactions.	Failure to volitionally release smolts during the natural outmigration timing may adversely affect homing, survival, and increase risk of adverse ecological interactions.

Question ID	Category	Question	Correct Answer	**Benefit/Risk**	Benefit	Risk
66	Release	Are there protocols for fish release timing?	Y	Y	Releasing fish in a manner that simulates natural seasonal migratory patterns improves the likelihood that harvest and conservation goals will be met and may reduce potential adverse ecological impacts.	Failing to release fish in a manner that simulates natural seasonal migratory patterns decreases the likelihood that harvest and conservation goals will be met and may increase the potential for adverse ecological impacts.
67	Release	Are all hatchery fish released at or adjacent to the hatchery facility (on-site)?	Y	N	Releasing fish within the historic range of that stock increases the likelihood that habitat conditions will support the type of fish being released and does not pose new risks of adverse ecological interactions with other stocks.	Releasing fish outside the historic range of that stock poses a risk that habitat conditions will not support the type of fish being released and poses new risks of adverse ecological interactions with other stocks.
68	Release	Are data routinely collected for released fish?	Y	NA	Releasing fish in the same subbasin as the rearing facility reduces the risk of dissemination of fish pathogens to the receiving watershed.	Not releasing fish in the same subbasin as the rearing facility increases the risk of dissemination of fish pathogens to the receiving watershed.
69	Release	Has the carrying capacity of the subbasin been taken into consideration in sizing this program in regards to determining the number of fish released?	Y	N	Taking the carrying capacity of the subbasin into consideration when sizing the hatchery program increases the likelihood that stock productivity will be high and may limit the limit the risk of adverse ecological and harvest interactions.	Failing to take the carrying capacity of the subbasin into consideration when sizing the hatchery program poses a risk to the productivity of the stock and may increase the risk of adverse ecological and harvest interactions.

Question ID	Category	Question	Correct Answer	**Benefit/Risk**	Benefit	Risk
70	Release	Are 100% of the hatchery fish marked so that they can be distinguished from the natural populations?	Y	NA	Marking 100% of the hatchery population allows them to be distinguished from the natural population and prevents the masking of the status of that population and prevent overharvest of weaker stocks.	Not marking 100% of the hatchery population prevents them from being distinguished from the natural population and may the mask the status of that population and cause over harvest of weaker stocks.
71	Facilities	Does hatchery intake screening comply with California State, National Marine Fisheries Service, and/or other agency facility standards?	Y	N	Compliance with IHOT or National Marine Fisheries Service standards reduces the likelihood that intake structures cause entrapment in hatchery facilities and impingement of migrating or rearing juveniles.	Failure to comply with IHOT or National Marine Fisheries Service standards increases the risk of entrapment in hatchery facilities and impingement of migrating or rearing juveniles
72	Facilities	Does the facility operate within the limitations established in its National Pollution Discharge Elimination System (NPDES) permit?	Y	Y	Compliance with NDPES discharge limitations maintain water quality in downstream receiving habitat	Hatchery discharge may pose a risk to water quality in downstream receiving habitat
73	Facilities	If the production from this facility falls below the minimum production requirement for an NPDES permit, does the facility operate in compliance with state or federal regulations for discharge?	Y	NA	For facilities that fall below the minimum production requirement for an NPDES permit, compliance with these discharge limitations maintain water quality in downstream receiving habitat	For facilities that fall below the minimum production requirement for an NPDES permit, hatchery discharge may pose a risk to water quality in downstream receiving habitat

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74	Facilities	Is the facility sited so as to minimize the risk of catastrophic fish loss from flooding or other disasters?	Y	Y	Siting the facility where it is not susceptible to flooding decreases the likelihood of catastrophic loss.	Siting the facility where it is susceptible to flooding increases the likelihood of catastrophic loss.
75	Facilities	Is staff notified of emergency situations at the facility through the use of alarms, autodialer, and pagers?	Y	Y	Notification to staff of emergency situations using alarms, autodialers, and pagers reduces the likelihood of catastrophic loss.	Inability to notify staff of emergency situations using alarms, autodialers, and pagers increases the likelihood of catastrophic loss.
76	Facilities	Is the facility continuously staffed to ensure the security of fish stocks on-site?	Y	Y	Continuous facility staffing reduces the likelihood of catastrophic loss.	Lack of continuous facility staffing increases the likelihood of catastrophic loss.
85	Effectiveness	Is the percent hatchery-origin fish (first generation) in natural spawning areas estimated?	Y	Y	Estimating the proportion of hatchery fish spawning in the wild allows evaluation of composition targets and prevents hatchery returns from masking the status of the natural population.	Percent hatchery fish spawning in the wild is not estimated! Not estimating the proportion of hatchery fish spawning in the wild prevents evaluation of composition targets and allows hatchery returns to mask the status of the natural population.
86	Accountability	Are standards specified for in-culture performance of hatchery fish?	Y	Y	Having in-culture performance goals provides clear performance standards for evaluating the program.	The program lacks standards for in-culture performance. Of hatchery fish, making it difficult to determine causes for program successes and failures.
87	Accountability	Are in-culture performance standards met? How often?	Y	Y		

Question ID	Category	Question	Correct Answer	**Benefit/Risk**	Benefit	Risk
88	Accountability	Are standards specified for pre-release characteristics to meet post-release performance standards of hatchery fish and their offspring?	Y	N	Having post release performance goals provides clear performance standards for evaluating the program.	The program lacks specified standards for post release performance of hatchery fish and their offspring, making it difficult to determine success and failures and their causes.
89	Accountability	Are post-release performance standards met?	Y	NA		
90	Accountability	Are hatchery programming and operational decisions based on an Adaptive Management Plan? For example, is an annual report produced describing hatchery operations, results of studies, program changes, etc.? If a written plan does not exist, then the answer is No.	Y	N	This program has an annually updated written adaptive management plan describing program goals, operations, and results. This makes it possible to base hatchery operations on adaptive management principles.	This program lacks an annually updated, written plan describing program goals, operations, and results. This makes it difficult to base hatchery programming and operations on adaptive management principles.