Natural Production Monitoring and Management in the Deschutes Basin
Project Narrative

Project Name	Natural Production Monitoring and Management
Project Number	2008-311-00
Proposer	Confederated Tribes of the Warm Springs Reservation of Oregon (CTWSRO)
Short Description	Project Purposes: (1) Continue annual monitoring of natural production of spring Chinook salmon and steelhead in streams on the Warm Springs Indian Reservation, Oregon, (2) implement new projects to increase and improve monitoring technology and methods, and (3) provide co-management support of Deschutes River Basin fisheries.
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ABSTRACT

Spring Chinook salmon (*Oncorhynchus tshawytscha*) and steelhead (anadromous *O. mykiss*) are integral parts of the cultural and spiritual identity of the people of the Confederated Tribes of the Warm Springs Reservation of Oregon (CTWSRO). These species are also of high economic and recreational value to non-tribal members in the Deschutes River Basin. The numbers of wild spring Chinook salmon and steelhead adults returning to Reservation streams have varied over the three decades, with a decline in the past 4 years. The specific causes for these variations and recent decline are unknown.

Status and trend monitoring programs in the Columbia River Basin provide important information to evaluate the effects of management actions on salmonid populations and their habitats, and provides a measure of the increasing, decreasing, or steady state of a population through time. The CTWSRO has monitored the natural production of spring Chinook salmon and steelhead for over 30 years in the Warm Springs River Basin and Shitike Creek, the two stream basins on the Reservation that support natural spawning and rearing of these species.

The goals of this project are to 1) continue the annual life stage monitoring of wild steelhead and spring Chinook salmon populations in Reservation streams, and 2) provide management and co-management direction of the fisheries resources in the Deschutes River Basin. Life-stage monitoring will allow for effective trend monitoring at the basin, watershed, and sub-watershed scales. The information provided by these monitoring efforts will be used to direct management actions in the Deschutes River Basin, including harvest seasons and regulations, hatchery operations, and restoration activities. The collection of these monitoring data are essential to determine if the CTWSRO and its co-managers are achieving the long-term adult escapement goals as defined by the Deschutes River Subbasin Management Plan (DRSMP) (NPCC 2005).

TECHNICAL AND SCIENTIFIC BACKGROUND

The CTWSRO has monitored aspects of the natural production of spring Chinook salmon and steelhead in Reservation streams for over three decades, beginning with smolt outmigration monitoring on the Warm Springs River in 1977 (Tables 1 and 2). Redd counts on index reaches began in 1982 for steelhead and 1986 for spring Chinook salmon.

Table 1. Spring Chinook monitoring activities by the CTWSRO 1977 - 2009

Activity	Season	Years Conducted	
		Warm Springs River	Shitike Creek
Outmigrant Trapping	Spring/Fall	1977-Present	1995-Present
Index Site Redd Counts	Late Summer	1986-Present	1986-Present
Juvenile Rearing	Summer	2002-2004, 2006-Present	1986-1989, 2000-2004, 2006-Present
Adult Spawning Escapement	Spring/Summer	1981-Present (@ WSNFH)	2005-Present (Video monitoring at weir)

Table 2. Summer steelhead monitoring activities by the CTWSRO 1977 - 2009

Activity	Season	Years Conducted	
		Warm Springs River	Shitike Creek
Outmigrant Trapping*	Spring/Fall	1977-Present	1995-Present
Index Site Redd Counts	Spring	1982-Present	1982-Present
Juvenile Rearing*	Summer	2002-2004, 2006-Present	1986-1989, 2000-2004, 2006-Present
Adult Spawning Escapement	Late Winter / Spring	1981-Present (@ WSNFH)	2005-2008

* Individuals enumerated only, no population estimates generated

During the time span of this proposed project, the CTWSRO will continue life-cycle monitoring efforts as a means of maintaining annual trend status data for spring Chinook salmon and steelhead populations in Reservation streams. These monitoring efforts will focus on the life history stages that are spent in Reservation streams: adult spawning (redd surveys), juvenile rearing, juvenile outmigration, and eventual adult returns and spawning migrations.

Due to a high rate of personnel turnover, periodical lack of staff, and competing priorities, many of the monitoring efforts on the CTWSRO Reservation during the past three decades have been conducted with varying methodologies and levels of effort that complicate comparisons between years. This proposed project will address the need for standardized data collection methods that allow for between-year comparison and estimation of population sizes at multiple life history stages for each brood year, both during the time span of this project and beyond. This will be accomplished by review of data collection protocols and methods and creation of protocol documents that will allow biologists in the future to collect meaningful and comparable data.

Chinook salmon, which are the primary species of cultural identity for the people of the Warm Springs Tribes, has been (and will continue to be) the main focus of monitoring efforts. Methodologies for monitoring of Chinook salmon are relatively well established, and will be continued and improved upon as necessary.

Although steelhead are an important component of anadromous fish populations in the Deschutes River, little past work by the CTWSRO has focused specifically on steelhead production monitoring, and will be a focus of this proposed project. Data has been collected on *O. mykiss* juveniles both at the outmigrant traps and during summertime snorkeling, but little effort has been put into the analysis of this data specifically for steelhead. To this end, historic estimates for juvenile outmigration, summertime rearing densities, and life stage population estimates for steelhead are lacking. A problem that complicates assessment of steelhead populations is the difficulty in differentiating between resident *O. mykiss* (a.k.a. redband trout) and steelhead juveniles. Both life history types spawn and rear in the Warm Springs River and Shitike Creek, but the ratio of redbands to steelhead is unknown.

Results of this proposed project will also be utilized to evaluate the efficacy of habitat restoration actions by the CTWSRO Deschutes River Restoration Program (DRRP). This project (BPA #2008-301-00) will be conducting both large-scale and small-scale habitat restoration efforts on the Deschutes River and its tributaries. Among the metrics used for determining success of the DRRP is increased production of juvenile spring Chinook and steelhead in the restoration sites.

Study Area and Biological Background

The Warm Springs Indian Reservation is located on the east slope of the Cascade Mountains in Oregon, north and east of Mt. Jefferson (Figure 1). The Reservation is approximately 660,000 acres in size and contains a large portion of the Deschutes River basin downstream of the Pelton-Round Butte hydro-electric project. Due to their High Cascade origin, many of the Reservation watersheds have excellent water quantity and quality resulting in a stronghold for Deschutes basin anadromous and resident fish populations. The Reservation provides habitat for migration, spawning, and rearing by ESA-listed Mid-Columbia wild summer steelhead, spring Chinook salmon, bull trout, redband trout, and a mainstem Deschutes population of fall Chinook salmon.

All natural production of spring Chinook salmon in the Deschutes River basin occurs in the Warm Springs River and Shitike Creek. Summer steelhead spawn and rear in much the same physical locations as spring Chinook salmon in Shitike Creek and the Warm Springs River watershed, but also spawn in the mainstem Deschutes River. The juveniles of the two species rear in similar habitats and undoubtedly interact; however, the intensity and effects of these interactions are unknown.

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Figure 1. Fish Species Distribution on the Reservation of the Confederated Tribes of Warm Springs.

The Warm Springs watershed covers 526 square miles, reaching from nearly 6,000 feet in elevation in the Cascade Mountains to 1,230 feet at its confluence with the Deschutes River at RM 84. The river flows 53 miles and provides 41 miles of anadromous fish habitat. Two major tributaries to the Warm Springs River, Mill Creek and Beaver Creek, also support anadromous fish. Shitike Creek drains 76 square miles, with elevations ranging from 5,280 to 1,476 feet. It extends 30 miles, providing 25.7 miles of anadromous fish habitat, and joins the Deschutes River at RM 97.

Adult fish returns to the Warm Springs River are counted at the Warm Springs National Fish Hatchery (WSNFH), which has a barrier weir that allows for enumeration of all upstream migrating fish, including spring Chinook salmon (Table 3), and summer steelhead (Table 4). The U.S. Fish and Wildlife Service (USFWS) operates the WSNFH in cooperation with the CTWSRO and produces approximately 750,000 spring Chinook salmon smolts annually for release into the Warm Springs River.

The majority of natural spawning of spring Chinook salmon takes place upstream of the WSNFH. Wild runs of spring Chinook salmon to the Warm Springs River has varied greatly over the past three decades, from a low of 162 adults in 1995 to a high of over 2,600 in 2000. Return of hatchery adults to the WSNFH began in 1981 and has varied from a low of 42 in 1994 to a high of nearly 7,000 in 2002 (Table 3). The WSNFH collects 630 hatchery fish annually for broodstock purposes. The remainder of hatchery-origin salmon in excess of broodstock needs is donated to the CTWSRO and distributed to the Tribal membership for consumption.

Annual monitoring of the trends of wild and hatchery spring Chinook populations in the Warm Springs River is an essential part of fisheries management in the Deschutes River. Spring Chinook harvest seasons and limits at the Sherar's Falls fishery, which includes Tribal platform and hook-and-line fisheries as well as a sport hook-and-line fishery, are directly based upon pre-season predictions of the adult wild spring Chinook run past the WSNFH. These preseason predictions are generated cooperatively by the USFWS, Oregon Department of Fish and Wildlife (ODFW), and CTWSRO.

The data generated by the activities described below contribute to the life cycle monitoring program conducted by the CTWSRO for steelhead and Chinook salmon in the Warm Springs River Basin and Shitike Creek. Data collection includes adult spawning escapement, redd surveys, juvenile rearing, and juvenile outmigration. Continued collection of this data allows for comparison of multiple life stages for each brood year, such as potential egg deposition, egg- to fry- to-smolt survival, recruits per spawner, and smolt-to-adult returns. These analyses will also aid in identify areas of high or low productivity in Reservation streams and determining factors that may be mitigated by management actions or habitat restoration activities.

Table 3. Wild and hatchery spring Chinook salmon at the WSNFH, 1975 – 2009.

Return Year	Wild Adults	Wild Jacks	Hatchery Adults	Hatchery Jacks
1975	2,182	0	0	0
1976	2,878	0	0	0
1977	1,505	101	0	0
1978	2,584	76	0	0
1979	1,322	73	0	0
1980	968	34	0	0
1981	1,525	54	85	0
1982	1,408	46	895	21
1983	1,523	34	355	16
1984	1,192	164	789	203
1985	1,099	56	1,073	36
1986	1,656	55	152	197
1987	1,697	86	484	258
1988	1,578	69	431	393
1989	1,344	65	2,362	176
1990	1,821	46	1,324	66
1991	773	40	600	44
1992	1,040	17	771	20
1993	528	6	295	14
1994	425	10	42	10
1995	162	75	216	75
1996	1,261	26	712	23
1997	861	9	1,129	9
1998	248	23	647	6
1999	367	127	2,644	126
2000	2,622	81	6,666	79
2001	2,155	97	4,369	97
2002	1,388	51	6,840	51
2003	1,280	120	5,906	117
2004	2,350	78	3,436	108
2005	677	30	962	201
2006	1,015	68	2,636	140
2007	367	32	1,196	366
2008	529	24	1,896	245
2009	421	191	2,133	553
35 Year Average	**1,278**	**59**	**1,459**	**104**

Table 4. Unmarked and Hatchery Steelhead at the WSNFH, 1977 - 2009.

Year	Wild (Unmarked)	STRAY (Hatchery)	Total	Year	Wild (Unmarked)	STRAY (Hatchery)	Total
1977	136	No Data	136	1993	79	115	194
1978	417	No Data	417	1994	135	147	282
1979	378	16	394	1995	95	106	201
1980	311	42	353	1996	85	168	253
1981	397	46	443	1997	243	349	592
1982	569	39	608	1998	214	380	594
1983	255	35	290	1999	98	80	178
1984	431	129	560	2000	325	421	746
1985	577	89	666	2001	509	319	828
1986	373	56	429	2002	734	988	1722
1987	822	692	1514	2003	880	578	1458
1988	522	699	1221	2004	282	177	459
1989	385	204	589	2005	327	60	387
1990	339	182	521	2006	256	86	342
1991	165	129	294	2007	398	278	676
1992	280	403	683	2008	305	105	410
1993	79	115	194	2009	128	57	185
				32 Year Average	**347**	**233**	**566**

RATIONALE AND SIGNIFICANCE TO REGIONAL PROGRAMS

The Warm Springs River and Shitike Creek are within the boundary of the Lower Westside Deschutes River Assessment Unit (LWDRAU), as defined in the DRSMP (NPCC 2005). This assessment unit includes the 100 miles of mainstem lower Deschutes River, Shitike Creek, and the Warm Springs River (NPCC 2005, Section ES.2, page ES-3, and Section 4.1, page 4-2). Spring Chinook salmon and summer steelhead are two of five aquatic focal species identified by the DRSMP (NPCC 2005, section 3.2.1, page 3-1). The DRSMP (page MP-11) includes the following 25-year objectives to be met for spring Chinook salmon and steelhead adult spawning escapement in the LWDRAU:

- Achieve and maintain an annual run of 2,600 to 2,800 adult spring Chinook to the Deschutes River destined for the LWDRAU streams.
- Achieve a spawning escapement of 2,200 to 2,300 adult wild spring Chinook salmon above the barrier dam at the WSNFH.
- Achieve a spawning escapement of 400 to 500 adult wild spring Chinook salmon into Shitike Creek.
- Achieve and maintain a run of 4,500 to 5,500 naturally produced adult summer steelhead into LWDRAU streams.

The achievement of these escapement numbers is a long-term goal of the CTWSRO and its co-managers of the fisheries resources in the Deschutes Basin, but is a goal that may not be reached during the span of this project. Attaining these escapement numbers will require an understanding of the sources of mortality at each of the life stages of each of these species (i.e. the “bottlenecks) that can be addressed through management or restoration activities. The first goal of this proposed project is to provide the monitoring necessary to identify these bottlenecks and determine whether management actions and habitat restoration activities are working towards these long-term goals.

The second goal of this project is to provide management and co-management of the fisheries resources in the Deschutes Basin. The CTWSRO works in coordination with ODFW, our fisheries co-managers in the basin, as well as our other research partners, to share information and identify and implement the strategies necessary to successfully achieve the goals of the DRSMP and the Mid-Columbia Steelhead Recovery Plan.

RELATIONSHIP TO OTHER CTWSRO PROJECTS

Table 5. Relationship to other projects

Funding Source	Project #	Project Title	Relationship (brief)
USFWS	13310-7-J141	Cooperative Agreement between USFWS and CTWSRO	Cooperatively manage the Warm Springs National Fish Hatchery, investigate effects of hatchery fish on wild fish populations in the Deschutes River Basin.
PCSRF	2007-03-01	Fish Production Assessment on the Warm Springs Reservation VII	Monitor spring Chinook and steelhead on Reservation streams; provide equipment and infrastructure to improve monitoring efforts.
BPA	2008-301-00	CTWSRO Deschutes River Restoration Program	Develop habitat restoration activities directed at increasing salmonid production in Reservation streams; share personnel to monitor effectiveness of habitat restoration activities.
BPA	2008-307-00	CTWSRO Sockeye Development	Share personnel and equipment to monitor kokanee population dynamics in Lake Billy Chinook; investigate methods of reestablishing sockeye runs in the Deschutes Basin.

PROJECT HISTORY

This is a newly proposed BPA Project, but it will continue monitoring efforts that have been ongoing in Reservation streams since the late 1970's (See Tables 1 and 2).

PROPOSAL BIOLOGICAL GOALS AND OBJECTIVES

The following goals include activities that will be implemented in 2010, and describe potential activities that may take place during the 10-year span of this program:

- Goal 1) Continue and improve annual life stage monitoring of wild steelhead and spring Chinook salmon in the Warm Springs River and Shitike Creek.

- Goal 2) Provide management and co-management direction of fisheries resources in the Deschutes River Basin.

Goal 1) Continue and improve annual life stage monitoring of wild spring Chinook salmon and steelhead in the Warm Springs River Basin and Shitike Creek.

A) Juvenile Outmigration Monitoring

Two rotary screw traps will be operated near the mouths of Shitike Creek (5-foot trap) and the Warm Springs River (8-foot trap) from March – June and October - December annually to estimate the number of outmigrating juvenile Chinook salmon and *O. mykiss* (steelhead or rainbow trout) and other species.

Field Methods: The traps will be operated up to 5 days a week (depending on water levels, releases of hatchery fish, and other factors). All fish collected from the traps will be anesthetized using MS-222, identified to species, counted and placed in a recovery bucket. The first 20 of each species on each day will be measured and weighed. After recovery, all fish will be returned to the river. During the first 3 days of each week, up to 100 fish of each species and age category will be marked with a fin clip (upper or lower caudal on a rotating weekly basis) and released approximately 1/2 mile upstream of the trap. Recaptured individuals will be counted (but not measured or weighed) to estimate trap efficiency.

Passive integrated transponder (PIT) tags will be applied to all juvenile Chinook salmon migrants (1+ in fall and 1+ in spring) and all *O. mykiss* juveniles >100mm captured in the Shitike Creek and Warm Springs River outmigrant rotary screw traps. Based on data from 2005 - 2009, an average of about 4,400 1+ juvenile Chinook salmon and 480 juvenile *O. mykiss* over 100 mm are captured annually at the two traps. In 2009, tagging efforts were focused during the fall trapping period only (October - December) in order to give time for environmental compliance permits to be in place. Approximately 1,500 juvenile Chinook and 500 juvenile *O. mykiss* >100mm were tagged in 2009. Starting in 2010, up to 5,000 fish (~4,000 Chinook and ~1,000 *O. mykiss*) will be tagged annually during the spring and fall trapping periods.

PIT tag technology has been used successfully to monitor wild populations of steelhead and salmon throughout the Columbia River Basin. RPA 50.3 of the Columbia River 2008 FCRPS Bi-Op recommends increasing the number of natural origin Chinook and steelhead PIT tagged in the Columbia River Basin. Tagging wild juvenile steelhead and salmon at outmigrant traps will allow for investigation into several areas of interest, including outmigrating timing to Bonneville Dam, harvest information, and smolt-to-adult return rates to Reservation streams. This information can also be used to determine if the long-term goals of the DRSMP (See page 8) are being met.

Data Analysis and Reporting: The data collected at the screw traps will be used to generate estimates of the number of juvenile *O. mykiss* and Chinook salmon outmigrating from Shitike Creek and the Warm Springs River for the spring and fall trapping periods. Estimates for each week (or trapping period) are generated run using The Seber - Peterson mark recapture methodology (Seber 1982):

$$N_0 = \frac{(M + 1)(C + 1)}{(R + 1)} - 1$$

Where C = the total number of fish captured, M = the number marked and released upstream, and R = the number recaptured.

Weekly estimates are expanded for the number of days the trap was not operated. The total estimates from each week are summed to generate a seasonal estimate.

Estimates will be generated for three age classes of Chinook salmon (spring 0+, spring 1+, and fall 1+) and five size classes of *O. mykiss* (0-50mm, 51-100mm, 101-150mm, 151-200mm, and 201mm and above). For each period of trapping (typically weekly), estimates will be generated for each group of fish (species and age) based on the number of unmarked fish caught, the number of fish marked, and the number of marked fish recaptured. Results, including 95% confidence intervals, will be reported for each season, each species, and for each brood year.

PIT tagging data will be uploaded weekly into the PITAGIS Regional data base. Both screw trap sites have been identified as tagging locations, and this uploading of data is currently underway.

B) Collect tissue samples for genetic analysis of *O. mykiss* in the Warm Springs River Drainage

Lack of an accurate (or at least defendable) estimate of outmigrating steelhead smolts from westside Deschutes River tributaries presents a large hole in the life-history data of this species. Outmigrating juvenile *O. mykiss* from the Warm Springs River may come from anadromous parents (steelhead) or resident parents (redband trout). The qualitative "calls" of steelhead or resident fish captured at the outmigrant traps based upon physical characteristics (e.g., silvery, torpedo shaped steelhead smolts or darker, deeper bodied resident fish) are of unknown accuracy. Genetic analysis is a potential tool that can be used to confirm or refute these qualitative calls. Collecting samples from known steelhead or resident adults provides a genetic baseline for comparison. Comparing genetic samples from juveniles of unknown origin to known resident and anadromous baseline data could assist in determining the proportion of resident versus anadromous fish in the sampled fish, and determine the success of visual assignments made at the time of capture.

In 2009, approximately 500 genetic samples were collected from Reservation streams, which included 200 juveniles from the Warm Springs River outmigrant trap, 100 adults from the adult ladder at the WSNFH, 100 juveniles from Beaver Creek, and 100 juveniles from the upper Warm Springs River. The juvenile fish in Beaver Creek and the Upper Warm Springs River were collected by electrofishing. The samples were shipped for analysis to the Hagerman Genetics Laboratory, Hagerman, Idaho, and results are still pending.

The objectives of the genetic collections are to 1) determine the population structure of *O. mykiss* in the Warm Springs River; 2) determine the proportion of resident and anadromous juvenile *O. mykiss* outmigrating from the Warm Springs River; and 3) expand standardized *O. mykiss* data in the Deschutes River and Columbia River Basins. The answers to objective #2 depend entirely on the answers to objective #1. If there is no evidence to support they hypothesis of multiple subpopulations of *O. mykiss* in the Warm Springs River Basin (i.e. steelhead adults produce resident redband trout offspring, and resident redband trout produce steelhead offspring), there will be no way to accurately estimate steelhead smolt outmigration through genetic analyses. However, this information will still be valuable in understanding the life history patterns of *O. mykiss* in the Deschutes Basin.

The CTWSRO will continue to collect samples from *O. mykiss* in the Warm Springs River Basin in 2010 and beyond (or at least until objective #1 above has been satisfactorily answered). Tissue samples will be collected from approximately 200 juveniles at the outmigrant trap, and from approximately 100 adult steelhead and 100 resident *O. mykiss* captured in the weir at the WSNFH. At the outmigrant trap, each juvenile *O. mykiss* that tissue samples are taken from will be visually inspected at the time of capture and a qualitative assignment (steelhead or resident) will be made. The adult samples will be added to already existing collections from previous years, and will provide a basis for comparison to the juvenile samples. After these tissue samples have been collected, they will be shipped to a contracted genetics laboratory for analysis.

C) Summer Rearing Snorkel Surveys

Four streams on the Reservation; the Warm Springs River, Mill Creek, Beaver Creek, and Shitike Creek, are sampled annually via snorkeling during July and August annually to collect information on rearing densities of juvenile salmon and *O. mykiss*. Each of these streams has been segmented into reaches (3 in the Warm Springs River, 2 in Mill Creek, 5 in Beaver Creek, and 7 in Shitike Creek) based on geomorphological differences, and cover all accessible reaches of these streams from above the upper-most reaches of spawning activity to the mouths. The data collected in this objective will be used in combination with redd survey and adult spawning escapement data to identify areas of high or low productivity in Reservation streams, and provide information on annual trends of productivity.

Sampling methods: A subsample of pools and riffle habitat within each of these reaches will be sampled annually. Approximately 10% of the pools and 1-2% of the riffle habitat in each reach will selected for daytime snorkeling using a systematic sampling method from a random starting point. A selected number of pools will be repeated as index sites in day and night dives each year for direct annual comparison. Studies in the upper Deschutes River Basin have indicated that densities of juvenile Chinook salmon may differ greatly between day and night surveys, which may be a function of temperature or the presence of predators (Lovtang 2005). Additionally, below certain temperatures, juvenile Chinook salmon may conceal themselves in the substrate during the day, but emerge to feed at night (Van Dyke et al 2010). Direct comparison between night surveys among years and between day and night surveys within years will allow for a more accurate evaluation of relative broodyear production, and begin the process of identifying behavioral differences (e.g. daytime concealment) between and among stream reaches, potential causative factors for those behaviors, and a better understanding of how these might affect our seasonal density estimates.

Field Methods: A team of two or four divers, depending on the size of stream, will start at the bottom of each unit and move upstream, counting fish by species and age class. Three passes will be conducted in each unit, with divers switching lanes between passes. Habitat information will be collected for each pool and riffle, including: temperature prior to and after sampling, unit length, maximum depth, unit width at max depth, depth at pool tail crest, number of pieces of large wood within bankfull channel (>3 m in length, > 10 cm at small end, root wads may be less than 3 m), and a categorical measure of percent undercut bank (Classes: 0-25%, 25-50%, 50-75%, 75-100%). Approximately 70 pools and 25 riffle segments in 13 stream reaches will be sampled during the months of July and August.

In the lower reaches of the Warm Springs River, the river is large, deep, and visibility is often too poor to accurately count fish for density estimates. Instead, we will determine the presence or absence of rearing salmonids in these reaches annually.

Additional habitat information and snorkeling efforts may also be gathered in coordination with the CTWRSO DRRP to ensure commonality of measurements and to provide information for the monitoring of the efficacy of habitat restoration projects.

Data analysis and reporting: The data collected during snorkel surveys will be used to generate a population estimate for juvenile Chinook salmon in each pool, using a bounded count methodology. For each species and age class in each pool, a population estimate for each pool (N_{pool}) is made by using the formula:

$$N_{pool} = n_{max} + (n_{max} - n_{max-1})$$

Where n_{max} is the maximum observed number in one of the three passes, and n_{max-1} is the pass with second highest observed number.

Once estimates have been created, statistical tests will be performed to: 1) search for differences in fish densities between and among reaches and streams; 2) investigate relationships between fish densities and habitat variables; and 3) compare annual results to previous years' data. Summaries of other fish species observed (e.g. bull trout) will also be reported.

D) Spawning Ground (Redd) Surveys

Spawning ground surveys for summer steelhead and spring Chinook salmon will be conducted on index reaches in Beaver, Mill, Badger, and Shitike Creeks, and the upper and lower Warm Springs River. It should be noted that our surveys do not cover the entire geographic range of spawning, primarily due to difficult access to some of the canyon reaches. However, our index reach surveys can provide valuable information on annual variation in spawning escapement, and can be used to provide estimates of survival-to-spawning and prespawning mortality.

Field Methods: A team of two or three surveyors begin surveys at the top of each reach and walk downstream. For each survey, the date, time, and water temperature are recorded. When a redd is identified, it will be counted and flagged on a nearby riparian tree. Typically, each reach is surveyed up to three times over the course of a six or seven week period. Redd surveys for summer steelhead are conducted beginning in late April and ending in early June, and spring Chinook surveys are conducted between the last week in August and the first week of October.

Analysis and Reporting: Steelhead survey data (collected in April through early June) will be compiled and reported in the early summer. Spring Chinook survey data (collected in August through early October) will be reported in the fall. These data will be distributed to both the USFWS and ODFW. All GPS coordinates of redds will be entered into a database. The CTWSRO began collecting GPS data on redds in 2005. Analysis of redd data will allow for the investigation into trends of redd distribution on an annual basis.

Prespawning mortality is estimated for populations in the Warm Springs River Basin by fish per redd ratios. These ratios are dividing the total number of fish passed at the WSNFH by the number of redds counted in the upper basin. Prespawning mortality of wild Chinook salmon adults upstream of the hatchery has increased in the past decade; an average of 5.1 fish per redd was estimated between 2000 and 2007 compared to a ratio of 3.3 fish per redd between 1990 and 1999. The causes for this apparent increase in prespawning mortality are unknown, but the awareness of these data is important for the holistic management of Chinook salmon in the basin.

E) Enumerate adult escapement into Shitike Creek and the Warm Springs River

Shitike Creek - A picket weir with a camera box is installed annually in Shitike Creek to count upstream migrating Chinook salmon. The camera is connected to a digital video recorder (DVR) which is switched out and reviewed several times a week. The weir / camera combination is installed in late April / early May, after the main threat of high water has passed. The weir was operated as a capture facility during the steelhead migration period (February – April) in 2005 – 2008; however, high water events in March and April of those years often overtopped the weir, complicating the reliability of escapement estimates. In 2010 and for the foreseeable future, steelhead escapement in Shitike Creek will be estimated based on the total number of redds counted and established fish per redd ratios.

Warm Springs River - The USFWS enumerates all upstream escapements of steelhead and Chinook salmon at the WSNFH, and has the ability to handle all upstream migrating fish. No hatchery-origin fish are intentionally passed upstream of the hatchery. Data on numbers and species of fish passed upstream are shared with the CTWSRO fisheries program, and are an important part of our life cycle monitoring program.

F) Estimate harvest of Chinook salmon and Steelhead in the Deschutes Basin.

Annually, the CTWSRO and ODFW generate preseason estimates of adult spring Chinook salmon escapement to the Deschutes River. These estimates rely heavily on run reconstruction of the previous year's escapement, and are used directly when developing regulations for sport and Tribal harvest in the Deschutes River.

Harvest in the Deschutes River is focused at and around the Sherars Falls area (Rkm 70.4). Annual creel surveys by both ODFW and CTWSRO creel clerks at Sherars Falls provide this information. Data is collected on numbers of fishermen, effort (hours), technique (scaffold or hook and line) and the numbers of fish harvested. Further information on harvested fish includes origin (wild or hatchery), size (for age estimation), and any other distinguishing marks (e.g. fin clips or floy tags).

Goal 2) Provide management and co-management direction of the fisheries resources in the Deschutes River Basin.

A) Cooperate in Deschutes River Basin Fisheries Management Activities

The CTWSRO exclusively manages fisheries resources on Reservation lands, and along with the ODFW, cooperatively manages fisheries on all Tribal ceded lands, which includes the Deschutes River Basin, the John Day River Basin, and the Hood River Basin. Other agencies and research partners in the Deschutes River Basin include the USFWS, US Forest Service, Bureau of Land Management, Portland General Electric, and local irrigation districts, watershed councils and public interest groups. It is in the interest of the CTWSRO to attend meetings with these groups and others to stay informed on fisheries issues in the Deschutes Basin and to make sure Tribal interests and policies are heard and understood.

Actively cooperating in fisheries management activities is an essential part of meeting salmon recovery goals in the future. The objectives of goal #1 of this project provide the data on the numbers and trends of the life stages of salmon and steelhead in the Deschutes Basin. However, those data must be analyzed and used to make informed decisions about land management, habitat restoration, harvest regulations and seasons, potential supplementation, and other issues. Management activities that must be addressed annually include development of preseason escapement forecasts, setting harvest seasons and regulations, managing license sales and distribution, and providing enforcement of regulations. Note that not all of these activities will be charged to BPA Accords funds – some will be funded through Tribal dollars or other grants and contracts.

B) Provide co- management and assistance with fish handling at the Warm Springs National Fish Hatchery

The USFWS and the CTWSRO co-operatively manage the WSNFH, which is located on Tribal land leased to the USFWS. The operation of the WSNFH is operated under a co-operative Operational and Implementation Plan that is updated every five years. The current document expires in 2011 (CTWRSO and USFWS 2007), and the CTWSRO will take the lead in writing the new 2012-2017 document.

Staff from the CTWSRO, along with staff from the USFWS, serves on the Hatchery Evaluation Team (HET) for the WSNFH. The HET meets quarterly to receive updates on hatchery operations, evaluate and comment on proposed studies, and disseminate information on existing or completed studies. Additionally, the CTWSRO and the USFWS alternately host an annual meeting for presentation of study results and hatchery operations. This annual meeting also provides an opportunity for members of the Tribal and non-tribal public, staff from other agencies in the Deschutes Basin, and Tribal Council and Committee members to learn about operations at the WSNFH.

Although the WSNFH in primarily a production facility, it is also used as a tool to improve and enhance runs of wild steelhead and spring Chinook. Management actions at the hatchery are used to meet the long-term Deschutes Basin goal of achieving a spawning escapement of 2,200 to 2,300 adult wild spring Chinook salmon above the barrier dam at the WSNFH.

When the WSNFH is inundated with steelhead and/or Chinook salmon, CTWSRO staff may be called upon to assist with fish sorting, handling, and distribution to Tribal Membership, or to assist with other hatchery operations. Although the spring and summer months (April - September) are the busiest months of the year in terms of fish handling, CTWSRO staff may be requested to assist in operations at any time of the year. The CTWSRO and the USFWS have an annual cooperative agreement that supplies partial funding to the CTWSRO Fisheries Program for these duties.

FACILITIES AND EQUIPMENT

Facilities, personnel, equipment, and vehicles will be provided by the CTWSRO. New equipment purchases with BPA funds will include new computers, analysis software, office supplies, PIT tags and PIT tag readers, field gear including waders, uniforms polarized glasses, and dive gear (masks and snorkels), and digital cameras. Other equipment purchases in the future may include gear necessary for data collection, including waders, dry suits and snorkeling gear, inflatable kayaks and paddles, polarized sunglasses, nets, chemicals for fish handling, and hand and power tools.

The costs for portions of 3 GSA vehicles (equivalent of 29 months) will be charged to this budget annually. Other costs include lodging, per diem and travel to Oregon AFS conferences and various meetings, and subcontracts for repair and maintenance of rotary screw traps.

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Key Personnel:

JENS LOVTANG, FISHERIES MANAGEMENT SUPERVISOR
PRINCIPAL INVESTIGATOR / PROJECT MANAGER

Education

Oregon State University, M.S. Fisheries Biology, 2005
Humboldt State University, B.S Natural Resources Planning, 1995

Work Experience

Confederated Tribes of Warm Springs
Fisheries Management Supervisor, October 2009 – Present
Fish Production Biologist, November 2005 – October 2009

Oregon Department of Fish and Wildlife, Corvallis, Oregon
Experimental Biology Aide, Gearhart Mountain Bull Trout Project, July – August 2005
Experimental Biology Aide, Siletz River Fall Chinook Project, September - October 2005

Oregon State University, Corvallis, Oregon
Graduate Research Assistant (M.S. Candidate), January 2002 – June 2005

Portland General Electric, Madras, Oregon
Fish Technician, Pelton Round Butte Project April – November 1999

Deschutes National Forest, Sisters Ranger District, Sisters, Oregon
Seasonal Fisheries Biologist, 1996 – 1998

Recent Publications

Confederated Tribes of the Warm Springs Reservation of Oregon and The United States Fish and Wildlife Service. 2007. Warm Springs National Fish Hatchery, 2007-2011 Operational Plan and Implementation Plan. USFWS, Columbia River Fisheries Program Office, Vancouver, WA.

Lovtang, J.C. 2008. Confederated Tribes of Warm Springs, Fish Production Program, 2007 Annual Report. Confederated Tribes of Warm Springs, Warm Springs, OR

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LISA HEWLETT-DUBISAR, FISHERIES BIOLOGIST
PROJECT IMPLEMENTATION

Education:
Portland State University, B.S Environmental Science, 2000

Work Experience
The Confederated Tribes of Warm Springs
Fisheries Biologist**,** November 2005 - Present
Make recommendations and mitigations to conserve, protect, and enhance fisheries resources. Apply the Tribal Integrated Resource Management Plan to timber sales and other land use practices. Write biological assessments on ESA listed fish species. Review proposed projects and write biological evaluations. Frequently communicate with various state and federal agencies. Conduct spring Chinook, steelhead, and bull trout redd counts. Use GPS and GIS to geographically present field data. Construct a fish weir to collect summer steelhead kelts and to monitor underwater video to enumerate upstream migrating adult salmonids. Present project results in technical reports, maps, and professional presentations.

Oregon Department of Fish and Wildlife
Experimental Biology Aid,
February 2005 – October 2005; June 2004 – October 2004; June 2001 – October 2001;
Performed various sampling techniques to determine escapement and productivity of spring Chinook and summer steelhead in the John Day subbasin. PIT tagged emigrating smolts using rotary screw traps and 100ft beach seine. Performed Chinook, steelhead, and bull trout spawning ground surveys. Identified fin marks, sex, origin, collect scale, kidney, genetic, and ovary samples from salmonid carcasses. Operated and navigated drift boat and jet sled down the Mainstem John Day River.

Department of Environmental Quality
Natural Resource Specialist 1, June 2004 – October 2004

Oregon State University
Research Assistant, February 2001 – June 2001

JOB-RELATED PUBLICATIONS:
Hewlett, L.M. 2007. The Confederated Tribes of the Warm Springs Reservation of Oregon. Shitike Creek Summer Steelhead (Oncorhynchus mykiss) Kelt Reconditioning: Reproductive Success, Monitoring, and Assessment.

Lovtang, J., **L. M. Hewlett**, and A. Mitchell. 2006. The Confederated Tribes of the Warm Springs Reservation of Oregon Fish Production Program. Annual Progress Report 2006.

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ARTHUR MITCHELL, LEAD IMPLEMENTATION TECHNICIAN

Art has worked for the CTWSRO Department of Natural Resources since 2002. His experience with the CTWSRO Fish Production program includes serving as crew leader for spring and fall migrant trapping, redd surveys, snorkeling efforts, and the Shitike Creek steelhead kelt reconditioning program. Art coordinates field activities for the program, including snorkeling and redd counts, and oversees data entry for all field data collection.

Education

Graduated from Molalla Union High School
Molalla, Oregon 1986

Professional Experience

Confederated Tribes of Warm Springs, 2002 - present
Lead Technician, Fish Production Program
Duties: Coordinate and implement Tribal fisheries research projects including operation and maintenance of field gear (e.g., picket weirs, migrant traps); maintain equipment; lead daily field crew activities; effectively communicate, orally and written; enter, verify, and assist with summarizing of field data; assist in report preparation; and coordinate field sampling activities with a variety of entities.

Ironworkers Union Local #27, Portland, Oregon
Apprentice Ironworker 2000-2002

Yakama Nation, Land Enterprises, Wapato, Washington
Irrigation Field Crew Boss, 1994-2000