Smith River Adult Trout and Salmon Surveys for Summer 2003

Report to the California Dept. of Fish and Game
In fulfillment of Grant P0210556
Sept. 29, 2003

Prepared, on behalf of the Smith River Alliance, by:

Gary Reedy, Fisheries Biologist
P.O. Box 177, Occidental, CA 95521
(707) 874-9984, reedy@asis.com

Background

Coastal cutthroat trout (*Oncorhynchus clarki clarki*), steelhead trout (*Oncorhynchus mykiss*), and chinook salmon (*Oncorhynchus tshawytscha*) are all native to the Smith River and adults of each of these species use the Smith River during the summer months. The exceptional clarity of the Smith River enables annual summer-time surveys of fish abundance and distribution by direct observation. The summer-run steelhead and spring-run chinook salmon, present in the river during summer, are very rare compared to the winter-run steelhead and fall-run chinook salmon popularly known to the Smith River. Adult cutthroat trout are present in the Smith River during summer in high densities.

The Smith River National Recreation Area (USFS) and the California Department of Fish and Game have attempted to monitor summer adult fish populations of the Smith River since 1982. Due to variable staff and funds, the monitoring effort has not been consistent from year to year, and usually lacks the effort required to entirely cover the main forks of the river. The most complete surveys occurred in 1992-1994 when the main forks of the river were subject to some coarse habitat mapping.

Since 2000, the Smith River Alliance has sponsored and coordinated a volunteer-based survey of adult fish in the South Fork Smith River in August. The event includes training of participants in the fish counting protocol developed by USFS staff in 1994, and has been very popular among participants for the educational experience as well as the opportunity to contribute to an important fisheries monitoring program. Results of the volunteer-based surveys are reported to the USFS and CDFG.

Funds from CDFG provided the opportunity to attempt comprehensive surveys of all three forks of the Smith River in 2003. The combined lengths of the North Fork, Middle Fork, and South Fork Smith River, which provide holding habitat for anadromous salmonids, measure 75 miles or more.

Survey Methods

Teams of two or more snorkelers count adult fish while moving from the upstream to the downstream end-points of designated survey segments. Survey segments range in length from 1.0 to 4.5 miles. All segments of each Fork of the river are surveyed in the shortest period of days possible. The month of August is the best time to conduct these surveys because minimum flows and high temperatures confine fish to holding habitats that are most easily examined, and the fall run of chinook salmon has not yet begun.

Each team is assigned a captain with adequate experience for confirming fish identification and providing leadership in the application of optimal techniques. Team captains tally observed fish on dive slates before and after surveying each large pool. The following optimal techniques are employed to increase the probability of observing each fish and reduce the probability of over-counting:

- Snorkelers all receive training in the Smith River prior to collecting data.
- Each team includes a snorkeler who dives to examine holding sites under cover of boulders, logs or ledges. Diver is "spotted" by adjacent snorkeler to avoid unseen displacement of fish.
- Teams maintain positions and assigned lanes while moving downstream.
- Snorkelers communicate each fish observation by pointing and vocalizing.
- Teams keep all heads in the water until completely through each pool or run.
- Riffles, pocket-water and turbulent areas are surveyed to the degree possible without compromising safety.
- Rapid entry into pools from upstream riffles is preceded by the stealthy entry of one or more snorkelers from the bank.
- Snorkelers calibrate their size estimates underwater by using props of known length.
- Fish counting activity is conducted between the hours of 10:00 and 5:00 pm to provide optimal light conditions.

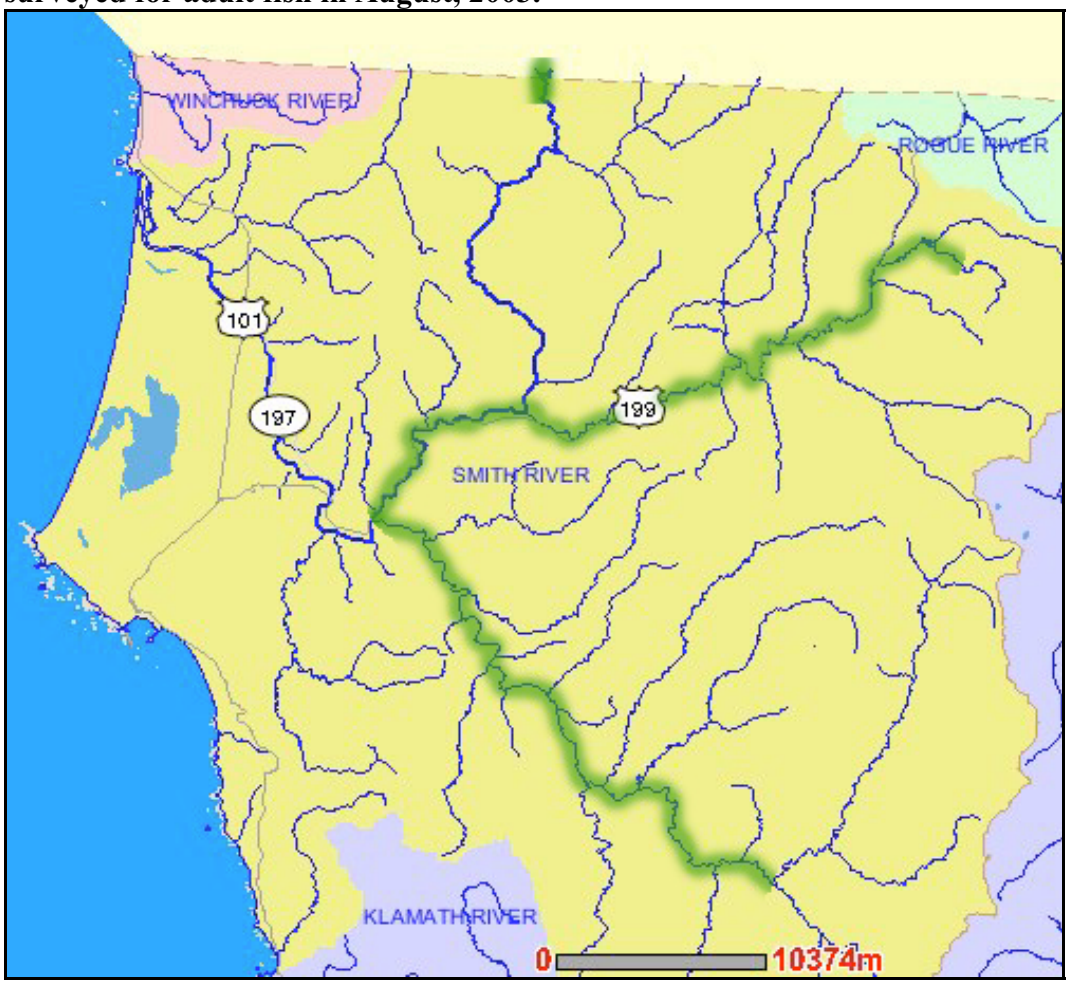
Fish are counted according to categories represented in Table 1. The categories represent all adult forms of salmonid fish present in the Smith River during summer. In addition, suckers are counted.

Results

Twenty-four volunteers were trained in survey techniques on August 1, the day prior to the volunteer fish count during which 14 miles of the South Fork were surveyed. On August 5, nine USFS staff were trained in the same technique prior to their field surveys. USFS surveyed an additional 10.5 miles of the South Fork and 24.5 miles of the Middle Fork. Despite original intentions, no CDFG staff were available to participate in the surveys due to temporary travel restrictions for non-essential state activities.

Figure 1 shows the extent of adult fish surveys in the Smith River during August, 2003. All surveys were completed between August 2 and August 13, except for the 4.0 mile segment of the North Fork surveyed on August 25. The identical total mileage of 24.5 miles on each the South Fork and Middle Fork is a coincidence. The total length of surveyed segments in the Smith River in 2003 was 53 miles.

Figure 1: The Smith River drainage network with green highlighting sections surveyed for adult fish in August, 2003.



The Middle Fork was completely surveyed from confluence with the South Fork up to a Middle Fork Falls which is a barrier to anadromous salmonids. The South Fork was completely surveyed from confluence with the Middle Fork to Eightmile Creek in the Siskiyou Wilderness Area. At least 5 and up to 10 additional miles of the upper South Fork, deep within the Wilderness Area, provide holding habitat for anadromous salmonids but were not surveyed in 2003 due limited staff availability. Also due to limits in staff, only one segment of the relatively inaccessible North Fork was surveyed. The lower 13 miles of the North Fork requires a three day wilderness trip. At least 3 and up to 12 additional miles of upper North Fork within the state of Oregon provide holding habitat for anadromous salmonids.

The total count of fish by category for both the Middle Fork and South Fork is shown in Table 1. Only three summer steelhead were seen in both forks combined. Of the 31 observed chinook salmon, 17 were seen in the South Fork. Of the 126 resident rainbow trout, 29 were seen in the South Fork. Of the 16 half-pounders, 12 were seen in the South Fork. Adult cutthroat less than 10" in length (small) were not counted in the South Fork, but 600 cutthroat greater than 10" (medium and large) were seen in the South Fork compared to 408 in the Middle Fork.

Table 1: Categories of adult fish, size range, and total counts for 24.5 miles surveyed in both the South Fork and Middle Fork Smith River, August 2003.

Fish Category	Species	Size Range (inches)	South Fork	Middle Fork
Cutthroat, large	*O. clarki clarki*	*12 - 20"*	290	223
Cutthroat, medium	*O. clarki clarki*	*10 - 12"*	310	185
Cutthroat, small	*O. clarki clarki*	*7 - 10"*	na	144
Resident Rainbow	*O. mykiss*	*10 - 14"*	29	97
Steelhead	*O. mykiss*	*16 - 28"*	2	1
Half-pounders	*O. mykiss*	*14 - 16"*	12	4
Chinook	*O. tshawytscha*	*18 - 42"*	17	14
Sucker	*C. rimiculus*	*8 - 20"*	6	88

A four mile segment of the North Fork was surveyed on August 25, but data on cutthroat was lost near the end of the day when a dive slate broke away in a cascade. The density of cutthroat in the North Fork appeared to be similar to that found in the South Fork. The number of adult cutthroat in the four miles of North Fork surveyed was estimated to be 60 large, 65 medium and 85 small. One chinook salmon and four resident rainbow trout were observed. No summer steelhead were found.

The 53 miles surveyed in 2003 were comprised of 20 individual segments. Fish counts for each segment, distance of segment, dates, names of surveyors and auxiliary notes can be viewed in data table of appendix file Smithfishcounts03.xls. These data may be useful for examining variation in observed abundance among crews and locations, but such analysis is beyond the scope of this report.

Former surveys most often classified adult cutthroat as those larger than 12" and those less than 12". Some surveys in the 1991-1995 defined the smaller category as those cutthroat less than 12" but greater than 10". Volunteers surveying the South Fork in 2000-2003 were instructed to not count adult cutthroat less than 10" in size. This simplification for the volunteers came out of concern that the challenge of surveying the more dispersed and well-hidden small adult cutthroat would overwhelm their function and compromise counts of the other fish categories. The simplification still permits comparison of adult cutthroat greater than 10" in size.

Water clarity in the South Fork enables the identification of fish at distances of up to 15 feet depending on sunlight and other factors. Visibility is markedly better in the Middle

Fork and better still in the North Fork. Water clarity in North Fork enables the identification of fish at distances of up to 75 feet.

Water temperature measurements were taken using hand-held thermometers on five occasions and ranged from 60 to 68 deg. F. Temperature typically increased 1-3 degrees over the day, and the Middle Fork was three degrees warmer than the South Fork at their confluence. The North Fork was warmer than the South Fork when measured comparatively, although not warmer than 68 degrees F on the day of measurement. Adult cutthroat trout were often observed using thermal refuge provided by springs and groundwater seeps.

Two segments of the South Fork, surveyed using volunteers on August 2, were resurveyed by USFS staff on August 5. The counts from these two repeat surveys are presented in Table 2 and provide a means of assessing the precision or variability of direct observations used in these surveys. The volunteer teams that surveyed segment SF4 on August 2 had the least amount of experience. The volunteer team that surveyed segment SF7 on August 2 was as experienced, and as least as well equipped, as the USFS crew following them three days later. The repeat counts reveal variation in the numbers of resident rainbow trout, half-pounders, and cutthroat trout. One member of the first crew to survey segment SF7 identified a summer steelhead before it immediately swam upstream. No chinook salmon or suckers were seen in either segment.

Table 2: Fish counts from two repeated segments of the South Fork in August, 2003. Categories represent three size classes of cutthroat trout, resident rainbow trout (RBT), half-pounders, and chinook salmon.

SEG	DATE	CTT>12"	CTT10-12"	CTT<10"	RBT	SHT	1/2 lb'r	Chinook
SF4	2-Aug	14	22	na	1	0	0	0
SF4	5-Aug	20	41	28	3	0	2	0
SF7	2-Aug	29	23	na	0	1	0	0
SF7	5-Aug	20	25	na	2	0	0	0

The coefficient of variation (CV) for repeat counts of cutthroat trout ranged from 0.08 to 0.60. The CV for repeat counts of medium and large cutthroat in segment four was 0.08 and 0.36, respectively. The CV for other categories of salmonid were greater or equal to 1 where fish were observed, but the very low numbers of these fish make it difficult to describe variance. Moreover, the high variation for counts of resident rainbow trout, half-pounders, and chinook salmon may not be representative of variation over the entire survey if the variation results from movement of fish among segments. Repeated counts on August 5 were used instead of counts on August 2 when totaling fish numbers.

Estimating Population Size

Surveys of adult fish in the Smith River during August, 2003 provide more coverage of the Middle Fork and South Fork than any previous efforts, but only a small sample of the North Fork. Of the 75-89 miles of holding habitat available in all three forks combined, the 2003 surveys covered 53 miles. However data for some categories of cutthroat were not available for all 53 miles surveyed. Using the proportion of length surveyed, the number of total fish observed were used to estimate the total number of fish using the main forks of the Smith River. These estimates, along with their component data are reported in Table 3.

Table 3. The total number of fish counted by category, length of segments associated with those total counts, and population estimates for the total combined main forks (75-89 miles) of the Smith River in August 2003.

Adult Fish Category	Total Obs.	Miles Surv.	Min. Estimate[1]	Max. Estimate[2]
Cutthroat >12"	513	49	785	932
Cutthroat 10-12"	495	49	758	899
Cutthroat <10"	144	24.5	441	523
Resident Rainbow	130	53	184	260
Steelhead	3	53	5	7
Half-pounders	16	53	23	32
Chinook	31	53	44	62
Sucker	94	53	133	188

1. Minimum estimate based on 75 miles of total habitat.
2. Maximum estimate based on 89 miles of total habitat.

These population estimates do not account for different densities of fish in different portions of the Smith River. For example, the uppermost segments of both the South Fork and North Fork, which lie within or adjacent to Wilderness areas, have been found to contain greater numbers of summer steelhead and spring chinook than the lower portions of those forks, when surveyed in two previous years. Due to such uneven distribution, the maximum estimates in Table 3 probably underestimate the total number of summer steelhead and spring chinook in the combined forks of the Smith River. Different distributions of resident rainbow trout, half-pounders and cutthroat may exist but the data do not so clearly indicate a pattern that would affect the estimates in Table 3.

The population estimates in Table 3 are based on only 75-89 miles of habitat in the three forks of the Smith River and omit all tributaries and the mainstem from the sampling frame. Tributary surveys by the USFS in previous years indicate that very few, if any, summer steelhead, half-pounders, and spring chinook are found in tributaries during summer (Mike McCain, pers.com). While it has not been confirmed that summer steelhead and spring chinook do not use deep, temperature-stratified pools of the mainstem Smith River during August, ambient water temperatures in the mainstem frequently exceed 70 degrees F, indicating that fish would not hold in the mainstem

instead of moving upstream to cooler water. In conclusion, it may be reasonable to consider the estimated total number of summer steelhead and spring chinook in 75-89 miles of the three forks to be representative of basin-wide population estimates, but more data on use of tributaries on the mainstem Smith River is warranted.

The precision of estimates in Table 3 should be considered in the context of several factors related to the bias of fish counts. Fish count data used in the estimation are not actual numbers of fish per segment, but the number determined by crews of varying experience and diligence. Due to the fact that all snorkelers were trained with the same techniques, the 2003 effort surely represents the best effort yet to acquire thorough and consistent data for adult fish in the Smith River during summer. However, the probability that fish will be seen (i.e. the bias of counts) still varies among crews and local conditions (i.e. light, depth and cover). Actual techniques used in the field did not completely adhere to optimal techniques listed in Methods. Most notably, USFS staff were required by agency rules to wear stream boots, thus precluding the ability for many crews to investigate deep cover. Also, volunteer teams with minimal experience sometimes had difficulty maintaining positions and coordinating entry into pools.

The methods used in 2003 attempted to produce the most precise fish counts while preserving the ability to monitor trends in fish abundance using data that was first collected in 1982. Particular techniques employed by the former surveys are not known in detail, but likely resulted in counts of no less bias than counts in 2003 which were guided by the optimal techniques. Assessment of trends in fish abundance is beyond the scope of this report. However, a review of available data for the years 1982, 1991-1995, and 2000-2002 indicate that the observed abundance of fish in 2003 is within the range observed in previous years, but that the abundance of summer steelhead in 2003 may be the lowest of all years surveyed. By contrast to the three summer steelhead observed over 53 miles in 2003, 34 summer steelhead were observed over 41.5 miles in 1992.

Recommendations

Based on the experience of coordinated surveys in 2003 and previous years, the following recommendations are offered for the purpose of increasing the precision of future estimated salmonid populations in the Smith River during summer, and the evaluation of trends in those populations. These recommendations should also helpful for the purpose of increasing understanding of fish distribution and habitat use in the Smith River during summer.

Count adult cutthroat trout according to three size categories.
Additional observation and feedback from snorkelers in 2003 indicates that, while small adult cutthroat (7-10”) do have a lower observation probability, volunteer surveyors can handle the task of including them in the survey. The maintenance of a medium size category (10-12”) enables maximum comparison among years by pooling categories, when necessary.

Support the continuation of the Volunteer Fish Count with enhanced training.
The volunteer fish count in 2003 drew 30 surveyors, 16 of whom had participated in one of fish counts from the three previous years. With little cost and many educational benefits, this event is developing a pool of increasingly experienced surveyors. Enhancement of training would best be supported by funds for training materials (e.g. poster board for fish identification) and assistant trainers.

Provide for the coordination of training and surveys among CDFG and USFS staff.
The thoroughness of the 2003 effort is a surprising success considering the late notice of unavailability from CDFG staff. Any success is due to the flexibility of USFS staff in responding to the call for help. Future efforts will be enhanced in quality and quantity by advance coordination.

Strengthen the sampling frame with respect to stratification and basin-wide context.
As discussed in the previous section, lack of data on adult salmonid use of the mainstem and tributaries limits estimation of population size to the three forks. Some inexpensive research of existing documents and investigative field-work could provide the basis for developing a method of generating basin-wide estimates of annual abundance. In addition, analysis of the patterns of fish distribution within the three forks could lead to a sampling scheme that uses fewer segments and less cost to generate equally precise estimates of abundance.

Emphasis the use of optimal techniques and reduction of observational variance.
The methods described in this report are essential to generating precise counts of fish by direct observation. The assessment of observational variability given here should be repeated for crews that adhere to the techniques. This assessment would provide for determining the feasibility and sensitivity of detecting changes in fish abundance.

Acknowledgements

This survey effort relied on funding by the Department of Fish and Game, Salmon and Steelhead Trout Restoration Account and the assistance of many generous individuals. Thanks to the contribution of USFS Six Rivers National Forest staff and 25 volunteers, a minimum of 550 hours were applied to Smith River adult surveys during August, 2003. Special and sincere thanks go to Tom Weseloh, Darrel Warnock, Mike McCain and Joe Gillespie.