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DEPARTMENT OF FISH AND GAME

FEDERAL AID IN SPORT FISH RESTORATION
2000 Annual Performance Report
Program F-71-R-25

REGIONAL FISHERIES MANAGEMENT INVESTIGATIONS
UPPER SNAKE REGION (Subprojects I-G, II-G, III-G, IV-G)

PROJECT I.	**SURVEYS AND INVENTORIES**
Job a.	**Upper Snake Region Mountain Lakes Investigations**
Job b.	**Upper Snake Region Lowland Lakes Investigations – Island Park Reservoir, Ririe Reservoir, Henrys Lake**
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PROJECT II.	**TECHNICAL GUIDANCE**
PROJECT III.	**HABITAT MANAGEMENT**
PROJECT IV.	**POPULATION MANAGEMENT**

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2000 ANNUAL PERFORMANCE REPORT

State of:	Idaho	Program:	Fisheries Management F-71-R-25
Project:	I-Surveys and Inventories	Subproject:	I-G Upper Snake Region
Job No.:	a	Title:	Mountain Lakes Investigations

Contract Period: July 1 2000 to June 30 2001

ABSTRACT

There were no mountain lake surveys in the Upper Snake Region during this contract period.

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2000 ANNUAL PERFORMANCE REPORT

State of: Idaho

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Project I: Surveys and Inventories

Subproject: I-G: Upper Snake Region

Job: b - Island Park Reservoir, Ririe Reservoir, Henrys Lake

Title: Lowland Lakes Investigations

Contract Period: July 1 2000 to June 30 2001

ABSTRACT

Gill nets were set on Island Park Reservoir on May 16, 2000 to assess species composition and monitor relative abundance of fish species. Gill net catch composition on Island Park Reservoir in May was 73% nongame fish (Utah chub *Gila atraria*, Utah sucker *Catostomus ardens*, and redside shiner *Richardsonius balteatus*). Hatchery and wild rainbow trout *Oncorhynchus mykiss* comprised 18%, while splake (lake trout *Salvelinus namaycush* x brook trout *S. fontinalis*), kokanee salmon *O. nerka*, brook trout and mountain whitefish *Prosopium williamsoni* accounted for 9% of the catch.

Routine creel surveys were conducted on Ririe Reservoir to monitor catch rates and species composition, and to evaluate experimental stockings of catchable-size Yellowstone cutthroat trout *O. clarki bouvieri* and sterile triploid rainbow trout. Overall catch rate from June 9 to September 18 averaged 0.69 fish/h and harvest rate averaged 0.43 fish/h. Harvest composition was 48% hatchery rainbow trout, 21% yellow perch *Perca flavescens*, 19% kokanee salmon, and 10% Yellowstone cutthroat trout. Smallmouth bass *Micropterus dolomieu* and splake comprised about 2% of the harvest. Hatchery Yellowstone cutthroat trout comprised 9% of the total trout stocked and 10% of the trout harvest. Evaluation of sterile triploid rainbow trout was inconclusive due to improper identification of marked fish in the creel.

The 2000 spawning operations at Henrys Lake produced 1,436,500 eyed cutthroat trout eggs and 343,800 eyed hybrid trout eggs. All hybrid trout eggs were heat-shocked to produce sterile triploids. Cutthroat trout in the Hatchery Creek run averaged 436 mm and hybrid trout averaged 443 mm. No brook trout eggs were taken in 2000. Catch composition in six net-nights of gillnetting (custom nets) at Henrys Lake was 10% cutthroat trout, 52% hybrid trout, 28% brook trout, and 10% Utah chub. Catch composition in additional sampling with standard Idaho Department of Fish and Game (Department) experimental gillnets was 29% cutthroat trout, 13% hybrid trout, 6% brook trout, 50% Utah chub, and 2% redside shiner.

Natural production from three main spawning tributaries to Henrys Lake (Duck, Targhee, and Howard creeks) was estimated at 138,640 fish. The apparent low production from these tributaries warrants further investigation.

Assessments of genetic status of Yellowstone cutthroat populations in Henrys Lake and its tributaries were continued. In random lake samples of *Oncorhynchus spp* (n = 71), the overall introgression level was 14%. However, within this sample, those fish phenotypically identified as cutthroat trout (n = 37) were less than 1% introgressed.

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OBJECTIVE

To obtain current information for fishery management decisions on lowland lakes and reservoirs, including angler use, success, harvest and opinions, fish population characteristics, stocking success, return-to-the-creel for hatchery trout, limnology and develop appropriate management recommendations.

METHODS

Island Park Reservoir

Since the 1992 drawdown and renovation of Island Park Reservoir, annual standardized gillnetting has been used to monitor species composition, relative abundance, and size structure of the fishery in the lake. On May 8-9, 2000, four sinking and three floating experimental gill nets were fished at standardized locations (seven net-nights; Dillon et al. 2000). Set and pull times for each net were recorded, and all captured fish were identified, enumerated, and measured. Relative abundance data were compiled and compared to data from 1993-1999.

Ririe Reservoir

A routine creel survey was implemented on Ririe Reservoir to monitor catch and harvest rates and species composition in the harvest. Additional objectives in 2000 were to assess relative return to creel of sterile triploid and normal diploid hatchery rainbow trout *Oncorhynchus mykiss*, and to evaluate a stocking of catchable-size Yellowstone cutthroat trout *O. clarki bouvieri*. Triploid rainbow trout were given left pelvic fin clips, and diploids were given right pelvic fin clips. Hatchery cutthroat trout were obtained from Jackson National Fish Hatchery and reared at Mackay State Fish Hatchery to an average size of about 300 mm. Survey dates were June 8 to September 18, with random days and start times generated with the Department creel survey software. No angler counts were done. Creel clerks were instructed to identify and measure all fish observed in the harvest, and to inspect all harvested rainbow trout for fin clips.

Henrys Lake

Spawning Operation

The Hatchery Creek fish ladder was opened on March 1 and remained in operation until May 5. Fish ascending the ladder were identified as cutthroat trout or hybrid trout (rainbow trout x cutthroat trout) and enumerated. A sub-sample of approximately 10% of each group was measured (fork length). Hybrid trout were produced with cutthroat trout eggs and Kamloops rainbow trout sperm obtained from Hayspur Hatchery. Cutthroat trout males and females were spawned to produce cutthroat trout for supplemental stocking in Henrys Lake and other Idaho fisheries. No brook trout *Salvelinus fontinalis* eggs were taken from Henrys Lake in 2000.

As in 1999, all hybrid eggs produced in 2000 were subjected to heat-shock to induce triploidy. In 1999, all eggs for hybrid production were taken the first four days the fish ladder was open. Because both eye-up and triploidy induction rates were relatively poor in 1999, we elected to take eggs for hybrid production later in the run in 2000. Eggs for hybrid trout production were taken on March 23 and 27 and on April 6 and 27. It is hypothesized that egg quality, and perhaps survival and induction rates, would improve with later egg collection. For each spawn day, cutthroat trout eggs (seven females, pooled) were fertilized with Hayspur Kamloops sperm (five males, pooled). Ten minutes after fertilization, eggs were poured into Heath trays and immersed in a 27°C circulating water bath for 20 min. Eye-up rates were monitored and compared to 1999 hybrid egg lots. All hybrid eggs were shipped to Mackay Hatchery for hatch and rearing. In early September, research personnel took blood samples from 60 fish, and had the samples analyzed for ploidy.

Disease samples were taken from fish collected from the cutthroat trout spawning run. Ovarian fluids were collected from cutthroat trout (seven fish, pooled samples) during spawning at Henrys Lake Hatchery. Twelve batches of five fish each (60 fish total) were sacrificed for whirling disease sampling. All samples were sent to the Eagle Fish Health Laboratory (EFHL) for analysis.

Genetic Analyses

The genetic inventory of the Henrys Lake cutthroat trout population continued in 2000. The focus of this inventory was to estimate the level of rainbow trout introgression in a random lake-wide sample of *Oncorhynchus spp.*, and within this sample to estimate introgression in fish identified phenotypically as cutthroat trout. On July 13-15, ten experimental gill nets were set at random sites around the lake. By this date, it was assumed that all surviving spawners from the previous spring would have reentered the lake, and were randomly mixed within the lake. Each net was set at dusk and pulled the following morning. To avoid any bias in selection of fish, a sampling protocol was implemented before each net was pulled and before any fish were observed. For each set, every second or third *Oncorhynchus* encountered was included in the genetics sample. Each fish was placed on ice and returned to Henrys Lake Hatchery. At the hatchery, each fish was identified based on phenotype and measured (total length). Tissue samples (eye, liver, heart, and muscle) were collected from each fish, placed in labeled bags, and frozen. Samples were shipped frozen to the Washington Department of Fish and Wildlife genetics lab in Olympia, WA for genetic analysis using protein electrophoresis. A total of 13 protein loci were examined, eight of which were reliably diagnostic between rainbow trout and cutthroat trout. Genetic results were expressed as the overall level of rainbow trout introgression present in the sample (i.e., the number of rainbow trout alleles observed / total number of alleles examined).

Gillnetting

As part of routine population monitoring, gill net samples were collected from six standardized locations (total six net nights) on May 22-24. Nets were set at dusk and retrieved the following morning. Set and pull times were recorded and captured fish were identified to species and measured (total length).

Because the gill nets used for standard monitoring at Henrys Lake do not effectively sample Utah chub *Gila atraria*, trend data for chub abundance and size structure are lacking. On May 22-24, six additional gill net locations were established for using standard Department experimental nets. Again, set and pull times were recorded, and captured fish were identified and measured.

Tributary Fry Trapping

Prior to 2000, natural production to Henrys Lake had never been quantified. Tributary fencing, canal fish screens, and fish passage projects have been in place since the late 1980s, and habitat conditions in major spawning tributaries (Howard, Targhee, and Duck creeks) appear to have improved. However, natural reproduction in the lake appears to be insignificant. In 1998 fry trapping efforts, partial estimates of natural production in Howard Creek were obtained, but traps were installed too late to estimate total production. Based on observations of fin-clipped fish during the 1999 creel survey, hatchery fish comprised over 90% of the cutthroat trout harvest.

During 2000, Krey-Meekin fry traps were used to monitor and estimate total fry production from Howard, Targhee, and Duck creeks. Traps were installed on June 7-8 near the mouths of each tributary. On June 23 an additional trap was installed on Duck Creek, approximately one kilometer upstream of the mouth, due to poor catch near the mouth. Each trap was checked daily. All captured fry were enumerated, and a sub-sample was measured (total length). When catch rates were sufficient, trapping efficiency was estimated by marking and releasing fry 200-400 m upstream of the trap. Marking was done by immersing 100-150 fry in a solution of Bismarck brown dye (0.75 g per 3 gal water) for 20 min. All marked fry were held overnight to assess mortality before release. Recaptures were identified and enumerated at each trap site. Total fry emigration for each mark-recapture interval was estimated by dividing the total number of new fry captured during that interval by the efficiency for that interval. Interval estimates and variances were summed to provide an overall estimate of fry emigration in each tributary.

RESULTS AND DISCUSSION

<u>Island Park Reservoir</u>

A total of 718 fish were captured with a combined gillnetting effort of seven net-nights (Table 1). Catch composition included nine species. Game fish (trout, char, mountain whitefish *Prosopium williamsoni*, and kokanee salmon *O. nerka*) comprised 27% of the total catch, compared to 37% in May 1999 samples. Utah chub, Utah sucker *Catostomus ardens*, and redside shiner *Richardsonius balteatus* comprised 73% of the catch, compared to 62% in 1999. Hatchery and wild rainbow trout comprised 18% of the catch, down from 23% in 1999 samples. A total of seven splake (brook trout x lake trout *Salvelinus namaycush*) and four Lahontan cutthroat trout were sampled.

Table 1. Gill net catch composition in Island Park Reservoir, Idaho, May 2000.

		Species								
Net Location	Soak time (hrs)	Utah Chub	Rainbow trout	Brook trout	Kokanee	Mountain whitefish	Utah sucker	Redside shiner	Splake	Total
Brush Pile	16.3	106	18	1	3	0	2	0	2	132
Bill's Island	18.3	171	14	3	30	1	54	24	2	299
Mill Creek	19.5	46	14	6	1	0	0	0	2	69
Trudes Bay	20.2	13	17	2	1	0	9	0	1	43
Goose Island	21.7	14	22	0	2	0	15	0	0	53
Goose box #25	20.2	18	19	0	2	1	1	0	0	41
Goose box #56	20.5	40	26	0	2	1	10	2	0	81
Total	136.7	408	130	12	41	3	91	26	7	718
Percent	-	56.8	18.1	1.7	5.7	0.4	12.7	3.6	1.0	-

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Ririe Reservoir

From June 9 to September 18 creel clerks interviewed 247 anglers who fished 497 hours, caught 341 fish, and harvested 214 fish. Mean catch rate was 0.69 fish/h and mean harvest rate was 0.43 fish/h. Harvest composition was 48% hatchery rainbow trout, 21% yellow perch *Perca flavescens*, 19% kokanee salmon, and 10% Yellowstone cutthroat trout. Only one smallmouth bass *Micropterus dolomieu* was observed in the harvest.

The experimental stocking of hatchery Yellowstone cutthroat trout appeared to be successful. The 1,500 fish stocked comprised about 9% of the total trout stocking and 10% of the observed trout harvest.

Comparisons of triploid and normal rainbow trout were compromised by inadequate identification of fin clips in the field. Creel clerks inspected each harvested fish for left pelvic clips (triploids), but did not record right pelvic clips (diploid). Despite this uncertainty, fish recorded as triploids comprised over 60% of the trout harvest, whereas fish recorded as unmarked comprised only 22%. This suggests that triploid fish return to creel at a higher rate than diploid fish, but clearly a more rigorous evaluation is needed.

Henrys Lake

Spawning Operation

A total of 4,195 cutthroat trout ascended the spawning ladder between March 1 and May 5, with 2,215 males and 1,980 females. Hybrid trout totaled 8,530 fish, with 3,788 males and 4,742 females. Mean fork length for male and female cutthroat trout was 440 and 433 mm, respectively (Figure 1). Combined average cutthroat trout fork length was 437 mm. Hybrid trout males and females averaged 450 and 438 mm, respectively (Figure 2). Combined average hybrid trout length was 443 mm.

The proportion of cutthroat trout in the spawning run was 33%, much lower than recorded in the recent past. Over the previous five years, cutthroat trout comprised an average of 70% of the spawning run. However, selection and classification at the hatchery ladder has changed markedly in the last year. With the recent emphasis on genetic analyses, awareness of genetic issues has increased, and hatchery and management personnel have been much more selective in determining which fish are classified as cutthroat trout. With this change in classification criteria, cutthroat trout numbers appear to be declining, both in the 2000 hatchery ladder data and in the 1999 creel survey data. Clearly, cutthroat trout numbers have not declined as dramatically as these data suggest, and this is largely an artifact of more conservative fish classification. It is also important to note that despite several decades of less stringent selection criteria at the hatchery ladder, current introgression levels in phenotypic cutthroat trout are low (see genetic analysis section below). In future monitoring activities, it is recommended that the ladder be sorted into three groups of fish: 1) phenotypically “pure” cutthroat trout which meet our intensive selection criteria and could be used for spawning; 2) cutthroat trout which are not obvious hybrids but do not meet the criteria, and, 3) obvious phenotypic hybrid trout.

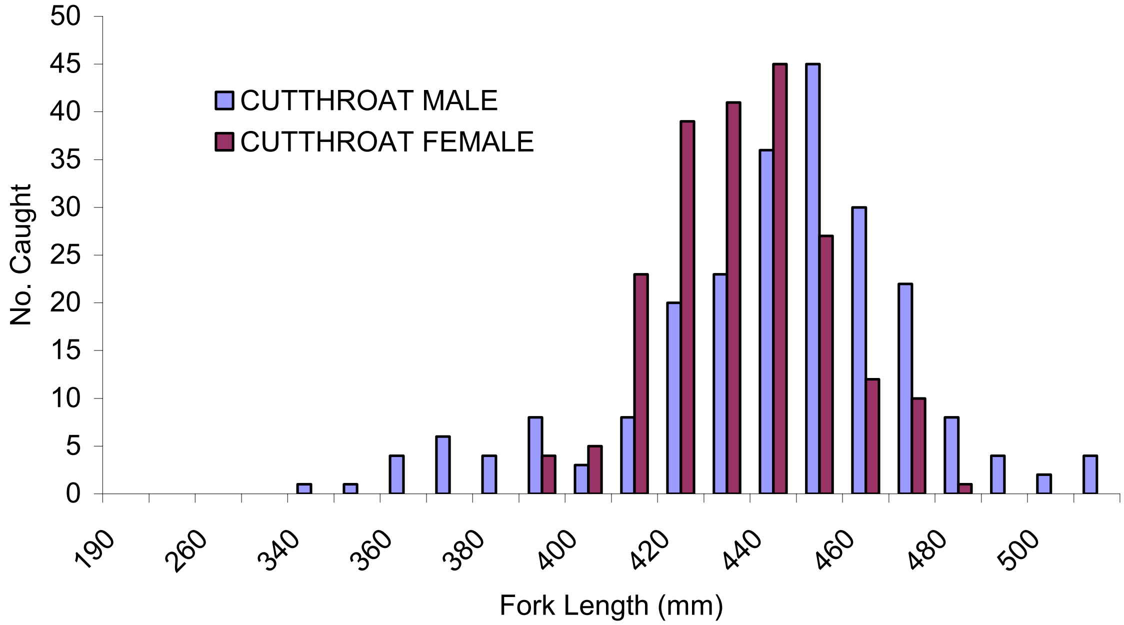

Figure 1. Length-frequency distribution of cutthroat trout captured ascending the Hatchery Creek fish ladder, Henrys Lake, Idaho in 2000.

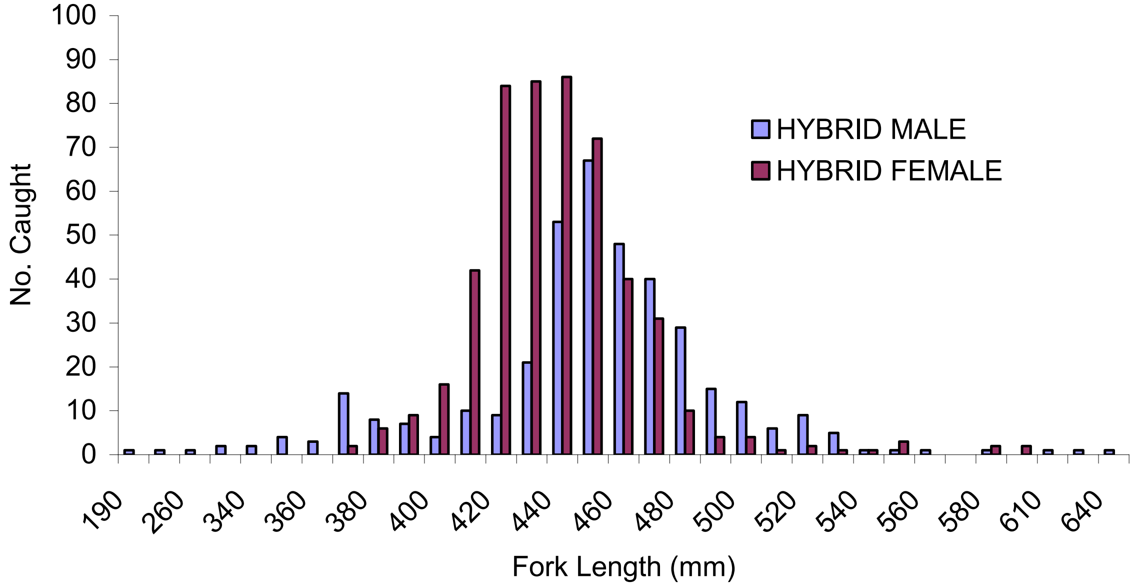

Figure 2. Length-frequency distribution of hybrid trout captured ascending the Hatchery Creek fish ladder, Henrys Lake, Idaho in 2000.

Cutthroat trout green eggs totaled 2,386,437 from 904 females for an average fecundity of 2,639 eggs per female. Eyed cutthroat trout eggs totaled 1,436,528 for an overall eye-up rate of 60%.

Hybrid trout green eggs (all heat-shocked) totaled 993,750 from 375 cutthroat trout females for an average fecundity of 2,650 eggs per female. Eyed hybrid trout eggs totaled 343,798 for an overall eye-up rate of 35%.

Results from cutthroat trout ovarian fluid disease samples were not obtained in time for inclusion in this report. Eleven of 12 pooled samples (five fish each) from the ladder tested positive for *Myxobolus cerebralis*, the causative agent for whirling disease.

This was the second year induction of triploidy was attempted for all Henrys Lake hybrids. Overall eye-up rate was poor again (35%) and about 25-40% lower than typical for untreated hybrid eggs. Estimated overall triploidy induction rate was 65%, substantially lower than is being achieved in domestic Hayspur and kamloop rainbow trout. Additional modifications to the heat-shock process may be necessary to achieve induction rates approaching 100%. Hydrostatic pressure shock should also be investigated as a means of achieving sterility, although using this technique at a production level will be more difficult than heat-shocking. One additional alternative may be producing a reciprocal hybrid cross with cutthroat trout sperm and kamloop rainbow trout eggs, although performance of such a cross is unknown.

Genetic Analysis

Lake-wide sampling effort (10 net-nights) resulted in capture of 298 fish. Seventy-one *Oncorhynchus spp*. were randomly selected for genetic analysis. Of these, 37 were phenotypically identified as cutthroat trout, 29 as hybrid trout, and 5 as undetermined.

In the overall sample (n = 71 fish) 1,076 alleles were examined. Of these, 148 (14%) were rainbow trout alleles. This is probably the best estimate of the introgression level in the Henrys Lake trout population. In those fish phenotypically identified as cutthroat trout (n = 37) a total of 552 alleles were examined. Of these, only 4 (1%) were rainbow trout alleles. In phenotypically indeterminate fish (n = 5) a total of 78 alleles were examined, 6 (8%) were rainbow trout alleles.

A number of conclusions can be drawn from these results. The most important is that, despite a long history of hybrid and rainbow trout stocking, the overall introgression level of rainbow trout genes in Henrys Lake is moderate. Note that this sample included hybrid trout that are produced at the hatchery and stocked annually. Fish that we identified in the field as cutthroat trout appear to be introgressed at a very low level (<1%). This suggests that hatchery selection for "pure" cutthroat trout has been quite successful over time, and that the reproductive contribution of hybrids to the overall lake population has been negligible.

In the six Henrys Lake tributaries sampled in 1998-1999, nuclear and mitochondrial DNA techniques did detect varying levels of introgression (Dillon and Gamblin 1999). Although phenotypic hybrid trout do ascend Henrys Lake tributaries and are assumed to spawn in the wild with other hybrids and with cutthroat trout, there is no evidence that this has resulted in extensive hybridization in the lake-wide cutthroat trout population. This could be because the contribution of natural recruitment to the lake population is low (see Fry Trapping Section below). Alternatively, hybrid trout may be reproductively less fit than native cutthroat trout, or backcrossed hybrids may be less viable than F1 hybrids or native cutthroat trout.

Gillnetting

A total of 81 fish were collected in the seven net-nights with standard Henrys Lake nets (Figure 3). Catch composition was 10% cutthroat trout, 52% hybrid trout, 28% brook trout, and 10% Utah chub. Cutthroat trout ranged from 274 to 482 mm total length, hybrid trout 225 to 536 mm, and brook trout 240 to 449 mm. Brook trout contribution to gill net catches has increased markedly in the last five years, up from 3% in 1995. Although total sample size is relatively small, the Utah chub component is the highest ever recorded for this standard netting effort, up from 8% in 1999.

Six experimental gill nets set to establish monitoring sites for Utah chub captured a total of 193 fish (Figure 4). Utah chub comprised 50% of the sample, cutthroat trout 29%, hybrid trout 13%, brook trout 6%, and redside shiner 2%.

Tributary Fry Trapping

In each tributary, traps were installed prior to migration of trout fry back to Henrys Lake (June 7-8). Fry emigration peaked in early-July in Howard Creek, mid-July in Duck Creek, and late July in Targhee Creek (Figure 5).

In Howard Creek, catch rates were sufficient to conduct seven efficiency estimates from June 16 to July 26. Efficiency ranged from 14% to 41%. Total fry outmigration from June 7 to September 2 was estimated at 41,737 (SE 8,389).

In Duck Creek, the bulk of the emigration took place from July 5 to August 1. Four efficiency estimates were made during this time, ranging from 2% to 16%. Total fry outmigration from June 23 to September 12 was 86,809 (SE 30,175). Poor efficiency, particularly late in the outmigration period, contributed to broad confidence bounds for this estimate.

In Targhee Creek, catch rates were much lower than in other tributaries. Only two efficiency estimates were attempted, on July 29 and August 5. Because estimated efficiencies were similar among intervals, results were pooled to provide an overall efficiency estimate of 13%. Based on this efficiency, total fry emigration from June 8 to September 19 was estimated at 10,094 (SE 1,823).

The estimated total fry production from these three primary spawning tributaries was 138,640. Some additional emigration may have occurred outside our sampling period, but is considered minimal based on the declining catch rates observed by the end of the sampling period. Traps were run into the fall, anticipating additional emigration. However, because hatchery cutthroat trout fingerlings were stocked into tributaries from early to mid-September, traps were shut down at this time. Despite the uncertainty of fall migrations, production from these three tributaries appears minimal, especially placed in context of the 1,000,000 hatchery fingerlings stocked annually. Results from the 1999 creel survey also suggest that only a small

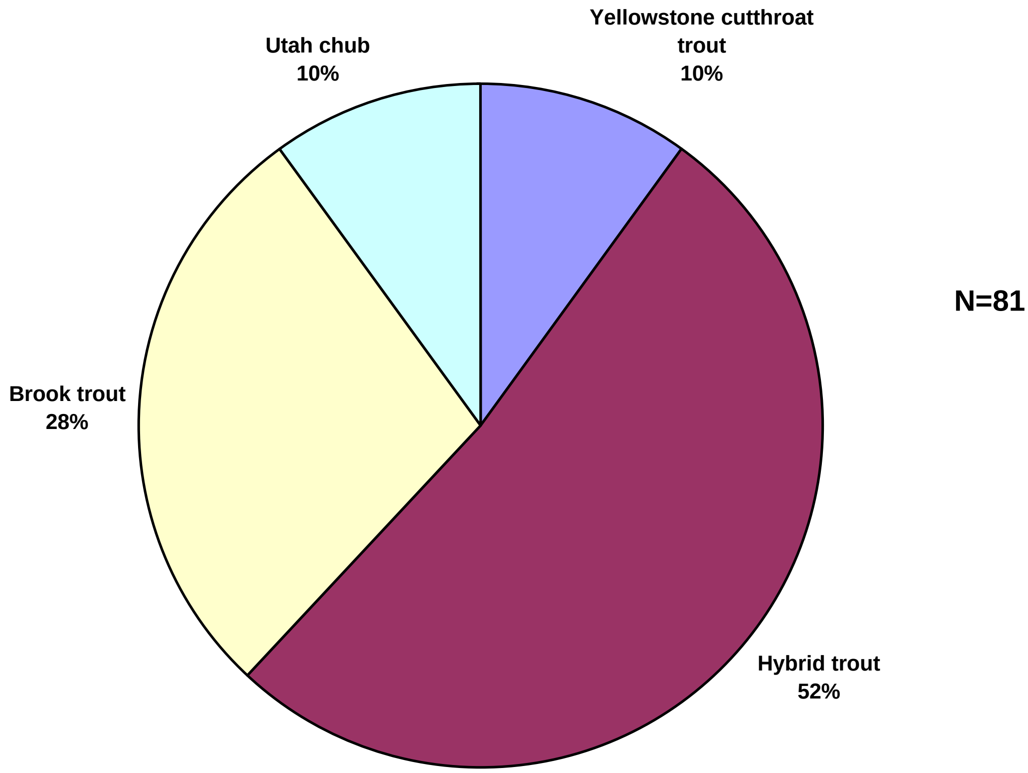

Figure 3. Catch composition of fish caught in six gill net nights of effort on Henrys Lake, Idaho in 2000.

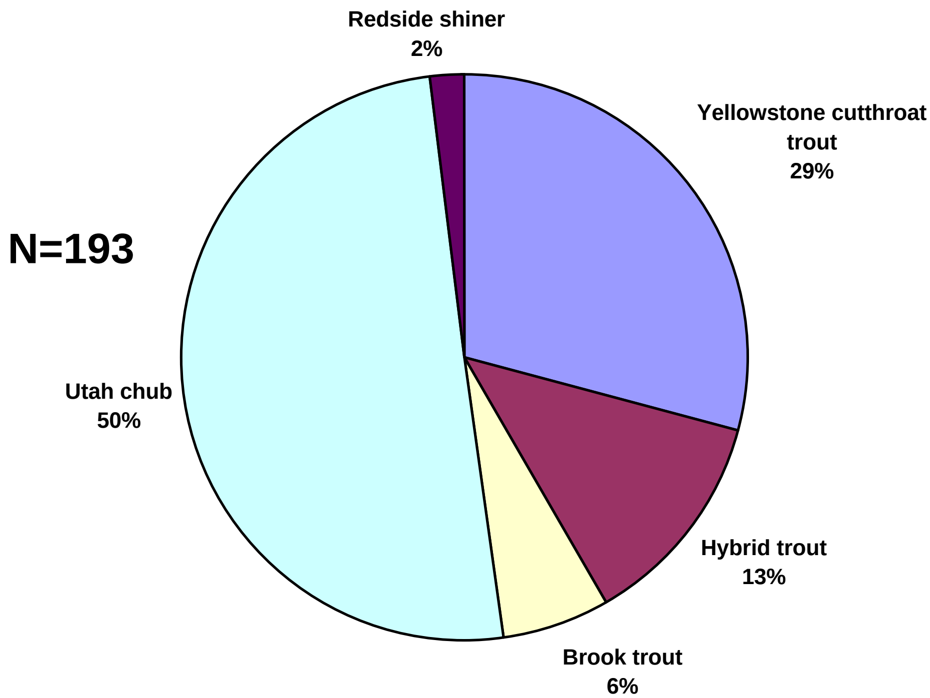

Figure 4. Catch composition of fish captured with six net-nights of effort with experimental gill nets on Henrys Lake, Idaho in 2000. Nets were targeting nongame fish.

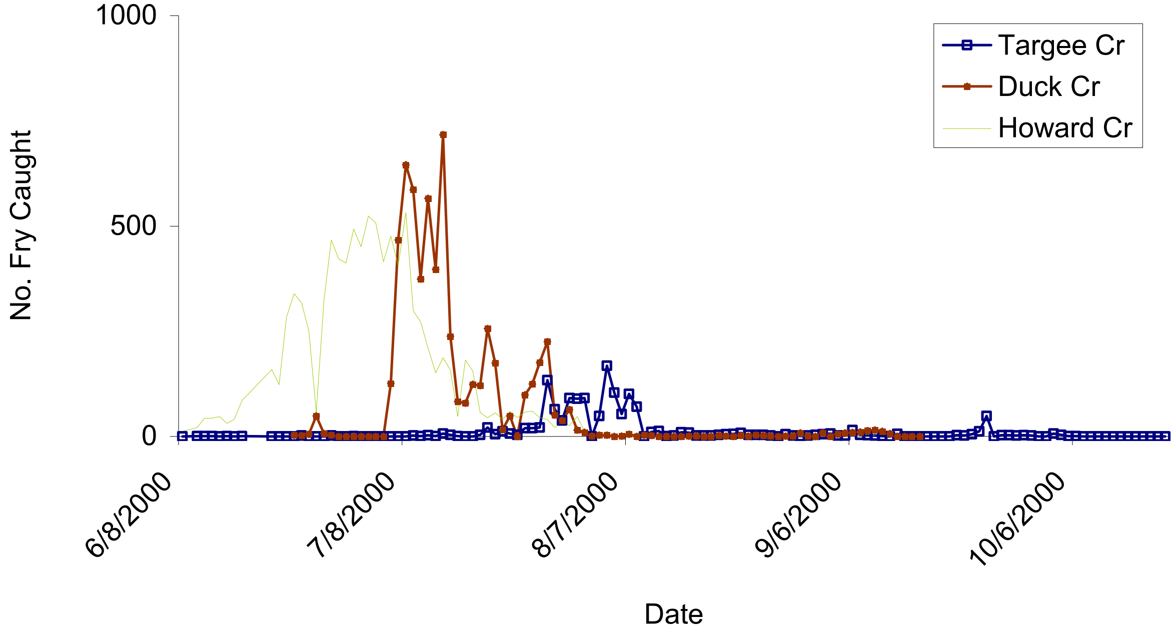

Figure 5. Timing of trout fry emigration from various tributaries to Henrys Lake, Idaho in 2000.

fraction of the fishery is provided by naturally produced fish. Based on fin clips, virtually all of the cutthroat trout harvest in 1999 was hatchery fish. Additionally, if natural production was contributing a significant portion of the lake fishery, introgression levels in the lake-wide cutthroat trout population should have fallen somewhere between levels in tributary and hatchery ladder samples. In fact, introgression levels for phenotypic cutthroat trout selected randomly from the lake are almost identical to those at the hatchery ladder.

It is unclear why natural reproduction is poor in these tributaries. Large spawning runs are observed annually in each, although spawning escapement has never been quantified. Habitat enhancements such as riparian fences and canal fish screens have been in place for a decade, and spawning and rearing habitat appears to be excellent. We suggest that additional investigations focus on spawner inventories, redd counts, and perhaps egg-to-fry survival in Henrys Lake tributaries. Also, because whirling disease is present in the drainage, we suggest capturing and rearing naturally produced fry to monitor survival.

RECOMMENDATIONS

Island Park Reservoir

1. Continue spring gill net surveys to monitor changes in species composition.

2. Institute lake-wide creel survey to monitor effort, catch composition, size of catch and catch rates over the course of a fishing season.

Ririe Reservoir

1. Continue experimental stockings of hatchery Yellowstone cutthroat trout.

2. Institute a structured, lake-wide creel survey to monitor effort, catch rates, species composition, and relative returns of various groups of stocked hatchery fish. Survey should encompass the entire fishing season.

Henrys Lake

1. Continue annual standard gill net surveys to describe general population trends.

2. Continue to evaluate sterile hybrid production and stocking program; develop evaluation plans to assess triploid hybrid performance in Henrys Lake. Investigate alternative methods for triploidy induction.

3. Increase emphasis on evaluating spawning escapement, spawning habitat and natural recruitment in key tributaries of Henrys Lake.

2000 ANNUAL PERFORMANCE REPORT

State of:	Idaho	Program:	Fisheries Management F-71-R-25
Project:	I-Surveys and Inventories	Subproject:	I-G Upper Snake Region
Job No.:	c[1] Henrys Fork Snake River Big Lost River	Title:	Rivers and Streams Investigations

Contract Period: July 1 2000 to June 30 2001

ABSTRACT

An electrofishing survey of the Box Canyon Reach of the Henrys Fork of the Snake River was conducted during May 2000. With estimates derived from this sample, the population of recruited (>150 mm) wild rainbow trout (WRB) *Oncorhynchus mykiss* was estimated at 12,221 fish (SD 792). This represents a three-fold increase over the 1996 estimate conducted on this same stretch of river by the Idaho Fish and Game Department (Department). Historical trends in the Box Canyon Reach have shown a decline in WRB beginning in the early 1980s, followed by a gradual increase in densities after 1996.

Six sections of the Big Lost River drainage above Mackay Reservoir were electrofished during July 2000. These samples were used to estimate the population size of both rainbow trout and brook trout *Salvelinus fontinalis*. Salmonid densities in the Bartlett Point Road area (Harry Canyon) were estimated at 298 rainbow trout/ha and 54 brook trout/ha, and reflected an increase in both species over previous samples. Brook trout were the dominant salmonid in the East Fork sections (Whitworth and Fox creeks) and outnumbered rainbow trout. Estimates of abundance for rainbow trout in these sections were 139 (Whitworth Creek) and 110 (Fox Creek). Brook trout were estimated at 170 and 534, respectively. The estimates for the East Fork were similar to results found in 1997, and indicate a stable population exists in this area.

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OBJECTIVE

To obtain current information for fishery management decisions on rivers and streams, including angler use, success, harvest and opinions, fish population characteristics, spawning success, habitat characteristics, return-to-the-creel for hatchery trout and develop appropriate management recommendations.

METHODS

Box Canyon Population Estimate

Mark-Recapture density estimates were conducted on the Box Canyon Reach of the Henrys Fork. Two drift boat electrofishers made a total of eight passes during the marking event. All captured fish were identified, measured and given an upper caudal fin punch. Six passes were made during the recapture event. To avoid duplicate counting, fish captured during each recapture pass were given a lower caudal fin punch. Mark-recapture data were analyzed with MR5 software (MDFWP 1994).

Big Lost River Population Estimates

Population estimates were derived for the Bartlett Point Road area (2.24 km long, 3.1 ha total area) and the East Fork (Fox Creek; 1.16 km long, 1.4 ha, and Whitworth Creek; 1.38 km long, 1.7 ha) of the Big Lost River. Multiple passes were made using backpack electrofishing gear. Fish were marked during the first run, and examined for marks on subsequent runs. Population estimates were derived using the MR5 data analysis program.

RESULTS AND DISCUSSION

Box Canyon Population Estimate

A total of 1,284 wild rainbow trout *Oncorhynchus mykiss* >150 mm were sampled in marking and recapture runs combined. Other fish sampled included brook trout *Salvelinus fontinalis* (n=2), rainbow x cutthroat trout *O. clarki* hybrids (n=4), kokanee *O. nerka* (n=2) and hatchery rainbow trout (n=6).

Wild rainbow trout sampled in this reach ranged in size from 150 to 575 mm (Figure 1). Sampling efficiency increased slightly with fish size. Estimated abundance of wild rainbow trout 150 mm was 13,447 fish using the modified Peterson method and 12,221 fish using the log-likelihood method (Table 1). Abundance estimates equate to about 3,362 fish/rkm. These estimates reflect the highest densities recorded since 1993, and reflect an increasing trend in abundance since the low recorded in 1996.

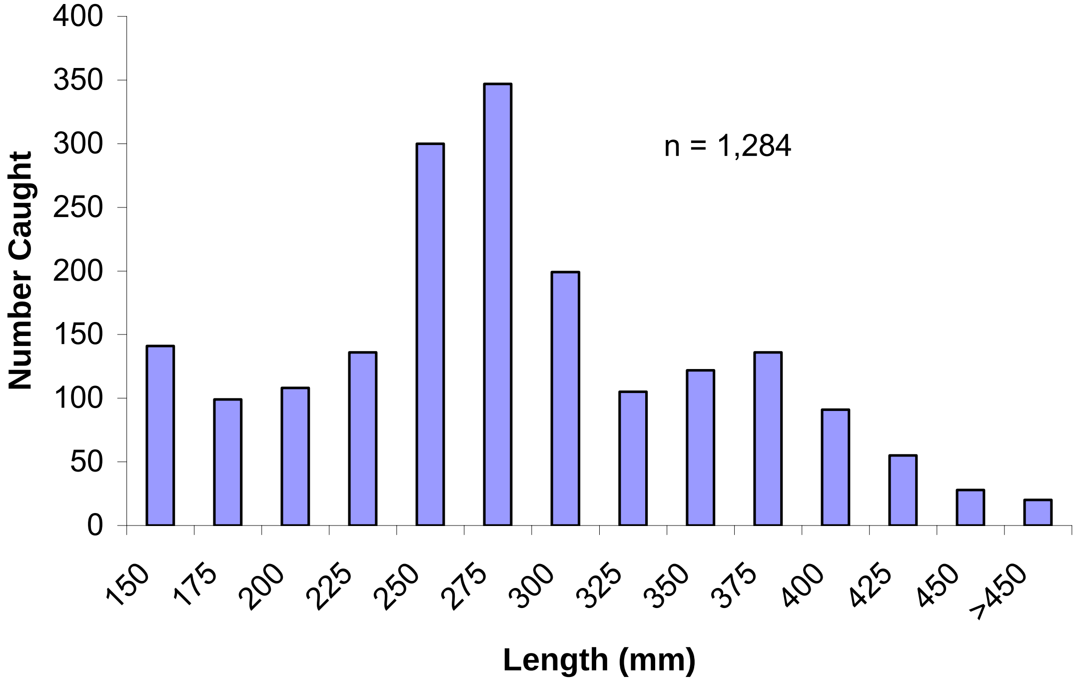

Figure 1. Length frequency distribution for wild rainbow trout collected electrofishing in the Box Canyon Reach of the Henrys Fork Snake River, Idaho, May 2000.

Table 1. Estimated abundance of wild rainbow trout >150 mm in the Box Canyon Reach of the Henrys Fork of the Snake River, Idaho, 1993 – 2000.

Season/Year	Modified Peterson method (MPM)	Log-likelihood method (LLM)	No./ River mile by MPM (LLM)	No./ Reach MPM (LLM)	RSD-Q (400 mm)
Fall 1993	~10,000		~4,200	11,800	NA
Spring 1994	7,234	9,359	3,014 (3,900)	8,489 (10,920)	39
Spring 1995	6,080	5,904	2,533 (2,460)	7,092 (6,888)	28
Spring 1996	3,390	4,210	1,413 (1,754)	3,965 (4,911)	20
Spring 1997	5,302	5,278	2,209 (2,199)	6,185 (6,157)	13
Spring 1998	6,619	8,527	2,758 (3,553)	7,722 (9,948)	12
Spring 1999	4,807	5,110	2,003 (2,129)	5,608 (5,961)	15
Spring 2000	13,447	12,221	5,603 (5,092)	15,744 (14,258)	10

Big Lost River Population Estimates

A total of 167 rainbow trout and 54 brook trout were collected in the Bartlett Point Road area of the Big Lost River. Rainbow trout ranged in size from 150 to 458 mm, while brook trout ranged in size from 150 to 346 mm (Figure 2). Density estimates in this area showed the rainbow trout population to be 295 fish/ha, the highest level estimated since 1988 (Table 2). Densities of brook trout were also higher than recorded previously; although this is the first year these fish were captured in sufficient numbers to estimate population size. Yellowstone cutthroat trout were captured in the 2000 survey, but in very low abundance.

Population trends in the East Fork of the Big Lost River (Whitworth and Fox creeks) show rainbow trout populations to be relatively stable at 139 fish (82 fish/ha) in Whitworth and 110 fish (78.6 fish/ha) in Fox Creek. However, brook trout populations appear to have increased substantially over the past several years. Densities in Whitworth Creek have increased nearly three times levels found during 1996, while in Fox Creek; densities have nearly doubled from 1996 levels. Although Yellowstone cutthroat trout were present in both creeks, densities were lower than necessary to calculate abundance.

RECOMMENDATIONS

1. Continue monitoring of the Box Canyon reach of the Henrys Fork Snake River to address population changes over time.

2. Conduct additional sampling in the headwaters of the Big Lost River. Consider habitat measurements and classifications in this sampling in order to attempt to explain the increase in brook trout population changes.

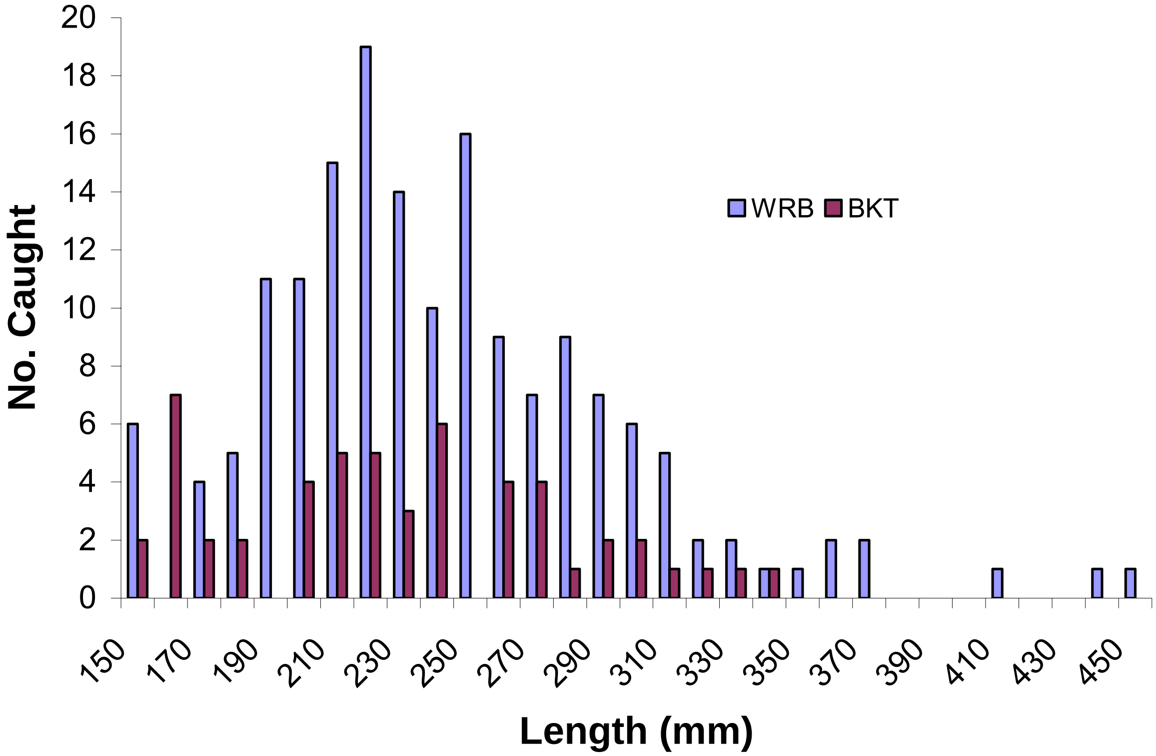

Figure 2. Length-frequency distribution for rainbow trout (WRB) and brook trout (BKT) captured electrofishing in the Bartlett Point Road area of the Big Lost River, Idaho in 2000.

Table 2. Trout population trends in three sections of the Big Lost River drainage, Idaho 1986-2000.

Location	Year	Rainbow Trout	Brook Trout
Bartlett Point Road	1988	452	29[a]
	1990	469	2[a]
	1996	552	19[a]
	1997	653	19[a]
	2000	925	168
Whitworth (East Fork)	1986	281	2[a]
	1990	102	8[a]
	1996	118	62
	1997	139	170
Fox Creek (East Fork)	1986	30	22[a]
	1990	126	45
	1996	55	296
	1997	88	503
	2000	110	534

[a] No population estimate possible; numbers are total fish captured.

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2000 ANNUAL PERFORMANCE REPORT

State of: Idaho

Program: Fisheries Management F-71-R-25

Project I: Surveys and Inventories

Subproject I-G: Upper Snake Region

Job: c^2 - South Fork Snake River

Title: Rivers and Streams Investigations

Contract Period: July 1, 2000 to June 30, 2001

ABSTRACT

In the South Fork Snake River, a total of 1,205 trout were captured during two days of electrofishing at the Conant section in October 2000. Trout species composition and relative abundance were cutthroat trout *Oncorhynchus clarki* (66%), rainbow trout *O. mykiss* and hybrid rainbow X cutthroat trout *O. clarki x mykiss* (22%), and brown trout *Salmo trutta* (11%). No lake trout *Salvelinus namaycush* or kokanee *O. nerka kennerlyi* were caught. Fish densities were not estimated because of low flows. Mean total length was 315 mm for cutthroat trout, 307 mm for rainbow and hybrid trout, 312 mm for brown trout, and 313 mm for all species combined. Quality stock density (QSD) was 2.3% for cutthroat trout, 13.8% for rainbow and hybrid trout, 12.8% for brown trout, and 6.0% for all species combined.

A total of 1,672 trout were captured during four days of electrofishing at the Twin Bridges section in September and October 2000. Trout species composition and relative abundance were cutthroat trout (28%), rainbow trout and hybrid trout (1%), and brown trout (71%). No lake trout or kokanee salmon were caught. Estimated densities were 654 fish/km for cutthroat trout, 1,820 fish/km for brown trout, and 2,503 fish/km for all species combined. Rainbow and hybrid trout density estimates were not possible due to the small sample size. Mean total length was 310 mm for cutthroat trout, 296 mm for rainbow and hybrid trout, 284 mm for brown trout, and 291 mm for all species combined. Quality stock density (QSD) was 5.8% for cutthroat trout, 0.0% for rainbow and hybrid trout, 3.1% for brown trout, and 3.9% for all species combined.

Rainbow and hybrid trout were not removed at Conant but were sacrificed at Twin Bridges during recapture runs (11 fish).

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INTRODUCTION AND STUDY AREA

Since 1986, trout populations in the South Fork Snake River have been monitored annually using electrofishing. Four river sections have been electrofished (Figure 1): Palisades (5.0 km), Conant (4.9 km), Twin Bridges (2.9 km), and Lorenzo (4.8 km). However, only the Conant section has been sampled every year, a portion of which was sampled in 1982 as well (Moore and Schill 1984). The last creel census was conducted in 1996 (Schrader et al. 2003).

On August 14, 1998, Yellowstone cutthroat trout *Oncorhynchus clarki bouvieri* was petitioned to be listed as a threatened species under the Endangered Species Act. The focus of work this year was to collect data supporting the Idaho Department of Fish and Game (Department) response to the petition (IDFG 2000a, 2000b). Besides providing multi-year trend monitoring data (Palisades, Conant, and Lorenzo sections), we assisted in a range-wide, paired-sampling project that covered 74 sites throughout Eastern Idaho. The objective was to compare density estimates from the late 1980s to those obtained in 1999 and 2000 at the same locations using the same methods. For the South Fork Snake River, we focused on the Conant and Lorenzo sections in 1999 and the Twin Bridges section in 2000. We did not sample at the Palisades section because of the difficulty distinguishing hatchery cutthroat trout (flushed from Palisades Reservoir). In 2000, we also sampled at the Menan section of the main Snake River just below the confluence of the South Fork and Henrys Fork Snake River, but these data are presented in separate reports (IDFG 2000b, Meyer et al. 2001, 2003). Finally, we collected 60-fish genetics samples (of random *Oncorhynchus spp.*) at Palisades, Conant, Twin Bridges, and Lorenzo in the South Fork Snake River and at Menan in the main Snake River. These samples were archived but have not been analyzed (M. Powell, University of Idaho, personal communication).

Special regulations restricting harvest of cutthroat trout were enacted upstream of the Heise measuring cable to Irwin in 1984 and extended to Palisades Dam in 1988 (Appendix A). Based on this success, the restricted cutthroat trout harvest regulation was implemented throughout eastern Idaho in 1990 and included the lower South Fork (below Heise) and all South Fork tributaries. The two fish, none between 8-16 inches, regulation was extended to all trout species (including brown trout *Salmo trutta*) in the main stem (but not tributaries) in 1992. Emergency changes in 1999 removed rainbow trout *O. mykiss* (and later hybrid trout *O. clarki x mykiss*) from special regulations, returning them to the general six fish bag limit with no size restrictions. The minimum size restriction (8 inches) for cutthroat and brown trout was eliminated in 2000. The lower river (below the Heise cable) is open year-round to fishing, whereas the upper river is closed December 1 to Memorial Day weekend.

OBJECTIVES

To obtain current information for fishery management decisions on rivers and streams, including angler use and success, harvest and opinions, fish population characteristics, spawning success, habitat characteristics, return-to-the-creel for hatchery trout, and to develop appropriate management recommendations. Specific objectives related to the South Fork of the Snake River were to:

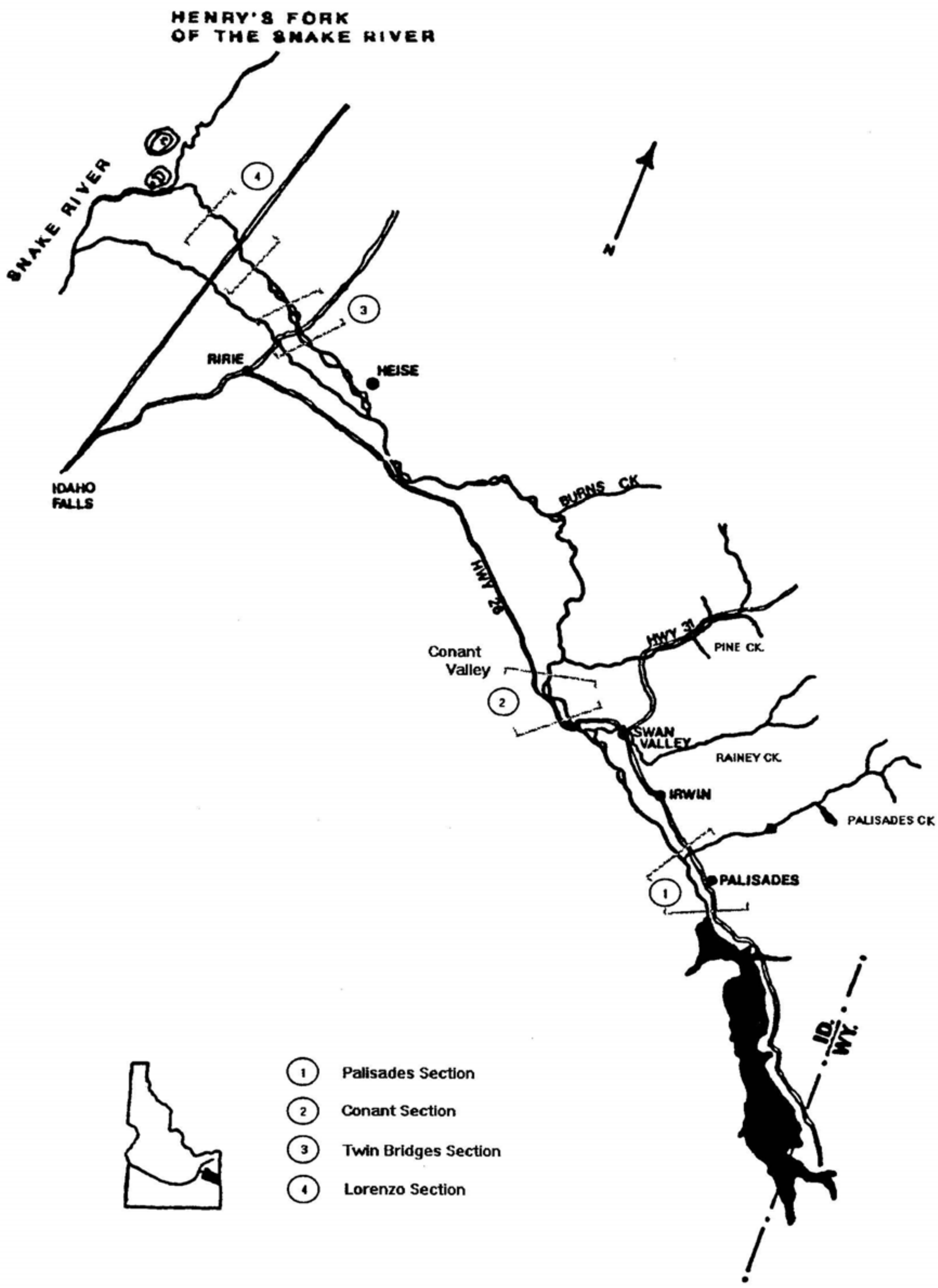

Figure 1. Map of South Fork Snake River showing electrofishing sections.

1. Monitor South Fork Snake River trout populations by electrofishing.

2. Summarize trout species composition, relative abundance, size structure, average fish length, quality stock density (QSD), and density.

METHODS

During 2000, the Conant section was electrofished on October 19 and 26, and the Twin Bridges section was electrofished on September 28-29 and October 4-5. Recapture runs were not conducted at Conant because of low flows. The upper or lower half of a section was sampled each day. At Conant, flows varied from 87.8 to 95.2 m^3/s (3,100 to 3,360 ft^3/s) at the Irwin gage (USGS, unpublished data; Appendix B). At Twin Bridges, flows varied from 54.4 to 62.0 m^3/s (1,920 to 2,190 ft^3/s) at the Lorenzo gage (USGS, unpublished data; Appendix C). A minimum of 70.8 m^3/s (2,500 ft^3/s) is needed at either section for safe boat operation and efficient sampling.

Fish were captured using direct-current (DC) electrofishing gear (Coffelt VVP-15 powered by a Honda 5000 W generator) mounted in an 18-foot Alumaweld sled with a 150 hp outboard jet. We used pulsed DC current through two boom-and-dangler anodes fixed to the bow while driving downstream. The boat hull was the cathode. Similar to previous years, the VVP settings were at 150-200 V, 5-7 A, 20% pulse width, and 60-90 Hz (pulses per second).

We attempted to capture all species and sizes of trout. Hereinafter, “rainbow trout” will refer to rainbow and hybrid trout combined. Fish were anesthetized, identified, and measured to the nearest millimeter for total length (TL). Brown trout less than 150 mm and all other species less than 100 mm (approximately age-0) were not marked, as they are not effectively recruited to the gear. Age-1 and older fish were marked with a caudal fin punch and released. All rainbow trout caught during recapture runs at Twin Bridges were killed. In addition, 44 mountain whitefish at Twin Bridges and 49 mountain whitefish *Prosopium williamsoni* at Menan were sacrificed for a genetics study (A. Whitely, University of Montana, personal communication).

Electrofishing data were entered and analyzed using the computer program Mark Recapture 5.0 (MR5; Montana Department of Fish, Wildlife, and Parks 1994). Other data were entered and analyzed using Microsoft Excel. General statistical analysis was conducted according to Zar (1984).

We assumed capture probabilities did not vary with species, and relative abundance was estimated using proportions of all individual trout captured (excluding recaptures). Although capture probabilities vary with fish length (Schill 1992), population size structures (length-frequency distributions) and average fish lengths were estimated using all sizes of individual fish captured. Quality stock density was estimated using the number of individual fish captured $\geq$406 mm divided by the number $\geq$203 mm, multiplied by 100. Density was estimated using two methods in the MR5 computer program. The log-likelihood method was preferred over the modified Peterson method if modeled efficiency curves were acceptable (termcode = 1 and at least one of two chi-square p-values>0.05).

RESULTS

Conant Electrofishing

A total of 1,205 trout were captured during two days of electrofishing in October 2000. Trout species composition and relative abundance were cutthroat trout (66%), rainbow trout (22%), and brown trout (11%; Figure 2, Appendix D). No lake trout *Salvelinus namaycush* or kokanee salmon *O. nerka kennerlyi* were caught. Less than 1% of the cutthroat trout captured was of hatchery origin.

The cutthroat trout length frequency distribution shows a weak group of age-1 fish (about 100 to 250 mm), although age-2 and older fish (>250 mm) are well represented (Figure 3). In contrast, fairly strong groups of age-1 rainbow and brown trout (about 150 to 300 mm) were observed, but not as strong as in the past (Figures 4 and 5). Ages were approximated from these frequency distributions and will be validated with otoliths in the future.

Mean total length (TL) was 315 mm for cutthroat trout, 307 mm for rainbow trout, 312 mm for brown trout, and 313 mm for all species combined (Appendix E). Quality stock density (QSD) was 2.3% for cutthroat trout, 13.8% for rainbow trout, 12.8% for brown trout, and 6.0% for all species combined. Because recapture runs were not made, sample sizes were about half of previous years, and fish densities were not estimated (Appendix F and G).

Twin Bridges Electrofishing

A total of 1,672 trout were captured during four days of electrofishing in September and October 2000. Trout species composition and relative abundance were cutthroat trout (28%), rainbow trout (1%), and brown trout (71%; Figure 2, Appendix H). No lake trout or kokanee salmon were caught. None of the cutthroat trout captured was of hatchery origin.

The cutthroat trout length frequency distribution shows a weak group of age-1 fish (about 100 to 250 mm), although age-2 and older fish (>250 mm) are well represented (Figure 6). In contrast, a fairly strong group of age-1 brown trout (about 150 to 300 mm) was observed, but not as strong as in the past (Figure 7). Ages were approximated from these frequency distributions and will be validated with otoliths in the future.

Mean total length (TL) was 310 mm for cutthroat trout, 296 mm for rainbow trout, 284 mm for brown trout, and 291 mm for all species combined (Appendix I). Quality stock density (QSD) was 5.8% for cutthroat trout, 0.0% for rainbow trout, 3.1% for brown trout, and 3.9% for all species combined. Sample sizes were similar to previous years.

Electrofishing sampling efficiencies (R/C) were also similar to previous years and ranged from 14% for brown trout to 27% for rainbow trout (Appendix J). Estimated densities of age-1 and older fish were 654 fish/km for cutthroat trout, 1,820 fish/km for brown trout, and 2,503 fish/km for all species combined (Figure 8; Appendix K). Similar to previous years, only 14 rainbow trout were captured and a density estimate was not possible. We killed all rainbow trout caught during recapture runs (11 fish).

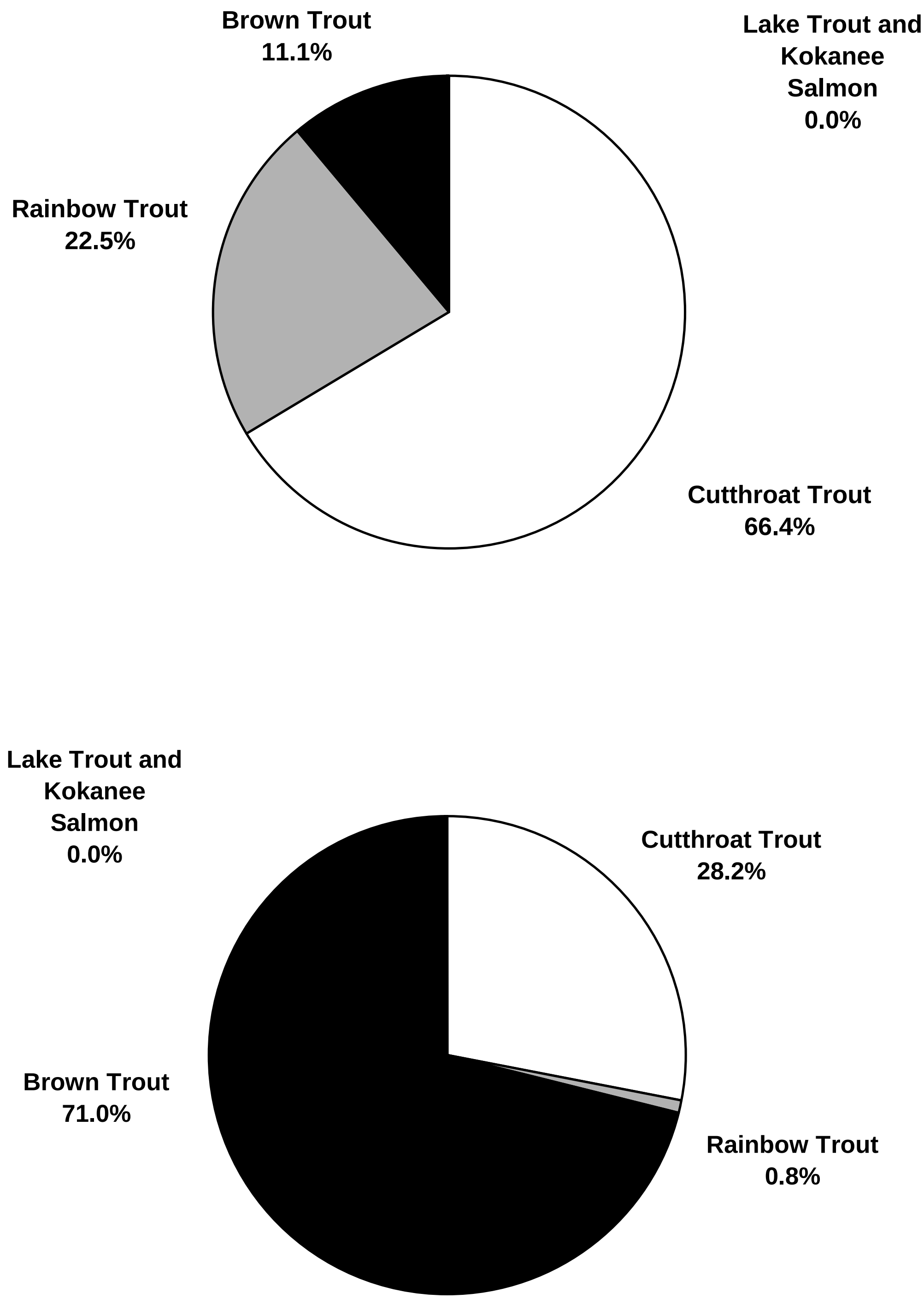

Figure 2. Trout species composition and relative abundance at the Conant (top, n=1,205) and Twin Bridges (bottom, n=1,672) electrofishing sections, South Fork Snake River, 2000. Results are from the MR5 database for all sizes of fish.

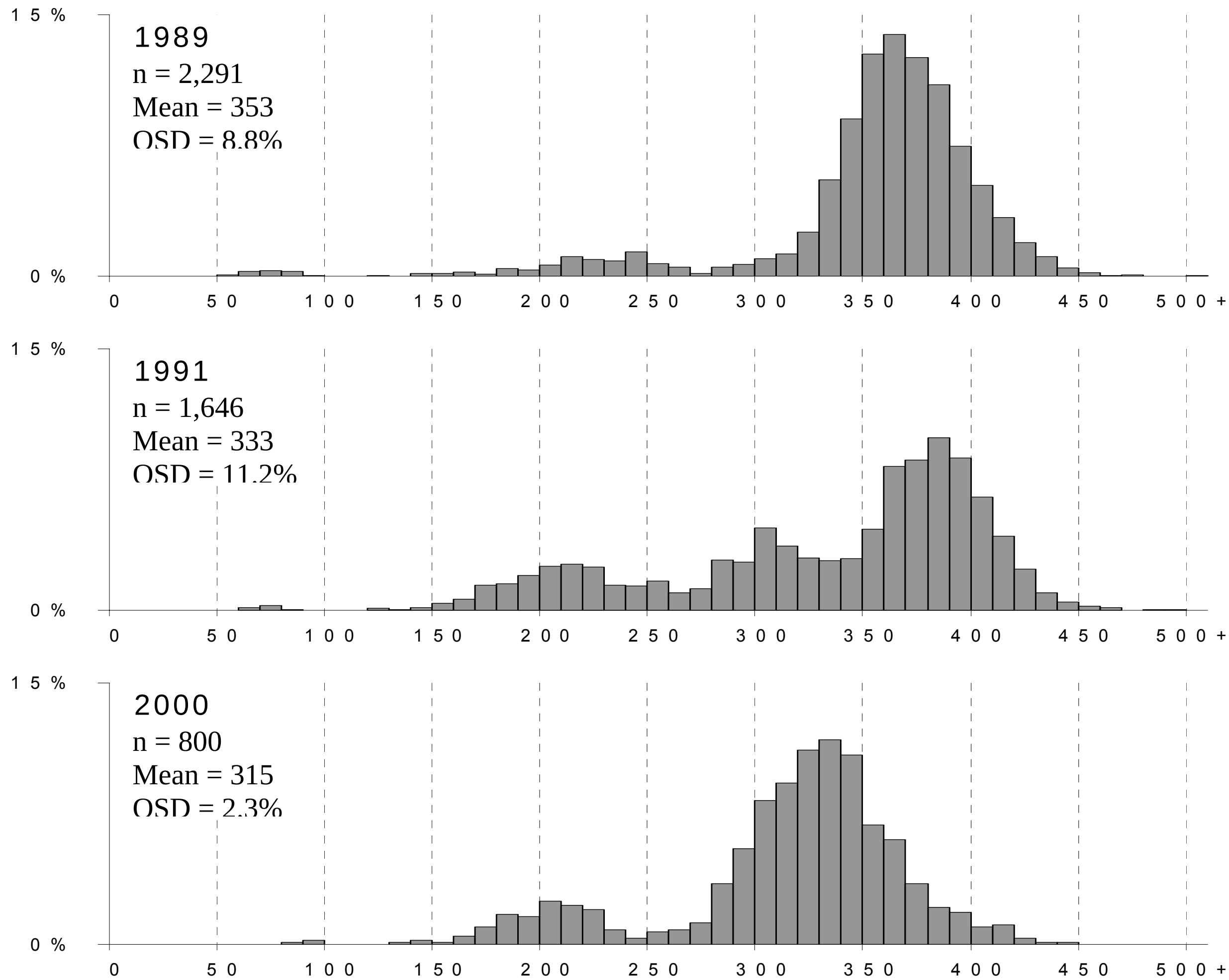

Figure 3. Length-frequency distributions of cutthroat trout captured in the fall at the Conant electrofishing section, South Fork Snake River. Note weak age-1 groups (about 100 to 250 mm) in 1989, 1991, and 2000. Total individual fish captured during mark and recapture runs = n. Results are from MR5 database for all sizes of fish.

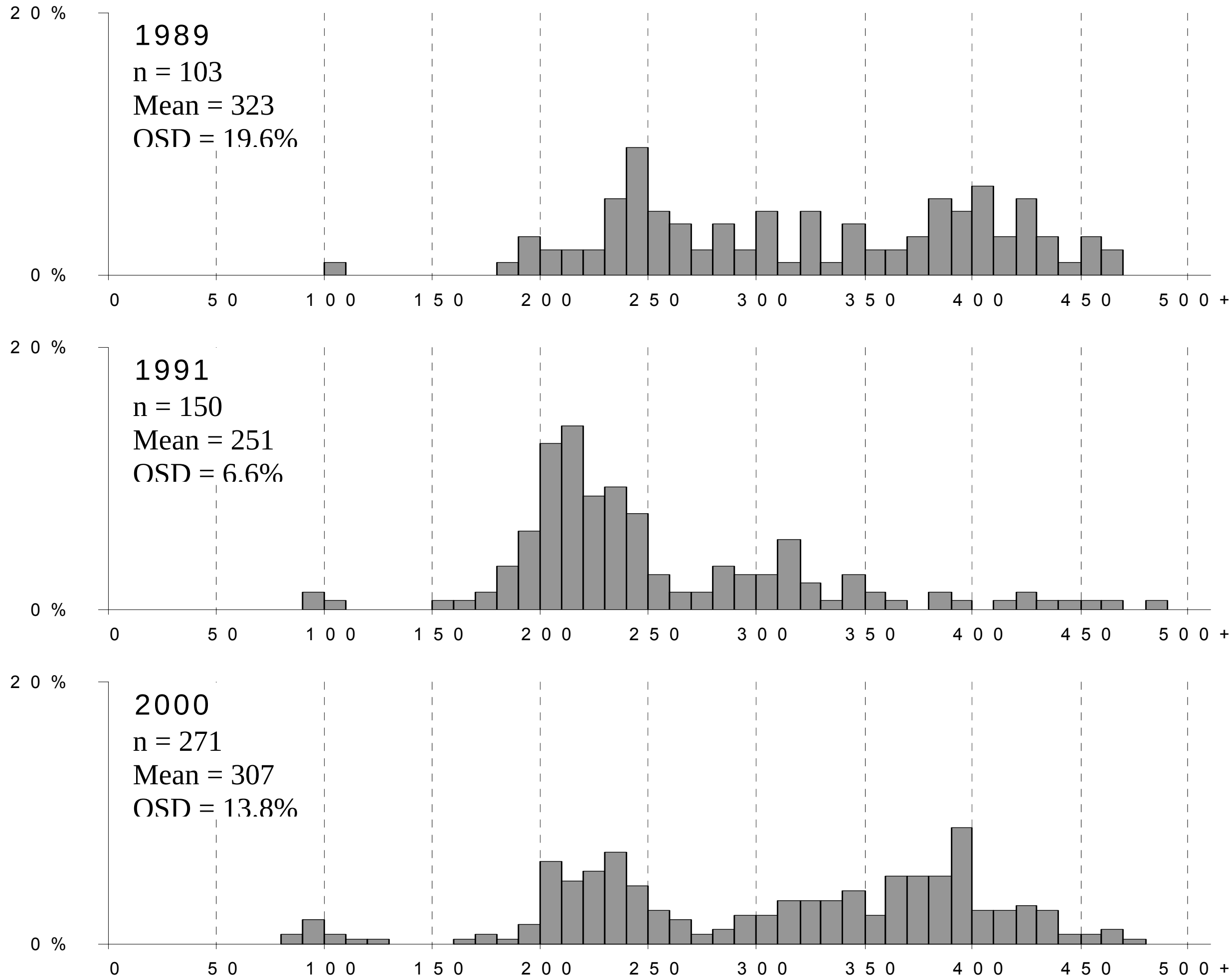

Figure 4. Length-frequency distributions of rainbow trout captured in the fall at the Conant electrofishing section, South Fork Snake River. Note a strong age-1 group (about 150 to 300 mm) in 1991, but less so in 1989 and 2000. Total individual fish captured during mark and recapture runs = n. Results are from MR5 database for all sizes of fish.

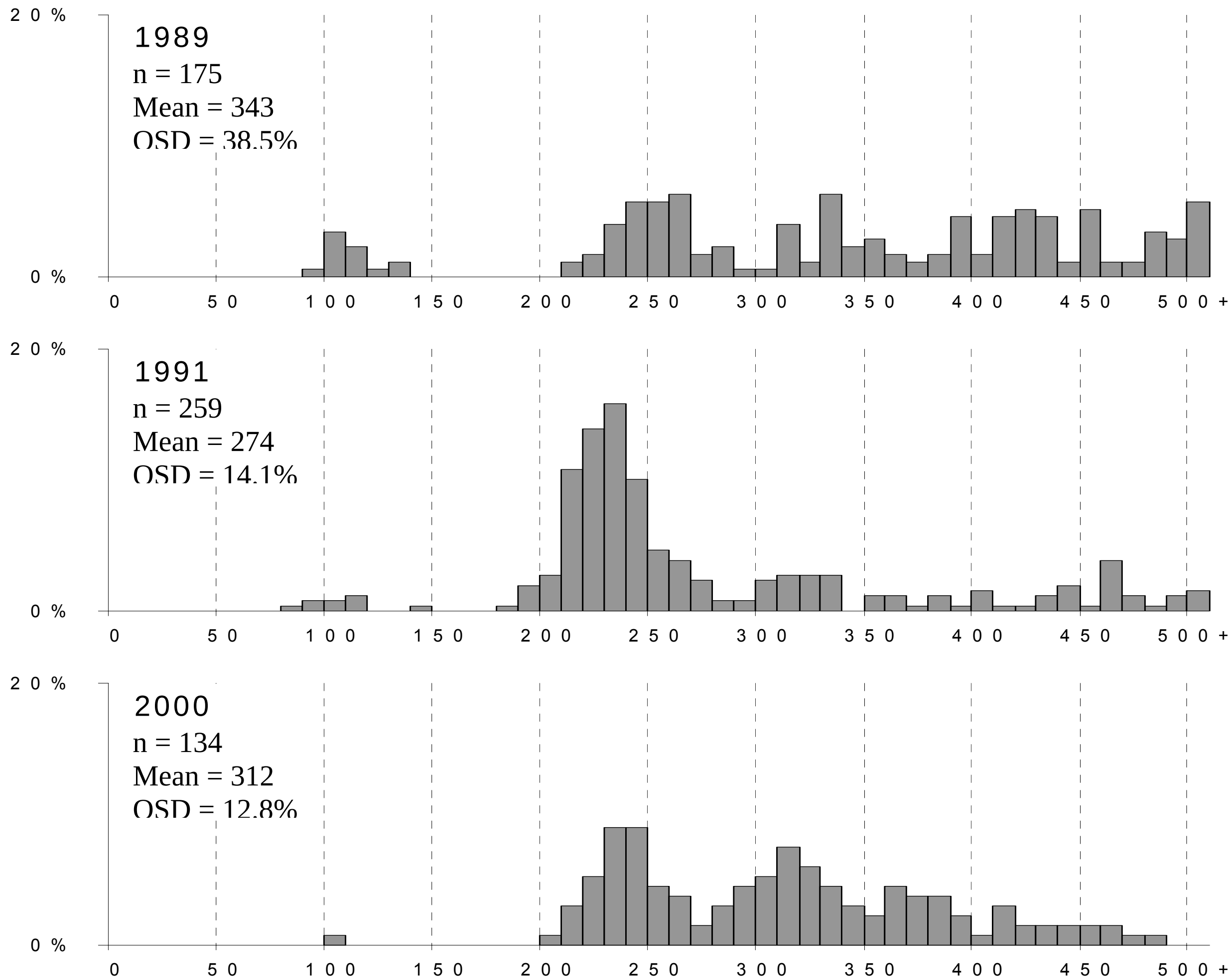

Figure 5. Length-frequency distributions of brown trout captured in the fall at the Conant electrofishing section, South Fork Snake River. Note a strong age-1 group (about 150 to 300 mm) in 1991, but less so in 1989 and 2000. Total individual fish captured during mark and recapture runs = n. Results are from MR5 database for all sizes of fish.

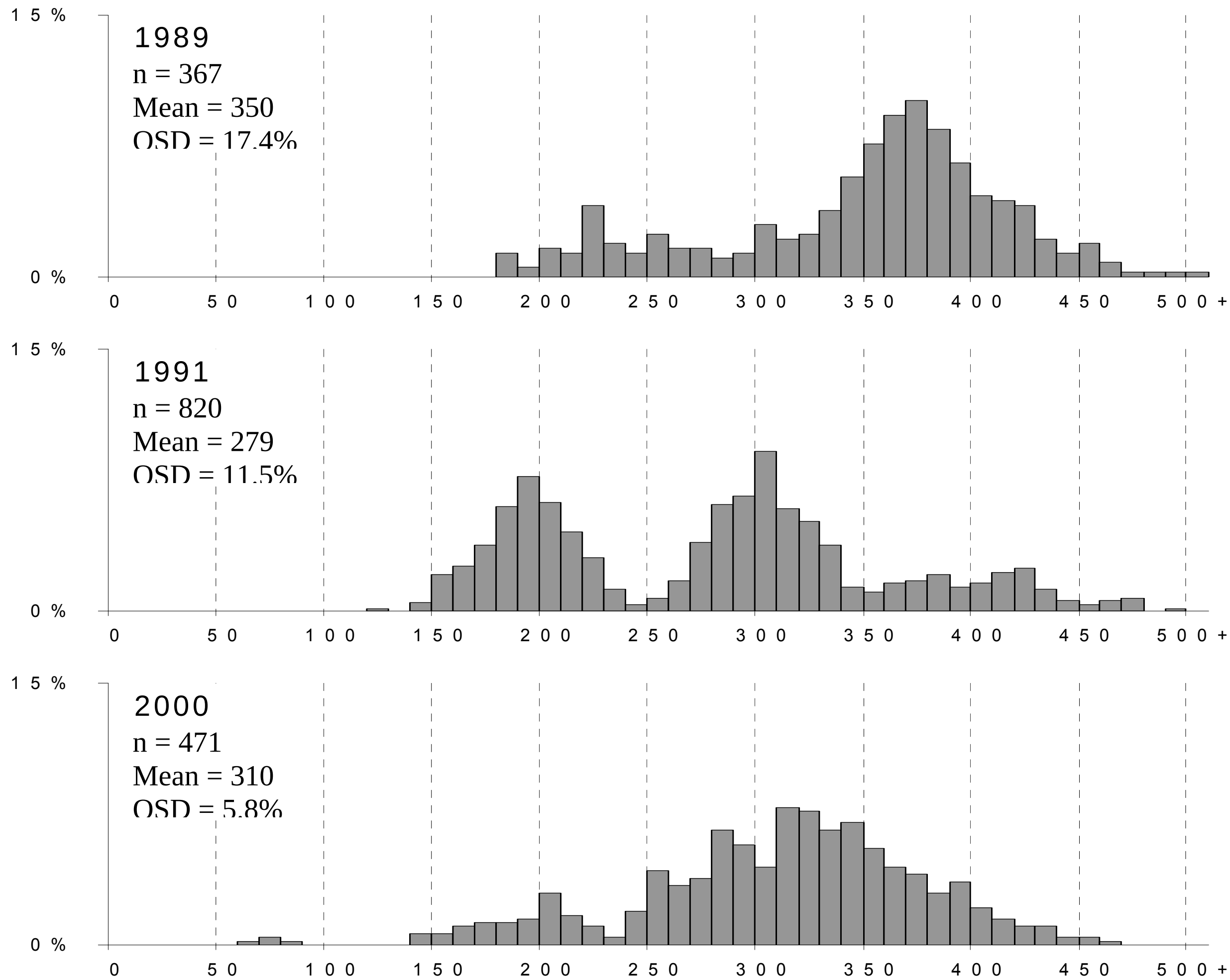

Figure 6. Length-frequency distributions of cutthroat trout captured in the fall at the Twin Bridges electrofishing section, South Fork Snake River. Note a strong age-1 group (about 100 to 250 mm) in 1991, but weak groups in 1989 and 2000. Total individual fish captured during mark and recapture runs = n. Results are from MR5 database for all sizes of fish.

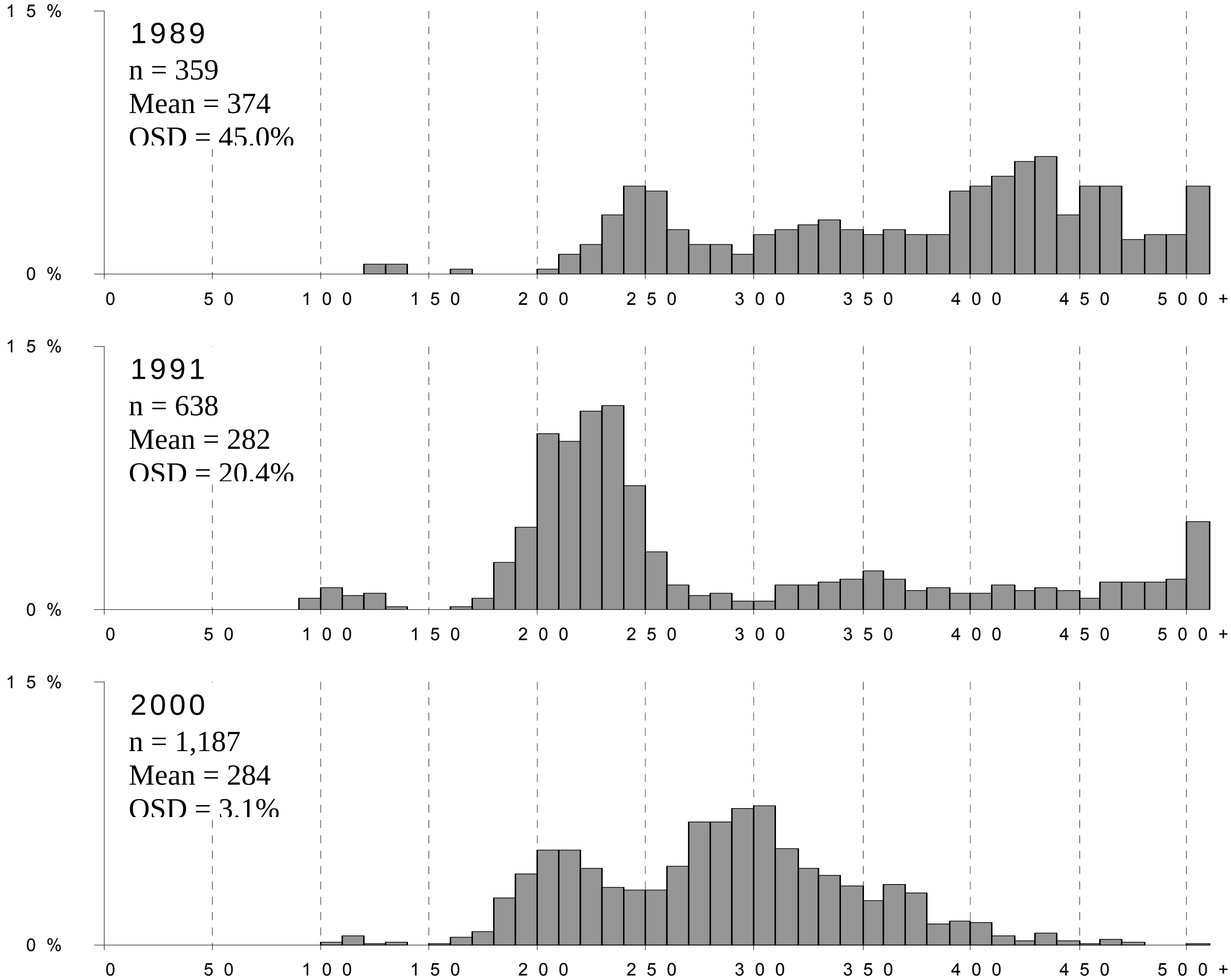

Figure 7. Length-frequency distributions of brown trout captured in the fall at the Twin Bridges electrofishing section, South Fork Snake River. Note a strong age-1 group (about 150 to 300 mm) in 1991, but less so in 1989 and 2000. Total individual fish captured during mark and recapture runs = n. Results are from MR5 database for all sizes of fish.

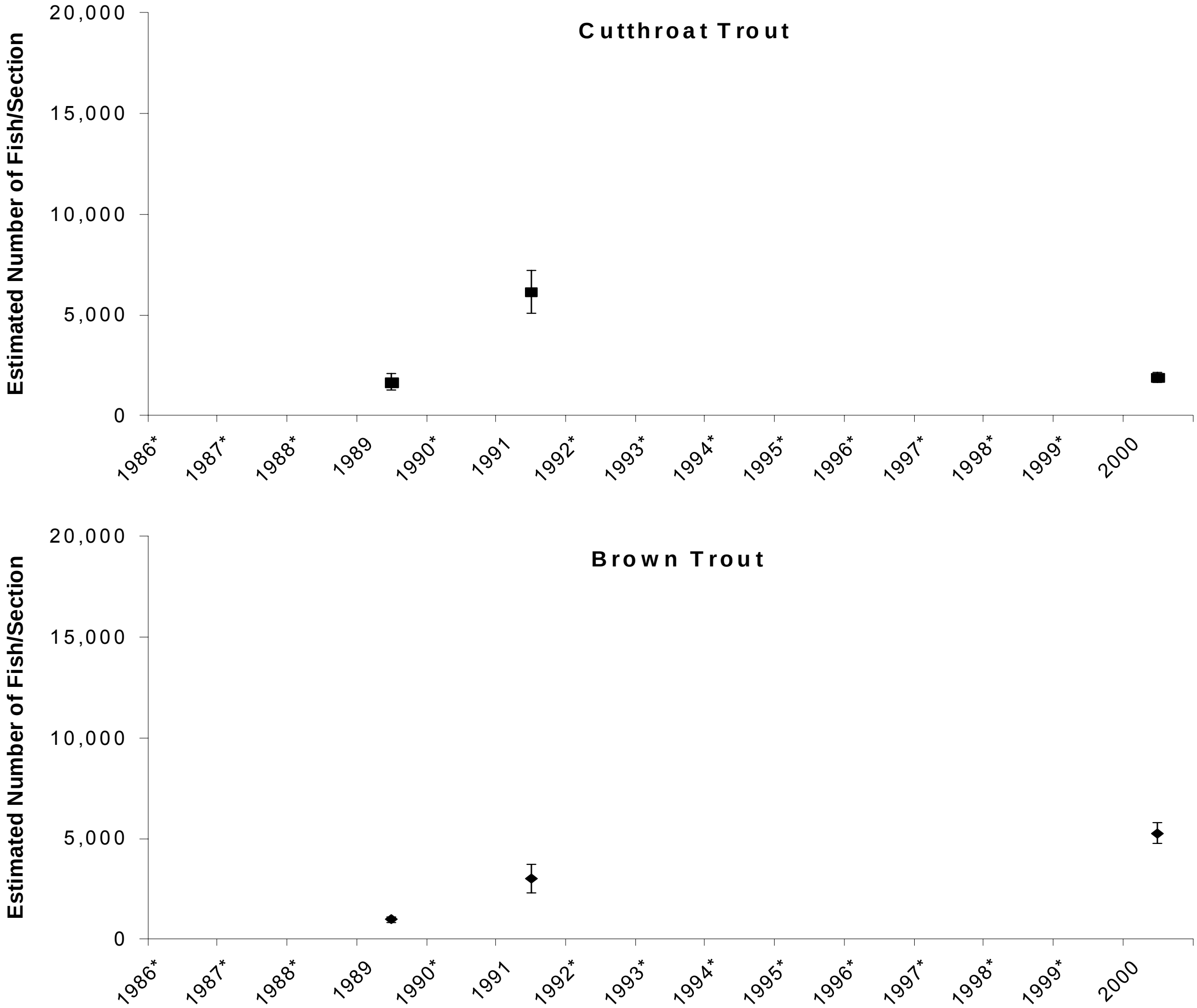

Figure 8. Abundance trends for age-1 and older cutthroat (top, ≥102 mm) and brown trout (bottom, ≥152 mm) at the Twin Bridges electrofishing section, South Fork Snake River, September and October 1989-2000. Confidence intervals are at 95%. Asterisks indicate years when no estimate was made.

DISCUSSION

At Twin Bridges in 2000, cutthroat trout density is similar to 1989 but significantly less than 1991 (Figure 8). Their relative abundance has also declined with increasing brown trout. This may or may not be due to natural population variation. At Conant, cutthroat trout relative abundance has declined from 80-90% to 50-60% – although the 2000 estimate is similar to that observed since the mid-1990s. In contrast, rainbow trout relative abundance has increased steadily (Figure 9). Rainbow trout at Conant (but not Twin Bridges) have increased an order of magnitude since 1989 – the first year an estimate was possible. We conclude that this growing rainbow trout population in the upper river is the major threat to the genetic integrity and long-term viability of cutthroat trout in the South Fork. Hopefully, liberalized rainbow trout harvest regulations implemented in 1999 will reverse these trends.

Cutthroat trout are much less abundant in the lower South Fork (at Twin Bridges) compared to the upper river (at Conant). This difference is probably due to recruitment limitations or irrigation diversion entrainment in the lower river. In contrast, brown trout are most abundant in the lower river and are increasing (Figure 8). Brown trout density estimates at Twin Bridges are highest on record - showing an upward trend similar to rainbow trout at Conant. It is likely that factors affecting cutthroat trout in South Fork have not had the same effect on rainbow and brown trout.

Cutthroat trout quality stock density (QSD) is the lowest on record at both Conant (2.3%; Figure 10) and Twin Bridges (5.8%). In contrast, rainbow and brown trout QSDs have held steady at Conant but declined to record lows at Twin Bridges. The declines are due to fewer large (>400 mm) fish rather than more small fish. It is likely that harvest, rather than recruitment limitations, explains the difference.

Because the 1982, 1986, and 1987 electrofishing efforts were conducted in November rather than in October, and the section was shortened in 1982 and 1987 resulting in smaller sample sizes, comparability of data from these years is somewhat limited. Similarly, the 1997 data may be confounded by significant habitat changes that occurred with near-record runoff of 1,275 m^3/s (45,000 ft^3/s).

RECOMMENDATIONS

1. Continue monitoring South Fork Snake River trout populations by electrofishing.

2. Develop length-weight regressions for each trout species. Predict fish weights from measured lengths and estimate biomass and standing crops for all sections and years. Compare relative weights.

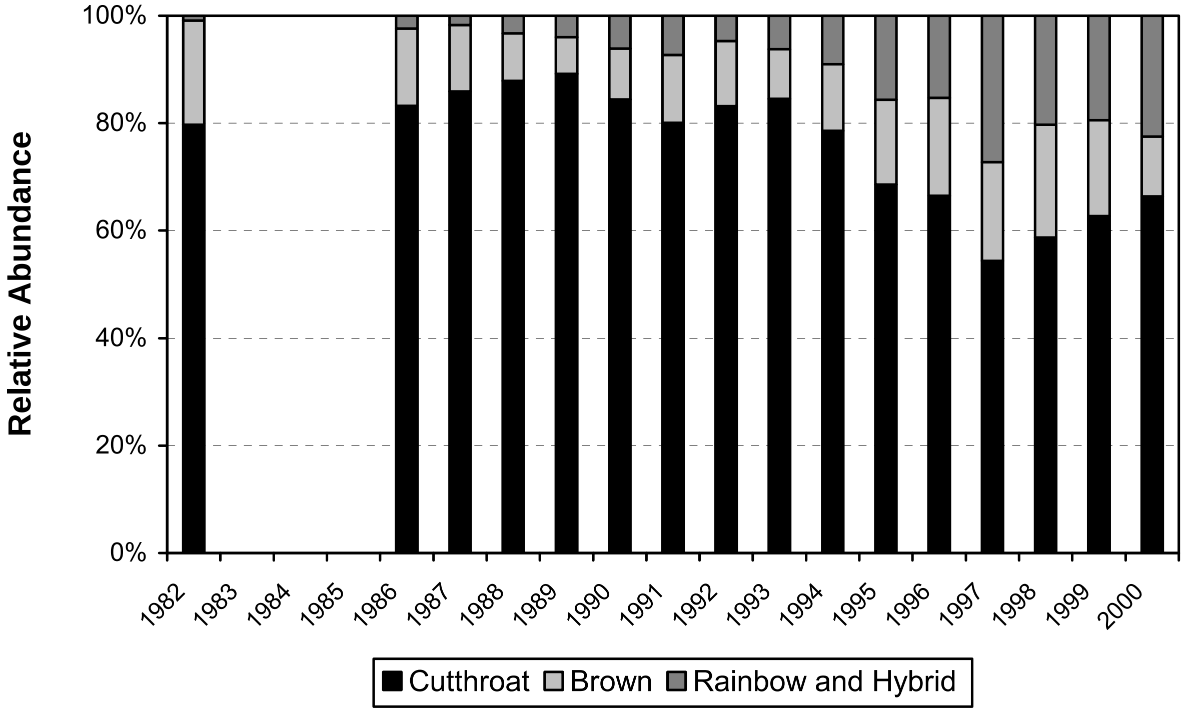

Figure 9. Trout relative abundance trends at the Conant electrofishing section, South Fork Snake River, 1982 to 2000. Results are from MR5 database for all sizes of fish (Appendix C) except for 1982, which is from Moore and Schill (1984).

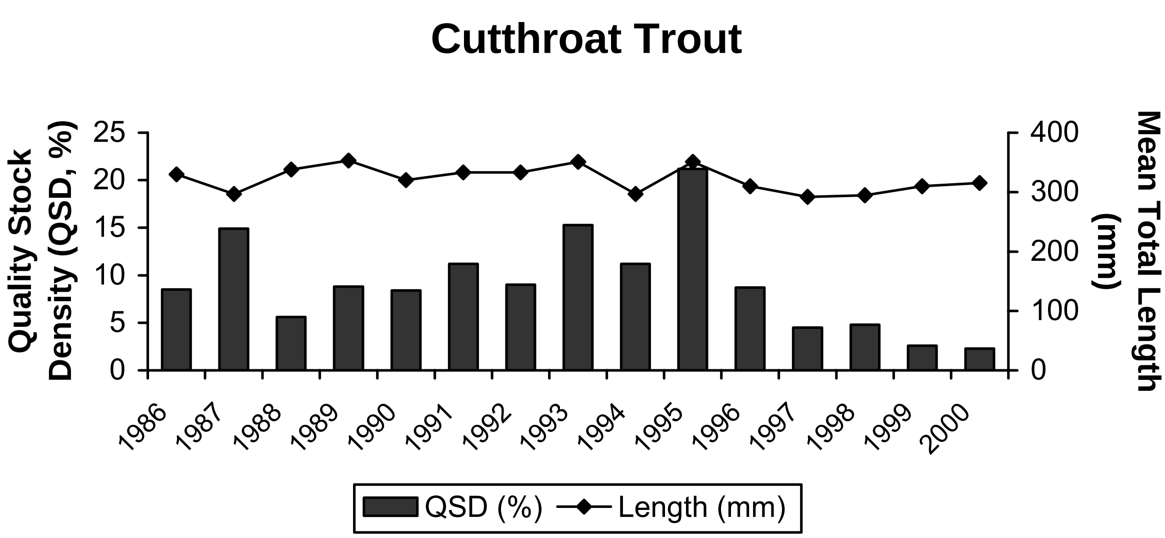

Figure 10. Cutthroat trout quality stock density (QSD) and mean total length trends at the Conant electrofishing section, South Fork Snake River, 1986 to 2000. Results are from MR5 database for all sizes of fish (Appendix D).

ACKNOWLEDGMENTS

Volunteers Bruce Penske (Department), John Hanson (Department), Don Kemner (Department), Ted Chu (Department-retired), Terry Thomas (Department), John O'Neill (Department), Dave Koehler (Department), Curtis Hendricks (Department), Brad Compton (Department), Matt Jaeger (MSU), and Wade Johnson (Department) helped with electrofishing. Paul Faulkner (Department) and Scott Host (Department) helped collect genetics samples. Fishery technician Ross Wehnke (Department) entered the data.

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APPENDICES

Appendix A. South Fork Snake River fishing regulations 1970-2001.

Year	Season	Trout bag & size limit	Special
1970	May 30 - Nov 30	7 lb. + 1 fish, not to exceed 15 fish	Whitefish open 3/1 to 4/30 Irwin to Dam; Mouth to Heise cable open all year
1971	May 29 - Nov 30	Same	Same
1972	May 27 - Nov 30	7 lb. + 1 fish, not to exceed 10 fish	Same
1973	May 26 - Nov 30	Same	All species open 3/1 to 9/30 Irwin to Dam; Mouth to Heise cable open all year
1974	May 25 - Nov 30	10 fish, not more than 2 exceeding 14”	Same
1975	May 24 - Nov 30	Same	Same
1976	May 29 - Nov 30	10 fish, not more than 5 exceeding 12”, and not more than 2 exceeding 18”	Same
1977	May 28 - Nov 30	6 fish, only 2 over 16”	Same, except dam tailrace closed
1978	May 27 - Nov 30	Same	Dam tailrace closed; all species open 5/27 to 9/30 Irwin to Dam; Mouth to Heise cable open 5/27 to 12/31
1979	May 26 - Nov 30	Same	Dam tailrace closed; all species open 4/1 to 9/30 Irwin to Dam; Mouth to Heise cable open all year
1980	May 24 - Nov 30	Same	Same
1981	May 23 - Nov 30	Same	Same
1982	May 29 - Nov 30	Same	Same, except open 9/1 to 11/30 within 100 yards of Burns Creek
1983	May 28 - Nov 30	Same	Same
1984	May 26 - Nov 30	Same, except Heise cable to Irwin only 2 CT, none between 10-16”, barbless hooks	Same
1985	May 25 - Nov 30	Same, except added hybrids	Same
1986-1987	May 24/23-Nov 30	Same	Same
1988-1989	May 28/27-Nov 30	6 fish, only 2 over 16”; except Heise cable to Dam only 2 CT or HYB, none between 10-16”	Mouth to Heise cable open all year; open 9/1 - 11/30 within 100 yards of Burns Creek
1990-1991	May 26/25-Nov 30	6 fish (except only 2 CT or HYB, none between 8-16”, on all rivers and streams)	Mouth to Heise cable open all year
1992-1993	May 23/29-Nov 30	2 fish, none between 8-16”	Same
1994-1995	May 28/27-Nov 30	Same	Same
1996-1997	May 25/24-Nov 30	Same	Same
1998	May 23 - Nov 30	Same	Same
1999	May 29 - Nov 30	6 fish (except only 2 CT, HYB, or BRN, none between 8-16”)	Same
2000-2001	May 27/26-Nov 30	6 fish (except only 2 CT or BRN, none under 16”)	Same

Appendix B. Sampling dates, flows, and catch rates at the Conant electrofishing section, South Fork Snake River, 1986-2000. Flows were recorded at the USGS Irwin gage. Catch rate results are from the MR5 database for all sizes of fish.

Sampling dates	Range of flows (m^3/s)	Range of flows (ft^3/s)	Mean flow (m^3/s)	Catch rate (fish/day)[a]
11/4,5, 6, 7,20 1986	100.2-107.0	3,540-3,780	101.7	413
11/5,6 1987[b,c]	24.6-26.6	869-941	25.6	174
10/3,4,11 1988	102.0-105.0	3,600-3,710	103.4	630
10/18,19,27 1989	84.7-86.7	2,990-3,060	86.1	930
10/11,12,18 1990	98.8-104.5	3,490-3,690	100.8	1,292
10/7,8,15 1991	127.2-135.7	4,490-4,790	131.7	741
10/14 1992[b]	60.3	2,130	60.3	719
10/13,14,21,22 1993	74.2-108.2	2,620-3,820	90.9	481
10/7,11,14 1994[b]	34.5-69.1	1,220-2,440	52.4	368
10/5,6,12,13 1995	72.8-115.8	2,570-4,090	93.2	436
10/3,4,10,11 1996	106.5-107.3	3,760-3,790	106.9	472
10/16,17,23,27 1997[d]	69.7-99.1	2,460-3,500	84.4	851
10/7,8,14,15 1998	91.5-126.6	3,230-4,470	109.6	593
10/13,14,20,21 1999	101.1-118.1	3,570-4,170	109.6	763
10/19,26 2000[b]	87.8-95.2	3,100-3,360	91.5	602

[a] Includes recaptured fish; catch rate = (M+C)/number days sampled.
[b] No recapture runs due to low flows.
[c] Only 3.2 km of larger 4.9 km section was electrofished with drift boat.
[d] Major habitat changes with spring runoff.

Appendix C. Sampling dates, flows, and catch rates at the Twin Bridges electrofishing section, South Fork Snake River, 1989-2000. Flows were recorded at the USGS Lorenzo gage. Catch rate results are from the MR5 database for all sizes of fish.

Sampling dates	Range of flows (m^3/s)	Range of flows (ft^3/s)	Mean flow (m^3/s)	Catch rate (fish/day)[a]
9/26,27; 10/4, 1989	52.4-55.8	1,850-1,970	53.8	264
9/9,10,17,24, 1991	62.6-104.5	2,210-3,690	87.3	388
9/28,29; 10/4,5, 2000 [b]	54.4-62.0	1,920-2,190	56.8	448

[a] Includes recaptured fish; catch rate = (M+C)/number days sampled.
[b] Major habitat changes with spring, 1997, runoff.

Appendix D. Trout species composition and relative abundance (%) at the Conant electrofishing section, South Fork Snake River, 1982-2000. Total individual fish captured during mark and recapture runs are in parentheses. Results are from MR5 database for all sizes of fish.

Year	Cutthroat trout[a]	Rainbow trout	Brown trout	Lake trout	Kokanee salmon	Total
1982[b,c,d]	79 (181)	1 (2)	19 (44)	1 (2)	0 (0)	100 (229)
1986[c]	83 (1,647)	2 (47)	14 (285)	<1 (4)	0 (0)	99 (1,983)
1987[c,e,f]	86 (299)	2 (6)	12 (43)	0 (0)	0 (0)	100 (348)
1988	88 (1,570)	3 (58)	9 (159)	<1 (1)	0 (0)	100 (1,788)
1989	89 (2,291)	4 (103)	7 (175)	0 (0)	0 (0)	100 (2,569)
1990	84 (2,978)	6 (216)	9 (335)	<1 (4)	0 (0)	99 (3,533)
1991	80 (1,646)	7 (150)	13 (259)	0 (0)	0 (0)	100 (2,055)
1992[e]	83 (598)	5 (34)	12 (87)	0 (0)	0 (0)	100 (719)
1993	85 (1,528)	6 (113)	9 (166)	0 (0)	0 (0)	100 (1,807)
1994[e]	79 (867)	9 (100)	12 (136)	0 (0)	<1 (1)	100 (1,104)
1995	69 (1,121)	16 (256)	16 (258)	0 (0)	0 (0)	101 (1,635)
1996	66 (1,190)	15 (274)	18 (325)	<1 (1)	<1 (1)	99 (1,791)
1997[g]	54 (1,676)	27 (840)	18 (567)	<1 (1)	<1 (2)	99 (3,086)
1998	59 (1,312)	20 (454)	21 (469)	<1 (1)	0 (0)	100 (2,236)
1999	63 (1,803)	19 (560)	18 (513)	0 (0)	0 (0)	100 (2,876)
2000[e]	66 (800)	22 (271)	11 (134)	0 (0)	0 (0)	99 (1,205)

[a] Includes hatchery cutthroat trout.
[b] Only 1.9 km of larger 4.9 km section was electrofished.
[c] Electrofishing conducted in early November rather than October.
[d] From Moore and Schill (1984), not MR5 database.
[e] No recapture runs due to low flows.
[f] Only 3.2 km of larger 4.9 km section was electrofished with drift boat.
[g] Major habitat changes with spring runoff.

Appendix E. Mean total length and quality stock density (QSD) of trout captured at the Conant electrofishing section, South Fork Snake River, 1986-2000. Total individual fish captured during mark and recapture runs equals n. QSD = (number $\geq$406 mm/number $\geq$203 mm) x 100. Results are from MR5 database for all sizes of fish.

Year	Cutthroat trout[a]			Rainbow trout			Brown trout			All trout[b]		
	n	Mean (mm)	QSD (%)	n	Mean (mm)	QSD (%)	n	Mean (mm)	QSD (%)	n	Mean (mm)	QSD (%)
1986[c]	1,647	330	8.5	47	307	11.4	285	338	29.0	1,983	330	11.5
1987[c,d,e]	299	297	14.9	6	262	0.0	43	249	11.5	348	292	14.3
1988	1,570	338	5.6	58	328	12.3	159	310	22.8	1,788	335	7.3
1989	2,291	353	8.8	103	323	19.6	175	343	38.5	2,569	351	11.2
1990	2,978	320	8.4	216	269	13.3	335	267	20.4	3,533	310	9.7
1991	1,646	333	11.2	150	251	6.6	259	274	14.1	2,055	320	11.3
1992[d]	598	333	9.0	34	282	2.9	87	264	6.6	719	323	8.4
1993	1,528	351	15.3	113	340	18.2	166	330	34.2	1,807	348	17.2
1994[d]	867	297	11.2	100	251	13.4	136	236	7.4	1,104	287	10.9
1995	1,121	351	21.2	256	277	10.6	258	287	15.8	1,635	328	18.7
1996	1,190	310	8.7	274	262	6.6	325	284	12.7	1,791	297	9.2
1997[f]	1,676	292	4.5	840	262	4.3	567	274	12.5	3,086	279	6.0
1998	1,312	295	4.8	454	318	13.3	469	279	8.4	2,236	297	7.4
1999	1,803	310	2.6	560	312	11.6	513	292	9.1	2,876	307	5.5
2000[d]	800	315	2.3	271	307	13.8	134	312	12.8	1,205	313	6.0

[a] Includes hatchery cutthroat trout.
[b] Includes lake trout and kokanee salmon.
[c] Electrofishing conducted in early November rather than October.
[d] No recapture runs due to low flows.
[e] Only 3.2 km of larger 4.9 km section was electrofished with drift boat.
[f] Major habitat changes with spring runoff.

Appendix F. Electrofishing statistics for the Conant section, South Fork Snake River, 1986-2000. Results are from MR5 database for all sizes of fish.

Year	Cutthroat trout[a]				Rainbow trout				Brown trout				All trout[b]			
	M[c]	C[c]	R[c]	R/C (%)	M	C	R	R/C (%)	M	C	R	R/C (%)	M	C	R	R/C (%)
1986[d]	1,171	546	70	13	32	17	2	12	186	107	8	7	1,393	670	80	12
1987[d,e,f]	299	ND[g]	ND	ND	6	ND	ND	ND	43	ND	ND	ND	348	ND	ND	ND
1988	1,101	567	98	17	41	18	1	6	115	48	4	8	1,257	634	103	16
1989	1,424	1,067	200	19	58	55	10	18	107	79	11	14	1,589	1,201	221	18
1990	1,768	1,527	317	21	118	112	14	12	213	134	12	9	2,102	1,774	343	19
1991	1,159	627	140	22	105	54	9	17	158	120	19	16	1,422	801	168	21
1992[e]	598	ND	ND	ND	34	ND	ND	ND	87	ND	ND	ND	719	ND	ND	ND
1993	998	630	100	16	78	41	6	15	110	66	10	15	1,186	737	116	16
1994[e]	867	ND	ND	ND	100	ND	ND	ND	136	ND	ND	ND	1,104	ND	ND	ND
1995	633	565	77	14	130	143	17	12	154	117	13	11	917	825	107	13
1996	714	548	72	13	165	114	5	4	216	127	18	18	1,097	789	95	12
1997[h]	914	926	164	18	436	476	72	15	352	298	83	28	1,703	1,702	319	19
1998	679	694	61	9	221	259	26	10	276	242	49	20	1,176	1,196	136	11
1999	1,021	899	117	13	347	242	29	12	297	247	31	13	1,665	1,388	177	13
2000[e]	800	ND	ND	ND	271	ND	ND	ND	134	ND	ND	ND	1,205	ND	ND	ND

[a] Includes hatchery cutthroat trout.
[b] Includes lake trout and kokanee salmon.
[c] M=number of fish marked on marking run; C=total number of fish captured on recapture run; R=number of recaptured fish on recapture run.
[d] Electrofishing conducted in early November rather than October.
[e] No recapture runs due to low flows.
[f] Only 3.2 km of larger 4.9 km section was electrofished with drift boat.
[g] ND = no data; no recapture runs.
[h] Major habitat changes with spring runoff.

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Appendix G. Estimated abundance (N) of age-1 and older cutthroat trout (≥102 mm), rainbow trout (≥102 mm), brown trout (≥152 mm), and all trout (≥102 mm) at the Conant electrofishing section, South Fork Snake River, 1986-2000. Results are from MR5 database and analysis using the log-likelihood estimator. Standard deviations are in parentheses.

First marking date	Cutthroat trout[a]		Rainbow trout		Brown trout		All trout[b]	
	N/section	N/km	N/section	N/km	N/section	N/km	N/section	N/km
11/4/86	14,161 (1,005)	2,890	NUE[c]	NUE	3,142 (632)	641	13,935 (608)	2,844
11/5/87	NE[d]	NE	NE	NE	NE	NE	NE	NE
10/3/88	7,306 (370)	1,491	NUE	NUE	1,652 (776)	337	9,005 (434)	1,838
10/18/89	7,860 (269)	1,604	310 (65)	63	936 (405)	191	8,788 (262)	1,793
10/11/90	11,416 (432)	2,330	1,004 (161)	205	1,806 (331)	369	14,633 (435)	2,986
10/7/91	6,854 (340)	1,399	657 (135)	134	954 (129)	195	7,920 (287)	1,616
10/14/92	NE	NE	NE	NE	NE	NE	NE	NE
10/13/93	7,364 (374)	1,503	538 (127)	110	663 (194)	135	8,058 (324)	1,644
10/7/94	NE	NE	NE	NE	NE	NE	NE	NE
10/5/95	6,029 (367)	1,230	1,326 (181)	271	1,442 (440)	294	8,349 (391)	1,704
10/3/96	7,361 (562)	1,502	2,982[e] (1,076)	609[e]	1,538 (196)	314	11,233 (640)	2,292
10/16/97[f]	5,609 (190)	1,145	3,037 (183)	620	1,809 (507)	369	9,659 (234)	1,971
10/7/98	8,286 (510)	1,691	2,257 (196)	461	1,189 (90)	243	10,770 (389)	2,198
10/13/99	9,051 (407)	1,847	3,207 (317)	654	2,508 (423)	512	13,873 (443)	2,831
10/19/00	NE	NE	NE	NE	NE	NE	NE	NE

[a] Includes hatchery cutthroat trout.
[b] Includes lake trout and kokanee salmon.
[c] NUE = no unbiased estimate possible as R ≤ 3 (Ricker 1975).
[d] NE = no estimate; recapture runs not made.
[e] Modified Peterson rather than log-likelihood estimate.
[f] Major habitat changes with spring runoff.

Appendix H. Trout species composition and relative abundance (%) at the Twin Bridges electrofishing section, South Fork Snake River, 1989-2000. Total individual fish captured during mark and recapture runs are in parentheses. Results are from MR5 database for all sizes of fish.

Year	Cutthroat trout	Rainbow trout	Brown trout	Lake trout	Kokanee	Total
1989	50 (367)	<1 (2)	49 (359)	0 (0)	0 (0)	99 (728)
1991	56 (820)	1 (18)	43 (638)	0 (0)	0 (0)	100 (1,476)
2000[a]	28 (471)	1 (14)	71 (1,187)	0 (0)	0 (0)	100 (1,672)

[a] Major habitat changes with spring 1997 runoff.

Appendix I. Mean total length and quality stock density (QSD) of trout captured at the Twin Bridges electrofishing section, South Fork Snake River, 1989-2000. Total individual fish captured during mark and recapture runs equals n. QSD=(number $\geq$406 mm/number $\geq$203 mm) x 100. Results are from MR5 database for all sizes of fish.

Year	Cutthroat trout			Rainbow trout			Brown trout			All trout[a]		
	n	Mean (mm)	QSD (%)	n	Mean (mm)	QSD (%)	n	Mean (mm)	QSD (%)	n	Mean (mm)	QSD (%)
1989	367	350	17.4	2	310	0.0	359	374	45.0	728	361	31.1
1991	820	279	11.5	18	304	20.0	638	282	20.4	1,476	281	15.7
2000[b]	471	310	5.8	14	296	0.0	1,187	284	3.1	1,672	291	3.9

[a] Includes lake trout and kokanee salmon.
[b] Major habitat changes with spring, 1997, runoff.

Appendix J. Electrofishing statistics for the Twin Bridges section, South Fork Snake River, 1989-2000. Results are from MR5 database for all sizes of fish.

Year	Cutthroat trout				Rainbow trout				Brown trout				All trout[a]			
	M[b]	C[b]	R[b]	R/C (%)	M	C	R	R/C (%)	M	C	R	R/C (%)	M	C	R	R/C (%)
1989	250	146	29	20	2	1	1	100	276	117	34	29	528	264	64	24
1991	527	331	38	11	11	8	1	12	329	346	37	11	867	685	76	11
2000[c]	261	246	36	15	6	11	3	27	680	587	80	14	947	844	119	14

[a] Includes lake trout and kokanee salmon.
[b] M=number of fish marked on marking run; C=total number of fish captured on recapture run; R=number of recaptured fish on recapture run.
[c] Major habitat changes with spring, 1997, runoff.

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Appendix K. Estimated abundance (N) of age-1 and older cutthroat trout (≥102 mm), rainbow trout (≥102 mm), brown trout (≥152 mm), and all trout (≥102 mm) at the Twin Bridges electrofishing section, South Fork Snake River, 1989-2000. Results are from MR5 database and analysis using the log-likelihood estimator. Standard deviations are in parentheses.

First marking date	Cutthroat trout		Rainbow trout		Brown trout		All trout[a]	
	N/section	N/km	N/section	N/km	N/section	N/km	N/section	N/km
9/26/89	1,665 (210)	574	NUE[b]	NUE	994 (72)	343	2,476 (134)	854
9/9/91	6,151 (539)	2,121	NUE	NUE	3,013 (356)	1,039	8,566 (413)	2,954
9/28/00[d]	1,896 (130)	654	NUE	NUE	5,279 (277)	1,820	7,260 (292)	2,503

[a] Includes lake trout and kokanee salmon.
[b] NUE = no unbiased estimate possible as R ≤ 3 (Ricker 1975).
[c] Modified Peterson rather than log-likelihood estimate.
[d] Major habitat changes with spring, 1997, runoff.

2000 ANNUAL PERFORMANCE REPORT

State of: Idaho | Program: Fisheries Management F-71-R-25

Project II: Technical Guidance | Subproject II-G: Upper Snake Region

Contract Period: July 1 2000 to June 30 2001

ABSTRACT

Technical guidance was provided to federal, state, county, municipal, and private agencies and entities upon request. Technical guidance was also provided to organized sportsmen's groups, conservation organizations, and private citizens in the form of fish pond development, stocking and management advice, funding requests and project feasibility opinions, and various conservation and educational programs.

Upper Snake Region fisheries management staff provided technical assistance and guidance to the following government agency and private groups:

Bingham County
Henrys Fork Foundation
Island Park Sportsmen Association
Sheridan Creek Restoration Committee
Henry's Fork Watershed Council (HFWC)
Henry's Fork Foundation
Upper Snake River Fly Fishers
Snake River Cutthroats (TU chapter)
U.S. Fish and Wildlife Service
Jackson National Fish Hatchery
U.S. Forest Service
U.S. Bureau of Land Management
City of Rexburg
North Fork Reservoir Company
Palisades Creek Canal Company
South Fork Watershed Advisory Group
Fall River Rural Electric Cooperative
The Nature Conservancy
HFWC Water Quality Subcommittee
Boise Valley Fly Fishers
Region 6 Wildlife Council
Idaho Department of Parks and Recreation
Idaho Department of Water Resources
Idaho Department of Lands
U.S. Bureau of Reclamation
Idaho Water Resource Board
Eagle Rock Bass Masters
City of Idaho Falls
Teton Regional Land Trust
Wyoming Game and Fish Department
Idaho National Environmental and Engineering Lab
Bonneville County
Fremont County
Henrys Lake Foundation
Idaho Division of Environmental Quality
U.S. Natural Resources Conservation Service
One Fly Committee
PacifiCorp
Idaho Fish and Wildlife Foundation
Southwest Flyfishers
Ted Trueblood Chapter Trout Unlimited
HFWC Native Trout Sub-Committee

Staff responded to numerous requests for technical assistance and permit processing by private pond owners. Particular attention was given to private pond permit applications in the South Fork Snake River, Willow Creek, Teton River and Henrys Lake watersheds, where native Yellowstone cutthroat trout *Oncorhynchus clarki bouvieri* management goals might conflict with private requests to stock rainbow trout *O. mykiss* in those watersheds.

Author:

Mark Gamblin
Regional Fisheries Manager

2000 ANNUAL PERFORMANCE REPORT

State of: Idaho Program: Fisheries Management F-71-R-25

Project: III - Habitat Management Subproject: I-G Upper Snake Region

Contract Period: July 1 2000 to June 30 2001

ABSTRACT

The South Fork Snake River tributary weir and diversion screen projects have been under development since 1997. The objectives are to: 1) minimize entrainment of downstream migrating trout into the irrigation diversions; 2) provide adequate upstream fish passage through the diversion/fish weir structure; and 3) serve as a fish trapping facility to manage spawning escapement from the South Fork Snake River to Palisades Creek and minimize rainbow trout *Oncorhynchus mykiss* x cutthroat trout *O. clarki* introgression.

The Palisades Creek irrigation and fish weir trapping facility was completed during 2000. However, the facility was not utilized during the 2000 spawning season. Improvements to the Rainey Creek weir site include floating, inclined plane weir panels and an upstream trash rack, which were installed in October 2000. With this final improvement, the Rainey Creek diversion is now complete and meets the outlined objectives. Construction of the Burns Creek fish trapping facility was started and completed during the fall of 2000. This facility, along with the other two facilities will begin operation in the spring of 2001.

Author:

Mark Gamblin
Regional Fisheries Manager

OBJECTIVES

1. Work with landowners to improve/restore habitat on degraded streams on private property with good potential to enhance wild trout recruitment.

2. Provide upstream and downstream fish passage in key wild trout spawning and recruitment streams.

2000 ACTIVITIES

Henrys Lake

The Henrys Lake tributary riparian fence and fish screen project operated without significant problems in 2000. Several fish screens have been scheduled for maintenance or repair over the next several years.

South Fork Snake River Tributaries

Palisades Creek

The fish screen on the Palisades Canal was operated and maintained in 2000. The Palisades Creek irrigation and fish weir trapping facility was completed during 2000. However, the facility was not utilized during the 2000 spawning season.

Rainey Creek

The Rainey Creek diversion and fish ladder was operated in 2000 to provide fish passage over the diversion structure with the newly completed fish ladder. Improvements to the Rainey Creek weir site include floating, inclined plane weir panels and an upstream trash rack, which were installed in October 2000.

Burns Creek

Construction of the Burns Creek fish trapping facility was started and completed during the fall of 2000. This facility will ensure irrigation water delivery and provide for fish passage and fish trapping capability at that site. This facility, along with the other two facilities will begin operation in the spring of 2001.

<u>Willow Creek Tributaries</u>

Sellars Creek

The Sellars Creek fence was operated to improve and maintain riparian habitat on Sellars Creek.

2000 ANNUAL PERFORMANCE REPORT

State of: Idaho Program: Fisheries Management F-71-R-25

Project: IV – Lake Restoration Subproject: I-G Upper Snake Region

Job: Population Management Title: Lake Restoration

Contract Period: July 1 2000 to June 30 2001

ABSTRACT

The Thurmon Creek drainage fish renovation project was implemented for a second time during October 2000. The 1999 Fintrol application appeared to be ineffective in spring and backwater areas common in the drainage, particularly on Middle Thurmon Creek and Golden Lake. Treatment included a combination of antimycin, liquid rotenone, and rotenone sand. Tributaries were treated with a combination of Fintrol drip stations (15µg/L), rotenone sand, and backpack sprayers with liquid rotenone. The lake perimeter was treated with liquid rotenone (3 mg/L) applied with an airboat. Rotenone sand was also applied to vegetated areas around the perimeter. The main body of the lake was then treated with Fintrol (15 µg/L), again applied by airboat. Mortalities were observed in all tributaries, with only a handful observed in the lake. No attempt was made to quantify mortalities. Throughout the 2000 treatment, there were no observed mortalities in live cage fish held downstream from the permanganate station. A comprehensive assessment will occur in spring 2001, prior to Yellowstone cutthroat trout *Oncorhynchus clarki bouvieri* reintroduction. A completed project report is included in Appendix A.

Authors:

Jeff Dillon
Regional Fisheries Biologist

Mark Gamblin
Regional Fisheries Manager

INTRODUCTION AND METHODS

From late June through early August 2000, the Thurmon Creek drainage was sampled with backpack electrofishing gear to assess the effectiveness of the 1999 chemical renovation of Golden Lake and the Thurmon Creek drainage. This renovation was intended to remove undesirable trout species (rainbow trout *Oncorhynchus mykiss* and brook trout *Salvelinus fontinalis*) prior to reintroduction of Yellowstone cutthroat trout *O. clarki bouvieri*. Data collected during these surveys indicated the initial application of antimycin was unsuccessful, as over 700 brook trout were collected in Middle Thurmon Creek. The majority of these fish would have been young-of-the-year (YOY) during the initial treatment phase in 1999. Additional chemical treatments (antimycin in combination with rotenone) of the Thurmon Creek assemblage were applied during early October 2000. Drip stations were established on all tributaries to the lake (dispensing 15 μg/L Fintrol antimycin), and combined with the use of rotenone sand. Additional antimycin was applied to the lake with an airboat at the rate of 15 μg/L in combination with liquid rotenone applied at 3 mg/L. A detoxification drip station was established directly downstream from the dam, dispensing 4 mg/L of potassium permanganate.

RESULTS AND DISCUSSION

Fish mortalities were observed in all tributaries to Golden Lake, while only a handful of mortalities were observed in the lake. No attempts were made to quantify mortalities, as the 1999 treatment removed the bulk of fish in the Thurmon Creek drainage. Additionally, there were no observed mortalities from fish held in live cages below the detoxification station, or downstream from the 2000 activities. A detailed analysis of this project is presented in Appendix A.

RECOMMENDATIONS

1. Assess effects of the 2000 chemical renovation of Thurmon Creek prior to reintroduction of Yellowstone cutthroat trout.

APPENDIX A

FINAL REPORT

1999 and 2000 Thurmon Creek / Golden Lake Renovation

Jeff Dillon, Regional Fishery Biologist
Mark Gamblin, Regional Fishery Manager

BACKGROUND

In 1997, the Native Trout Subcommittee of the Henrys Fork Watershed Council began work to identify and prioritize waters in the upper Snake River where Yellowstone cutthroat trout *Oncorhynchus clarki bouvieri* populations could be enhanced or reintroduced. The committee identified Thurmon Creek and Golden Lake, within the Harriman State Park and wildlife sanctuary, as a possible site for reintroduction. Non-native rainbow trout *O. mykiss* and brook trout *Salvelinus fontinalis* were the only trout species present in the drainage at that time, and no angling is permitted in the drainage. Because in most cases Yellowstone cutthroat trout do not persist over time with rainbow and brook trout populations, near-complete eradication of the existing fish community was considered necessary prior to reintroducing cutthroat trout.

TREATMENT AREA

The headwaters of Thurmon Creek originate at the base of Thurmon Ridge north and west of Harriman State Park (Figure 1). Three separate spring complexes give rise to West, Middle, and East Thurmon creeks. West and Middle Thurmon creeks flow directly into Golden Lake. A small, unnamed spring complex to the southwest also flows directly into the lake. An irrigation diversion just above the mouth of Middle Thurmon Creek is currently inoperable. East Thurmon Creek is completely diverted into an irrigation canal near the lake. The canal follows the east shore of the lake, and is connected to the lake only by a culvert near the dam. When Golden Lake is full, virtually all of the East Thurmon Creek flow remains in the canal and is used for pasture irrigation and stock watering on Harriman State Park. During spring runoff, water in the canal can reach and flow into the Henrys Fork.

Golden Lake covers approximately 54 acres at full pool, with a maximum depth of less than 10 ft. Volume at full pool is about 180 acre-feet. Dense aquatic vegetation is present throughout the lake. Below Golden Lake, Thurmon Creek flows approximately two miles into Silver Lake, which drains into the Henrys Fork. The entire Golden Lake – Thurmon Creek drainage lies within the Harriman Wildlife Sanctuary and no angling is permitted.

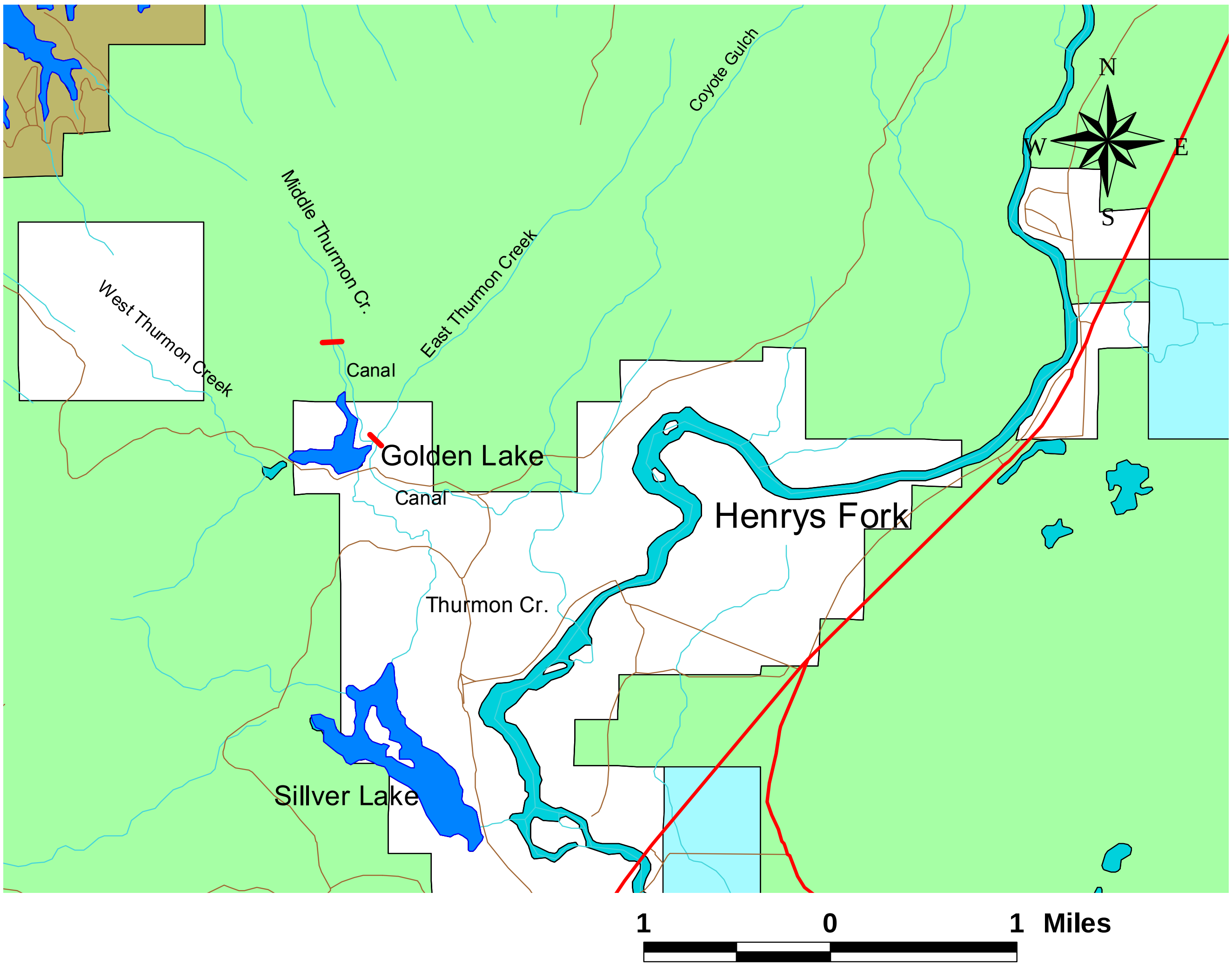

Figure 1 Map of Golden Lake, Thurman creeks and Silver Lake, Idaho.

Although Yellowstone cutthroat trout were the only trout native to the drainage, they have likely been absent for at least 50 years. In addition to rainbow and brook trout, the fish community prior to treatment included what are assumed to be native redside shiner *Richardsonius balteatus,* long nosed dace *Rhinichthys cataractae*, and sculpin *Cottus spp*. Introduced Utah chub *Gila atraria* were present in Golden Lake, but low in abundance. In late summer and early fall, brook trout and sculpin were the predominant species in tributaries, while all species were present in the lake.

Target Fish Species

Rainbow and brook trout were the species specifically targeted for removal. Additional non-target species expected to succumb were longnose dace, redside shiner, Utah chub, and sculpin. No estimate of biomass or number of fish killed was made. Native non-target species will be reintroduced to the treated drainage in addition to Yellowstone cutthroat trout.

Pre-Treatment Preparations

In late summer and fall of 1998, we collected flow and water chemistry data throughout the drainage. We measured flows (cfs) in each spring source and in the mainstem of each tributary. We estimated travel time for water from each spring source to the lake by adding fluoroscene dye and following its progression downstream. We used a digital meter to measure pH in the mainstem of each tributary and the Golden Lake outflow, and measured temperatures at the spring source for each.

To assure an accurate estimate of the elevation-volume relationship for Golden Lake, we contracted calculations out to the engineering firm that had constructed a morphometric map for the lake in 1992. We were provided estimates of volume at one-foot intervals in elevation, and used these data to calculate chemical application rates for the lake treatment.

To prevent non-native fish from re-colonizing the drainage after the treatment, we designed and installed permanent fish barriers on the three outlets on Golden Lake dam, and one barrier in the east Thurmon Creek canal approximately 400 m downstream of the dam. All barriers were self-cleaning grates constructed with ¾-inch steel pipe with ½-inch gaps between pipes.

1999 TREATMENT

Drawdown and Fish Salvage

Three weeks prior to the treatment, Golden Lake was drawn down approximately three feet to kill aquatic vegetation around the periphery. The lake was then filled again and allowed to spill over the spillway for several days to flush vegetation. Immediately prior to the treatment the lake was again drawn down to approximately 30-35 surface acres and 75 acre-feet. This level is below normal spillway height and the only discharge from the dam was through a gated culvert approximately 50 ft east of the spillway.

To minimize risks to non-target fish outside the treatment area, we installed a temporary picket weir approximately one mile below Golden Lake dam, and salvaged fish in Thurmon Creek between the dam and the weir. We used two backpack shockers and a crew of 12 to 15 volunteers. A total of 40 to 50 adult rainbow and brook trout and over 1,000 juvenile trout were hauled to the Henrys Fork and released. Immediately prior to the treatment, Department and volunteer crews used a drift boat electrofisher in Golden Lake to salvage approximately 170 adult rainbow and brook trout and relocate them to the Henrys Fork.

Discharge Detoxification

We constructed a detoxification station below the Golden Lake dam spillway to neutralize any antimycin that flowed out of the lake. Potassium permanganate ($KMnO_4$) was metered into the outlet with an electric hopper. The $KmnO_4$ was put into solution with water and pumped into a perforated pipe suspended above the stream. Target application rate was 2ppm, which equated to 3.5 g/min of $KmnO_4$ per cfs of stream flow. Two backup detoxification stations (30-gal drums filled with concentrated $KmnO_4$ solution) were prepared, one just downstream from the hopper and one at the picket weir site.

Antimycin Treatment and Detoxification

Tributary and lake treatments took place on October 5, with a crew of 22 assisting. All personnel were assigned a specific task for the treatment. Personal safety equipment (chemical gloves, goggles, respirators, Tyvek suits) was provided for any crewmember applying or in the vicinity of antimycin.

To monitor effectiveness of the treatment, small live cages containing 3-5 hatchery rainbow trout were placed at the lower end of each tributary, at two sites in the lake, and in the spillway above the detoxification station. Live cages were retrieved 4-6 hours after the treatment started. Another live cage was placed downstream at the picket weir. These fish were inspected periodically throughout the duration of the treatment.

Before treatments began the gated culvert on the dam was closed, allowing virtually no flow (<1 cfs) past the dam.

Tributary treatments began at 0900 hrs. Target application rate and duration for antimycin in tributaries was 15ppb for 3-4 hrs. We built constant-rate drip stations using standard plastic oil pans and plastic 5-gal buckets. Each bucket was notched with a one-inch hole in the top lip, and three ½-inch diameter holes were drilled approximately one inch below the notch. We drilled one 1/16-inch hole in the bottom edge of the oil pan. The bucket was then filled with 4 gallons of water and the prescribed amount of antimycin solution. The oil pan was placed on top of the bucket, and the whole apparatus inverted and placed on a platform above the stream. This provided a relatively constant flow through the 1/16-inch hole, which lasted approximately 3.0-3.5 hr. Antimycin concentration was adjusted for each tributary site based on stream flow at that site. We used a simple formula to calculate volume of stock antimycin solution (10% concentration) to add to each bucket at each site to achieve a constant 15ppb application.

$$\text{Volume antimycin (ml)} = 15.1 \times \text{flow (cfs)} \times \text{time (hrs)}$$

Preliminary bioassays on East Thurmon Creek indicated that duration of toxicity in the tributaries was approximately 2.5 hrs. Drip stations were spaced along each tributary so that water travel time between stations did not exceed 1.5 hours. Start time of each drip station was staggered so that the antimycin–treated water from each tributary entered the lake at approximately the same time. Total antimycin application for each tributary is provided in Table 1.

Table 1. Characteristics of Golden Lake tributaries, and October 1999 Fintrol treatment protocols for each.

Tributary	Number of primary springs	Total flow (cfs)	pH in mainstem	Number of Fintrol drip stations	Total volume (pints) of Fintrol used
West Thurmon	5	13.5	8.4	7	3.2
Middle Thurmon	3	8.0	8.0	5	2.0
East Thurmon	2	5.0	8.2	6	2.7

In all visible seeps, springs, and backwaters not treatable with drip stations, antimycin was applied using backpack pesticide sprayers filled with concentrated solution (10ppm). Personnel were instructed to spray each seep or spring three times over a period of three hours.

Lake application began at 1200 hrs, the time at which treated tributary water first reached the lake. The target application rate in Golden Lake was 10 ppb antimycin. Because the lake was so shallow after the drawdown, conventional boat operation was impossible. We contracted with an airboat operator to treat the lake with an airboat rigged with boom sprayers. A total of 20 pints of 10% stock solution was diluted with water and applied to the lake surface.

We began operating the detoxification system below the spillway at 1200 hrs. We estimated outflow to be <1cfs, and calibrated the $KMnO_4$ hopper accordingly. Discharge from the dam remained at 1-2 cfs for over 12 hrs, at which time water levels reached the spillway and flow below the dam gradually increased. We continued to monitor flows and adjust $KMnO_4$ application for 48 hrs post-treatment.

Post-treatment Sampling

On October 14, 1999 we set two experimental mesh gill nets in Golden Lake. Nets were each fished for four hours. On November 17-19, Henrys Fork Foundation (HFF) crews made a total of four overnight net-sets. On November 30, HFF crews used backpack electrofishing gear to sample a total of approximately 2.5 stream miles in West, Middle, and East Thurmon creeks. From June 21 to August 9, 2000 we sampled the entire length of each tributary with backpack electrofishing gear.

RESULTS AND DISCUSSION

Antimycin Treatment and Detoxification

Tributary and lake applications proceeded as planned, with few complications. Use of the airboat in the lake did produce high turbidity, particularly in the very shallow west end of the lake. Caps on some of the backpack sprayers leaked and had to be repaired. Consequently, some small seeps and springs did not receive the complete treatment protocol during the prescribed time frame. Most were sprayed at least twice.

Dead and dying fish were observed in the tributaries shortly after treatments began. All live cage fish near the mouths of tributaries were dead when live cages were recovered at approximately 1800 hours. Live cage fish in the lake were also dead. Live fish were observed in the lake up to 48 hours after the treatment, but all appeared to be suffering ill effects from antimycin exposure. Live cage fish below the dam were also ill but alive up to 48 hours post-treatment.

The detoxification station below the spillway was in operation for 48 hours. Prior to the lake refilling and spilling, no dead or dying fish were observed in the stream below the dam. The live cage fish at the weir were dewatered when the dam discharge was stopped during the lake treatment. These fish died, but there were no other dead or dying fish in the vicinity.

Post-treatment Sampling

Fall 1999 gillnetting effort in Golden Lake totaled over 78 net-hours with six sets. No fish were captured. Tributary electrofishing in 1999 yielded no fish in West or East Thurmon creeks. One brook trout (160 mm) was captured and removed from middle Thurmon Creek just above the diversion.

Intensive tributary sampling in summer 2000 indicated few remaining fish in West Thurmon Creek (10 fish captured) and East Thurmon Creek (17 fish captured). In middle Thurmon Creek, however, over 700 brook trout were captured and removed. Almost all were yearlings (80 to 130 mm), indicating that Fintrol application in fall 1999 was not effective in removing age-0 brook trout.

We concluded that the 1999 Fintrol application greatly reduced brook and rainbow trout abundance in Golden Lake and in West and East Thurmon creeks. East and West Thurmon creeks originate in discrete spring complexes, and remain in discrete channels before entering Golden Lake. Few spring and seep areas are found on the lower ends of these tributaries. Fintrol treatment was unsuccessful in Middle Thurmon Creek, particularly for YOY brook trout. The lower ½-mile of Middle Thurmon Creek has extensive springs, seeps, and backwaters adjacent to the stream. Although these areas were treated 2-3 times each with backpack sprayers, we suspect that this Fintrol exposure was insufficient to kill fish. Because it was critical to remove as many potentially competing or hybridizing fish as possible prior to cutthroat reintroduction, it was decided to repeat the treatment, with some modifications, in fall of 2000.

2000 TREATMENT

Because the 1999 Fintrol application appeared to be ineffective in spring and backwater areas common in the drainage, particularly on Middle Thurmon Creek, the 2000 treatment included a combination of Fintrol, liquid rotenone, and powdered rotenone. In September, flow, volume, and water chemistry data were collected to assure there were no significant differences from 1999 data (Tables 2 and 3). We increased the number of Fintrol drip stations on tributary mainstems.

Drawdown and Fish Salvage

Prior to the 2000 treatment, fish were again salvaged below Golden Lake, and a temporary picket weir installed approximately ½-mile downstream. The lake was drawn down, filled, and flushed as in 1999, again leaving 75 acre-feet, or about 40% of full pool volume. No attempt was made to salvage the lake because few fish survived the first treatment. One fish barrier was repaired.

Chemical Application and Detoxification

East Thurmon Creek was treated on October 9, and remaining tributaries and Golden Lake were treated on October 11 (Tables 2 and 3). Both rotenone (liquid and powder) and Fintrol were used in the 2000 treatment. Powdered rotenone was used to formulate rotenone sand, using the directions in the AFS rotenone procedures manual. Tributaries were treated with a combination of Fintrol drip stations (15 ppb), rotenone sand, and backpack sprayers with liquid rotenone. The lake perimeter was treated with liquid rotenone (3 ppm) applied with an airboat. Rotenone sand was also applied to vegetated areas around the perimeter. The main body of the lake was then treated with Fintrol (15 ppb), again applied by airboat.

Table 2. Characteristics of tributaries to Golden Lake, and Fintrol and rotenone application rates used in the October, 2000 treatment.

Location	Treatment date	# of primary springs	Stream length (km)	Dis-charge (cfs)	Temperature (°C)	pH	Travel time headwaters to lake (hr:min)	# of Fintrol drip stations	Total volume Fintrol used (pints)	Total rotenone powder applied (lbs)	Total Nusyn-Noxfish applied (gal)
East Thurmon	10/9/00	2	5.3	6	8-10	8.2	7:00	10	5.3	10	0
Middle Thurmon	10/11/00	3	1.8	8	7-8	8.0	1:25	5	2.9	40	13
West Thurmon	10/11/00	5	2.4	14	9	8.4	1:40	6	4.2	25	7

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Table 3. Characteristics of Golden Lake, and Fintrol and rotenone application rates used in the October 2000 treatment.

Surface area at full pool	54 acres
Volume at full pool	181 ac-ft
Volume at drawdown	75 ac-ft
Temperature (^{o}C)	3-8
pH	10.7
Total volume Fintrol used	22.6 pints
Total volume Nusyn-Noxfish used	20 gal
Total wt rotenone powder used	75 lbs

Live-car fish were distributed in the lake and near the mouth of each tributary to monitor success of the treatment. Additional live-cars were placed between the dam spillway and the detoxification station, and at the picket weir ½-mile downstream.

To alleviate public concerns over impacts to invertebrates, Forest Service personnel collected an array of invertebrates from tributaries just prior to the treatment. These were held in sealed containers until after the treatment, and then released back into tributaries.

The Golden Lake discharge was turned off at the time of chemical application. Less than two cfs of seepage initially exited the lake. This gradually increased over the next 48 hours until the lake filled and began passing inflow (25 cfs). Potassium permanganate (4 ppm) was applied just below the dam to neutralize both rotenone and antimycin entering Thurmon Creek. The live-car between the dam and permanganate drip was periodically restocked with fish to monitor toxicity of the discharge. The permanganate drip was shut down after five days, at which time live-car fish no longer showed signs of rotenone or antimycin exposure.

Treatment Conditions

Lake water temperatures in 2000 varied from 3°C to 8°C during the course of the treatment and detoxification. Tributary temperatures at the springs were consistently 8°C to 9°C. Lake pH was 10.7 and tributary pH ranged from 8.0 to 8.4. Weather on the main treatment day was cold and breezy, with occasional snow flurries.

RESULTS AND DISCUSSION

Mortalities were observed in all tributaries, with only a handful observed in the lake. No attempt was made to quantify mortalities. Throughout the 2000 treatment, there were no observed mortalities in live-car fish held downstream from the permanganate station. A comprehensive assessment will occur in spring 2001 prior to cutthroat trout reintroduction. This will include backpack electrofishing the entire length of each tributary.

Problems Encountered

Due to the complexity of both treatments, most of the problems were logistical and did not affect the outcome of the treatment. With over 20 people used for the main treatments (many of whom were not familiar with the area), a great deal of effort went into detailing assignments and ensuring each individual had appropriate instruction and safety training. During the 2000 treatment there were minor miscommunications with some of the crews detailed to tributary drip stations, which resulted in one station starting about 20 minutes later than planned.

Formulation and use of the rotenone sand was problematic. Ten days prior to the treatment, the sand, rotenone powder, and gelatin were mixed in a small concrete mixer. We added water while mixing until the mixture began to clump. At the time the sand mixture was placed into buckets for storage the texture seemed to match that described in the manual. However, we suspect that too much water was added to the mixture. The mixture apparently fermented within three days, blowing the lids off many of the buckets, and also turned to a thick slurry which was difficult to handle. Consequently, distributing the sand at prescribed rates at the treatment sites was more difficult than expected. For future applications of rotenone sand, we suggest mixing small test batches and adjusting the amount of water. Test batches should be checked after several days, after which the best ratio of ingredients can be selected and used for large-scale production.

Because of the shallow nature of Golden Lake, using an airboat to distribute chemicals to the lake was the only feasible option in this case. However, this is probably not a preferred method, particularly for applying antimycin. Antimycin can cause painful eye irritation, and prop wash from the airboat sometimes misted shore support crews. Although all personnel were provided with protective goggles, and no eye irritation was reported, crews had to be very conscious of eye protection at all times.

Another potential hurdle was the regulatory requirements for aquatic pesticide applications. Two Idaho Department of Agriculture inspectors were on site for the treatment. Although they did not halt the treatment, they did point out several procedural shortcomings. They indicated that having only one or two certified applicators for a treatment of this scale was insufficient. Each applicator (backpack sprayer, mixer, boat operator, drip station attendant) is required to be certified for aquatic pesticide application, or must be under the direct supervision (within eyesight) of a certified applicator. There was also confusion over legal requirements for product labeling, safety, and record keeping (application rates, area, etc.). All of this information was available on-site, but in our case the certified applicators were not the people who actually calculated the application rates. We expect that Department of Agriculture oversight of fish eradication projects will increase, and recommend planning for future projects include meeting with inspectors for review and approval of chemical application and safety protocols.

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