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The Resources Agency
DEPARTMENT OF FISH AND GAME

2003-2004 ANNUAL REPORT
TRINITY RIVER TRIBUTARIES
WINTER-RUN STEELHEAD SPAWNING SURVEY REPORT
PROJECT 1d1

Prepared by

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Northern California - North Coast Region

Anadromous Fisheries Resource Assessment Monitoring Program
June 2004

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ABSTRACT

This report documents results of spawning surveys conducted by the California Department of Fish and Game on randomly selected Trinity River tributaries from March through May of 2003. This is the fourth consecutive season of spawning surveys on selected tributaries and serves to create an index of in-river spawning steelhead abundance by enumerating redds. Between March and May 2003, we observed a total of 97 redds in 79 kilometers of surveyed habitat. Overall redd density for all tributaries surveyed was 1.22 redds/kilometer. The highest redd density occurred in Eltapom Creek (3.85 redds/km), while zero redds were observed in three tributaries: Rattlesnake, Dutch, and Pelletreau Creeks. During the course of the surveys, crews encountered 55 adult steelhead, 21 of which were observed in Reading Creek.

INTRODUCTION

The current state of knowledge regarding steelhead (*Oncorhynchus mykiss*) spawning in the Trinity basin is limited. Most prior spawner surveys within the KMP ESU concentrated on salmon and were therefore terminated prior to steelhead spawning. Prior surveys have been conducted on main-stem Trinity River tributaries in 1964, 1971, 1972, and 1974 to monitor the effect of Lewiston Dam on steelhead populations. Most recently, steelhead spawning surveys were conducted in South Fork Trinity River tributaries in 1989 - 1995 under the California Department Fish and Game's Trinity River Project. This season marks the fourth year of spawning surveys conducted by the

Anadromous Fisheries Monitoring Assessment Program (formerly the Steelhead Research and Monitoring Program) on selected Trinity River tributaries. Traditional basin-wide estimates of steelhead abundance provide little information on the distribution of steelhead spawning. Surveys conducted to enumerate successful steelhead spawning and habitat utilization in tributaries will help to assess this critical component of life history.

Klamath Mountains Province steelhead were recently petitioned to list under the Endangered Species Act, but the listing was found to be "not warranted" by review of the National Marine Fisheries Service on March 28, 2001. Steelhead in the Trinity basin can be split into three races based upon spatial and temporal segregation: summer, fall, and winter. Summer-run fish enter freshwater in April through September and over-summer in deep pools prior to entering smaller tributary streams during the first November rain. They continue to migrate upstream through January, and spawn in January and February. (Barnhardt, 1986). Fall-run fish, referred to as summer run-B in systems such as the Rogue, enter freshwater in September and October and spawn from January through April (Currier, personal communication). Winter-run steelhead enter the mouth of the Klamath and migrate upstream from November 1st through April 30th (Barnhardt, 1986). Winter-run steelhead spawning begins in early March and continues through May (Fukushima and Lesh, 1998). Historically, Moffitt and Smith (1950) observed, prior to the completion of Trinity Dam, that spawning of winter-run steelhead began in the upper Trinity drainage in the last part of February, peaking in late March and early April, with some scattered spawning continuing through early June. Previous spawning surveys of Trinity tributaries by the Department of Fish and Game from 2000-2002 showed that spawning in main-stem tributaries peaked in early April, approximately three weeks prior to peaks in the South Fork basin in late April and early May (Garrison, 2002).

Study Objectives

1. Quantify the number of steelhead redds in selected tributaries.

2. Assess spawning habitat conditions.

3. Verify successful spawning.

4. Create index for future comparison of redd numbers. Selected tributaries are included in future surveys for comparison and possible trend analysis.

5. Determine temporal and spatial spawning distribution of steelhead in Trinity River tributaries.

6. Verify and assess barriers to steelhead migration on surveyed tributaries.

Study Area

The area covered by these spawning surveys includes all anadromous tributaries of the Trinity basin upstream of the New River, including the South Fork of the Trinity River. A stratified random sampling design was used to select tributaries within the basin. To develop a sampling universe, all anadromous tributaries within the named basins were identified. The entire basin was then stratified into two sub-basins, the South Fork and the main-stem, each of which was sampled approximately evenly at a 10% sampling rate. Originally, nine tributaries were selected from each basin. Two tributaries had to be dropped from the main-stem basin due to high flow problems. No replacement tributaries in the main-stem were chosen due to time restraints. The following Trinity River tributaries were surveyed from their confluence to an upstream migrational barrier except where noted.

Smoky Creek was surveyed from the South Fork Trinity River confluence to a waterfall barrier 4.1 km upstream. Access is only available through private property owned by Jon Ostrat near Silver Creek. Smoky Creek’s remoteness has spared it from most recent land management activities, leaving the creek in a rather pristine condition. Stream condition inventories of Smoky Creek by the US Forest Service in 1998 stated the quality and quantity of gravel in Smoky Creek was not found to be a critically limiting factor to steelhead, although high redd gravel embeddedness values could impede fry emergence. Overall, they concluded that the Smoky Creek watershed is one of the premier tributary systems of the South Fork Trinity River, with ample salmonid habitat, cool water temperatures, relatively low sediment recruitment and an ample riparian and structural cover component (Garrison, 1999).

Rattlesnake Creek was surveyed from the South Fork Trinity River confluence to a waterfall barrier 16.21 km upstream. Access is available via State Route 36. Lower Rattlesnake Creek has a steep high energy channel dominated by bedrock and boulder substrate. The lower creek is littered by large wooden restoration structures installed by the CCC in the early 1990s. Most of these structures were installed in areas of excessive gradient and have been blown out creating piles of cabled large wood debris. The middle and upper sections of Rattlesnake Creek are predominated by B channel and exhibit a healthy mix of deep pools, large wood and adequate spawning habitat. Major anadromous tributaries to Rattlesnake Creek include Post Creek, Little Rattlesnake, and North Fork Rattlesnake Creeks.

Plummer Creek was surveyed from the South Fork Trinity River confluence to a waterfall barrier 5.18 km upstream. Access is available through River Spirit Land Conservancy or by Friend Lake trail. The Department currently has a land-owner access agreement with David Rose of the South Fork Land Conservancy (River Spirit) in which a small fee is paid to help maintain their extensive private road system in exchange for year-round access. Problems with deep snow at both access points usually prevent surveys until early April.

Eltapom Creek was surveyed from the South Fork Trinity River confluence to a waterfall barrier 1.26 km upstream. Access is only available by crossing the South Fork Trinity River (SFTR), off of Forest Highway 311. A raft is recommended and sometimes necessary for crossing the SFTR at higher flows, especially in March and early April. Eltapom Creek is often referred to as the gem of the South Fork Trinity River; it has excellent spawning gravel, sufficient holding pools, and a dense riparian corridor. Although very short in length, it consistently shows high redd densities and fish counts.

Pelletreau Creek was surveyed from the South Fork Trinity River confluence to a log jam/ depositional barrier 1.41 km upstream. Access is made from FH 311 just south of Hyampom. Downstream from the 311 bridge (about 200 meters) was surveyed with binoculars after private property access permission was denied. Pelletreau Creek was heavily impacted by the 1964 flood, which raised the level of the creek over 8 feet from sediment deposition. This creek is still in the early stages of recovery as it slowly moves a large sediment plug downstream to the South Fork Trinity River.

East Fork of Hayfork Creek (EF Hayfork) was surveyed from its confluence with Hayfork Creek to Byron Gulch approximately 6.77 km upstream. There is no permanent barrier on EF Hayfork; for the second season however, a temporary log jam barrier blocks anadromy approximately 0.2 km upstream of the confluence with the North Fork East Fork. EF Hayfork has been heavily impacted by historic mining, evidenced by large piles of mine tailings that stand above the channel. Even through much of the boulder/cobble framework needed to retain gravel has been removed, plentiful spawning gravel and suitable habitat flourishes. Major anadromous tributaries to EF Hayfork include Potatoe Creek and North Fork East Fork Hayfork Creek.

Potatoe Creek was surveyed from its confluence East Fork Hayfork Creek to a waterfall barrier 4.03 km upstream. Access is available via FH 343. Potatoe Creek is the major tributary to the East Fork Hayfork and has only two small third-order anadromous tributaries. Potatoe Creek is dominated by a high energy channel that alternates between A and B channel type. It has sufficient pools and excessive amounts of large wood, but is limited by the availability of spawning substrate. Several active gravel recruitment sites exist on upper Potatoe Creek, but these small areas of inner gorge mass wasting provide very angular substrate dominated by decomposed granite to the upper creek.

Tule Creek was surveyed from its confluence with Hayfork Creek to a long cascade barrier approximately 5.8 km. upstream. The confluence of Tule Creek is accessible by walking the fence-line from the Salt Creek confluence; the remainder of Tule Creek is accessible via FH 10. Tule Creek is one of the larger tributaries to Hayfork Creek and drains the west side of the mountains creating the Hayfork Valley. The lower reach of Tule Creek is predominantly C channel type with excellent spawning areas and plentiful gravel. The riparian corridor is dominated by thick willows with the occasional alder. The middle of the lower reach of creek contains a large seasonal beaver pond; no barriers to passage are created by the pond, but it sure complicates crew passage.

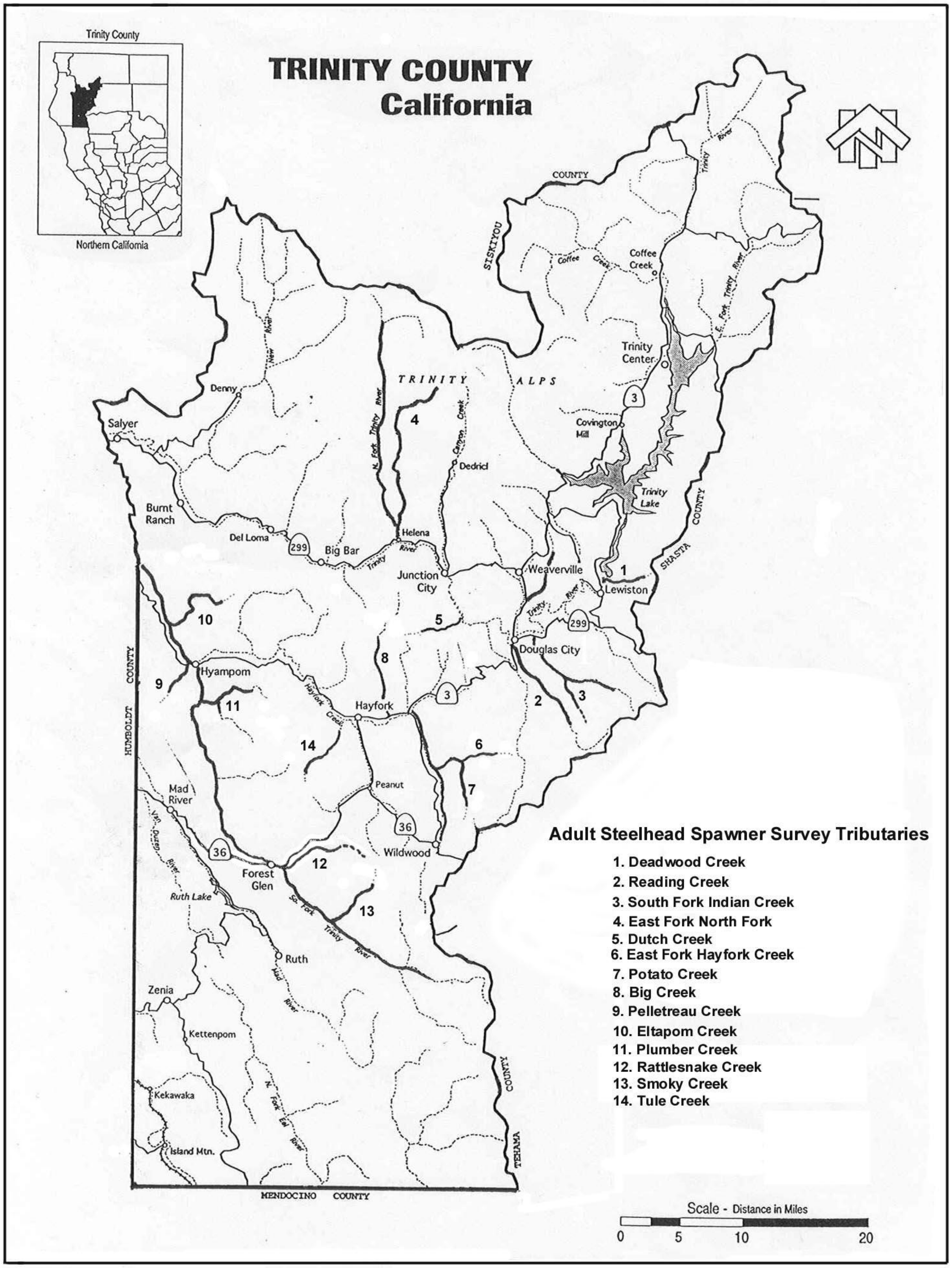


Figure 1. Map of Trinity basin with selected spawner survey tributaries.

Deadwood Creek was surveyed from its confluence with the Trinity River to a waterfall barrier 3.82 km upstream. Access is available from Deadwood Road. Deadwood is the uppermost tributary to the Trinity River below Lewiston Dam. Deadwood Creek has a steep high energy channel in the lower kilometer, that flattens out into a section of sinuous, complex spawning habitat with adequate large wood and a dense riparian corridor. One aesthetic problem is that Deadwood has become a dumping ground for trash, cars, and used appliances; these litter the banks of the creek in several areas, but have not yet led to any perceived or observable acute pollution problems.

South Fork of Indian Creek (SF Indian) was surveyed from its confluence with Indian Creek to a waterfall barrier 1.49 km upstream. Access is available via Reading Creek Rd. and by an unnamed SPI logging road. SF Indian has a bedrock dominated high energy channel, with no anadromous tributaries. Some spawning habitat is available in the lower reach, but gravel availability in the upper reach is sporadic. SF Indian has an abundance of deep pools and a thick riparian corridor.

Dutch Creek was surveyed from its confluence with the Trinity River to a culvert barrier created by a SPI logging road. Access is available via Dutch Creek Road, but it is not advisable to drive to the confluence, especially during winter flows. Access is available to the uppermost reach via an SPI logging road. In the event of heavy rains or other events which close the logging road, an historical mining ditch is used for access on the uppermost reach of Dutch Creek. Dutch Creek has a steep channel which alternates from A to B channel type. Spawning habitat is limiting in all areas except around the meadow near the access point. The mouth of Dutch Creek could prove problematic and may be negatively affecting fish numbers; although the mouth is not a barrier to fish passage, it passes through a narrow maze of willow trees, which dissipate much of its energy before it enters the main-stem Trinity River. This lack of attraction flow could be the reason few winter fish are found up Dutch Creek.

Reading Creek was surveyed from its confluence with the Trinity River to Byron Gulch approximately 20.86 km upstream. Reading Creek is the largest creek (5^{th} order) included in current spawning surveys. Due to the nature of the depositional channel, gravel availability is not considered a limiting factor to salmonid production. Lower reaches have long beds of clean, well sorted gravel. A log jam barrier was encountered just downstream of Byron Gulch, and was considered impassable by adult steelhead this season. Access is available via Reading Creek road and several SPI logging roads.

METHODS

Sampling Frame/Tributary Selection

The sampling frame for this study consists of all anadromous water of the Trinity River upstream of the New River, but including the South Fork Trinity River. Tributaries of the Trinity located within the Hoopa Square are also not included. The sampling frame was developed by scouring U.S. Forest Service habitat typing files located in the Hayfork and Weaverville Forest Service Fisheries offices. Tributaries located in the Six Rivers National Forest were confirmed with the local Forest Service zone fisheries biologist (L. Morgan, personal communication). Most habitat typing data from the Forest Service is 15-30 years old; some barriers are classified as semi-permanent, i.e. log-jams, short cascade fields. We are currently verifying and expanding our sampling universe when time allows.

Tributaries were selected with a weighted stratified random sample. Each tributary was assigned a weighted sampling probability dependent upon proportion of available anadromous mileage compared to available mileage in basin strata. Weighted sampling probabilities were used in order to evenly sample the basin by complete anadromous tributary distance instead of standardized length systematically sampled reaches. Spatial distribution of steelhead spawning in the Trinity basin is highly sporadic; I wanted to minimize chance of selected non-representative reaches, and better examine the "big picture" of spawning in a selected tributary. The sampling universe was stratified into the South Fork tributaries and main-stem tributaries. Each tributary was assigned a range of numbers corresponding with its anadromous mileage, therefore the probability that any one tributary would be sampled was based on the portion of anadromous habitat to that of the total sampling frame. From each strata, nine tributaries were selected. Several tributaries from each strata were dropped due to logistical complications. The East Fork of the South Fork Trinity was selected, but could not be surveyed due to winter conditions. Brock Gulch was selected in the main-stem strata, but dropped because of inadequate flow for fish passage and spawning. The East Fork North Fork and Big French Creek have been dropped from the main-stem strata due to their extreme size and dynamic flow regime (Crews had problems navigating large water in remote environmental extremes). One additional tributary was dropped from each strata due to the refusal of private property permission; Big Creek was dropped from the South Fork strata. East Weaver Creek was dropped from the main-stem strata.

The same panel of selected tributaries is revisited every year. No new panel or revisit schedules have been implemented since the project's inception in 1999. A revised revisit schedule with several panels is planned for implementation next year at the conclusion of the five-year pilot period.

Private Property Permission

Permission to survey across private property is obtained from all landowners prior to any surveys being conducted. Specific parcels to be surveyed across are identified using ParcelQuest© software, which is updated biennially. All landowners are notified by mail and asked to return a postcard allowing the Department permission to survey the named tributary across their property with the condition that crews stay below the high-water mark. Additional permission is ascertained in cases where access to the tributary across a landowners property is necessary. Letters verifying permission are sent out annually in late January or early February. Sierra Pacific Industries (SPI) is the largest private landowner in Trinity County and has been most cooperative in allowing permission on all SPI lands.

Timing

All tributaries are surveyed every three to four weeks from March through May. Main-stem tributaries are surveyed first due to historically earlier spawning when compared to the South Fork basin. Survey reaches are surveyed sequentially from confluence to headwaters whenever possible. Some timing adjustment was necessary due to snow, rain events, and problems with funding for technicians. Table 1 (below) lists pass dates per reach and tributary.

Table 1. Tributary pass schedule.

Tributary	Pass Date			
	Pass 1	Pass 2	Pass 3	Pass 4
Deadwood	3/4/2004	3/24/2004	4/20/2004	5/19/2004
Dutch/R1	3/2/2004	4/1/2004	4/15/2004	5/17/2004
Dutch/R2	3/2/2004	4/1/2004	4/15/2004	5/18/2004
South Fork Indian	3/5/2004	3/25/2004	4/15/2004	5/14/2004
East Fork Browns	3/11/2004	4/2/2004	4/23/2004	5/21/2004
Reading/R1	3/8/2004	3/25/2004	4/19/2004	5/10/2004
Reading/R2	3/9/2004	3/29/2004	4/20/2004	5/10/2004
Reading/R3	3/10/2004	3/30/2004	4/21/2004	5/11/2004
Reading/R4	3/10/2004	3/30/2004	4/21/2004	5/12/2004
Reading/R5	3/11/2004	4/2/2004	4/22/2004	5/13/2004
Rattlesnake/R1	3/17/2004	4/13/2004	5/3/2004	6/8/2004
Rattlesnake/R2	3/18/2004	4/13/2004	5/5/2004	6/10/2004
Rattlesnake/R3	3/22/2004	4/14/2004	5/6/2004	6/14/2004
Smoky	3/23/2004	4/12/2004	4/29/2004	6/16/2004
Potato/R1	3/18/2004	4/6/2004	4/30/2004	5/26/2004
Potato/R2	3/17/2004	4/7/2004	4/27/2004	5/28/2004
East Fork Hayfork/R1	3/16/2004	4/5/2004	4/26/2004	5/24/2004
East Fork Hayfork/R2	3/16/2004	4/6/2004	4/26/2004	6/1/2004
Tule/R1	3/15/2004	4/8/2004	4/28/2004	6/2/2004
Tule/R2	3/15/2004	4/8/2004	4/28/2004	6/3/2004
Pelletreau	3/24/2004	5/3/2004	6/11/2004	
Eltapom	4/5/2004	5/3/2004	6/4/2004	
Plummer	5/4/2004			

Redd Identification

Crews are trained in proper redd identification prior to the beginning of the season. Ultimately, an experienced crew leader is present to make all "tough calls" in terms of redd identification. In-experienced technicians often overlook redds or have trouble distinguishing steelhead redds from scour hydraulics or lamprey and resident trout redds. The following criteria (Table 2) is used to insure proper identification of steelhead redds; not all criteria must necessarily be satisfied in order for a redd to be called a redd.

Table 2. Redd identification criteria.

Criteria	Explanation
Location	Most redds are located in pool tail-outs or riffles; Briggs (1953) found that most redds occupied the transitional area between pools and riffles.
Size	Hunter (1973) found the area of average steelhead redds to be 4.4 meter^2, although, redds are often smaller when spawning habitat is limited or constrained by channel morphology.
Structure	Redd should consist of a pit and mound (tail-spill), with the mound downstream of the pit. Steelhead redds can be easily differentiated from lamprey redds, as lamprey redds lack a mound or tail-spill.
Substrate size	Steelhead prefer to spawn in gravel 0.6-10.2 cm in diameter. (Smith, 1973).
Gravel sorted	The substrate of freshly constructed redds is usually well sorted, with larger gravel positioned anterior compared to smaller gravel.
% fines	Redds should not be overly embedded with fine substrate, as the mechanics of redd construction should wash away fine sediment.
Water velocity	There must be adequate velocity to insure oxygenation of eggs. Bovee (1978) found optimum velocity for steelhead spawning at 2 feet/sec.
Pit/tailspill mechanics	Redds should be properly spatially positioned, so that the pit is upstream of the tail-spill and gravel excavated from pit could form tail-spill.
Lack of algae or detritus	New constructed redds should be free of algal formation (i.e. periphyton) and detritus. Detritus often accumulates in the pit of older redds.
Presence of fish on redd	Presence of an actively spawning pair of fish indicates probable construction of a successful redd. Test digging can often be confused for successful completion of a redd.

The following data was recorded on all redds encountered during the course of the survey. GPS coordinates were taken using a Garmin 12XL receiver utilizing the NAD 29 datum. All redd measurements were taken using a water-proof tape measure. During measurements, extreme caution was taken to avoid disturbing redds. Redds currently under construction (fish on redd) were not measured at that time, to avoid disturbing spawning. These redds were measured on the subsequent pass. All encountered redds are flagged with date, redd number, position, and recorders intials, to prevent double counting, and to allow future evaluation.

Table 3. Data recorded on each redd.

Data Field	Description
Redd I.D.#	3 digit code with the first digit being the reach no. and the second two being the consecutive redd no. for that reach e.g. R101=reach 1, redd no.1
GPS coordinates	Lat/Long waypoint of redd location
Pit length	Pit length measured parallel to the flow
Pit width	Pit width measured perpendicular to the flow
Depth 1	Depth from substrate to bottom of the pit
Depth 2	Depth from water surface to bottom of the pit
Pit substrate	Dominant substrate in the pit
Tail spill length	Tail spill length measured parallel to the flow
Tail spill width 1	Tail spill width perpendicular to the flow at 1/3 of the distance down from the upstream end
Tail spill width 2	Tail spill width perpendicular to the flow at 2/3 of the distance down from the upstream end
Tail spill substrate	Dominant substrate in the tail spill
Habitat type	Habitat type where redd is located
Redd type	Condition of redd: 1=well defined recently completed 2=well defined but not new 3=not well defined 4=older and difficult to identify, may be questionable
Comments	Redd location description and information on redd condition

RESULTS

This season (2004), a total of 189 redds were observed during surveys encompassing 79.0 kilometers of habitat. Summary redd and fish observation data by tributary is provided in Table 4. Evidence of steelhead spawning was observed in all but three creeks: Rattlesnake, Dutch and Pelletreau. Live adult steelhead were encountered in all creeks in which redds were observed. An attempt was made to identify presence or absence of an adipose fin on all live fish observed. Of the 55 steelhead observed during this season's surveys, only 7 (12.7%) could properly be identified as of wild or hatchery origin. All seven fish identified were of wild origin, with an adipose fin still remaining intact. Only one carcass was recovered during the 2003 survey season, on the East Fork of Hayfork Creek. The carcass was a wild male steelhead measuring 68 cm fork length. Scale and genetic samples were taken, but have yet to be analyzed. One spaghetti tagged fish was observed in Reading Creek. This fish was presumably tagged at the Willow Creek weir on the lower Trinity and was most likely a fall-run steelhead as Willow Creek weir concludes operations in mid-November. This suggests that on the Trinity, there is possibly overlap in spawn timing between fall and winter-run steelhead.

Fish were only observed actively constructing a redd on 9% of redds counted (5 of 55). This percentage may seem low, but with a low sampling periodicity (about once per month), and assuming it takes three days to construct a redd (Hannon, Healey and Deason, 2003), you would expect to see only 10% of the redds being actively constructed.

Table 4. Trinity River winter-run steelhead spawning survey summary results, March-May 2004.

Tributary	**Mileage (km)**	**Redds**	**Redds/km**	**Adult Steelhead**
Plummer	5.2	16	3.08	0
Smoky	4.1	8	1.95	3
Rattlesnake	16.2	12	0.74	0
East Fork Hayfork	6.8	37	5.44	4
South Fork Indian	1.5	4	2.67	1
Potato	4	6	1.50	0
Reading	20.9	48	2.30	31
Dutch	3.7	2	0.54	0
Eltapom	1.3	17	13.08	0
Pelletreau	1.4	0	0.00	0
Deadwood	3.8	22	5.79	105
Tule	5.8	13	2.24	0
East Fork Browns	4.3	4	0.93	2
Totals	79	189	2.39	146

Redd location was characterized by habitat type for all redds observed. Not surprisingly, steelhead preferred to spawn in pool tail-outs (48.6%), followed in preference by runs (28.1%), riffles (23.9%) and glides (1%). No redds were located in other types of habitat, most likely due to the need for suitable flow. The average depth of water over the pit for all redds observed was 13.5 inches (34.29 cm). The average depth of excavation (material removed from pit to create tail-spill) was 4.5 inches (11.43 cm).

All redds were measured utilizing methods put forth by Gallagher (2002). Table 5 (below) provides summary area measurements for all redds observed by tributary. Overall, the average total area of all redds observed during the survey was 29.65 ft^2. The smallest redd observed during the survey occurred on Reading Creek in a predominantly boulder riffle and measured 7.16 ft^2. The largest redd was also observed in Reading Creek and measured 169.08 ft^2. Studies conducted in Washington and Idaho have both approximated average steelhead redd area at 47 ft^2 (Hunter, 1973, Reiser and White 1981). Redds in the Trinity basin may be smaller than those constructed by steelhead of a more northern latitude, but the range of sizes overlap and are very similar.

Table 5. Redd area measurements by tributary.

Tributary	N=	Mean Pit Area (ft^2)	Mean Tailspill Area (ft^2)	Mean Total Redd Area (ft^2)	Minimum Total Redd Area (ft^2)	Maximum Total Redd Area (ft^2)	95% Confidence Mean Redd Area (+/-ft^2)
Deadwood	11	5.266414	6.427714	11.69413	5.680555	20.51042	3.291965
Eltapom	17	5.621732	8.589869	14.2116	7.25	31.60416	3.072754
E.F. Hayfork	37	7.009759	9.431775	16.44153	3.409722	39.50694	2.568609
S.F. Indian	4	3.385416	4.978298	8.363715	6.326388	12.30555	4.341459
Plummer	16	7.06901	8.87348	15.94249	7.652777	27.82639	3.53288
Potato	6	3.704861	5.822338	9.527198	4.361111	18.8368	5.566625
E.F. Browns	4	6.498263	10.35851	16.85677	11.80208	20.47917	5.977808
Reading	45	9.270061	14.26119	23.53125	6.177083	85.59027	4.861916
Smoky	8	5.31684	7.476562	12.7934	7.611111	20.5625	3.612996
Tule	13	6.408119	7.72142	14.12954	4.354166	35.74305	4.764713
Dutch	2	3.430555	8.703124	12.13368	9.361111	14.90625	35.22868
Rattlesnake	12	4.41956	5.254051	9.67361	3.652778	23.51042	3.963145
Overall	175	5.616716	8.158194	13.774909	3.409722	85.59027	

Spawning peaked on main-stem tributaries of the Trinity in early April and in the South Fork tributaries in mid-April. The final redd observed in the main-stem tributaries was recorded on April 23; No redds were found in South Fork tributaries after May 22. Figure 2 (below) compares cumulative redds observed by date in the main-stem tributaries versus the South fork tributaries.

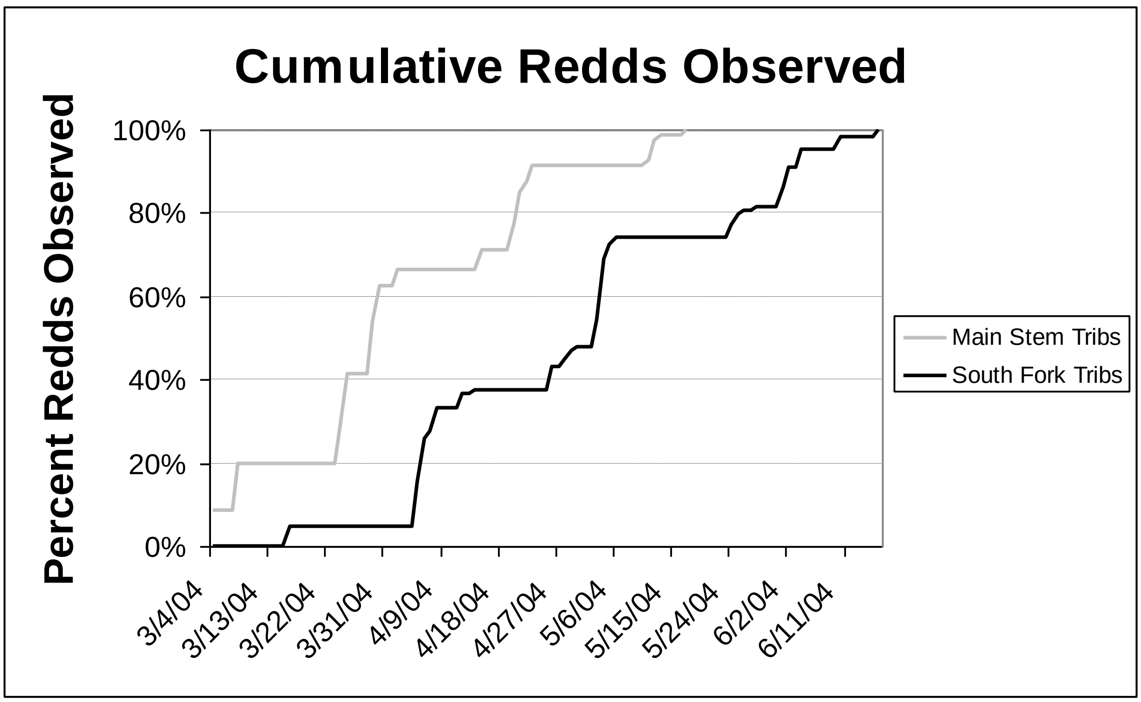


Figure 2. Cumulative steelhead redds observed by date, main-stem basin vs. South fork basin.

Water temperature was recorded at the beginning and end of each survey. Temperatures ranged from 4°C on a cold morning in March, to 14°C on a hot May afternoon. Patrick Higgins (personal communication, 2000) hypothesizes that South Fork Trinity steelhead begin spawning when water temperatures approach 8°C. Hunter (1973) states the range of preferred temperatures for steelhead spawning at 3.9-9.4°C. Almost all spawning in the Trinity basin has been completed prior to water temperatures reaching 10°C. Daily recorded temperatures for each tributary surveyed are listed in Appendix 2.

DISCUSSION

Redd or spawning surveys serve as a good, but partially incomplete means of monitoring steelhead spawning escapement. For future clarification, I will use the terminology "redd survey" and "spawning survey" interchangeably for the remainder of this report. Redd surveys are most appropriate when other means of estimating adult escapement or spawning success are not appropriate or impossible to conduct. In the Trinity basin, problems do occur which limit the ability to estimate the abundance of winter-run steelhead. High flows and the extended length of adult steelhead migration make weir estimates partial at best. Several weirs were constructed to estimate winter-run steelhead run-size by the Department in 1989-1992 at Sandy Bar and at Forest Glen on the South Fork of the Trinity River (CDFG, 1990-95). Efforts were finally terminated after multiple blow-outs due to high flows.

The availability of spawning habitat could possibly inhibit spawning and resulting production of steelhead, especially in smaller order tributaries, where gravel availability is scarce. The amount of suitable stream substrate for spawning varies with the size (order) of the stream and species of salmonid using it, as Boehne and House (1983) learned from their study of two coastal and two Cascade Range watersheds in Oregon. First and second order streams were rarely used by anadromous salmonids; the larger anadromous steelhead, Coho, and Chinook salmon spawned in a few third-order streams, but most were found in fourth- and fifth-order streams. As stream order increased, gradient decreased but stream length, width, and depth increased. The amount of spawning gravel per kilometer of stream was greatest in fourth order coastal watersheds and fifth order Cascade range watersheds. Precursory examinations of gravel in surveyed tributaries have found that in the Trinity basin gravel retention could be impeded by the following factors: effects of historic mining and the 1964 flood. Retention of gravel is often problematic, even in fourth- and fifth-order streams due to incision of the channel as a result of historic mining. This incision causes loss of channel sinuosity, and increases channel energy, especially during high flow events. Without the complexity associated with a sinuous channel, little large wood or boulder/cobble framework is available to sort and retain gravels. Further complicating the problem is the long lasting effects of the 1964 flood; this 100-year flood aggraded spawning beds up to eight feet deep with unsuitable substrate; most tributaries continue to down-cut through this aggregation, and have yet to reach channel equilibrium 40 years later.

No apparent trend is evident when examining redd survey data collected over the past four seasons. Results from the 2000 season appear to confirm the trend of declining numbers of redds recorded in the Trinity basin in the 1990s. Redd counts from 2001 document an even greater decline; worse than the historic low recorded in 1995. Last season's redd counts (2002) document the most successful spawning season for winter-run steelhead in the Trinity basin since 1990. This year's counts (2003) are slightly higher than average, and when compared to previous years seem to confirm the sporadic nature of yearly counts.

Steelhead run size is highly variable from year to year, but the data gathered over the last 40 years in the Trinity basin shows the general trend that steelhead run sizes are diminishing. Redd surveys during 2003 season documented a slightly above average year for Trinity basin steelhead; To compare, work by D.A. La Faunce in 1964 sets up good base-line numbers for natural production of steelhead in the Trinity basin (Table 6). Those surveys show that adult steelhead estimates were markedly higher in 1964 than in any of the following years.

Surveys conducted by D.W. Rogers in 1971, show that there had already been a sharp decline in steelhead spawning since 1964 (Table 7). This could have been an anomalous year, but surveys in 1972-1974 of other tributaries in the system continue to show this general trend.

Table 6. Summary results of work by D.A. LaFaunce (1964). A steelhead spawning survey of the upper Trinity River system.

Tributary surveyed	Distance surveyed (km.)	Redds observed	Redds/km.
Deadwood Creek	1.66	27	16.26
S.F. Indian Creek	0.37	4	10.8
E.F.N.F. Trinity	12.0	218	18.16
Reading Creek	16.3	279	17.11
Dutch Creek	2.6	72	27.6

Table 7. Results of steelhead spawning surveys conducted by D.W. Rogers (1971).

Tributary surveyed	Distance surveyed (km.)	Redds observed	Redds/km.
Deadwood Creek	3.7	0	0
S.F. Indian Creek	1.85	3	1.62
Reading Creek	19.25	35	1.81
Dutch Creek	1.85	0	0

The four year life-cycle of winter-run steelhead in the Trinity basin is important in analyzing the success of a cohort and that cohort's progeny. This year is the fourth season of spawning surveys completed by the Department in the Trinity basin, so it is impossible to look at the effect of spawning escapement on their returning progeny four years later. But we can examine the relationship of recent years to results of surveys in the early nineties (two life-cycles ago). Table 8 compares recent AFRAMP surveys (2000-2003) to surveys conducted on those same tributaries by the Department (1990-

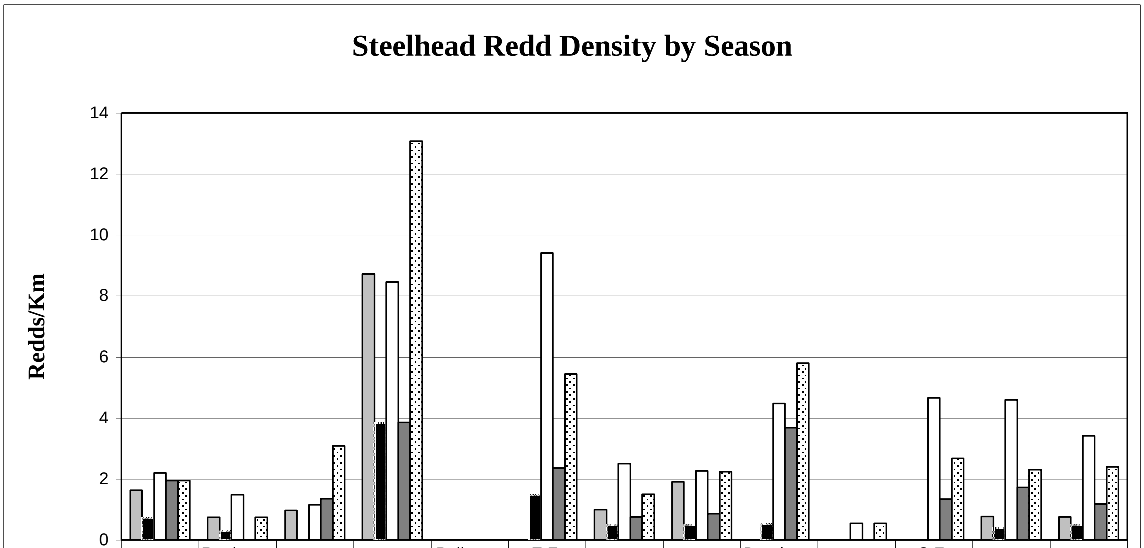
1995). Rattlesnake Creek proves a good example. This year no redds or fish were observed on Rattlesnake Creek. Notice that eight years ago (2 life-cycles ago), redd density on Rattlesnake Creek was 0.1 redds per kilometer. Apparently, the drought of 1995 heavily impacted the run-size and subsequent escapement of winter steelhead, which effects are still seen two full life-cycles later in 2003. Overall, there is an observable cyclic "trend" in redd numbers: A moderate year is proceeded by a bad year, which is proceeded by a good year, which is proceeded by a moderate year. Another possible scenario to explain missing cohorts in Rattlesnake Creek and other impacted creeks is that during dry years, late spring and summer flows are almost non-existent, consequently, young of the year winter steelhead emerge too late and fail to successfully out-migrate to more appropriate summer rearing habitat downstream in the South Fork Trinity.

Table 8. Results of work by CDFG (1990-1995) steelhead spawning surveys compared with previous three years spawning survey (2000, 2001, 2002, 2003).

Tributary	1990	1991	1992	1993	1994	1995	2000	2001	2002	2003	2004
Eltapom Creek	14.0	6.2	10.0	13.5	19.2	2.5	8.72	3.84	8.46	3.85	13.1
Pelletreau Creek	0	2.5	0	0	1.7	0.9	0	0	0	0	0
E.F. Hayfork Creek	4.3	2.7	0.6	0.4	2.2	0.3	0	1.47	9.41	2.35	5.44
Potato Creek	2.1	0	0.4	0.4	0.9	0	0.99	0.50	2.5	0.75	1.5
Tule Creek	9.5	0.5	2.2	1.6	2.4	0.4	1.9	0.48	2.26	3.68	2.24
Plummer Creek	NS	6.6	7.9	5.0	6.1	2.1	0.97	0[1]	1.15	1.35	3.08[1]
Rattlesnake Creek	2.6	0.8	1.8	0.4	0.8	0.1	0.74	0.31	1.48	0	0.74
Smoky Creek	6.6	5.0	5.9	1.9	1.9	2.1	1.63	0.73	2.19	1.95	1.95
Overall[2]	3.28	2.1	1.95	0.95	1.87	0.52	0.76	0.47	3.42	1.18	2.39

1 Poor conditions and less numerous surveys portray fewer redds or fish than most likely were present.

2 Overall densities are for all surveys conducted by DFG that season in the Trinity Basin; 1990-1995 surveys were of South Fork tributaries only.



	Smoky	Rattlesnake	Plummer	Eltapom	Pelletreau	E.F. Hayfork	Potato	Tule	Deadwood	Dutch	S.F. Indian	Reading	Totals
2000	1.63	0.74	0.97	8.72	0	0	0.99	1.9	0	0	0	0.77	0.76
2001	0.73	0.31	0	3.84	0	1.47	0.5	0.48	0.53	0	0	0.38	0.47
2002	2.19	1.48	1.15	8.46	0	9.41	2.5	2.26	4.47	0.54	4.66	4.59	3.42
2003	1.95	0	1.35	3.85	0	2.35	0.75	0.86	3.68	0	1.33	1.72	1.18
2004	1.95	0.74	3.08	13.08	0	5.44	1.5	2.24	5.79	0.54	2.67	2.3	2.39

Tributary

Figure 3. Redd density by tributary, AFRAMP surveys 2000-2004.

Table 9. Redds observed by tributary, AFRAMP surveys 2000-2004.

Tributary	**2000**	**2001**	**2002**	**2003**	**2004**
Smoky	10	3	9	8	8
Rattlesnake	12	5	24	0	12
Plummer	5	0	6	7	16
Eltapom	11	5	11	5	17
Pelletreau	0	0	0	0	0
E.F. Hayfork	0	10	64	16	37
Potato	4	2	10	3	6
Tule	16	4	19	5	13
Deadwood	0	2	17	14	22
Dutch	0	0	2	0	2
S.F. Indian	0	0	7	2	4
Reading	16	8	96	36	48
Totals	74	39	265	96	185

Results of this spawning survey have important fisheries management implications; fisheries managers use escapement data to analyze the ability of a stock to sustain recreational fisheries. Proposals have recently been submitted to the Fish and Game Commission to increase the bag limit on the Trinity and to allow the take of wild steelhead. The Department must make management recommendations based upon the best available science documenting the status of the steelhead in the basin. The results of this project are currently the only data available examining population status and trends of winter-run steelhead in the Trinity Basin. Results from this spawning survey showed a 91% decrease in steelhead spawning since 1964. The Department used this justification to recommend not allowing the take of wild steelhead on the Trinity River. Should spawning surveys show a prolonged increase in escapement throughout the basin, additional fisheries and decreased angling restrictions (increased opportunities) could be considered.

Problems are commonplace and often complicate and sometimes prevent redd surveys from occurring. Possible problems include adequate survey frequency, redd discrimination by species, tributary sample selection, access, and private property permission. Some of these problems create suspicion or bias within the data, while others prevent the proper coverage of a selected tributary.

One primary problem that affects sample design, as well as proper and even coverage, is access. Most of the Trinity basin is composed of rugged mountainous terrain with little road coverage. Roads that do exist are often poorly maintained logging roads, which rarely lead to the confluence of a selected tributary. Some tributaries lie within wilderness areas, where no roads exist, and hiking in to survey is the only possibility. Access problems are further compounded by extreme winter conditions such as snow storms. Some tributaries, such as Plummer Creek in South Fork Trinity basin are inaccessible by road until late April due to heavy snow-pack.

High flows often have a negative effect on survey periodicity and quality. High flows often prevent surveys by limiting travel through the stream corridor and impeding visibility. Rain further impedes a surveyor's ability to detect redds by breaking the smooth surface of the water, making underwater terrain features nearly invisible. Some redds could and probably were missed during pass two of Reading Creek, when rain and high flows complicated and impeded surveys.

Discrimination of redds created by different fish species is a problem which often complicates redd surveys in systems where several species of fish co-exist and spawn during similar time frames. Several fish species temporally co-exist in the Trinity basin, several of which have similar spawning time frames; coho salmon (*Oncorhynchus kisutch*) enter the watershed in November and December and spawn in January and February. Similarly, pacific lamprey (*Lampetra tridentata*) migrate into the system in the fall and winter, and spawn during the spring months. Small trout exhibiting a resident life-history also co-exist in the system and spawn during the spring. Several measures are taken by crews to ensure proper classification of steelhead redds. All redds with no substantial tail-spill or a pot diameter of less than 12 inches are consider resident trout or lamprey redds. Resident trout tend to utilize smaller substrate in areas with less apparent velocity. Lamprey redds are distinguished by a small circular pot and no tail-spill. In the Trinity basin, coho redds are infrequently confused with steelhead redds due to their earlier spawning (January/February vs. March-May). One selected tributary, Deadwood

Creek had significant signs of spawning coho, five coho carcasses were recorded during the March survey, yet no redds were discovered during those same surveys. Current research is being conducted to examine the differentiation of anadromous salmonid redds in system where multiple species co-exist. In the Noyo River basin, Sean Gallagher is having success using discriminant function analysis to differeniate coho from steelhead redds (Gallagher, 2001).

Surveys utilizing multiple technicians inherently suffer from problems with inter-observer variation, both with observer efficiency and the subjective nature of identifying redds. This can be minimized by pairing experienced with inexperienced technicians, sufficient training, and frequent quality control trials. In 2003, 21 quality control trials were conducted to assess the implications of inter-observer variation. As expected, experienced technicians (crew leaders and biologists) had a much greater efficiency at identifying redds; they were also much less likely to error by marking a redd, when no such redd was present. Some inexperienced technicians missed up to 50% of redds encountered. This is currently not recognized to be a problem, as all crews contain at least one experienced member.

Prior to the beginning of the first season in 2000, permission from private property owners was obtained on all tributaries to be surveyed. Tributaries with excessive refusal of landowners were dropped from the sampling frame, as were Big and East Weaver Creeks. Initially, permission was obtained from all 51 landowners bordering Reading Creek; this creek contains the most numerous parcels of private property. In 2003, one landowner rescinded permission to enter her property. This created a hole in coverage of approximately 1.25 kilometers of Reading Creek, all in Reach 3. Previous surveys of this reach indicate that the "hole" in coverage contains five suitable spawning areas, and two good holding pools. Every effort has been made to restore permission to enter this landowners property, but to no avail.

RECOMMENDATIONS

At the conclusion of the five year pilot period (this marks the completion of season four), a panel sampling design should be developed to more comprehensively cover the Trinity basin. Ideally, three rotating panels would be selected. The first panel would consist of currently sampled tributaries, to be revisited every year. The second panel would select different tributaries to be sampled each year. The third panel would again have different tributaries selected initially, but those selected tributaries would then be sampled every three years. This panel design is planned to be to coordinated with Julia Kelley, SPI wildlife biologist, and Department statistical staff.

The limits of the anadromy in the Trinity basin need to be verified in order to properly delineate the sampling universe and quantify habitat available to steelhead. Previously, an effort to identify barriers to anadromy was completed by Trinity Fisheries Consulting, but focused solely on road induced barriers (Trinity Fisheries Consulting, 1988). Most other barrier information relies on antiquated US Forest Service habitat typing files, produced in the late 1960s and 1970s. To date, AFRAMP has evaluated approximately 20 barriers to anadromy in the basin, but without supplemental funding, surveys can only proceed as time allows.

Coho salmon spawner surveys should be initiated to complement existing steelhead surveys. Few surveys quantifying Coho salmon spawning are currently conducted in the Trinity basin, with the only effort being made the US Forest Service, and only when funding for fisheries technicians allows (L. Everest, personal communication).

More intensive habitat evaluation needs to be included in the survey design. A quick, one pass field extensive evaluation should be made of quantity and quality of available spawning substrate in selected tributaries. Evaluation of spawning habitat was conducted previously by Fish and Game from 1994-1997 on South Fork Trinity tributaries (Borok and Jong, 1997). This effort should be expanded to include the entire sampling universe using a protocol similar to that put forward by Schuett-Hames and Pleus (1996). With the implementation of a rotating panel design, all anadromous Trinity tributaries would eventually be evaluated, and necessary restoration could be focused.

I recommend that some examination be attempted to look at the relationship between channel incision, removal of boulder framework, historical mining, and availability of spawning habitat. Historical mining in the late 1800s and early 1900s has resulted in the removal of bed-load framework necessary for the retention of suitable spawning gravel. Removal of this framework has further resulted in channel incision, and loss of channel sinuosity and habitat complexity. Evidence of these effects is made apparent by the large piles of mine tailings covering the banks of over half of all Trinity tributaries; some of the piles are over 50 feet high and several hundred feet wide.

All redds should be evaluated with each pass as season progresses to assess sufficient periodicity of surveys. Last year, all redds were evaluated during the last pass to determine if survey periodicity was sufficient. Of all the redds observed, only 52% were still visible during the last pass (Garrison, 2002). I recommend that all redds be re-evaluated during each subsequent pass to evaluate whether current survey periodicity is sufficient.

A more intensive effort should be undertaken to understand the relationship between the number of adult steelhead and the corresponding number of redds. The Oregon Department of Fish and Wildlife has five years of data in the Alsea and Nestucca basins that shows a strong relationship between redd counts and fish numbers (R^2=0.97, $p<0.001$). Using this regression as a calibration between adults and redds, they further suggest that redd counts are a good indicator of population size over a range of run-sizes form 35 – 2,131 fish (Susac and Jacobs, 2003).

A reliable funding source needs to be identified to insure that everything is fully operation by March 1st, and that funding for technicians proceeds unfettered through the completion of the season. This should insure a more even sampling effort that spans the entire season.

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Appendix 1. Reach location and total distance.

Stream/ Reach	Start Latitude/Longitude	End Latitude/Longitude	Reach distance (km)	Hike distance (km)	Total Distance (km)
Plummer	N40˚28.774 W123˚22.976	N40˚28.627 W123˚25.072	4.0	5.2	9.2
Eltapom	N40˚39.656 W123˚29.680	N40˚39.559 W123˚29.084	1.3	1.3	2.6
Pelletreau	N40˚37.164 W123˚28.414	N40˚36.942 W123˚28.657	0.6	0.8	1.4
Tule R1	N40˚33.079 W123˚12.849	N40˚31.465 W123˚13.490	3.8	1	4.8
Tule R2	N40˚31.447 W123˚13.493	N40˚30.758 W123˚14.279	2.0	1.2	3.2
East Fork Hayfork R1	N40˚29.335 W123˚04.142	N40˚30.136/W 123˚02.144	4.2	no hike	4.2
East Fork Hayfork R2	N40˚30.139 W123˚02.070	N40˚30.564 W122˚59.609	4.7	no hike	4.7
Potatoe	N40˚28.681 W123˚01.682	N40˚30.198 W123˚02.519	4.8	0.9	5.7
Smoky R1	N40˚18.869/W 123˚12.136	N40˚19.908 W123˚11.575	3.8	8.2	12
Smoky R2	N40˚28.681 W123˚01.684	N40˚30.198 W123˚02.521	3.5	7.3	10.8
Rattlesnake R1	N40˚23.342 W123˚16.842	N40˚22.198 W123˚18.726	4.6	no hike	4.6
Rattlesnake R2	N40˚23.110 W123˚14.369	N40˚23.281 W123˚17.004	5.0	no hike	5
Rattlesnake R3	N40˚23.221/W 123˚11.385	N40˚23.247 W123˚14.249	5.7	no hike	5.7
Reading R1	N40˚38.599 W122˚57.135	N40˚37.156 W122˚56.028	4.0	no hike	4
Reading R2	N40˚37.156 W122˚56.032	N40˚36.168 W122˚54.594	4.4	no hike	4.4
Reading R3	N40˚36.135 W122˚54.710	N40˚35.145 W122˚53.695	2.0	no hike	2
Reading R4	N40˚34.706 W122˚53.194	N40˚33.599 W122˚51.585	3.9	no hike	3.9
Reading R5	N40˚33.577 W122˚51.581	N40˚32.421 W122˚50.979	3.0	2.3	5.3
East Fork Browns	N40˚31.735 W122˚56.176	N40˚30.603 W122˚54.438	2.3	2.8	5.1
South Fork Indian	N40˚35.807 W122˚49.892	N40˚35.289 W122˚49.333	1.5	2.3	3.8
Dutch	N40˚39.878 W123˚00.930	N40˚39.425 W123˚03.010	3.2	3.2	6.4
Deadwood	N40˚43.089 W122˚48.091	N40˚42.847 W122˚45.826	3.8	no hike	3.8

Appendix 2: Survey beginning and ending water temperatures.

Stream Name	Reach	Date	Start Time	Start Water Temperature (C˚)	End Time	End Temperature (C˚)
Deadwood Creek	1	3/4/2004	8:45	6	13:45	7
Deadwood Creek	1	3/24/2004	9:20	9	14:15	10
Deadwood Creek	1	4/20/2004	9:33	8	13:00	8
Deadwood Creek	1	5/19/2004	9:15	7	14:50	9
Dutch Creek	1	3/2/2004	8:15	6	11:10	7
Dutch Creek	1	4/1/2004	10:50	7	12:30	8
Dutch Creek	2	4/1/2004	10:18	6	12:08	7
Dutch Creek	1,2	4/15/2004	10:12	7	13:13	8
Dutch Creek	1	5/17/2004	10:35	9	13:50	10
Dutch Creek	2	5/18/2004	9:25	9	13:50	9
East Fork Browns Creek	1	3/11/2004	9:15	6	14:15	8
East Fork Browns Creek	1	4/2/2004	9:00	5	12:07	7
East Fork Browns Creek	1	4/23/2004	9:30	7	12:12	8
East Fork Browns Creek	1	5/21/2004	9:35	10	13:45	12
East Fork Hayfork Creek	1	3/16/2004	9:12	6	12:36	8
East Fork Hayfork Creek	2	3/16/2004	9:30	7	13:05	7
East Fork Hayfork Creek	1	4/5/2004	9:55	7	13:00	9
East Fork Hayfork Creek	2	4/6/2004	9:00	7	13:50	8
East Fork Hayfork Creek	1	4/26/2004	9:30	8	12:00	10
East Fork Hayfork Creek	2	4/26/2004	10:00	8	14:00	9
East Fork Hayfork Creek	1	5/24/2004	9:40	11	13:05	12
East Fork Hayfork Creek	1	5/25/2004	8:35	9	10:35	10
East Fork Hayfork Creek	2	6/1/2004	9:20	10	14:50	13
Eltapom Creek	1	4/5/2004	11:20	8	13:20	8
Eltapom Creek	1	5/3/2004	10:25	10	13:05	11
Eltapom Creek	1	6/4/2004	10:25	12	13:08	13
Pelletreau Creek	1	3/24/2004	10:20	7		
Pelletreau Creek	1	5/3/2004	14:00	12	14:35	12
Pelletreau Creek	1	6/11/2004	9:25	10	10:20	10
Plummer Creek	1	5/4/2004	10:41	10	14:42	14
Potato Creek	2	3/17/2004	10:00	6	14:00	8
Potato Creek	1	3/18/2004	9:55	6	13:30	7
Potato Creek	1	4/6/2004	9:40	6	11:10	6
Potato Creek	2	4/7/2004	10:48	5	13:00	6
Potato Creek	2	4/27/2004	10:30	8	12:30	9
Potato Creek	1	4/30/2004	10:10	8	12:30	9
Potato Creek	1	5/26/2004	9:40	10	13:28	12
Potato Creek	2	5/28/2004	9:43	9	13:00	10
Rattlesnake Creek	2	3/18/2004	9:53	6	13:08	8
Rattlesnake Creek	3	3/22/2004	9:50	6	14:25	7
Rattlesnake Creek	2	4/13/2004	10:15	7	12:55	8
Rattlesnake Creek	1	4/13/2004	10:05	8	12:35	8
Rattlesnake Creek	3	4/14/2004	9:45	7	12:40	6

Stream Name	Reach	Date	Start Time	Start Water Temperature (C˚)	End Time	End Temperature (C˚)
Rattlesnake Creek	1	5/3/2004	9:30	11	13:30	13
Rattlesnake Creek	2	5/5/2004	9:00	10	13:15	12
Rattlesnake Creek	3	5/6/2004	9:20	10	13:00	9
Rattlesnake Creek	1	6/8/2004	8:45	10	14:42	11
Rattlesnake Creek	2	6/10/2004	9:00	10	15:20	14
Rattlesnake Creek	3	6/14/2004	9:00	12	14:00	13
Rattlesnake Creek	1	3/17/2004	9:30	6	12:40	8
Reading Creek	1	3/8/2004	9:27	5	13:09	8
Reading Creek	2	3/9/2004	8:50	6	13:50	8
Reading Creek	3	3/10/2004	9:10	6	11:45	7
Reading Creek	4	3/10/2004	9:45	6	13:20	6
Reading Creek	5	3/11/2004	8:38	5	12:40	7
Reading Creek	1	3/25/2004	9:35	8	13:20	7
Reading Creek	2	3/29/2004	8:40	7	12:30	10
Reading Creek	3	3/30/2004	10:09	8	13:25	9.5
Reading Creek	4	3/30/2004	9:30	8	12:30	8
Reading Creek	5	4/2/2004	9:06	6	12:37	7
Reading Creek	1	4/19/2004	10:20	8	13:40	7
Reading Creek	2	4/20/2004	9:00	7	14:09	8
Reading Creek	3	4/21/2004	10:00	7	11:55	8
Reading Creek	4	4/21/2004	10:00	7	13:32	7
Reading Creek	5	4/22/2004	9:34	5	12:00	6
Reading Creek	2	5/10/2004	9:00	9	12:50	12
Reading Creek	1	5/10/2004	8:50	9	12:50	11
Reading Creek	3	5/11/2004	9:25	8	12:40	11
Reading Creek	4	5/12/2004	10:00	8	14:55	10
Reading Creek	5	5/13/2004	8:40	7	13:06	10
Smoky Creek	1	3/23/2004	10:04	8	12:14	8
Smoky Creek	2	3/23/2004	10:00	6	12:45	8
Smoky Creek	1	4/12/2004	10:30	7	12:45	8
Smoky Creek	2	4/12/2004	9:50	6	12:20	7
Smoky Creek	2	4/29/2004	10:50	8	13:24	10
Smoky Creek	1	4/29/2004	10:40	9	13:15	10
Smoky Creek	2	6/16/2004	10:46	13	13:30	14
Smoky Creek	1	6/16/2004	10:20	12	13:30	14
South Fork Indian Creek	1	3/5/2004	9:45	6	12:15	7
South Fork Indian Creek	1	3/25/2004	9:20	6	11:00	6
South Fork Indian Creek	1	4/15/2004	9:07	5	11:12	5
South Fork Indian Creek	1	5/14/2004	9:00	8	11:50	8
Tule Creek	1	3/15/2004	9:00	8	12:45	8
Tule Creek	2	3/15/2004	9:00	6	11:06	6
Tule Creek	1	4/8/2004	8:42	7	11:23	8
Tule Creek	2	4/8/2004	8:45	7	10:25	8
Tule Creek	1	4/28/2004	10:30	10	13:30	11
Tule Creek	2	4/28/2004	10:40	9	13:20	10

Tule Creek	1	6/2/2004	9:50	12	14:45	14
Tule Creek	2	6/3/2004	9:15	11	13:20	12