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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, Palisades Reservoir, Ririe Reservoir, Mud Lake, Roberts Gravel Pond, and Henrys Lake
Job c[1].	Upper Snake Region Rivers and Streams Investigations-South Fork Snake River
Job c[2].	Upper Snake Region Rivers and Streams Investigations-Henrys Fork Snake River, Buffalo River
PROJECT II.	TECHNICAL GUIDANCE
PROJECT III.	HABITAT MANAGEMENT
PROJECT IV.	POPULATION MANAGEMENT

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1996 ANNUAL PERFORMANCE REPORT

State of: Idaho

Program: Fisheries Management

Project I: Surveys and Inventories

Subproject I-G: Upper Snake Region

Job: a

Title: Mountain Lakes Investigations

Contract Period: July 1, 1996 to June 30, 1997

ABSTRACT

No mountain lakes were surveyed by Idaho Department of Fish and Game personnel in the Upper Snake Region in 1996.

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1996 ANNUAL PERFORMANCE REPORT

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Title: Lowland Lakes Investigations - Island Park Reservoir, Palisades Reservoir, Ririe Reservoir, Mud Lake, Roberts Gravel Pond, Henrys Lake

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ABSTRACT

Gill net catch composition on Island Park Reservoir was 63% Utah chub *Gila atraria*, 21% Utah sucker *Catostomus ardens*, 10% hatchery rainbow trout *Oncorhynchus mykiss*, 5% wild rainbow trout, and 1% hybrid trout, with the remaining catch comprised of splake *Salvelinus fontinalis x S. namaycush*, Lahontan cutthroat trout *O. clarki henshawi*, and kokanee salmon *O. nerka kennerlyi*. Nongame fish were 84% of the total gill net catch, compared to 11% in 1994 and 38% in 1995. Spot creel checks indicated an average catch of 0.25 fish/h. Hatchery rainbow trout comprised 95% of the harvest. Zooplankton samples indicate that fish populations in Island Park Reservoir were not overexploiting forage resources.

An unstructured creel survey was conducted on Palisades Reservoir from May 11 through October 27. Creel clerks contacted 698 anglers who fished 2,241 hours and caught 490 fish, for an average catch rate of 0.22 fish/h. Harvest composition was 57% wild cutthroat trout, 24% hatchery cutthroat trout, 14% brown trout *Salmo trutta*, and 4% lake trout *Salvelinus namaycush*. The total cutthroat trout harvest was 70.5% wild fish and 29.5% hatchery fish.

An unstructured creel survey was also conducted on Ririe Reservoir from May 25 through October 20. Objectives included evaluating relative return of differentially marked hatchery rainbow trout catchables planted from Mackay and Hagerman hatcheries. Creel clerks contacted 1,010 anglers who fished 3,375 hours, caught 2,525 fish, and harvested 1,320 fish. Total catch rate was 0.75 fish/h. Harvest composition was primarily hatchery rainbow trout (55%), yellow perch *Perca flavescens* (23%), kokanee (9%), and wild rainbow trout (6%). Mackay Hatchery catchables returned to the creel at significantly higher rates than did Hagerman Hatchery catchables.

In a lowland lake survey on Ririe Reservoir, Utah chubs and Utah suckers comprised 88% of the total catch. Game fish in samples were yellow perch (7%), kokanee (5%), smallmouth bass *Micropterus dolomieu* (2%), and trout species (1%).

Catch data for seven bass tournaments on Ririe Reservoir were summarized. Average tournament catch rate for legal smallmouth bass was 0.15 fish/h.

The 1996 spawning operations at Henrys Lake produced 1,584,603 eyed cutthroat trout eggs, 1,252,724 eyed hybrid trout eggs, and 428,050 eyed brook trout *Salvelinus fontinalis* eggs. Cutthroat trout in the Hatchery Creek run averaged 443 mm, hybrid trout averaged 569 mm, and brook trout averaged 313 mm. Catch composition in six net nights of gillnetting at Henrys Lake was 49.1% cutthroat trout, 41.5% hybrid trout, and 9.4% brook trout.

Pathology reports confirmed the presence of *Myxobolus cerebralis*, the causative agent for whirling disease in Henrys Lake cutthroat trout. *Myxobolus* spores were detected in brook trout, but histology was unable to confirm the species.

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METHODS

Island Park Reservoir

Lowland Lake Survey

Island Park Reservoir was renovated in fall 1992 to decrease abundance of nongame fish, primarily Utah chub *Gila atraria* and Utah sucker *Catostomus ardens*. Abundance and size structure of all species has been monitored annually since the treatment. Gill net surveys to monitor relative abundance of game and nongame fish populations were continued in 1996. Four sinking and three floating gill nets were set at standardized sampling locations on July 16 and 17 (total 14 net nights). Set times and pull times for each net were recorded. Captured fish were identified, counted, and measured (total length=mm). Species composition, size structure, and catch rates for all species were summarized and compared to 1992-1995 data.

Spot Creel Checks

From May 25 through August 2 regional enforcement and fishery personnel did incidental creel checks on the reservoir. Information on angler effort, catch rate, and species harvested were recorded.

Limnology

On July 23, research personnel collected basic limnological data from three stations (off the dam, mid-reservoir, and west end). Secchi disk transparency and temperature and dissolved oxygen (DO) profiles were recorded at each site. Zooplankton samples were collected from each site and analyzed for abundance (# per liter) and size structure.

Palisades Reservoir

Spot Creel Checks

From May 11 through October 27, an unstructured access creel survey was conducted. Creel clerks recorded hours fished and catch and harvest data for each party. All harvested cutthroat trout *Oncorhynchus clarki* were examined for adipose fin clips, which indicated they were of hatchery origin. Catch rate, catch composition, and contribution of wild and hatchery cutthroat trout were summarized.

Ririe Reservoir

Spot Creel Checks and Catchable Evaluation

An unstructured roving survey was conducted from May 25 through October 20. The primary objective of the survey was to describe relative return to creel of large hatchery catchable rainbow trout *O. mykiss* from two different Idaho Department of Fish and Game (IDFG) hatcheries. From May through July, Mackay Hatchery planted 15,102 fish and Hagerman hatchery planted 10,246 fish, or a 60:40 stocking ratio. Hagerman fish were given an adipose fin clip and Mackay fish were given a right pelvic fin clip. Creel clerks were instructed to record angler effort and catch, and to examine hatchery rainbow trout for fin clips.

Lowland Lake Survey

On July 31, 1996 a standard lowland lake survey was completed on Ririe Reservoir. The survey consisted of eight gill net nights, four trap net nights, and 1.33 hours (on-time) of electrofishing. Captured fish were identified, enumerated, and measured.

Bass Tournaments

Catch data from four bass tournaments were compiled from a combination of mail-in tournament report forms and Upper Snake Region bass angler scorecards. Catch rates for legal (weighed-in) smallmouth bass *Micropterus dolomieu* were summarized for each tournament.

Henrys Lake

The fishery management biologist stationed at Henrys Lake Hatchery resigned from IDFG in June 1996, and the position was eliminated. Prior to this, the planned management activities for 1996 included continuing the spawn-taking and run monitoring, eliminating the creel survey for one year, and placing more emphasis on extensive population sampling in the lake. Due to the loss of the biologist position, only limited population survey data were collected. Ashton Hatchery personnel assumed responsibility for cutthroat, hybrid, and brook trout *Salvelinus fontinalis* spawning operations, fence and screen maintenance, and future creel census work.

Spawning Operation

The Hatchery Creek fish ladder was opened on March 2 and remained in operation until April 9. Fish ascending the ladder were identified as cutthroat or hybrid trout and enumerated. A subsample of 10% of each group was measured. Hybrid trout were produced with cutthroat trout eggs and Kamloops rainbow trout sperm obtained from Ennis Hatchery, Montana. Cutthroat trout

males and females were spawned to produce cutthroat trout for supplemental stocking in Henrys Lake and other Idaho fisheries.

On October 3, Ashton Hatchery personnel began a morpholine drip in the Henrys Lake Hatchery spawning facility. From October 8 through November 13 the fish ladder was opened to collect spawning brook trout. Fish entering the trap were sexed, enumerated, and measured. Spawning methods differed from previous years. Gametes were taken and pooled into groups of five at the spawn house. Oxygen was added to bags containing pooled sperm, and both egg and sperm bags were transported in coolers to Ashton Hatchery. At Ashton, ovarian fluid samples were taken, and the eggs were fertilized, disinfected, enumerated and placed into Heath stacks for incubation.

Disease samples were taken from both spawning runs. Ovarian fluids were collected from cutthroat trout during spawning at Henrys Lake Hatchery. A mixed-sex group of 60 adult cutthroat trout were also sacrificed for disease testing. All samples were sent to the Eagle Fish Health Laboratory. Brook trout ovarian fluid samples were obtained at Ashton Hatchery prior to egg fertilization, and 50 adult male brook trout were sacrificed from the spawning ladder.

Gillnetting

On June 5-7, gill net samples were collected from six standardized sampling locations (total six net nights). Nets were set at dusk and retrieved the following morning. Captured fish were identified to species, measured, and weighed.

Water Quality

Late winter (January-February 1997) dissolved oxygen concentrations were assessed at established sampling sites.

RESULTS AND DISCUSSION

Island Park Reservoir

Lowland Lake Survey

A total of 602 fish were captured in gill net sets (Figure 1, Appendix A). Catch composition was 63% Utah chub, 21% Utah sucker, 10% hatchery rainbow trout, 5% wild rainbow trout, and 1% rainbow x cutthroat trout hybrids. Splake *Salvelinus fontinalis x S. namaycush*, Lahontan cutthroat trout *Oncorhynchus clarki henshawi*, and kokanee salmon *O. nerka kennerlyi* each represented less than 1% of the catch. Nongame fish comprised 83% of the 1996 catch, an increase from 11% in 1994 and 38% in 1995.

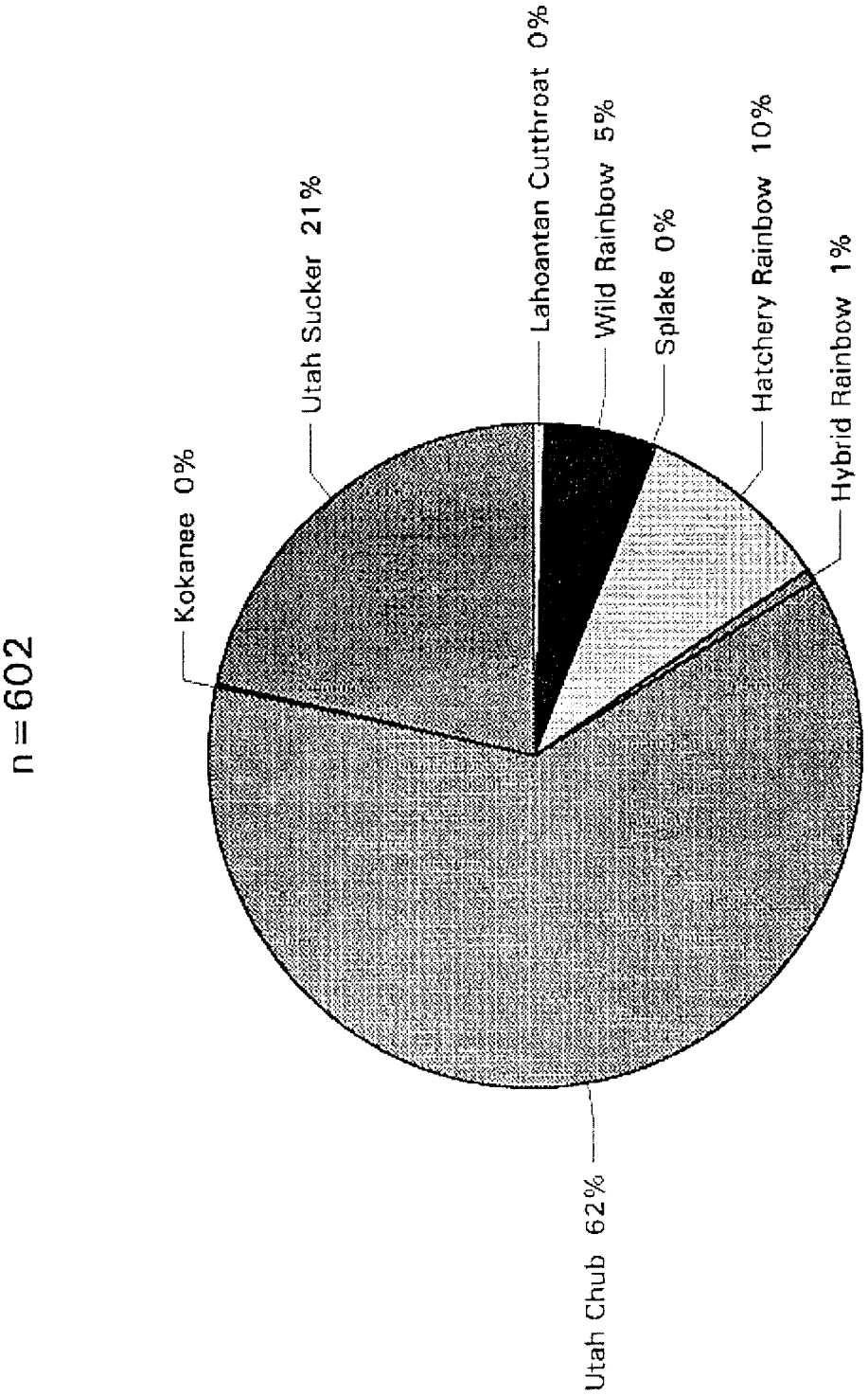


Figure 1. Catch composition for 1996 Island Park Reservoir gill net samples.

Spot Creel Checks

From May 25 through August 2, creel clerks contacted 174 anglers on Island Park Reservoir. These anglers fished a total of 400 hours and harvested 102 fish for an average catch rate of 0.25 fish/h. Harvest composition was 95% hatchery rainbow trout, with the remaining catch comprised of wild rainbow trout, hybrid trout, kokanee, and cutthroat trout.

Limnology

Temperature and oxygen profiles for July 23, 1996 are presented in Appendix B. Epilimnial temperatures exceeded tolerances for most salmonids, but metalimnion temperatures and dissolved oxygen were adequate to provide useable trout habitat. Zooplankton abundance and size structure are presented in Appendix C. Over 20% of the *Cladoceran* zooplankton sampled with standard (140 micron) nets were $\geq$1.5 mm. Despite the increasing nongame fish populations, the abundance of large *cladoceran* suggests no significant cropping by the current fish population.

Palisades Reservoir

Spot Creel Checks

From May 11 through October 27, creel clerks contacted 698 individual anglers in 295 interviews. They fished a total of 2,241 hours and caught 490 fish, for an average catch rate of 0.22 fish/h. Effort was comprised of 73% lure, 26% bait, and 1% fly fishing. Catch composition was 57% wild cutthroat trout, 24% hatchery cutthroat trout, 14% brown trout *Salmo trutta*, and 4% lake trout *Salvelinus namaycush*, plus <1% each of rainbow trout and kokanee. Of the cutthroat trout observed in the creel (n=352), 70.5% were wild fish and 29.5% were hatchery-released fish.

Ririe Reservoir

Spot Creel Checks and Catchable Evaluation

From May 25 through October 20, creel clerks contacted 1,010 individual anglers in 435 interviews. They fished a total of 3,375 hours, caught 2,525 fish, and harvested 1,320. Mean catch rate was 0.75 fish/h and harvest rate was 0.39 fish/h. Effort was comprised of 58% bait, 42% lure, and less than 1% fly fishing. Harvest composition was 54.7% hatchery rainbow trout, 22.7% yellow perch *Perca flavescens*, 8.8% kokanee, and 6.4% wild rainbow trout. Other checked fish included smallmouth bass (n=11), splake (n=10), lake trout (n=9), and brown trout (n=2).

Of the 535 marked rainbow trout observed in the creel, 169 (31.6%) were from the Hagerman Hatchery plant and 366 (68.4%) were from the Mackay Hatchery plant. Mackay Hatchery fish returned to the creel at a significantly (Chi-square; $p<0.05$) higher proportion than the 60:40 stocking ratio, indicating better post-stocking survival in the reservoir.

Lowland Lake Survey

Combined catch composition for all gear types is provided in Figure 2 and Appendix D. Utah chub and Utah sucker comprised 55 and 23% of the catch by number, respectively. Game fish sampled included yellow perch (7%), kokanee (5%), smallmouth bass (2%) and trout species (1%).

Bass Tournaments

Bass angler scorecards and tournament report forms were summarized for seven tournaments from June 9 through September 28, 1996 (Table 1). Average tournament catch rate for legal (weighed-in) fish ranged from 0.10 to 0.32 fish/h and averaged 0.15 fish/h. Virtually all legal fish caught were brought to weigh-in sites.

Henrys Lake

Spawning Operation

A total of 5,678 cutthroat trout, including 3,515 males (Figure 3) and 2,163 females (Figure 4) ascended the spawning ladder between March 2 and April 9. Hybrid trout totaled 1,665 fish, 978 males (Figure 5) and 687 females (Figure 6). Mean length for male and female cutthroat trout was 439 and 447 mm, respectively (Figure 7). Combined average cutthroat trout length was 443 mm. Hybrid trout males and females averaged 574 and 565 mm, respectively (Figure 8). Combined average hybrid trout length was 569 mm.

Cutthroat trout green eggs totaled 2,211,921 from 976 females for an average fecundity of 2,266 eggs per female. Eyed cutthroat trout eggs totaled 1,584,603 for an overall eye-up rate of 71.6%.

Hybrid trout green eggs totaled 1,945,047 from 762 females for an average fecundity of 2,552 eggs per female. Eyed hybrid trout eggs totaled 1,252,724 for an overall eye-up rate of 64.4%.

From October 8 through November 13 a total of 1,342 brook trout, including 836 males (Figure 9) and 547 females (Figure 10), ascended the fish ladder. Male and female brook trout averaged 319 and 306 mm for a combined average of 313 mm.

Brook trout green eggs totaled 533,435 from 384 females for an average fecundity of 1,389 eggs per female. Eyed eggs totaled 428,050 for an overall eye-up rate of 80%.

Cutthroat trout ovarian fluid disease samples showed no viral pathogens, and a low level of potential bacterial pathogens. In the adult cutthroat trout samples, microsporidian spores were detected by the digestion method in four of twelve pooled samples. Histology confirmed the spores were in the cartilage, indicating they were *Myxobolus cerebralis*, the causative agent of whirling disease.

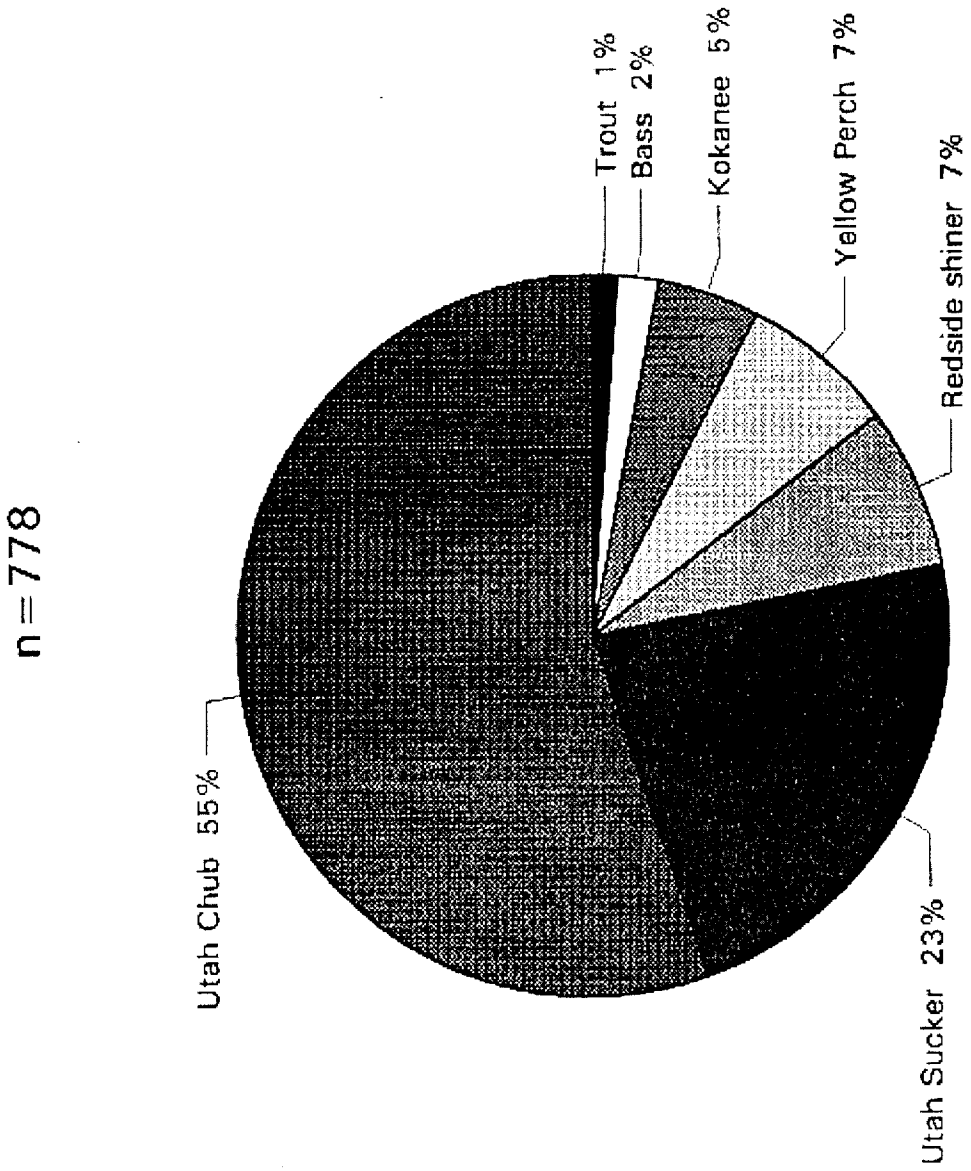


Figure 2. Catch composition for 1996 Ririe Reservoir lowland lake survey.

Table 1. Summary of 1996 bass tournament effort and catch for Ririe Reservoir.

Tournament dates	Number of anglers	Total hours fished	Number of legal fish weighed in	Catch rate for legal fish (fish/h)
6/9	19	210	20	.12
6/30	19	172	30	.17
7/20-21	28	392	48	.12
8/4	11	110	12	.11
8/24	10	99	32	.32
9/8	7	51	7	.14
9/28	7	59	18	.31
TOTALS	101	1,093	167	.15

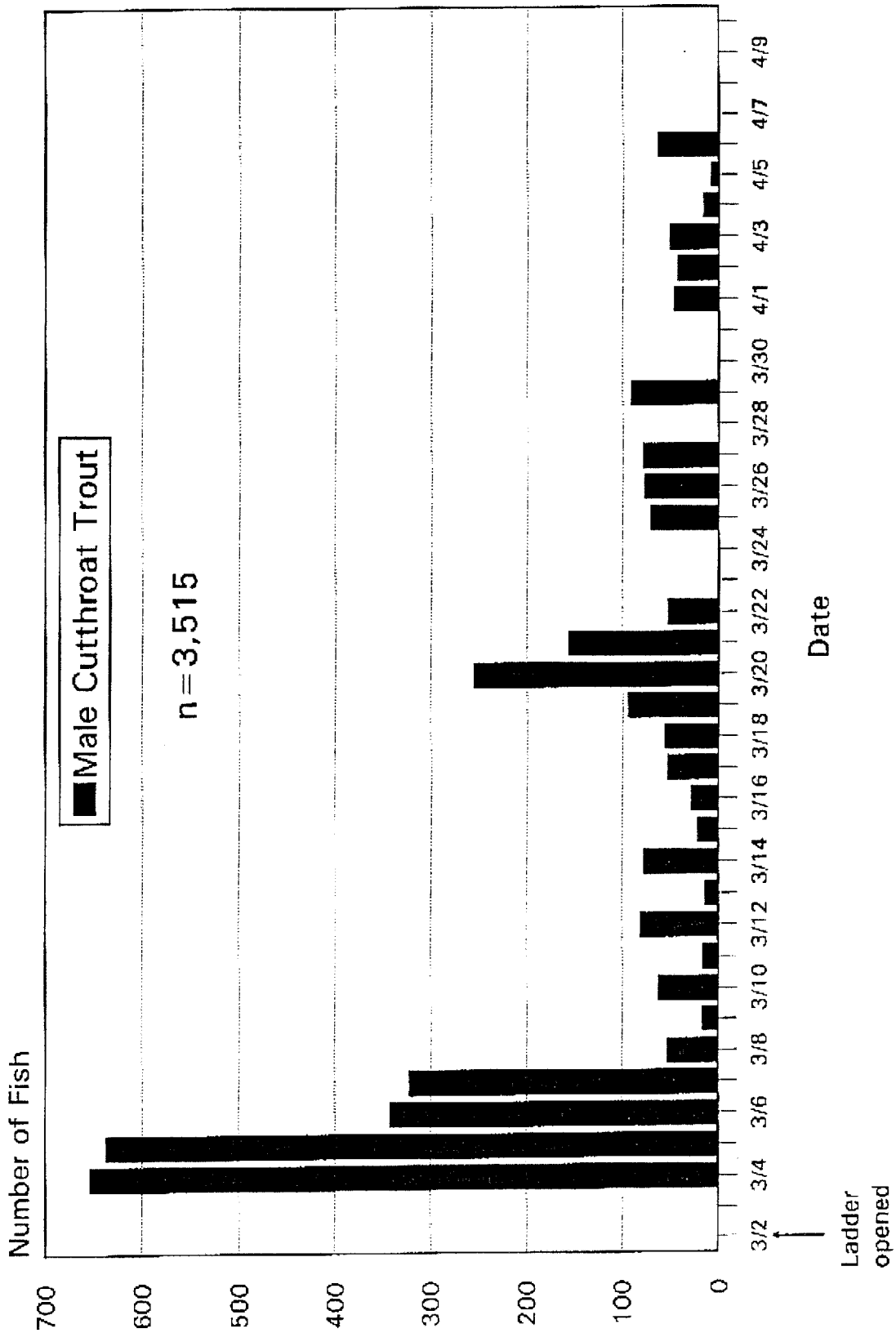


Figure 3. Run timing for male cutthroat trout at Henrys Lake Hatchery, 1996.

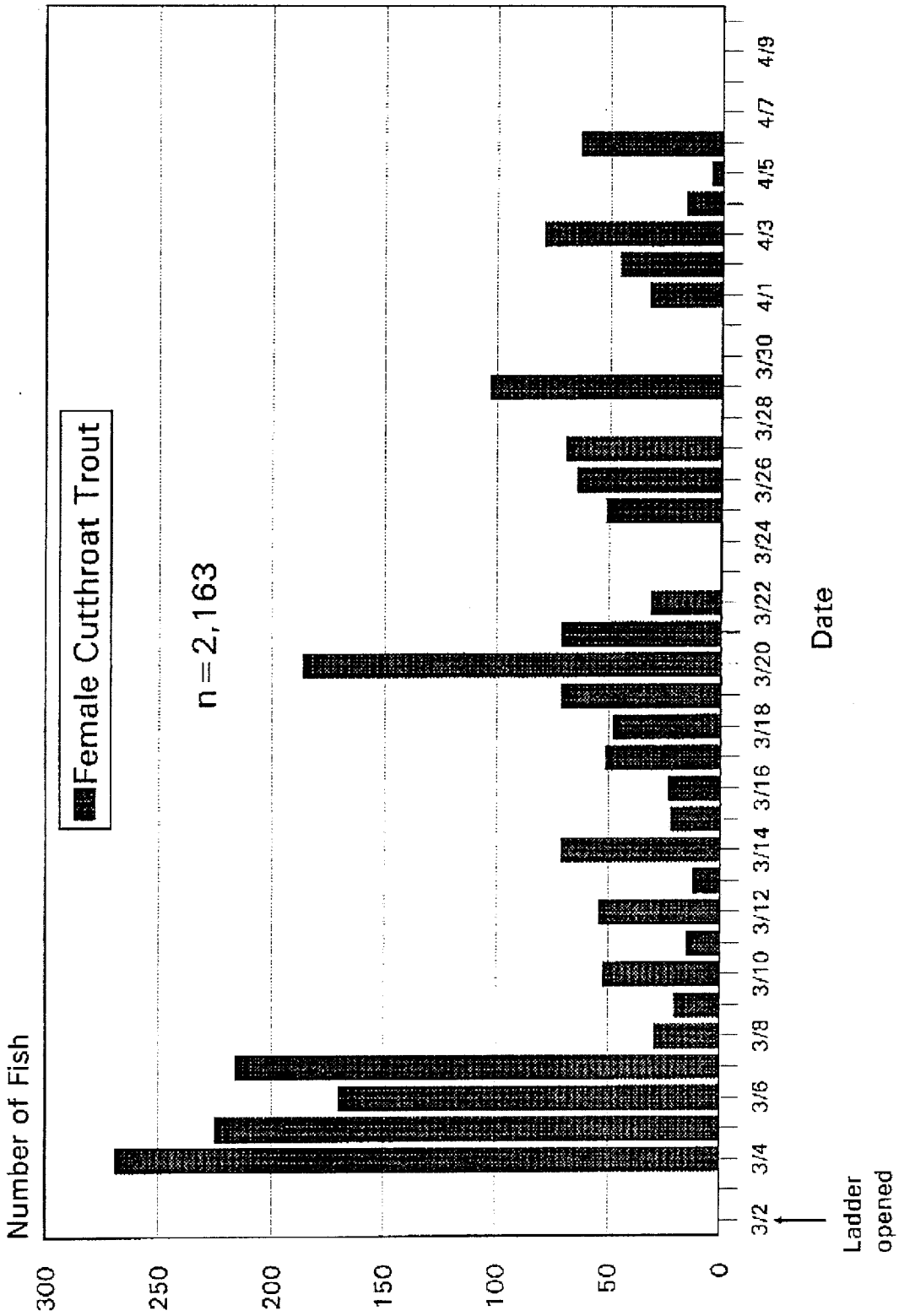


Figure 4. Run timing for female cutthroat trout at Henrys Lake Hatchery, 1996.

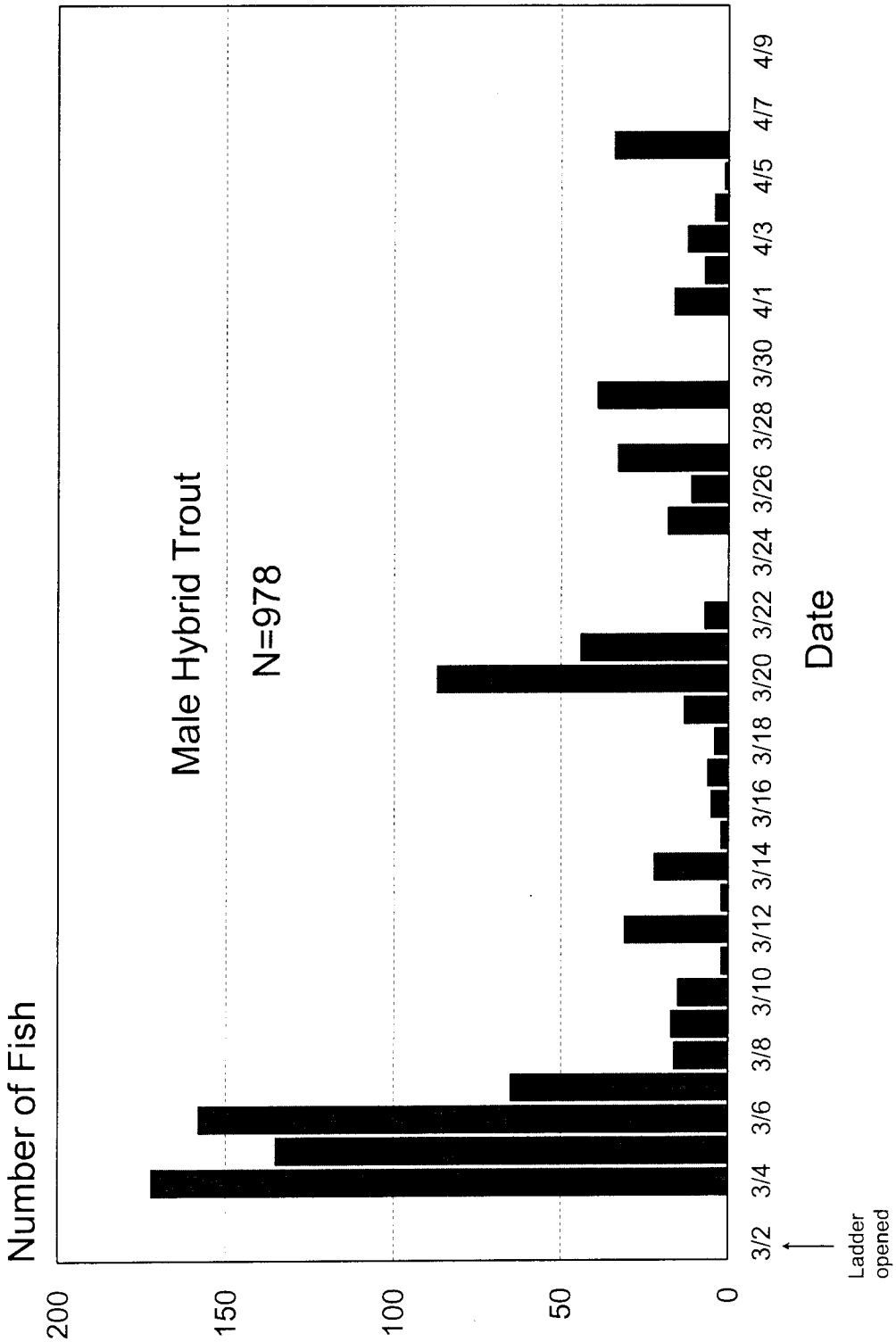


Figure 5. Run timing for male hybrid trout at Henrys Lake Hatchery, 1996.

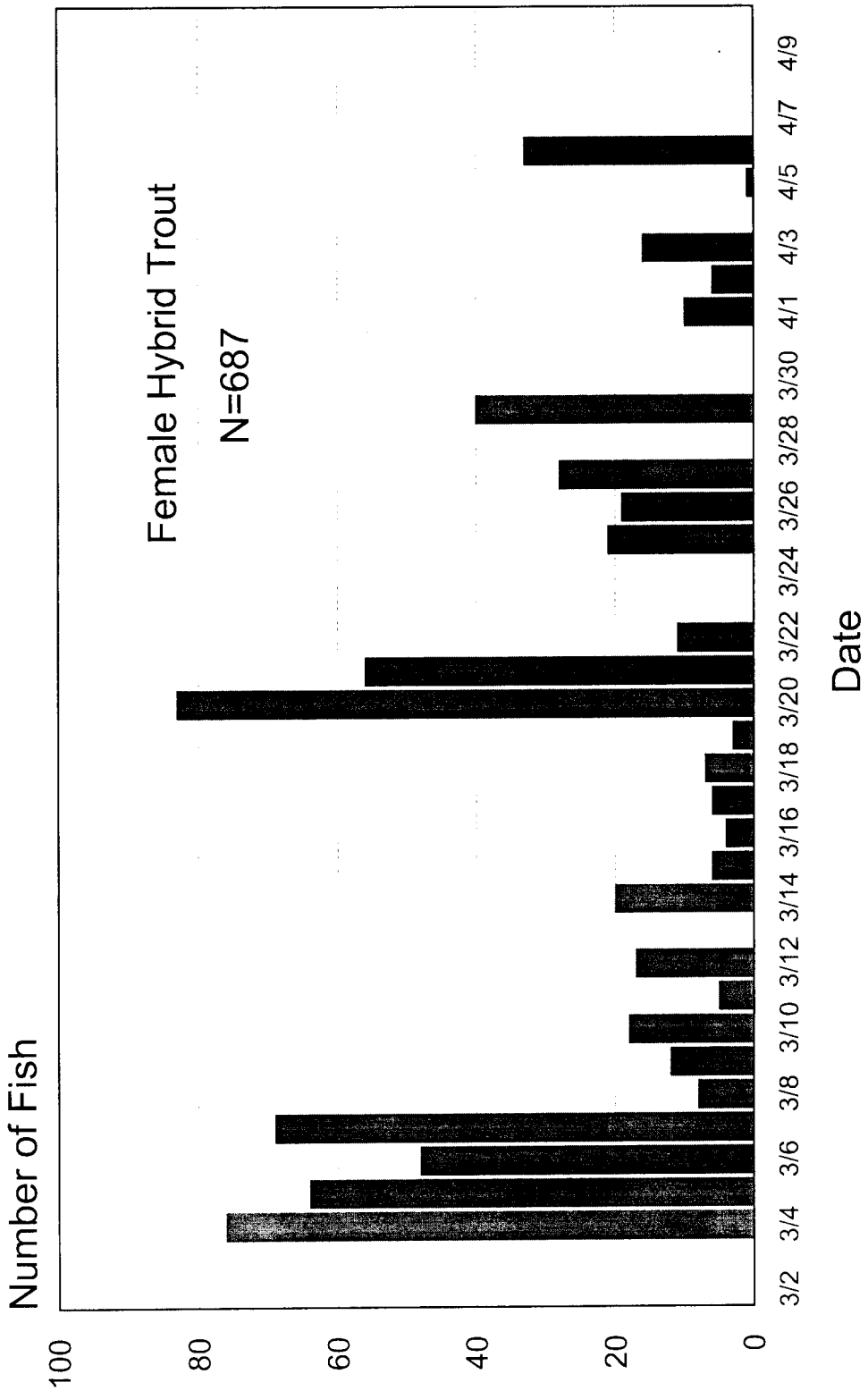
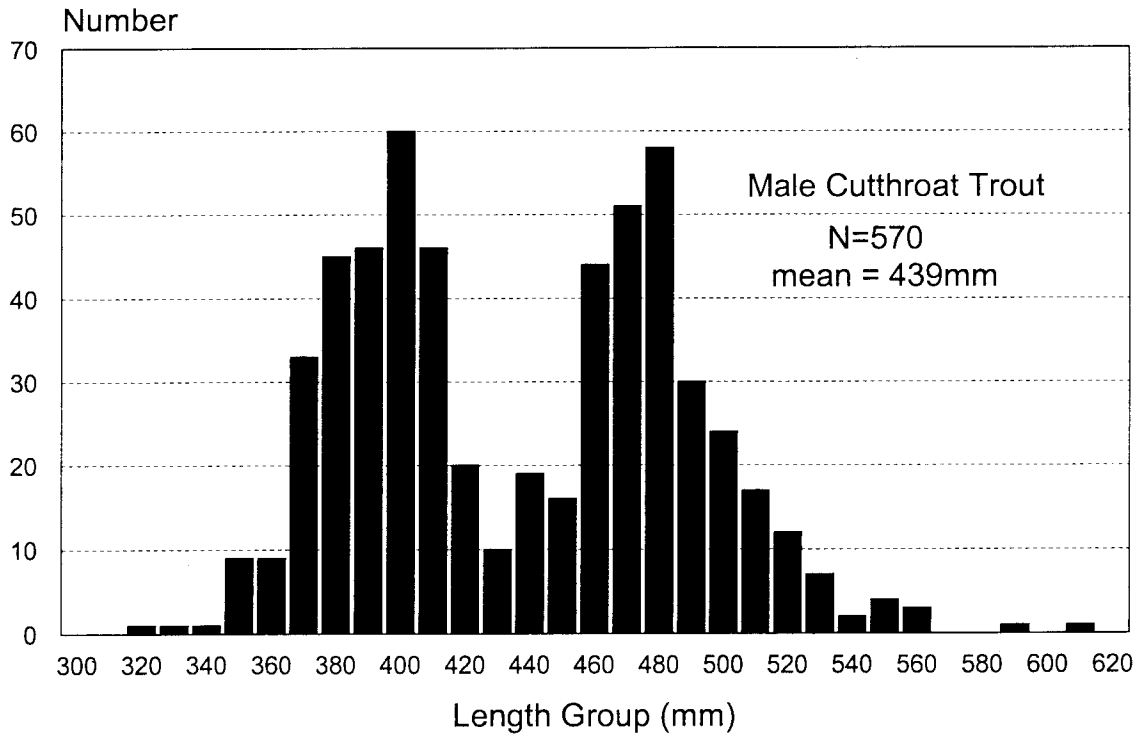


Figure 6. Run timing for female hybrid trout at Henrys Lake Hatchery, 1996.



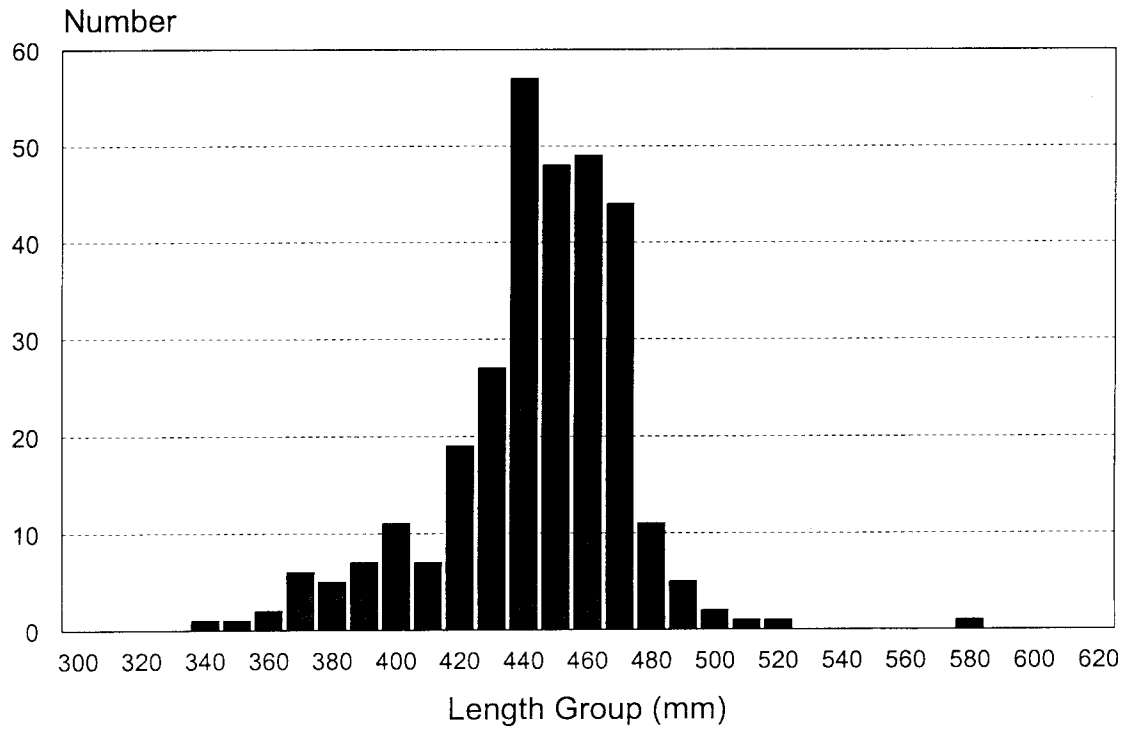
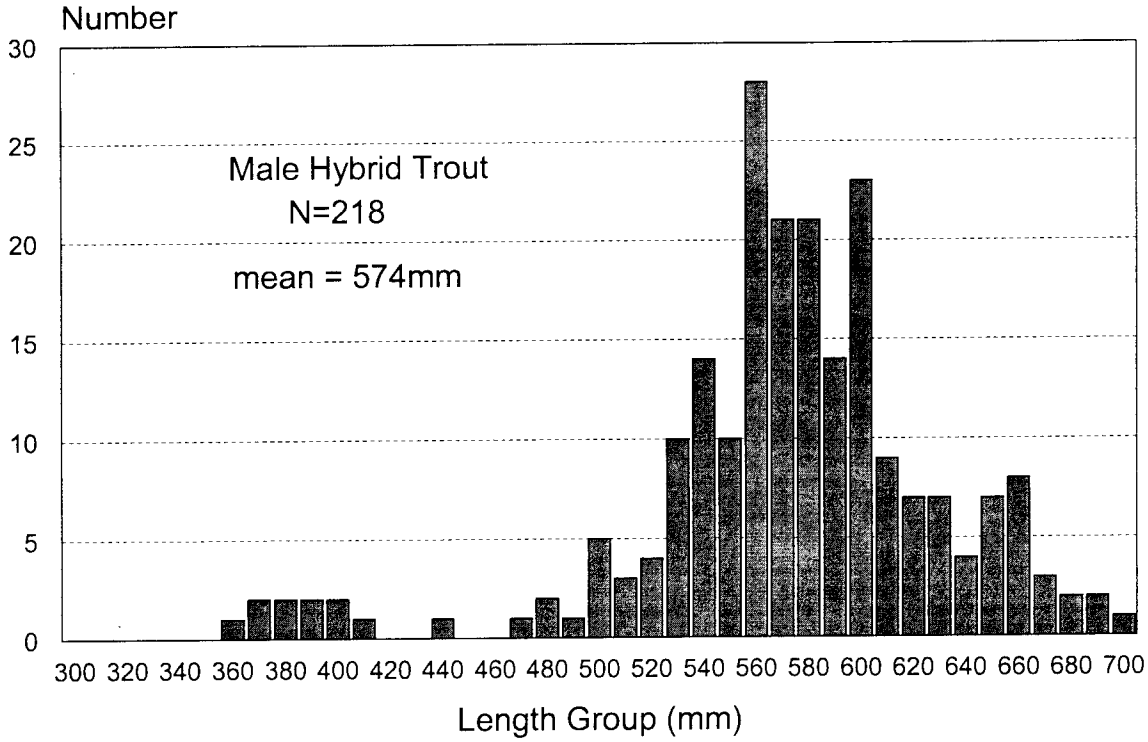


Figure 7. Length frequencies of male and female cutthroat trout in the Henrys Lake Hatchery spawning run, 1996.



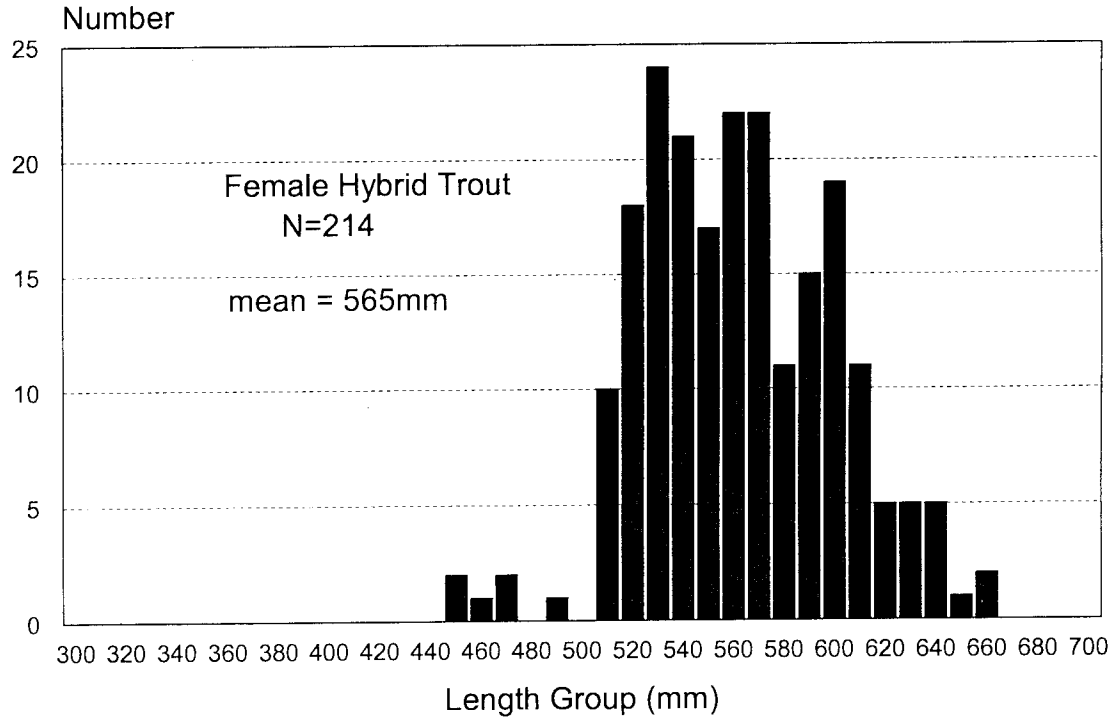


Figure 8. Length frequencies of male and female hybrid trout in the Henrys Lake Hatchery spawning run, 1996.

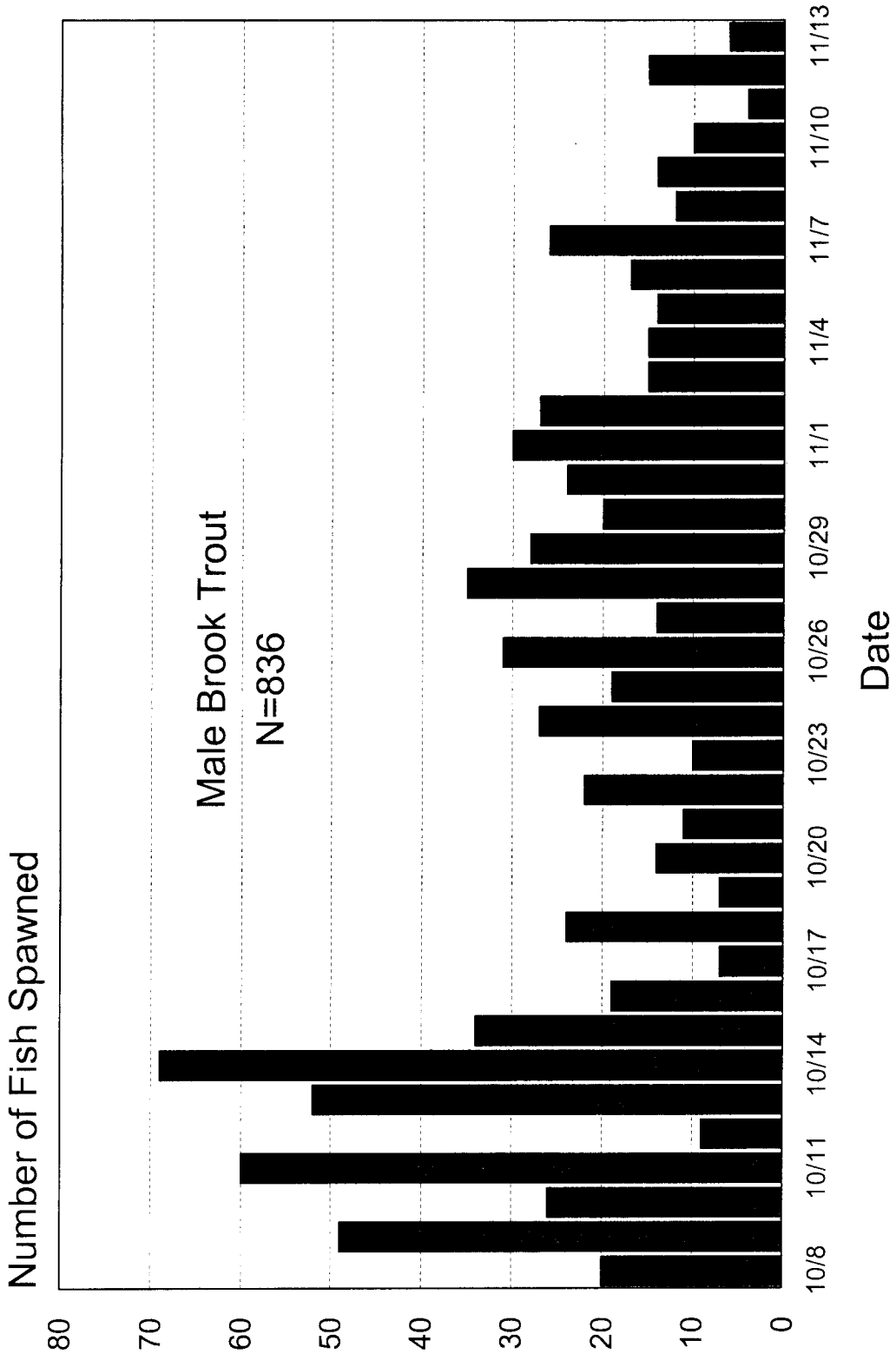


Figure 9. Run timing for male brook trout at Henrys Lake Hatchery, October-November 1996.

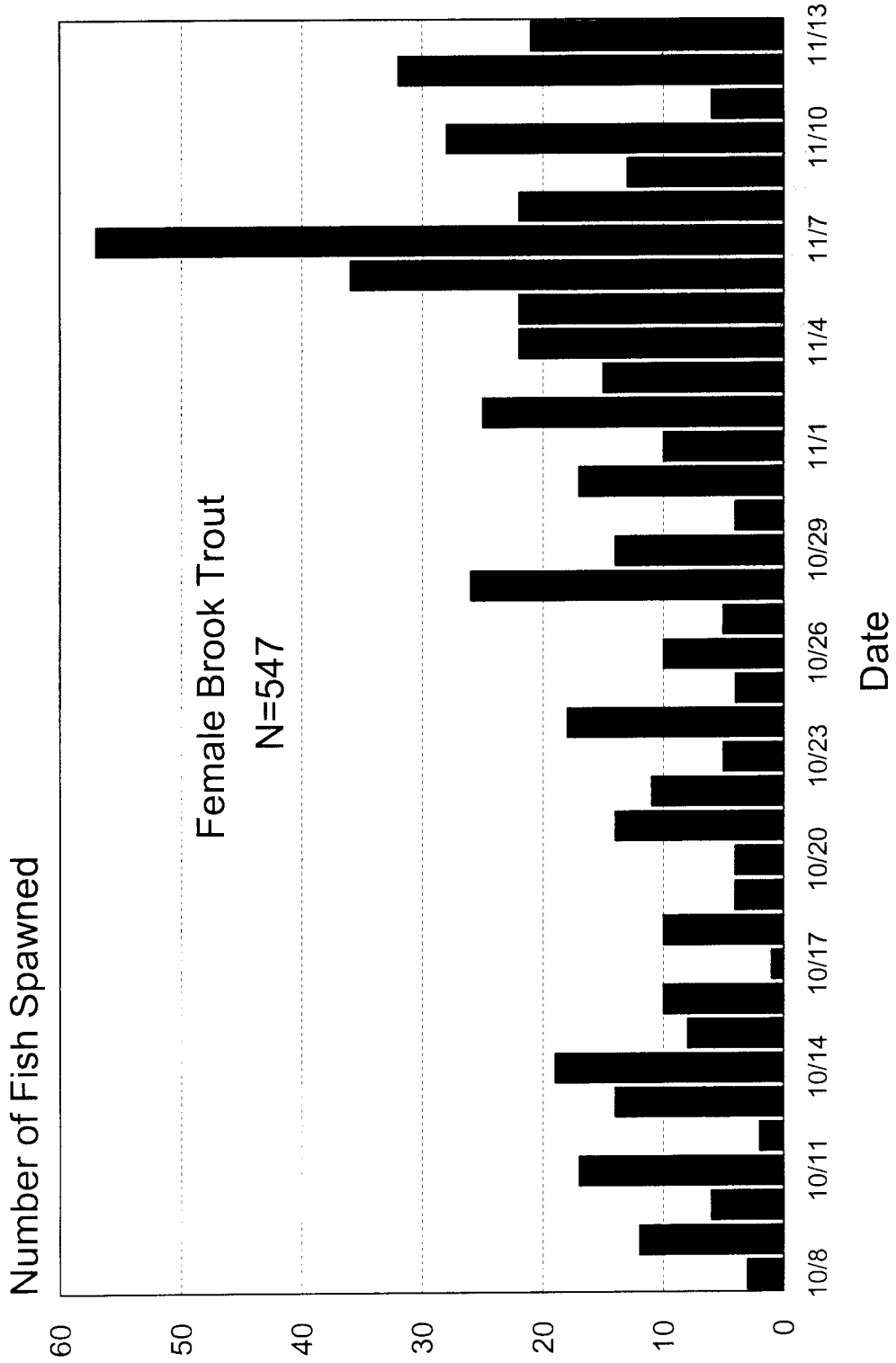


Figure 10. Run timing for female brook trout at Henrys Lake Hatchery, October-November 1996.

No pathogens were detected from brook trout ovarian samples. In adult brook trout samples, *Myxobolus* spores were detected by the digestion method, but histology was unable to confirm the species.

Gillnetting

A total of 53 fish were collected in the 6 net nights. Catch composition was 49.1% cutthroat trout, 41.5% hybrid, and 9.4% brook trout (Appendix E). No Utah chubs were sampled. Cutthroat trout ranged from 200-500 mm total length, hybrids 300-670 mm, and brook trout 230-420 mm.

Water Quality

Dissolved oxygen data were not compiled in time for inclusion in this report. The data will be presented in a report covering the 1997 field season.

RECOMMENDATIONS

Island Park Reservoir

1. Continue spring gill net surveys to monitor changes in species composition.
2. Continue spot creel checks to monitor catch composition, size of catch, and catch rates.
3. Begin mapping seasonal DO and temperature gradients to map useable trout habitat.
4. Discontinue stocking Lahontan cutthroat trout.

Palisades Reservoir

1. Continue evaluation of Jackson National Fish Hatchery Yellowstone cutthroat trout stocking program.

Ririe Reservoir

1. Continue evaluation of experimental splake stocking program.

Henrys Lake

1. Continue annual gill net surveys to evaluate status of Utah chub population.

2. Continue experimental sterile hybrid project.

3. Develop a winter aeration operations manual to provide guidelines for use of aeration system.

APPENDICES

Appendix A. Lowland lake survey results, Island Park Reservoir, 1996.

LOWLAND LAKES AND RESERVOIRS FISH SURVEY
COVER SHEET

LAKE/RESERVOIR NAME: Island Park Reservoir **REGION:** Upper Snake

DATE: 7/17/96 **SAMPLE CREW:** B. Rich (Horton / Anderson)

SCALE ENVELOPE NUMBERS: _____ to _____

SAMPLING CONDITIONS:

Water Temp. (^{o}C @ .5 m): _____ Air Temp. Range (^{o}C): _____ to

Secchi Range (m): _____ to

Wind (may circle more than one): 0-10 10-20 20+ mph

N NE E SE S SW W NW

SAMPLING EFFORT:

Combined floating and sinking gill net: 7 nights

Electrofishing: _____ hours; trap net: _____ nights

Other (including add'l size selective sampling): _____

SAMPLING LOCATIONS:

Draw or attach a lake/reservoir map and indicate fisheries and limnological sampling locations; footnoting with narrative if necessary.

KEY:

Trap Net

S-X Secchi reading

Gill Net (F,S,FS)

TDO-X Surface/bottom and profile readings

Electrofishing

LOWLAND LAKES AND RESERVOIRS FISH SURVEY
DATA SHEET (1 of 7)

LAKE/RESERVOIR NAME: Island Park Reservoir REGION: Upper Snake
DATE: 7/17 - 7/18/96 SAMPLE CREW LEADER: B. Rich (Horton / Anderson)

Length	Species Utah sucker								
(mm)	G.N.	T.N.	E.F.	Add'l	(mm)	G.N.	T.N.	E.F.	Add'l
					370-379	7			
					380-389	7			
					390-399	5			
					400-409	9			
110-119	1				410-419	10			
120-129					420-429	7			
130-139					430-439	2			
140-149	1				440-449				
150-159					450-459	1			
160-169					460-469				
170-179					470-479				
180-189	2				480-489				
190-199	2				490-499				
200-209	4				500-509				
210-219	15				510-519				
220-229	14				520-529				
230-239	3				530-539				
240-249	5				540-549				
250-259	2				550-559				
260-269	3				560-569				
270-279	4				570-579				
280-289	3				580-589				
290-299					590-599				
300-309	2				600-609				
310-319	5				610-619				
320-329	1				620-629				
330-339	3				Batch:				
340-349	6				Size				
350-359	2				Number	129			
360-369	3				Total Wt.				

LOWLAND LAKES AND RESERVOIRS FISH SURVEY
DATA SHEET (2 of 7)

LAKE/RESERVOIR NAME: Island Park Reservoir REGION: Upper Snake
DATE: 7/17 - 7/18/96 SAMPLE CREW LEADER: B. Rich (Horton / Anderson)

Length range	Species Utah chub				Species redside shiner			
(mm)	G.N.	T.N.	E.F.	Add'l	G.N.	T.N.	E.F.	Add'l
80-89	1							
90-99	27				1			
100-109	17							
110-119	3							
120-129	1							
130-139	13							
140-149	38							
150-159	58							
160-169	64							
170-179	55							
180-189	38							
190-199	16							
200-209	17							
210-219	5							
220-229	1							
230-239	3							
240-249								
250-259	3							
260-269	5							
270-279	1							
280-289	1							
290-299								
300-309								
310-319	1							
320-329	1							
330-339	2							
340-349								
Batch Samples								
Size Range								
Numbers	371				1			
Total Weight								

LOWLAND LAKES AND RESERVOIRS FISH SURVEY
DATA SHEET (3 of 7)

LAKE/RESERVOIR NAME: Island Park Reservoir REGION: Upper Snake
DATE: 7/17 - 7/18/96 SAMPLE CREW LEADER: B. Rich (Horton / Anderson)

Length	Species wild rainbow trout								
(mm)	G.N.	T.N.	E.F.	Add'l	(mm)	G.N.	T.N.	E.F.	Add'l
					370-379	2			
					380-389	2			
					390-399				
					400-409				
110-119					410-419				
120-129					420-429				
130-139	1				430-439				
140-149					440-449				
150-159	1				450-459				
160-169	1				460-469	1			
170-179	1				470-479	1			
180-189	1				480-489	2			
190-199					490-499				
200-209	2				500-509				
210-219	1				510-519	1			
220-229	2				520-529				
230-239	2				530-539	1			
240-249	1				540-549				
250-259					550-559				
260-269					560-569	1			
270-279	2				570-579				
280-289					580-589				
290-299	2				590-599				
300-309	1				600-609				
310-319					610-619				
320-329	1				620-629				
330-339	1				Batch:				
340-349					Size				
350-359	1				Number	32			
360-369					Total Wt.				

LOWLAND LAKES AND RESERVOIRS FISH SURVEY
DATA SHEET (4 of 7)

LAKE/RESERVOIR NAME: Island Park Reservoir REGION: Upper Snake
DATE: 7/17 - 7/18/96 SAMPLE CREW LEADER: B. Rich (Horton / Anderson)

Length	Species Lahontan cutthroat trout								
(mm)	G.N.	T.N.	E.F.	Add'l	(mm)	G.N.	T.N.	E.F.	Add'l
					370-379				
					380-389	1			
					390-399				
					400-409				
110-119					410-419				
120-129					420-429				
130-139					430-439				
140-149					440-449				
150-159					450-459				
160-169					460-469				
170-179					470-479				
180-189					480-489				
190-199					490-499	1			
200-209					500-509	1			
210-219					510-519				
220-229					520-529				
230-239					530-539				
240-249					540-549				
250-259					550-559				
260-269					560-569				
270-279					570-579				
280-289					580-589				
290-299					590-599				
300-309					600-609				
310-319					610-619				
320-329					620-629				
330-339					Batch:				
340-349					Size				
350-359					Number	3			
360-369					Total Wt.				

LOWLAND LAKES AND RESERVOIRS FISH SURVEY
DATA SHEET (5 of 7)

LAKE/RESERVOIR NAME: Island Park Reservoir REGION: Upper Snake
DATE: 7/17 - 7/18/96 SAMPLE CREW LEADER: B. Rich (Horton / Anderson)

Length range (mm)	Species kokanee salmon				Species rainbow x cutthroat trout			
	G.N.	T.N.	E.F.	Add'l	G.N.	T.N.	E.F.	Add'l
470-479					1			
480-489								
490-499	1							
/								
110-119								
120-129								
130-139								
140-149								
150-159								
160-169								
170-179								
180-189								
190-199								
200-209								
210-219					1			
220-229								
230-239								
240-249								
250-259					1			
260-269								
270-279					1			
280-289								
290-299								
300-309								
310-319								
320-329								
330-339								
340-349								
Batch Samples								
Size Range								
Numbers	1				4			
Total Weight								

LOWLAND LAKES AND RESERVOIRS FISH SURVEY
DATA SHEET (6 of 7)

LAKE/RESERVOIR NAME: Island Park Reservoir REGION: Upper Snake
DATE: 7/17 - 7/18/96 SAMPLE CREW LEADER: B. Rich (Horton / Anderson)

Length (mm)	Species hatchery rainbow trout								
	G.N.	T.N.	E.F.	Add'l	(mm)	G.N.	T.N.	E.F.	Add'l
					370-379				
					380-389	1			
					390-399	2			
					400-409	3			
110-119					410-419	2			
120-129					420-429	2			
130-139	1				430-439	2			
140-149					440-449	1			
150-159	1				450-459				
160-169	3				460-469				
170-179					470-479				
180-189					480-489				
190-199					490-499	4			
200-209	1				500-509	1			
210-219					510-519				
220-229	1				520-529	1			
230-239					530-539				
240-249	5				540-549				
250-259	8				550-559				
260-269	4				560-569	1			
270-279	4				570-579				
280-289	1				580-589				
290-299	2				590-599				
300-309	1				600-609				
310-319	1				610-619				
320-329	1				620-629				
330-339					Batch:				
340-349	1				Size				
350-359					Number	56			
360-369	1				Total Wt.				

LOWLAND LAKES AND RESERVOIRS FISH SURVEY
DATA SHEET (7 of 7)

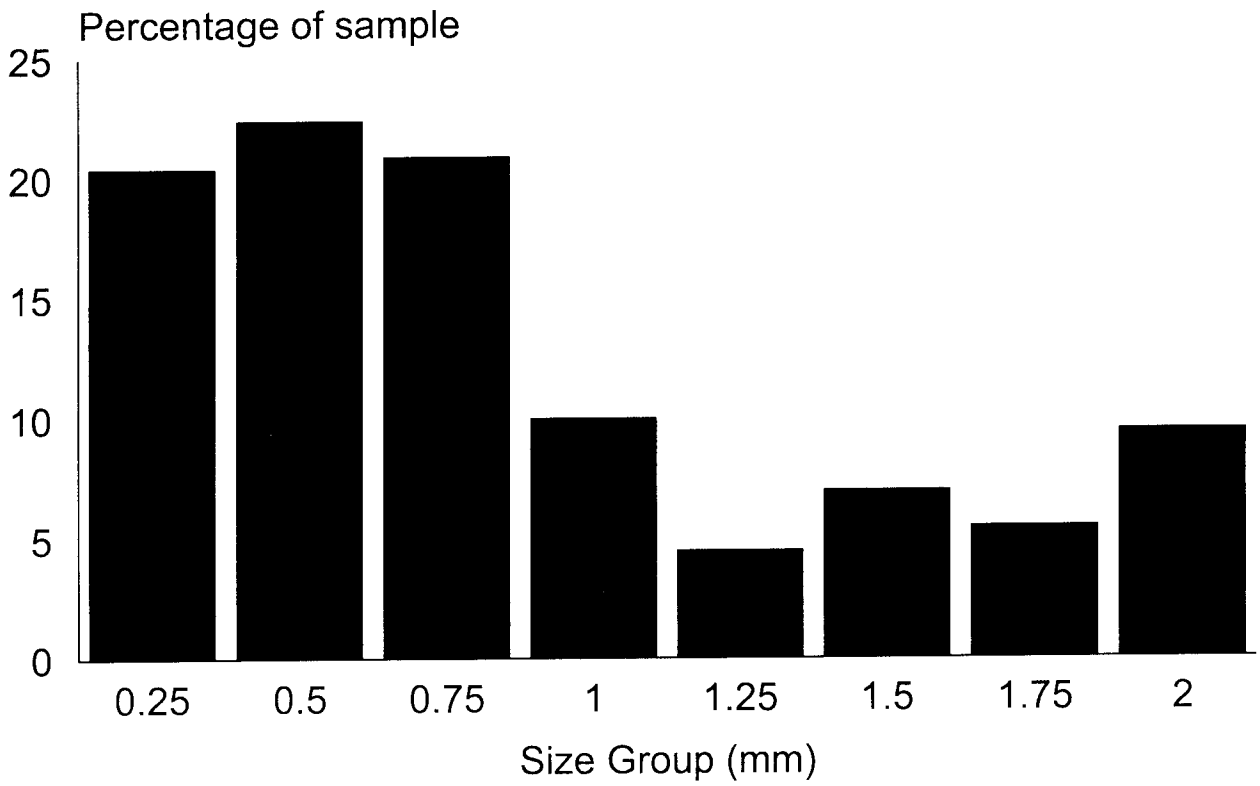
LAKE/RESERVOIR NAME: Island Park Reservoir REGION: Upper Snake
DATE: 7/17 - 7/18/96 SAMPLE CREW LEADER: B. Rich (Horton / Anderson)

Length range (mm)	Species splake				Species			
	G.N.	T.N.	E.F.	Add'l	G.N.	T.N.	E.F.	Add'l
110-119								
120-129								
130-139								
140-149								
150-159								
160-169								
170-179								
180-189								
190-199								
200-209								
210-219								
220-229								
230-239								
240-249								
250-259	1							
260-269								
270-279								
280-289								
290-299								
300-309								
310-319								
320-329								
330-339								
340-349								
Batch Samples								
Size Range								
Numbers	1							
Total Weight								

Appendix B. Temperature and dissolved oxygen profiles, Island Park Reservoir, July 23, 1996.

	Location					
	Off dam		West of Bill's Island		West end	
Depth (m)	DO (mg/l)	Temp. (°C)	DO (mg/l)	Temp. (°C)	DO (mg/l)	Temp. (°C)
Surface	8.1	22.0	8.7	21.4	9.1	20.4
1	8.0	22.0	8.6	21.4	9.0	20.4
2	8.0	22.0	8.6	21.4	8.9	20.3
3	8.0	22.0	8.6	21.4	8.8	20.0
4	8.0	22.0	8.7	21.1	9.2	19.9
5	8.0	21.9	8.6	20.5	9.2	19.8
6	8.4	20.9	8.4	20.2		
7	8.2	20.6	8.0	20.0		
8	7.3	20.0	7.7	18.3		
9	5.6	17.9	7.4	18.0		
10	5.3	17.6	6.0	17.7		
11			6.9	17.1		
12	5.6	17.0	7.7	17.0		
13			7.5	16.5		
14	5.4	16.5	7.1	16.4		
16	5.0	16.0				
18	3.1	15.4				
20	0.3	13.1				
22	0.5	11.9				

Appendix C. Size structure of zooplankton in Island Park Reservoir, July 23, 1996. Data represent pooled samples from nine net pulls from three reservoir locations.



Appendix D. Lowland lake survey results, Ririe Reservoir, 1996.

LOWLAND LAKES AND RESERVOIRS FISH SURVEY
COVER SHEET

LAKE/RESERVOIR NAME: Ririe Reservoir **REGION:** Upper Snake

DATE: 7/31/96 **SAMPLE CREW:** B. Rich (Horton / Anderson)

SCALE ENVELOPE NUMBERS: _____ to _____

SAMPLING CONDITIONS:

Water Temp. (^{o}C @ .5 m): _____ Air Temp. Range (^{o}C): _____ to

Secchi Range (m): _____ to

Wind (may circle more than one): 0-10 10-20 20+ mph

N NE E SE S SW W NW

SAMPLING EFFORT:

Combined floating and sinking gill net: 8 nights

Electrofishing: 1.33 hours; trap net: 4 nights

Other (including add'l size selective sampling): _____

SAMPLING LOCATIONS:

Draw or attach a lake/reservoir map and indicate fisheries and limnological sampling locations; footnoting with narrative if necessary.

KEY:

Trap Net

S-X Secchi reading

Gill Net (F,S,FS)

TDO-X Surface/bottom and profile readings

Electrofishing

LOWLAND LAKES AND RESERVOIRS FISH SURVEY
DATA SHEET (1 of 6)

LAKE/RESERVOIR NAME: Ririe Reservoir REGION: Upper Snake
DATE: 7/31/96 SAMPLE CREW LEADER: B. Rich (Horton / Anderson

Length range (mm)	Species Utah chub				Species Redside shiner			
	G.N.	T.N.	E.F.	Add'l	G.N.	T.N.	E.F.	Add'l
<80							4	
80-89							2	
90-99					1		7	
100-109					1		26	
110-119							13	
120-129								
130-139							3	
140-149								
150-159	1							
160-169	1		1					
170-179								
180-189			1					
190-199	1							
200-209	3	1	2					
210-219	32	15	6					
220-229	99	18	35					
230-239	71	17	35					
240-249	31	8	16					
250-259	12	5	2					
260-269	4		2					
270-279								
280-289	1							
290-299								
300-309								
310-319								
320-329								
330-339								
340-349								
Batch samples								
Size range								
Numbers	256	64	100		2		55	
Total weight								

LOWLAND LAKES AND RESERVOIRS FISH SURVEY
DATA SHEET (2 of 6)

LAKE/RESERVOIR NAME: Ririe Reservoir REGION: Upper Snake
DATE: 7/31/96 SAMPLE CREW LEADER: B. Rich (Horton / Anderson)

Length range (mm)	Species Utah sucker								
	G.N.	T.N.	E.F.	Add'l	(mm)	G.N.	T.N.	E.F.	Add'l
					370-379	6		3	
					380-389	3		7	
					390-399			3	
					400-409	1		3	
110-119					410-419			1	
120-129			3		420-429				
130-139			2		430-439				
140-149			3		440-449				
150-159			2		450-459				
160-169	2		6		460-469				
170-179			6		470-479				
180-189			2		480-489				
190-199			4		490-499				
200-209			1		500-509				
210-219					510-519				
220-229	1		1		520-529				
230-239	1	1	2		530-539				
240-249		1			540-549				
250-259		2	1		550-559				
260-269			1		560-569				
270-279		2			570-579				
280-289	2	1			580-589				
290-299	5	2			590-599				
300-309	4	2	3		600-609				
310-319	1	4	2		610-619				
320-329	3	1			620-629				
330-339	9	4	4		Batch:				
340-349	8	2	3		Size				
350-359	9	2	2		Number	63	24	69	
360-369	7		4		Total wt.				

LOWLAND LAKES AND RESERVOIRS FISH SURVEY
DATA SHEET (3 of 6)

LAKE/RESERVOIR NAME: Ririe Reservoir REGION: Upper Snake
DATE: 7/31/96 SAMPLE CREW LEADER: B. Rich (Horton / Anderson

Length range (mm)	Species Yellow perch				Species Smallmouth bass			
	G.N.	T.N.	E.F.	Add'l	G.N.	T.N.	E.F.	Add'l
<80								
80-89							1	
90-99								
100-109			3					
110-119			1					
120-129								
130-139		1	2				3	
140-149		1	1				2	
150-159	1	2	3				4	
160-169		4	2				1	
170-179		5						
180-189	1	12					1	
190-199		11						
200-209	1	4						
210-219		1						
220-229								
230-239							1	
240-249								
250-259								
260-269								
270-279								
280-289								
290-299								
300-309								
310-319								
320-329								
330-339								
340-349							1	
Batch samples								
Size range								
Numbers	3	41	12				14	
Total weight								

LOWLAND LAKES AND RESERVOIRS FISH SURVEY
DATA SHEET (4 of 6)

LAKE/RESERVOIR NAME: Ririe Reservoir REGION: Upper Snake
DATE: 7/31/96 SAMPLE CREW LEADER: B. Rich (Horton / Anderson)

Length range (mm)	Species Kokanee salmon								
	G.N.	T.N.	E.F.	Add'l	(mm)	G.N.	T.N.	E.F.	Add'l
					370-379	6			
					380-389	2			
					390-399				
					400-409				
110-119					410-419				
120-129					420-429	1			
130-139					430-439				
140-149					440-449				
150-159					450-459				
160-169					460-469				
170-179					470-479				
180-189					480-489				
190-199					490-499				
200-209					500-509				
210-219					510-519				
220-229					520-529				
230-239					530-539				
240-249					540-549				
250-259					550-559				
260-269					560-569				
270-279					570-579				
280-289					580-589				
290-299					590-599				
300-309					600-609				
310-319					610-619				
320-329					620-629				
330-339	2				Batch:				
340-349	5	1			Size				
350-359	8				Number	35	1		
360-369	11				Total wt.				

LOWLAND LAKES AND RESERVOIRS FISH SURVEY
DATA SHEET (5 of 6)

LAKE/RESERVOIR NAME: Ririe Reservoir REGION: Upper Snake
DATE: 7/31/96 SAMPLE CREW LEADER: B. Rich (Horton / Anderson

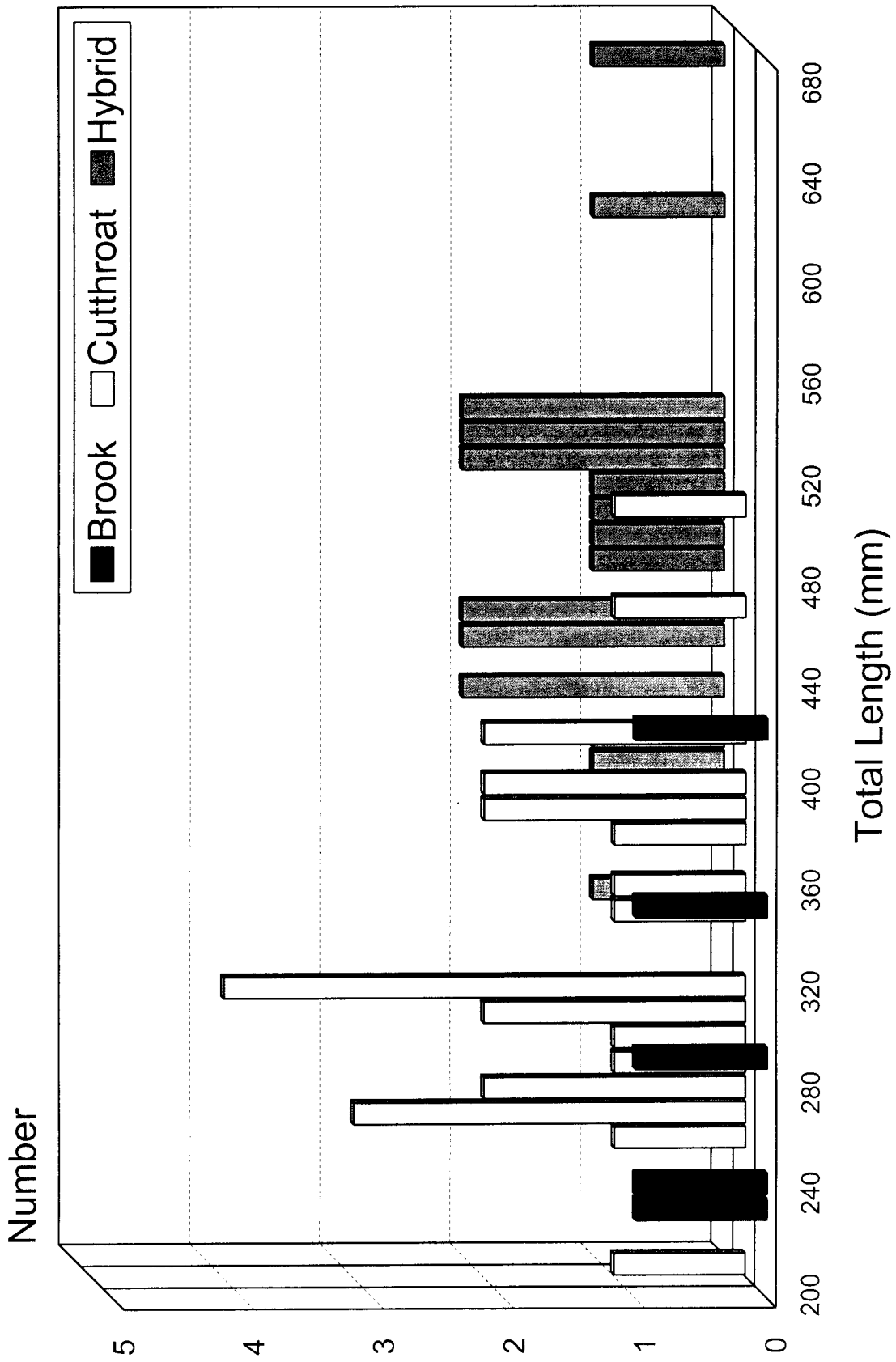
Length range (mm)	Species Wild rainbow trout				Species Wild cutthroat trout			
	G.N.	T.N.	E.F.	Add'l	G.N.	T.N.	E.F.	Add'l
110-119								
120-129								
130-139								
140-149								
150-159								
160-169								
170-179								
180-189								
190-199								
200-209								
210-219								
220-229								
230-239								
240-249								
250-259								
260-269								
270-279								
280-289								
290-299								
300-309								
310-319					1			
320-329								
330-339								
340-349	1							
Batch samples								
Size range								
Numbers	1				1			
Total weight								

LOWLAND LAKES AND RESERVOIRS FISH SURVEY
DATA SHEET (6 of 6)

LAKE/RESERVOIR NAME: Ririe Reservoir REGION: Upper Snake
DATE: 7/31/96 SAMPLE CREW LEADER: B. Rich (Horton / Anderson

Length range (mm)	Species hatchery rainbow trout				Species brown trout			
	G.N.	T.N.	E.F.	Add'l	G.N.	T.N.	E.F.	Add'l
<760					1			
110-119								
120-129								
130-139								
140-149								
150-159								
160-169								
170-179								
180-189								
190-199								
200-209								
210-219								
220-229								
230-239								
240-249								
250-259								
260-269								
270-279	2							
280-289								
290-299								
300-309	3							
310-319								
320-329								
330-339	1							
340-349								
Batch samples								
Size range								
Numbers	6				1			
Total weight								

Appendix E. Gill net catch composition and size structure for Henrys Lake, June 5-7, 1996.



1996 ANNUAL PERFORMANCE REPORT

State of: Idaho

Program: Fisheries Management

Project I: Surveys and Inventories

Subproject I-G: Upper Snake Region

Job: c[1] - South Fork Snake River

Title: Rivers and Streams Investigations

Contract Period: July 1, 1996 to June 30, 1997

ABSTRACT

A total of 1,791 trout were captured during four days of electrofishing in the Conant section of the South Fork Snake River in October 1996. Trout species composition and relative abundance were wild and hatchery cutthroat trout *Oncorhynchus clarki* (66%), wild rainbow/hybrid trout *O. mykiss* (15%), wild brown trout *Salmo trutta* (18%), lake trout *Salvelinus namaycush* (<1%), and kokanee salmon *O. nerka kennerlyi* (<1%). Cutthroat trout were at an all time low. In contrast, rainbow/hybrid trout were one percentage point less than the 1995 all time high. Brown trout have varied from 7% to 19% since 1982, the first year of electrofishing.

Length frequency distributions for each species show strong age 1 groups. Average fish length was 310 mm (12.2 in) for wild and hatchery cutthroat trout, 262 mm (10.3 in) for rainbow/hybrid trout, 284 mm (11.2 in) for brown trout, and 297 mm (11.7 in) for all species combined. Quality stock density (QSD) was 8.7% for wild and hatchery cutthroat trout, 6.6% for rainbow/hybrid trout, 12.7% for brown trout, and 9.2% for all species combined. The QSD has declined about half from last year but partly reflects the strong 1995 year class.

Estimated density of age 1 and older fish was 210 fish/ha for wild and hatchery cutthroat trout, 141 fish/ha for rainbow/hybrid trout, 44 fish/ha for brown trout, and 321 fish/ha for all species combined. Adult (>356 mm, or 14 in) cutthroat trout density was at an all time low.

The brown trout redd count was not conducted in 1996 and has been discontinued.

We conducted 1,750 interviews with 1,750 anglers during the 1996 summer fishing season (May 25 to September 13) in the upper river (dam to Heise cable). About 21% of anglers were nonresident, and 9% of all anglers were guided. The proportion of anglers fishing by gear type was 38% bait, 10% lures, and 52% flies. Average time spent fishing was 3.3 h.

Estimated angler effort in the upper river over the same time period was 169,142 h. More than half (54%) of the effort occurred during weekdays. Proportions of effort by angler type were 15% powerboat, 19% bank, and 66% float boat. Estimated catch rate was 1.12 fish/h, and estimated catch (including harvested and released fish) was 188,989 fish. Catch composition was 71% wild and hatchery cutthroat trout, 10% mountain whitefish *Prosopium williamsoni*, 12% brown trout, 7% rainbow/hybrid trout, and 1% other species.

Estimated harvest rate was 0.03 fish/h, and estimated harvest was 4,568 fish. We estimated 98% of the fish caught were released. Harvest composition was 54% wild and hatchery

cutthroat trout, 0% mountain whitefish, 25% brown trout, 20% rainbow/hybrid trout, and 3% other species. We did not account for hooking mortality.

Of 81 harvested fish independently identified by the angler and the creel clerk, 43 agreed as to being cutthroat trout, 12 agreed as rainbow/hybrid trout, 23 agreed as brown trout, and three agreed as other species. There was no disagreement. We conclude that anglers on the South Fork Snake River are able to accurately identify most of the trout they catch.

Comparative creel census statistics since 1966 suggest improved catch rates, a doubling of effort, and a tripling of catch since special regulations were implemented on the South Fork Snake River in 1984. Of concern, however, are decreasing proportions of cutthroat trout and increasing proportions of brown and rainbow/hybrid trout in the catch. Trends in angler and electrofishing catch suggest a potential threat to the genetic integrity and long-term viability of wild cutthroat trout populations in the South Fork Snake River.

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INTRODUCTION

In the mainstem South Fork Snake River, special regulations restricting harvest of cutthroat trout *Oncorhynchus clarki* were enacted upstream of the Heise measuring cable to Irwin in 1984 and extended to Palisades Dam in 1988 (Table 1). Based on this success, the Upper Snake River restricted cutthroat trout harvest regulation was implemented throughout eastern Idaho in 1990 and included the lower South Fork Snake River (below Heise) and all South Fork Snake River tributaries. The two fish, none between 8-16 inches regulation was extended to all trout species in the mainstem (but not tributaries) in 1992. 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 (Figure 1).

Wild trout populations in the main stem are monitored annually using electrofishing. Brown trout *Salmo trutta* redds have been counted since 1979, but counts were discontinued after 1994 (Appendix Table A-9). The last major creel census was conducted in 1982 (Moore and Schill 1984).

We focused our investigations in 1996 on electrofishing the Conant section and conducting another major creel census. We also coordinated with two independent research projects conducted in the drainage. Research results from the canal loss study in Palisades and Burns creeks will be published as a separate Idaho Department of Fish and Game (IDFG) publication. Results from the Utah State University graduate study on timing and location of rainbow/hybrid trout *O. mykiss* spawning will be published as a Master's thesis. Supplemental management information collected but not reported in these two publications will be presented next year.

Several additional tasks were continued from past years. We continued building a database for mainstem electrofishing data using a computer program developed by Montana Department of Fish, Wildlife, and Parks (MARKRECAPTURE 4.0 [MR4]; MDFWP 1994). Our primary purpose is to simplify and standardize analysis; prior data storage and analysis were cumbersome and not standardized (Elle et al. 1987; Corsi and Elle 1989; Elle and Corsi 1994; Corsi and Elle 1994; Elle and Gamblin 1993; Gamblin et al. 1993; Gamblin 1995; Gamblin et al. *in press, a*). Most of the data collected since 1986, representing some 30,000 fish handled, have now been entered and checked (Table 2). We began the process in 1994 and expect to finish next year.

Neither biomass nor standing crops have been estimated in the past (Elle et al. 1987; Corsi and Elle 1989; Elle and Corsi 1994; Corsi and Elle 1994; Elle and Gamblin 1993; Gamblin et al. 1993; Gamblin 1995; Gamblin et al. *in press, a*; Gamblin et al. *in press, b*; Schrader et al. *in press*). These estimates are useful when monitoring wild trout populations, especially when combined with abundance or density estimates. For example, densities might be decreasing whereas average fish size and standing crops might actually be increasing. Difficulties deriving biomass and standing crop estimates are resolved using the MR4 computer program. However, weights of individual fish have not been measured in the past. Beginning in 1994 and continuing through 1996, subsamples of fish have been weighed to develop length-weight regressions. These regressions for each wild trout species (cutthroat, rainbow/hybrid, and brown) will be developed, tested for significant spatial (between electrofishing sections) and temporal (between years) differences, and reported in the future. Final regressions will ultimately be used to predict fish weights from measured lengths, and to estimate historic and future biomass and standing crops.

Table 1. Mainstem South Fork Snake River fishing regulations, 1970-1997.

Year	Season	Trout bag/possession 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 - 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 10" - 16", barbless hooks	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, none 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, 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 8" -16"	Same
1994-1995	May 28/27-Nov 30	Same	Same
1996-1997	May 25/24-Nov 30	Same	Same

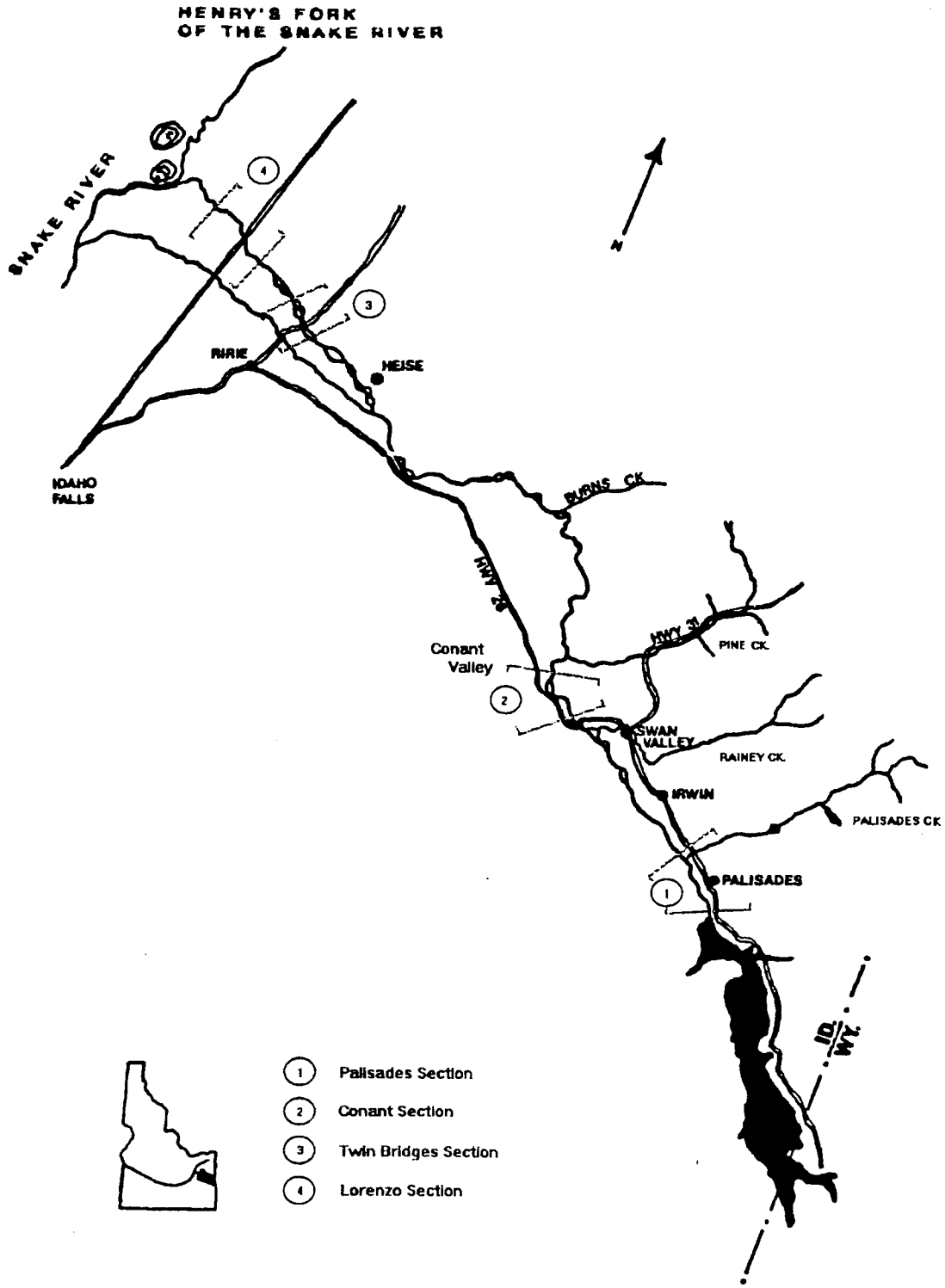

Figure 1. Map of South Fork Snake River showing electrofishing sections.

Table 2. Summary of electrofishing data from the South Fork Snake River that have been entered and checked using the computer program MR4. Sections are listed going upstream.

Section/year	Entered	Checked
Lorenzo		
1987	X	
1988	X	
1989	X	
1990	X	
1991	X	
1993	X	
1995	X	X
Twin Bridges		
1989	X	
1991	X	
Dry Canyon		
1991		
Conant		
1986	X	X
1987	X	X
1988	X	X
1989	X	X
1990	X	X
1991	X	X
1992	X	X
1993	X	X
1994	X	X
1995	X	X
1996	X	X
Palisades		
1987	X	X
1989	X	X
1991	X	X
1994	X	X
1995	X	

Population age structures and year class strengths have been estimated in the past, but ages were based solely on visual inspection of length frequency distributions (Elle et al. 1987; Corsi and Elle 1989; Elle and Corsi 1994; Corsi and Elle 1994; Elle and Gamblin 1993; Gamblin et al. 1993; Gamblin 1995; Gamblin et al. *in press, a*; Gamblin et al. *in press, b*; Schrader et al. *in press*). Ages have not been validated with known-age fish or with bony parts (scales or otoliths). Estimated population age structures are useful when monitoring wild trout populations by providing catch curves and mortality rates. Estimated year class strengths are useful in correlating trends with environmental perturbations, such as low stream flows. Difficulties deriving these age-based estimates are resolved using the MR4 computer program but require ages of some individual fish. From 1993 to 1995, subsamples of fish scales were collected to develop age-length keys; scales were not collected in 1996. These keys for each wild trout species (cutthroat, rainbow/hybrid, and brown) may eventually be developed, tested for significant spatial (between electrofishing sections) and temporal (between years) differences, and reported in the future. However, preliminary results have not been promising.

We assumed fish scales can be used to accurately age individual fish. Preliminary aging of scales from what appeared to be age 0 and age 1 fish (by length frequency distributions) indicated that further validation was needed. Saggittal otoliths are generally considered more reliable than fish scales for accurately aging fish but require killing the individual. We began collecting paired samples of scales and otoliths in 1995 for age corroboration, and we collected 26 samples from the creel census and electrofishing in 1996. Preliminary results were reported last year (Schrader et al., *in press*). However, real age validation requires a known-age marked group that is sampled over time. In 1996, canal loss research personnel adipose-clipped 7,399 out migrating fry in Burns Creek and 6,982 fry in Palisades Creek to provide this marked group. Final results of this age and growth work will be reported in the future.

STUDY AREA

Main Stem Electrofishing

Four river sections have been electrofished in various years since 1986 (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 the Conant section was sampled in 1982 as well (Moore and Schill 1984). Average stream widths of the sections are similar: Palisades (79 m), Conant (71 m), Twin Bridges (66 m), and Lorenzo (46 m).

Creel Census

In 1996 we censused from Palisades Dam down to the Heise gauging station (water measuring cable). This 64.4 km (40.0 mi) portion of the South Fork Snake River was last censused in 1979 by Moore (1980) and in 1982 by Moore and Schill (1984). Because of differences in angler access and fishing seasons, they divided the South Fork Snake River from Palisades Dam downstream to the Henrys Fork Snake River (62.8 km, 101.1 mi) into seven unequal-length sections (Figure 2; Table 3). Due to limited time and funds, we only censused the first four study sections in 1996. Since the 1979 and 1982 creel surveys, fishing seasons and bag limits have standardized throughout this area (Memorial Day to November 30 general season, 2 trout over 16

inch bag limit). Following is an updated description of the first four sections as described by Moore (1980) and Moore and Schill (1984):

Section 1 (Palisades Dam to Irwin footbridge abutments, 11.9 km)

A separate season (April 1 to September 30) was established in this section in 1973 to protect brown trout during spawning. The special season was abandoned beginning in 1988. The river in this area is confined to a single channel, flowing in long, shallow runs with poor riffle-pool structure. Palisades Creek is the only major tributary in this section. The river flows along the southwest edge of Swan Valley. Bank access is excellent for anglers at the dam, and fair along both sides of the river. Boat access is available at Palisades Dam (river mile [RM] 0.0) and Irwin (Huskey; RM 3.5) boat ramps.

Section 2 (Irwin footbridge abutments to Granite Creek, 16.4 km)

The river in this area flows through the northern end of Swan Valley into Conant Valley; Conant Valley and Swan Valley are separated by a narrowing of the valley floor for about 2 km. This section is characterized by much braiding and several extensive side channels. Good riparian vegetation and riffle-pool structure give the area good fish habitat during both high and low water flows. Several tributaries with fisheries enter in this section: Indian Creek, Fall Creek, Pritchard Creek, and Rainey Creek. Fall Creek enters the river on the south side over a 10 m high waterfall, making it inaccessible to river fish. It provides an important wintering area for trout below the falls due to warmer water from Fall Creek (Jeppson 1970). This is a favored fishing hole for both bank and boat anglers. The popular US Forest Service (USFS) Falls Campground is above the falls and along the South Fork Snake River. Access is fair in this section for bank anglers via a county road on the south side of the river and along parts of Highway 26. Boat access is available at Spring Creek (Highway 26 bridge; RM 13.0) and Conant Valley (RM 15.0) boat ramps.

Section 3 (Granite Creek to Black Canyon, 15.8 km)

Granite Creek enters the South Fork Snake River at the north end of Conant Valley. This is the beginning of the South Fork Snake River Canyon, which is bounded by the Big Hole Mountains to the north and Antelope Flat to the south. No public roads penetrate to the river in this section, with most access limited to boats coming from Sections 2 or 4. Access is essentially non-existent for bank anglers, and there are no public boat ramps. A pack trail runs down Dry Canyon, intersecting the South Fork Snake River about one-half way through the section. The river bottom is generally confined by steep basalt walls, which often create deep runs and large, deep pools. Short sections of braiding are common, creating many islands. Recreational floating for sightseeing and camping is very popular. Pine Creek is the only major tributary and enters near the upper end of this section; it is the largest drainage available to the South Fork Snake River fishery.

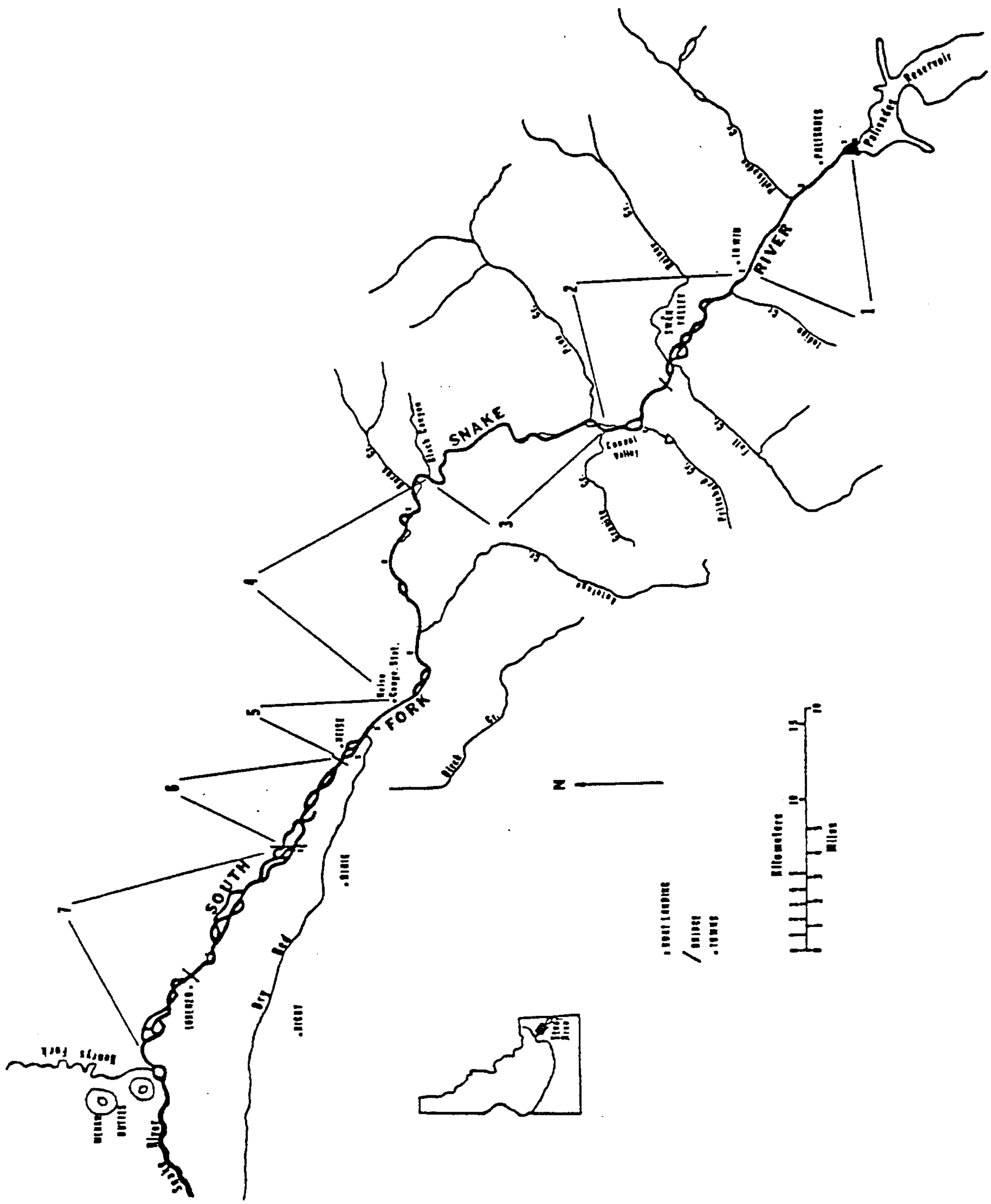

Figure 2. Map of South Fork Snake River showing creel census reaches (Moore and Schill 1984).

Table 3. Study sections for South Fork Snake River.

Section	Section	km	mi
1	Palisades Dam to foot bridge abutments near Irwin	11.9	7.4
2	Irwin to Granite Creek	16.4	10.2
3	Granite Creek to Black Canyon	15.8	9.8
4	Black Canyon to Heise Gauging Station (near Anderson Canal)	20.3	12.6
5	Heise Gauging Station to Heise Bridge	6.1	3.8
6	Heise Bridge to Archer-Ririe Highway Bridge	6.6	4.1
7	Archer-Ririe Highway Bridge to present mouth of Henrys Fork Snake River	24.0	14.9
	Mouth of Henrys Fork Snake River to Palisades Dam	101.1	62.8

Section 4 (Black Canyon to Heise gauging station, 20.3 km)

This section is still confined by canyon walls but has a wider valley bottom, resulting in shallower runs. A county road parallels the river on the north side up to Black Canyon, providing camping and excellent bank access. Many boats from Section 3 continue to this section. Boat access is available at Cottonwood (RM 29.0) and Wolf Flat (RM 36.0) boat ramps, although many boats launch at Byington (or Poplar; RM 40.5) just below the Heise measuring cable. The effects of farming on Antelope Flats are evident by increased siltation from Antelope Creek into the South Fork Snake River during periods of heavy rain. Burns Creek is the only major tributary in this section and has long been recognized as a major cutthroat trout spawning stream (Jeppson 1970; Moore 1980, 1981; Moore and Schill 1984).

OBJECTIVES

1. Monitor South Fork Snake River wild trout populations in the mainstem by electrofishing. Enter 1996 electrofishing data into MR4 computer program for standardized database and analysis. Estimate trout species composition, relative abundance, size structure, average fish length, quality size density (QSD), and density for selected electrofishing sections (Conant).

2. Monitor South Fork Snake River fishery in the mainstem by conducting a fully stratified, roving-type creel census. Enter 1996 and 1982 creel data into Creel Census System computer program for standardized database and analysis. Estimate angler effort, catch rate, catch and harvest, and other fishery parameters for the summer fishing season (opener to mid-September) on the upper river (above Heise cable).

METHODS

Mainstem Electrofishing

During 1996, the Conant section was electrofished on October 3, 4, 10, and 11 (Figure 1). Two marking run days were followed by two recapture run days about a week later.

Fish were captured using direct-current (DC) electrofishing gear (Coffelt VVP-15 powered by a Honda 5000 W generator) mounted in an 18-ft Alumaweld sled with 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. VVP settings were at 300 V, 5-7 A, 20% pulse width, and 20 Hz (pulses per second). When we measured them, water temperatures varied from 13°C to 14°C. Flows varied from 3,760 to 3,790 cfs (at Irwin gage; USGS, provisional data). Though sections were not blocked at each end, we assumed fish would not move beyond natural habitat boundaries between marking and recapture runs.

Attempts were made to capture all species and sizes of trout; mountain whitefish *Prosopium williamsoni* and nongame fish were ignored. Fish were anesthetized with MS-222 (tricaine methane-sulfonate), identified, examined for marks, measured to the nearest mm (TL), and weighed to the nearest gram. For each species, the first 10 fish captured were weighed per cm length group. Brown trout less than 150 mm and all other species less than 100 mm (approximately age 0) were not marked; age 1 and older fish were marked with a caudal fin punch and then released.

Electrofishing data for 1996 were entered and analyzed using the computer program MARKRECAPTURE 4.0 (MR4; MDFWP 1994).

It was assumed that capture probabilities did not vary with species, and relative abundance was estimated using proportions of all new trout captured. Although capture probabilities vary with fish length (Schill 1992), population size structures (relative length frequency distributions), and average fish lengths were estimated using all sizes of new fish captured. Quality stock densities were estimated using the number of new fish >16 in captured divided by the number >8 in, then times 100. Densities were estimated using two methods in the MR4 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).

Creel Census

A fully stratified, roving-type creel census was conducted on the upper 64.4 km (40.0 mi) of the South Fork Snake River during the 1996 summer fishing season (May 25 to September 13).

The census was stratified the same as Moore (1980) and Moore and Schill (1984). Besides being spatially stratified (river sections 1 to 4), sampling was temporally stratified by: 1) two-week intervals, 2) day type (weekday versus weekend/holiday day), and 3) time of day (morning, afternoon, and evening). Morning was considered 0630 to 1129, afternoon from 1130 to 1629, and evening from 1630 to 2130. Anglers were also stratified by their type of fishing: power boat, bank, or float boat. Power and float boat anglers were those people using a boat whether they were fishing from the boat or the bank. Power (motorized) boaters were anglers using a boat with any type of motor attached regardless of how it was being used (i.e. actually fishing with the motor running, or transportation to a bank fishing location, or transportation upstream so they could float the river to fish drifting downstream). Float (non-motorized) boaters were predominantly in Mackenzie-style drift boats but were also in canoes, rafts, and other types of watercraft.

The creel census procedures were designed to repeat Moore (1980) and Moore and Schill (1984). We conducted 12 angler counts in each two-week interval that always began on a Saturday. One-half of the counts were done on weekdays, and the remainder was done on weekend days and holidays. Specific count days were selected at random except that the opening day and holidays were always included. Specific count times were the same as those used in 1982 (Moore and Schill 1984); one-third were in the morning, one-third in the afternoon, and one-third in the evening. As in 1982, to save time and cost, two or three counts were conducted each count day. A fishing day was considered to be from sunrise to sunset. We used the same mean hours of daylight for each interval as in 1982 (from Idaho Falls sunrise and sunset tables).

As in 1982, anglers were counted on the South Fork Snake River using a jet boat. Counts generally began at Palisades Dam and always continued through all four sections. A layover was usually required at the Byington boat ramp until the start of the next count, which was then made going upstream. Fun boaters (not fishing) and jet skiers were also counted.

As in 1982, anglers were interviewed as often as practical on both count and non-count days, often using cars to interview anglers, particularly along roadways and at boat ramps. An attempt was made to interview at least one or more anglers in each specific strata (section, interval, day type, time of day, and angler type). For each individual angler, standard creel information was recorded: residence, type of angler (power boat, bank, drift boat), trip completed, hours fished by terminal gear type (bait, lure, fly), number of fish kept and released by species, and length (TL) of fish kept by species, if they were guided and if their fishing license was checked. To answer if anglers can accurately identify fish species in the South Fork Snake River, the species of each fish kept was recorded as identified by the angler versus the same fish as identified by the creel clerk.

Data collected in 1996 were entered and analyzed using the IDFG Creel Census System computer program (McArthur 1993). Raw data collected in 1982 by Moore and Schill (1984) were also entered for comparative analysis.

RESULTS AND DISCUSSION

Mainstem Electrofishing

Conant

Trout Species Composition and Relative Abundance - A total of 1,791 individual trout were captured during four days of electrofishing in October 1996. Trout species composition and relative abundance (Figure 3; Appendix Table A-1) were wild and hatchery cutthroat trout (66%), wild rainbow/hybrid trout (15%), and wild brown trout (18%). One lake trout *Salvelinus namaycush* (<1%) and one kokanee salmon *O. nerka kennerlyi* (<1%) were also captured. Hatchery cutthroat trout (fine-spotted), lake trout, and kokanee salmon are flushed from Palisades Reservoir; their numbers may be directly related to the extent of reservoir drawdown (Gamblin et al. 1993).

The proportion of wild and hatchery cutthroat trout captured by electrofishing in 1996 was at an all time low since electrofishing began in 1982 (Figure 3; Appendix Table A-1). The proportion has declined 3% since last year and has declined 23% since the all time high in 1989. In contrast, the proportion of rainbow/hybrid trout was one percentage point less than the all time high last year (16%), but is 14% above the all time low in 1982. This trend may constitute a threat to the genetic integrity and long-term viability of wild cutthroat trout populations in the South Fork Snake River. The proportion of brown trout captured by electrofishing has varied from 7% to 19% since 1982, and there is no apparent trend.

Size Structure, Average Length, and QSD - The wild and hatchery cutthroat trout length frequency distribution for 1996 shows good representation of what are believed to be age 1 fish (152 to 254 mm) (Figure 4). Likewise, strong groups of similar-sized age 1 wild rainbow/hybrid trout and brown trout are apparent. High water conditions during 1995, and minimum flows around 1,700 cfs (USGS, provisional data) during winter 1995-1996 probably contributed to producing this strong year class. Rainbow/hybrid trout and brown trout length frequency distributions show few age 2 and older fish, relative to younger fish and cutthroat trout. The relative decline in large fish of both species since the late 1980s cannot be explained, and an increase would have been expected after special regulations were implemented in 1992.

Results are confounded by the lack of age and growth data and by hatchery cutthroat trout flushed from Palisades Reservoir (see below). This will be resolved for future monitoring.

Average fish length was 310 mm (12.2 in) for wild and hatchery cutthroat trout (n=1190), 262 mm (10.3 in) for rainbow/hybrid trout (n=274), 284 mm (11.2 in) for brown trout (n=325), and 297 mm (11.7 in) for all species combined (n=1791) (Appendix Table A-2). For wild and hatchery cutthroat trout, QSD was 8.7%, 6.6% for rainbow/hybrid trout, 12.7% for brown trout, and 9.2% for all species combined. From last year, QSD has declined about half but partly reflects the strong 1995 year class.

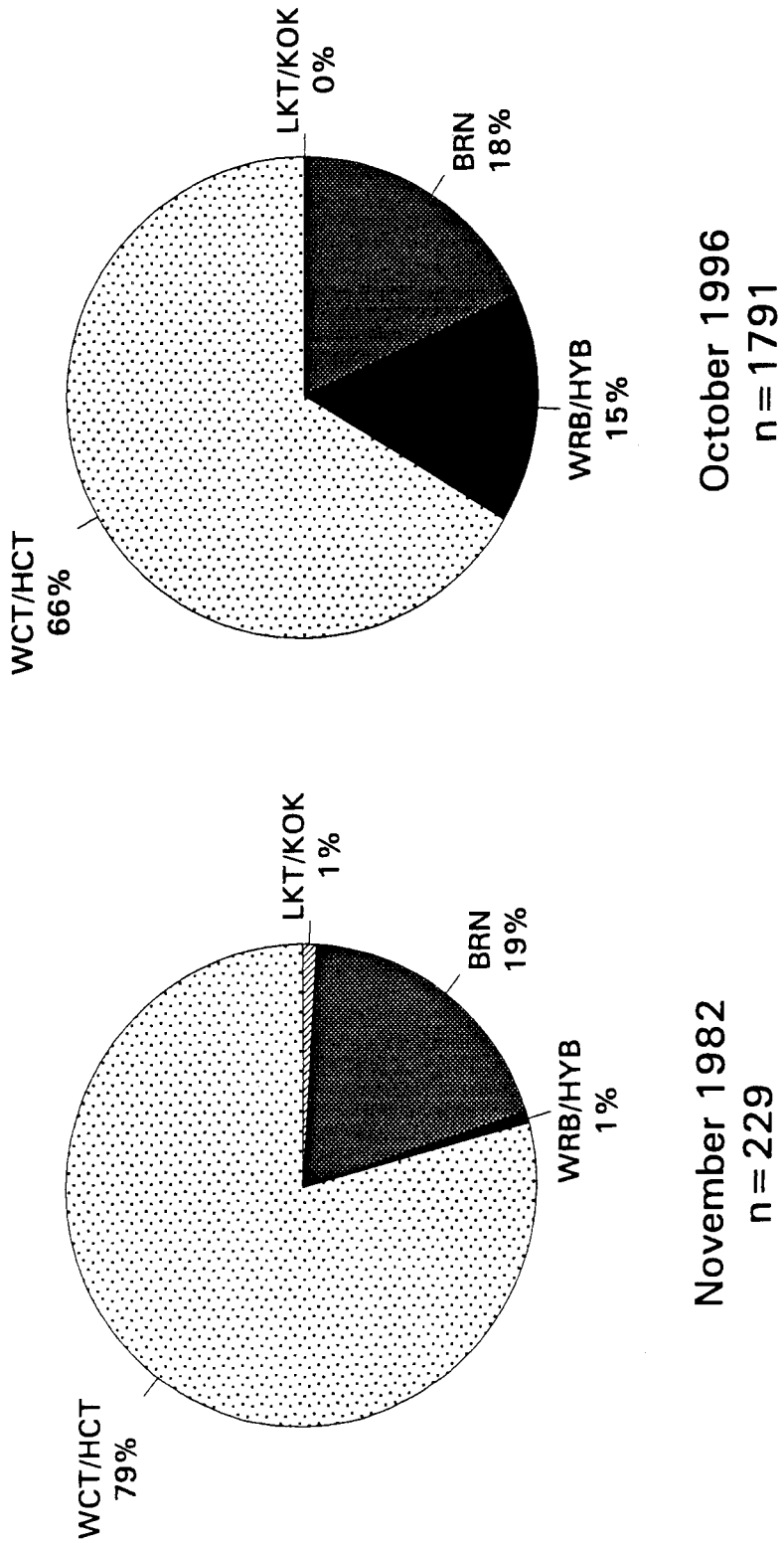

Figure 3. Trout species composition and relative abundance (%) at Conant electrofishing section, South Fork Snake River, 1982 and 1996. Total new fish captured during mark and recapture runs = n. Results for 1996 are from MR4 database for all sizes of fish; 1982 results are from Moore and Schill (1984).

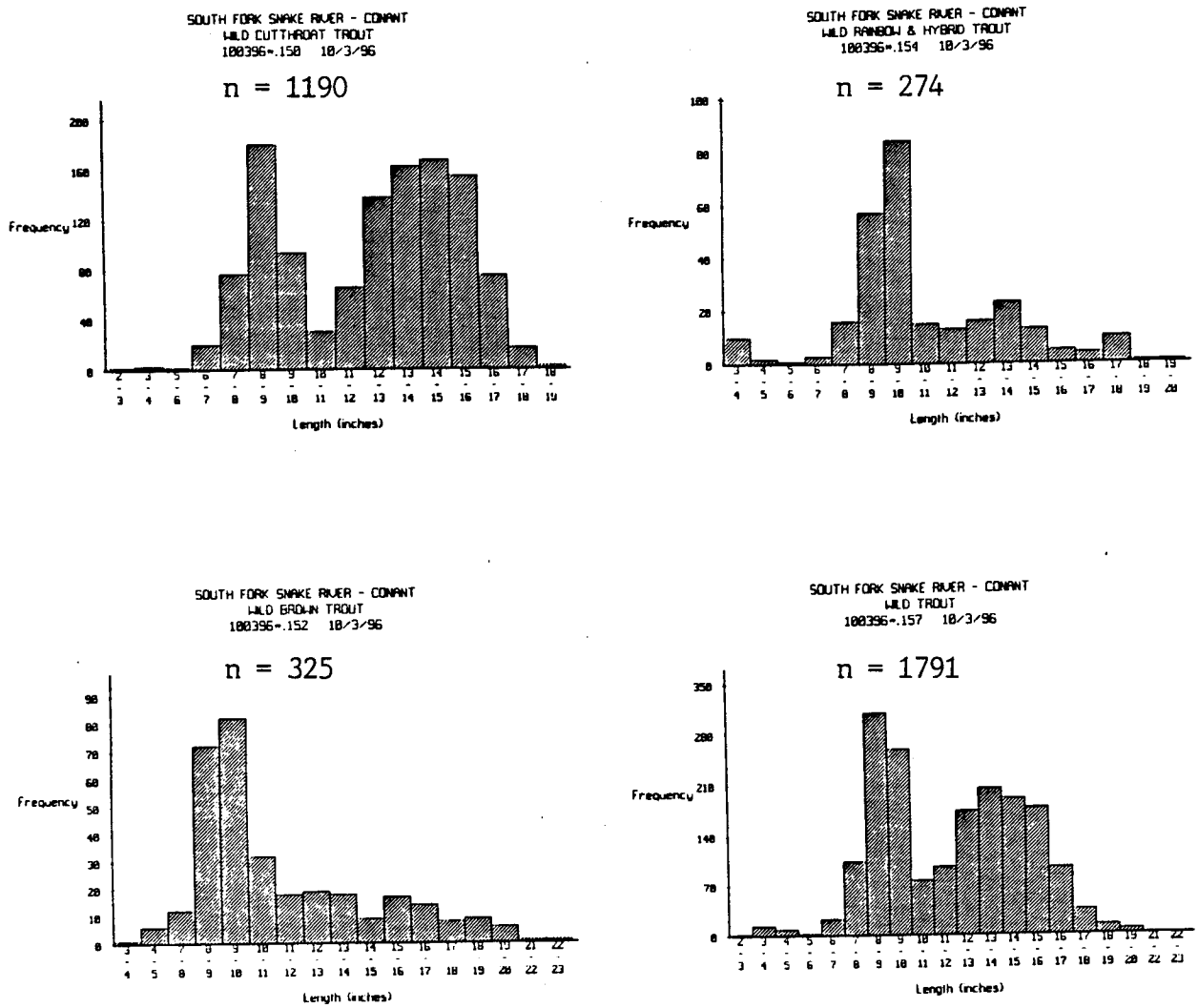

Figure 4. Length frequency distributions of wild cutthroat, rainbow/hybrid, and brown trout, all species combined, captured at Conant electrofishing section, South Fork Snake River, 1996. Total new fish captured during mark and recapture runs = n. Results are from MR4 database for all sizes of fish.

Density - For 1996, estimated density of age 1 and older fish was 210 fish/ha for wild and hatchery cutthroat trout (Appendix Table A-4), 141 fish/ha for rainbow/hybrid trout (Appendix Table A-5), 44 fish/ha for brown trout (Appendix Table A-6), and 321 fish/ha for all species combined (Appendix Table A-7). Age 1 and older fish were considered ≥102 mm (4 in) for cutthroat and rainbow/hybrid trout and ≥152 mm (6 in) for brown trout. These ages were corroborated using cross-sectioned otoliths and length frequency distributions in 1995 (Schrader et al., *in press*). Note the calculated estimate for all species combined (321 fish/ha) is smaller than the collective estimates for all species (395 fish/ha).

Density of age 1 and older cutthroat trout in 1996 was the same as 1993 and was greater than the all time low last year (Figure 5). The 1996 estimate partly reflects the strong 1995 year class. Decreasing numbers of larger fish (>356 mm, or 14 in) merit continued monitoring (Figure 6). These larger fish are the breeding stock that special 1984 regulations were intended to protect through one spawning season (Moore and Schill 1984).

Density of rainbow/hybrid trout in 1996 was at an all time high (Figure 5). However, this estimate is interpreted with caution, as electrofishing efficiency was unusually low (4%) (Appendix Table A-3). These results support trends reported above for relative abundance.

Hatchery Fish - All cutthroat trout stocked into Palisades Reservoir and the Salt River WY in 1996 had ventral (pelvic) fin clips (Appendix Table A-8). Six fish captured at Conant in fall 1996 had ventral clips and ranged 304-435 mm (12-17 in) in size. In addition, one fish captured had an adipose clip, and two others were believed to be hatchery fish without a clip (from 1995 stocking). We conclude less than 1% of the Conant cutthroat trout population is hatchery fish.

One brown trout (447 mm, or 18 in) had a left pectoral clip. And one rainbow/hybrid (175 mm, or 7 in) appeared to be a hatchery fish but had no clip

Creel Census

Summary

During the summer 1996 fishing season (May 25 to September 13) 1,750 angler interviews with 1,750 anglers were conducted in the upper South Fork Snake River (dam to Heise cable) (Table 4). Moore and Schill (1984) conducted 1,518 interviews with 2,758 anglers during the 1982 summer season (May 29 to September 17) and early season (April 1 to May 28 in section 1) in the same stretch. From these interviews in 1996, 21% of anglers were nonresident (11% in 1982) and 9% of all anglers were guided (2% in 1982). The proportion of hours fished by gear type was: 38% bait (64% in 1982), 10% lures (16% in 1982), and 52% flies (20% in 1982). Average time spent fishing was 3.3 h (3.6 h in 1982).

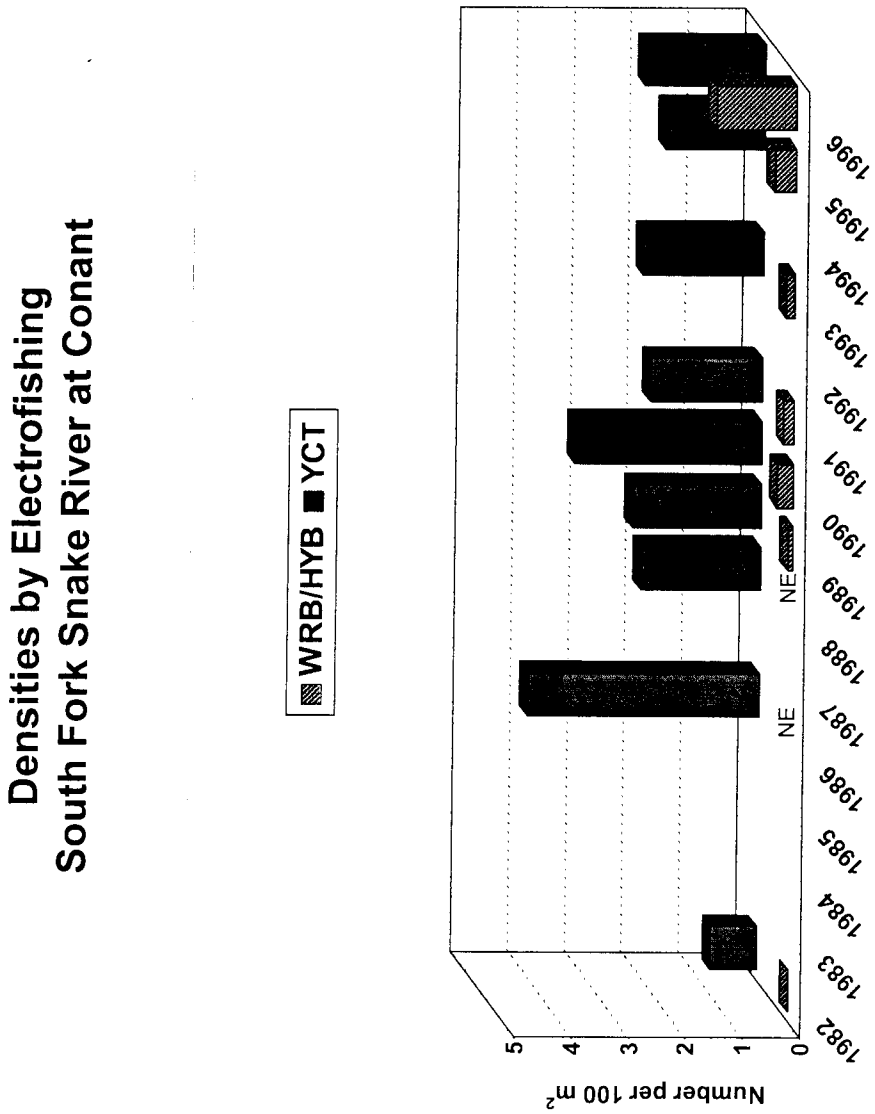

Figure 5. Estimated densities (fish/100 m^2) of rainbow/hybrid trout (WRB/HYB) versus cutthroat trout (YCT) at Conant electrofishing section, South Fork Snake River; 1982-1996. Density estimates are for age 1 and older (>100 mm) fish. NE = no estimate. Estimates for 1982 are from Moore and Schill (1984).

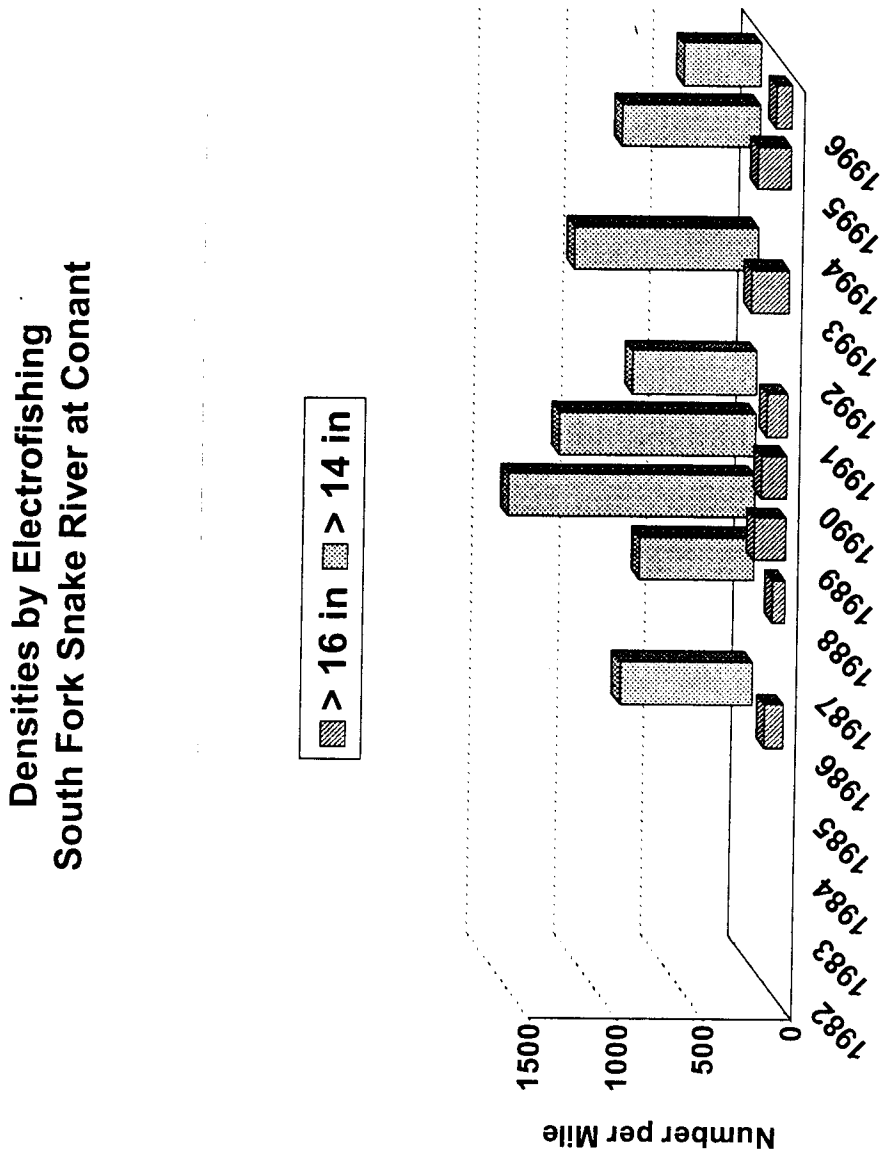

Figure 6. Estimated densities (fish/mi) of large (>16 in and >14 in) cutthroat trout at Conant electrofishing section, South Fork Snake River, 1986-1996.

Table 4. Summary of creel census statistics, upper South Fork Snake River, opener to mid-September, 1982 (Moore and Schill 1984, but entered and analyzed using IDFG Creel Census System computer program) and 1996 (present study).

Year	% Non-resident	% Guided	% Fishing by power boat	% Fishing by bank	% Fishing by float boat	% Fishing with bait	% Fishing with lures	% Fishing with flies
1982	11	2	22	60	18	64[a]	16[a]	20[a]
1996	21	9	15	19	66	38	10	52

Year	Effort (hours)	Average time fishing (hours)	% Weekday	Catch rate (fish/hour)	Total catch	Harvest rate (fish/hour)	Total harvest	% released
1982	53,170	3.6	47	0.90	47,730	0.53	27,937	41
1996	169,142	3.3	54	1.12	188,989	0.03	4,568	98

	% Catch composition[b]					% Harvest composition[c]				
Year	YCT	MWF	BRN	RBT	Other	YCT	MWF	BRN	RBT	Other
1982	67	20	9	1	2	63	20	12	2	2
1996	71	10	12	7	1	54	0	25	20	3

	% Catch composition[b]			% Harvest composition[b]		
Year	Power boat	Bank	Float boat	Power boat	Bank	Float boat
1982	27	56	16	23	68	10
1996	26	25	49	36	54	10

	% Catch composition[b]			% Harvest composition[b]		
Year	Bait	Lures	Flies	Bait	Lures	Flies
1982	47	17	36	63	16	21
1996	32	7	61	70	9	21

Year	Total number interviews	Number anglers interviewed
1982	1,518	2,758
1996	1,750	1,750

[a] Includes early opener (April 1) for section 1 (dam to footbridge abutments).
[b] From angler interviews.
[c] From stratified estimates.

Raw data from the 1982 (Moore and Schill 1984) and 1996 creel census were entered into the IDFG Creel Census System computer program (McArthur 1993) so comparative analyses could be made for similar time periods (opener to mid-September). Total angler effort in the upper South Fork Snake River in 1996 was estimated at 169,142 h (53,170 h in 1982) (Table 4). More than half (54%) of the total effort occurred during weekdays (47% in 1982). The estimated proportion of total effort by angler type was: 15% power boat (22% in 1982), 19% bank (60% in 1982), and 66% float boat (18% in 1982).

Estimated catch rate in 1996 was 1.12 fish/h (0.90 fish/h in 1982), and estimated total catch (including harvested and released fish) was 188,989 fish (47,730 fish in 1982; Table 4). Catch composition (from opener to mid-September angler interviews) was: 71% wild and hatchery cutthroat trout (67% in 1982), 10% mountain whitefish (20% in 1982), 12% brown trout (9% in 1982), 7% rainbow/hybrid trout (1% in 1982), and 1% other species (2% in 1982). Some of the 1982 catch was hatchery rainbow trout.

Estimated harvest rate was 0.03 fish/h (0.53 fish/h in 1982), and estimated total harvest was 4,568 fish (27,937 fish in 1982; Table 4). It was estimated that 98% of the fish caught were released (41% in 1982). Estimated harvest composition was: 54% wild and hatchery cutthroat trout (63% in 1982), 0% mountain whitefish (20% in 1982), 25% brown trout (12% in 1982), 20% rainbow/hybrid trout (2% in 1982), and 3% other species (2% in 1982). We did not account for hooking mortality. Some of the 1982 harvest was hatchery rainbow trout.

Of 81 harvested fish independently identified by the angler and the creel clerk, 43 agreed as being a cutthroat trout, 12 agreed as rainbow/hybrid trout, 23 agreed as brown trout, and 3 agreed as other species. There was no disagreement. We conclude that anglers on the South Fork Snake River are able to accurately identify trout caught.

Comparative creel census statistics going back to 1966 suggest improved catch rates, a doubling of effort, and a tripling of catch since special regulations were implemented on the South Fork Snake River in 1984 (Table 5). Of concern, however, are decreasing proportions of cutthroat trout, and increasing proportions of brown and rainbow/hybrid trout, in the catch. Cutthroat trout comprised 97% of the catch in 1966. Brown trout were not a significant proportion (>5%) of the catch until the early 1970s, rainbow/hybrid trout until the early 1990s. Note that these data are for various sections and intervals. Trends in angler catch composition suggest a potential threat to the genetic integrity and long-term viability of wild cutthroat trout populations in the South Fork Snake River.

Angler Effort

Estimated total angler effort in the upper South Fork Snake River during the 1996 summer fishing season (opener to mid-September) was 169,142 h (Table 6). This was more than triple the estimates for 1982 (53,170 h) and 1979 (43,343 h). Most total effort was in section 4 (Black Canyon to Heise cable, 49,379 h), followed by section 2 (Irwin footbridge abutments to Granite Creek, 44,546 h), section 3 (Granite Creek to Black Canyon, 42,907 h), and section 1 (Palisades dam to Irwin footbridge abutments, 32,310 h). No section had less effort than in 1979 or 1982.

Total effort peaked during interval 13 (August 17-30, 35,770 h) and was the least during interval 8 (June8-21, 4,256 h), probably due to high flows (Table 6). Only interval 8 had less effort than in 1982, but it was more than in 1979.

Table 5. Comparative creel census statistics, South Fork Snake River, 1966-1996 (from Moore 1980, Moore and Schill 1984, and present study).

Year	Effort (hours)	Catch rate (fish/hour)	Total catch	Catch Composition (%)[a]					Area & Time	Reference
				YCT	MWF	BRN	RBT	LKT		
1966	77,000	0.50	38,500	97	3	<1		<1	Dam - Heise June 1 - October 31	U.S. Fish and Wildlife Service (unpublished data)
1969	16,809	0.42	7,060	75	24	1			Black Can.-Heise Cable May 30 - November 30	Jeppson (1970)
1970	17,377[b]	0.56	9,731	85	8	6	1	<1	Dam - Black Canyon May 1 - November 30	Jeppson (unpublished data)
1972	33,390	0.51	17,029	75	20	2	3	<1	Dam - Heise July 1 - September 30	U.S. Fish and Wildlife Service (unpublished data)
1973	NE[c]	0.32	NE[c]	56	37	6	<1		Dam - Henrys Fork January 1 - Dec 31	Jeppson (1973)
1979	88,830	0.43	38,197	72	15	9	4	<1	Dam - Henrys Fork March 3 - February 29	Moore (1980)
1982	64,355	0.80	51,604	66	23	9	<1	2	Dam - Heise Cable April 1 - September 17	Moore and Schill (1984)
1996	169,142	1.12	188,989	71	10	12	7	<1	Dam - Heise Cable May 25 - September 13	Present study

[a] YCT = Yellowstone cutthroat trout; MWF = mountain whitefish; BRN = brown trout; RBT = rainbow trout; LKT = lake trout.
[b] Underestimated due to techniques used (Moore 1980).
[c] No estimate.

Table 6. Estimated angler effort (*f*, hours) by census section and interval, upper South Fork Snake River, 1979 (Moore 1980), 1982 (Moore and Schill 1984 but entered and analyzed using IDFG Creel Census System computer program), and 1996 (present study).

Interval #	1996 interval dates	Section 1			Section 2			Section 3			Section 4			Total		
		1979	1982	1996	1979	1982	1996	1979	1982	1996	1979	1982	1996	1979	1982	1996
7	25 May to 07 Jun	1,233	3,948	3,975	1,088	977	1,492	460	520	808	1,636	2,171	2,810	4,417	7,616	9,085
8	08 Jun to 21 Jun	623	4,800	2,413	609	719	333	200	297	591	1,450	1,048	919	2,882	6,864	4,256
9	22 Jun to 05 Jul	1,200	3,501	3,498	1,061	1,339	2,006	857	792	3,229	2,049	1,492	6,206	5,167	7,124	14,939
10	06 Jul to 19 Jul	500	2,976	3,327	1,348	936	5,497	2,371	1,424	4,399	2,652	1,499	5,068	6,871	6,835	18,291
11	20 Jul to 02 Aug	1,224	2,922	5,074	1,962	1,430	6,994	1,696	692	7,340	1,595	1,033	6,628	6,477	6,077	26,036
12	03 Aug to 16 Aug	2,439	2,635	4,731	1,716	1,689	9,991	1,881	1,835	9,192	1,115	1,619	11,115	7,151	7,778	35,029
13	17 Aug to 30 Aug	1,689	963	4,419	1,838	1,782	10,126	1,978	1,822	11,371	1,134	1,402	9,854	6,639	5,969	35,770
14	31 Aug to 13 Sep	669	932	4,873	690	1,744	8,107	1,150	1,130	5,977	1,230	1,101	6,779	3,739	4,907	25,736
Total	Opener to mid-Sep	9,577	22,677	32,310	10,312	10,616	44,546	10,593	8,512	42,907	12,861	11,365	49,379	43,343	53,170	169,142

The estimated proportion of total effort by angler type (Table 7) was 15% power boat (22% in 1982), 19% bank (60% in 1982), and 66% float boat (18% in 1982). However, total effort was about the same for bank anglers in 1982 (32,076 h) and 1996 (32,966 h). Powerboat angler effort more than doubled from 1982 (11,554 h) to 1996 (24,871 h), and float boat effort increased by a factor of almost 12 from 1982 (9,536 h) to 1996 (111,303 h). Effort by float boat anglers increased dramatically in all sections, whereas most of the increase by powerboat anglers was in section 4.

Angler Catch and Harvest Rate

The estimated catch rate in 1996 was 1.12 fish/h (0.90 fish/h in 1982), whereas the estimated harvest rate was 0.03 fish/h (0.53 fish/h in 1992) (Table 4). These rates were calculated by dividing the estimated total catch (or harvest) by total effort. Catch rates are not reported by strata (section, interval, species, angler type, gear type, etc.) because of problems obtaining them from the Creel Census System computer program (McArthur 1993).

Angler Catch and Harvest

The estimated total catch (including harvested and released fish) in 1996 was 188,989 fish, a significant increase from 47,730 fish in 1982 (Table 8). Catch composition was: 71% wild and hatchery cutthroat trout (67% in 1982), 10% mountain whitefish (20% in 1982), 12% brown trout (9% in 1982), 7% rainbow/hybrid trout (1% in 1982), and 1% other species (2% in 1982). Proportions of trout only (excluding mountain whitefish) are somewhat higher (Figure 7). Some of the 1982 catch was hatchery rainbow trout. Note that catch composition was based on angler interviews (the creel census program does not provide estimates).

The estimated proportion of the catch by angler type in 1996 (Table 8) was 26% power boat (27% in 1982), 25% bank (56% in 1982), and 49% float boat (16% in 1982). However, estimated catch by bank anglers almost doubled from 1982 (26,930 fish) to 1996 (48,057 fish). Catch by powerboat anglers more than tripled from 1982 (13,001 fish) to 1996 (48,927 fish), and catch by float boat anglers increased by a factor of 11 from 1982 (7,799 fish) to 1996 (92,005 fish).

The estimated proportion of the catch by gear type in 1996 (Table 8) was 32% bait (47% in 1982), 7% lure (17% in 1982), and 61% fly (36% in 1982). All catches by gear type increased from 1982 to 1996. These estimates could be biased as they were derived from angler interviews and total catch. However, we did not use anglers using more than one gear type to make the estimates. Because it is not possible to include gear type as a separate strata when making counts and estimating effort, catch estimates from the Creel Census System program are in error.

Estimated total harvest in 1996 was 4,568 fish, a significant decrease from 27,937 fish in 1982 (Table 9). From angler interviews, we estimated 98% of the fish caught were released (41% in 1982). Estimated harvest composition was 54% wild and hatchery cutthroat trout (63% in 1982), 0% mountain whitefish (20% in 1982), 25% brown trout (12% in 1982), 20% rainbow/hybrid trout (2% in 1982), and 3% other species (2% in 1982). Some of the 1982 harvest was hatchery rainbow trout. These are stratified estimates from the Creel Census System program.

Table 7. Estimated angler effort (*f*, hours) by census section and angler type, upper South Fork Snake River, opener to mid-September 1982 (Moore and Schill 1984 but entered and analyzed using IDFG Creel Census System computer program) and 1996 (present study).

		Section									
Angler type	Year	1		2		3		4		Total	
Powerboat	1982	299	(1%)	3,186	(30%)	4,009	(47%)	4,060	(36%)	11,554	(22%)
	1996	1,387	(4%)	5,315	(12%)	6,174	(14%)	11,995	(24%)	24,871	(15%)
Bank	1982	22,052	(97%)	3,863	(36%)	804	(9%)	5,357	(47%)	32,076	(60%)
	1996	21,665	(67%)	3,590	(8%)	846	(2%)	6,865	(14%)	32,966	(19%)
Float boat	1982	324	(1%)	3,568	(34%)	3,700	(43%)	1,944	(17%)	9,536	(18%)
	1996	9,259	(29%)	35,641	(80%)	35,885	(84%)	30,518	(62%)	111,303	(66%)
Total	1982	22,677	(43%)	10,616	(20%)	8,512	(16%)	11,365	(21%)	53,170	
	1996	32,310	(19%)	44,546	(26%)	42,907	(25%)	49,379	(29%)	169,142	

Table 8. Estimated angler catch (*c*) and catch composition (%) by species, angler type, and gear type, upper South Fork Snake River, opener to mid-September 1982 (Moore and Schill 1984 but entered and analyzed using IDFG Creel Census System computer program) and 1996 (present study). Note three different estimation methods. Catch is number harvested plus number released.

Statistic	Total catch X % of catch from angler interviews				Stratified calculations from IDFG Creel Census System computer program				Total effort X average catch rate			
	1982		1996		1982		1996		1982		1996	
Total catch[a]	47,730		188,989		47,730		188,989		47,730		188,989	
Catch composition by species:[b]												
YCT	32,198	(67%)	133,566	(71%)	N/A		N/A		19,673	(41%)	65,965	(35%)
RBT	281	(1%)	12,572	(7%)	N/A		N/A		532	(1%)	5,074	(3%)
BRN	4,525	(9%)	22,032	(12%)	N/A		N/A		2,127	(4%)	11,840	(6%)
MWF	9,644	(20%)	18,313	(10%)	N/A		N/A		6,912	(14%)	11,840	(6%)
Other	1,082	(2%)	2,506	(1%)	N/A		N/A		0	(0%)	1,691	(1%)
Total	47,730	(99%)	188,989	(101%)	N/A		N/A		29,244	(60%)	96,410	(51%)
Catch composition by angler type:												
Power boat	13,001	(27%)	48,927	(26%)	18,364	(38%)	22,300	(12%)	8,550	(18%)	12,187	(6%)
Bank	26,930	(56%)	48,057	(25%)	23,409	(49%)	31,438	(17%)	15,396	(32%)	16,153	(9%)
Float boat	7,799	(16%)	92,005	(49%)	6,594	(14%)	125,558	(66%)	2,193	(5%)	52,312	(28%)
Total	47,730	(99%)	188,989	(100%)	48,367	(101%)	179,296	(95%)	26,139	(55%)	80,652	(43%)
Catch composition by gear type:												
Bait	22,670	(47%)	61,178	(32%)	32,459	(68%)	102,094	(54%)	N/A		N/A	
Lure	8,054	(17%)	12,677	(7%)	43,251	(91%)	88,002	(47%)	N/A		N/A	
Fly	17,005	(36%)	115,134	(61%)	73,736	(154%)	197,951	(105%)	N/A		N/A	
Total	47,729	(100%)	188,989	(100%)	149,446	(313%)	388,047	(206%)	N/A		N/A	

[a] Total catch was estimated using a stratified random sampling design (see text) by the computer program and is considered the best estimate.
[b] YCT = Yellowstone cutthroat trout; RBT = rainbow trout; BRN = brown trout; MWF = mountain whitefish.

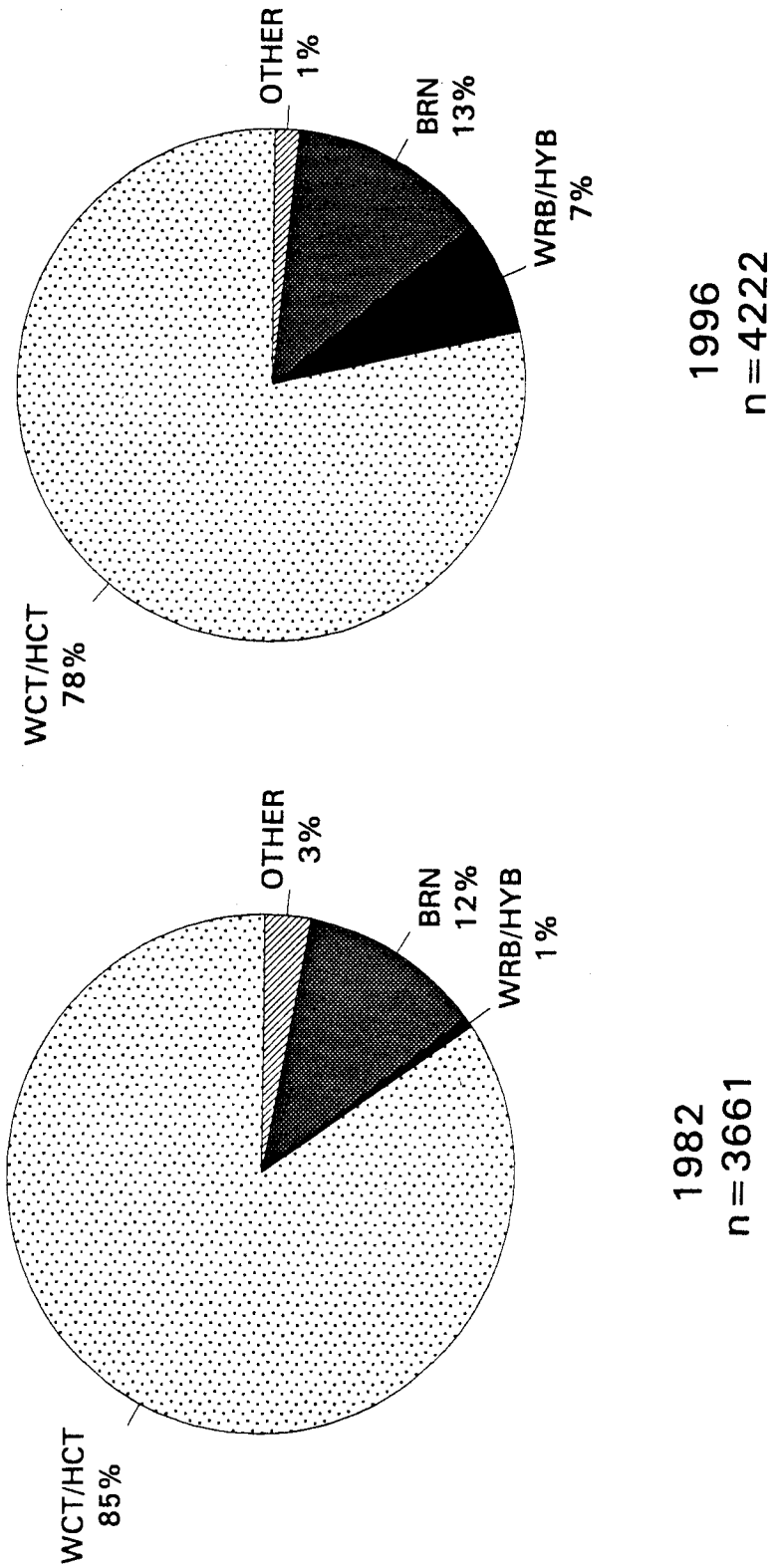

Figure 7. Trout catch composition (%) in the upper South Fork Snake River, opener to mid-September, 1982 and 1996. Total fish from angler interviews = n. Results are for all sizes of fish and, for 1982, are from Moore and Schill (1984, but entered and analyzed using IDFG Creel Census System computer program).

Table 9. Estimated angler harvest and harvest composition (%) by species, angler type, and gear type, upper South Fork Snake River, opener to mid-September 1982 (Moore and Schill 1984 but entered and analyzed using IDFG Creel Census System computer program) and 1996 (present study). Note two different estimation methods.

	Total harvest X % of harvest from angler interviews				Stratified calculations from IDFG Creel Census System computer program			
Statistic	1982		1996		1982		1996	
Total harvest[a]	27,937		4,568		27,937		4,568	
Harvest composition by species:[b]								
YCT	18,097	(65%)	2,446	(54%)	17,603	(63%)	2,484	(54%)
RBT	162	(1%)	619	(14%)	585	(2%)	894	(20%)
BRN	3,598	(13%)	1,356	(30%)	3,404	(12%)	1,132	(25%)
MWF	5,192	(19%)	0	(0%)	5,631	(20%)	0	(0%)
Other	888	(3%)	147	(3%)	627	(2%)	126	(3%)
Total	27,937	(101%)	4,568	(101%)	27,850	(99%)	4,636	(102%)
Harvest composition by angler type:								
Power boat	6,358	(23%)	1,658	(36%)	8,594	(31%)	652	(14%)
Bank	18,913	(68%)	2,473	(54%)	16,676	(60%)	2,281	(50%)
Float boat	2,667	(10%)	436	(10%)	2,711	(10%)	476	(10%)
Total	27,938	(101%)	4,567	(100%)	27,981	(101%)	3,409	(74%)
Harvest composition by gear type:								
Bait	17,554	(63%)	3,198	(70%)	25,773	(92%)	7,296	(160%)
Lure	4,588	(16%)	426	(9%)	27,721	(99%)	3,287	(72%)
Fly	5,794	(21%)	944	(21%)	34,633	(124%)	2,542	(56%)
Total	27,936	(100%)	4,568	(100%)	88,127	(315%)	13,125	(288%)

[a] Total harvest was estimated using a stratified random sampling design (see text) by the computer program and is considered the best estimate.

[b] YCT = Yellowstone cutthroat trout; RBT = rainbow trout; BRN = brown trout; MWF = mountain whitefish.

Most 1982 and 1996 harvest was by bank anglers and anglers using bait (Table 4). However, harvest significantly decreased by all angler types and gear types from 1982 to 1996.

Other

During the 1996 summer fishing season (May 25 to September 13) we conducted 1,750 angler interviews with 1,750 anglers in the upper South Fork Snake River (dam to Heise cable) (Table 4). In 1982 Moore and Schill (1984) conducted 1,518 interviews with 2,758 anglers during the summer season (May 29 to September 17) and early season (April 1 to May 28 in section 1) in the same stretch. From the 1996 interviews, 21% of anglers were nonresident (11% in 1982) and 9% of all anglers were guided (2% in 1982). Average time spent fishing was 3.3 h (3.6 h in 1982).

Of 81 harvested fish independently identified by the angler and the creel clerk, 43 agreed as to being a cutthroat trout, 12 agreed as rainbow/hybrid trout, 23 agreed as brown trout, and 3 agreed as other species. There was no disagreement. We conclude that anglers on the South Fork Snake River are able to accurately identify trout caught.

RECOMMENDATIONS

1. Continue electrofishing mainstem South Fork Snake River wild trout populations, electrofish Conant and Palisades sections in 1997, and analyze Lorenzo data 1987-1995.

2. Develop length-weight regressions for each wild trout species using electrofishing data collected in 1994 through 1996. Test for significant spatial (between sections) and temporal (between years) differences. Predict fish weights from measured lengths and estimate biomass and standing crops for all sections and years. Analyze for significant trends.

3. Use cross-sectioned otoliths to back-calculate length-at-age and annual increment of growth; use DISBCAL 89 program (Frie 1982; Missouri Department of Conservation 1989) to digitize otoliths and analyze data. Sample for known-age fish adipose clipped in 1996 to validate aging techniques.

4. Continue genetic sampling of wild cutthroat, rainbow, and hybrid trout populations to determine extent of genetic introgression.

5. Continue coordinating graduate student research on rainbow/hybrid trout spawning locations and timing; identify vulnerable stages (especially reproductive) of rainbow/hybrid trout populations and develop effective protocols for controlling this expanding and non-native species; and identify and protect remaining native cutthroat trout populations in the mainstem and tributaries.

6. Coordinate management and research guidelines with in-house Yellowstone Cutthroat Trout Management Team; model population dynamics in Wild Trout Workshop using MOCPOP computer program (Beamesderfer 1991).

7. Determine extent of recruitment to the riverine fishery (below Palisades Dam) from stocks in the reservoir, particularly hatchery fine-spotted cutthroat trout. Explore factors affecting this recruitment such as extent of reservoir drawdown. Develop accurate methods to differentiate reservoir fish from riverine fish and hatchery fish from wild fish.

ACKNOWLEDGMENTS

Fishery biological aide Clint Rasmussen and volunteers Kim Ragotzkie, Rick Henderson, Don Wright, Dave Koehler, and Bob Martin helped with electrofishing. Clint Rasmussen also entered electrofishing data. We especially thank fishery research biologist John Der Hovanisian and biological aides Donnie Wicher and Tom Alworth for marking multitudes of fry, helping operate the Palisades and Burns fish screens, and helping graduate student Rick Henderson collect additional information.

We wish to thank the many people who helped with the creel census. Fishery technician Travis Horton oversaw data collection and entered most of the data. Fishery biological aides Derek Fryer, Sam Nicholson, John Anderson, Michelle Nicholson, Donnie Wicher and Tom Alworth collected most of the data. Fishery research biologist Steve Elle provided valuable advice and much of the personnel and operating funds. We especially thank the U.S. Forest Service, Palisades District, for providing housing at the Snake River Guard Station in Conant Valley. The U.S. Bureau of Land Management assisted in additional data collection.

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APPENDICES

Appendix A. Mainstem trout population statistics, South Fork Snake River, 1986-1996.

Appendix Table A-1. Trout species composition and relative abundance (%) at the Conant electrofishing sections, South Fork Snake River, October, 1982-1996. Total new fish captured during mark and recapture runs is in parentheses. Results are from MR4 database for all sizes of fish.

Year	WCT & HCT[a,b]	WRB & HYB[a]	BRN[a]	LKT[a,b]	KOK[a,b]	Total
1982[c,d,e]	79 (181)	1 (2)	19 (44)	1 (2)	0 (0)	100 (229)
1986[d]	83 (1,647)	2 (47)	14 (285)	<1 (4)	0 (0)	99 (1,983)
1987[d,f,g]	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[h]	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[f]	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)

[a] WCT=wild cutthroat trout; HCT=hatchery cutthroat trout; WRB=wild rainbow trout; HYB=wild rainbow x cutthroat hybrid trout; BRN=wild brown trout; LKT=lake trout; KOK=kokanee salmon.
[b] HCT, LKT, and KOK are believed to emigrate from Palisades Reservoir and numbers are directly related to extent of drawdown.
[c] Only 1.9 km of larger 4.9 km section was electrofished.
[d] Electrofishing conducted in early November.
[e] From Moore and Schill (1984), not MR4 database.
[f] Only two marking and no recapture runs done due to low flows.
[g] Only 3.2 km of larger 4.9 km section was electrofished with drift boat.
[h] Only one marking and no recapture runs done due to low flows.

Appendix Table A-2. Mean total length and quality stock density (QSD, %) of wild trout captured at the Conant electrofishing section, South Fork Snake River, October, 1986-1996. Total new fish captured during mark and recapture runs=n. QSD = (number ≥16 in/number ≥8 in) x 100. Results are from MR4 database for all sizes of fish.

	WCT/HCT[a,b]			WRB/HYB[a]			BRN[a]			All[b,c]		
Year	n	(in)	QSD	n	(in)	QSD	n	(in)	QSD	n	(in)	QSD
1986[d]	1,647	13.0	8.5	47	12.1	11.4	285	13.3	29.0	1,983	13.0	11.5
1987[d,e,f]	299	11.7	14.9	6	10.3	0.0	43	9.8	11.5	348	11.5	14.3
1988	1,570	13.3	5.6	58	12.9	12.3	159	12.2	22.8	1,788	13.2	7.3
1989	2,291	13.9	8.8	103	12.7	19.6	175	13.5	38.5	2,569	13.8	11.2
1990	2,978	12.6	8.4	216	10.6	13.3	335	10.5	20.4	3,533	12.2	9.7
1991	1,646	13.1	11.2	150	9.9	6.6	259	10.8	14.1	2,055	12.6	11.3
1992[g]	598	13.1	9.0	34	11.1	2.9	87	10.4	6.6	719	12.7	8.4
1993	1,528	13.8	15.3	113	13.4	18.2	166	13.0	34.2	1,807	13.7	17.2
1994[e]	867	11.7	11.2	100	9.9	13.4	136	9.3	7.4	1,104	11.3	10.9
1995	1,121	13.8	21.2	256	10.9	10.6	258	11.3	15.8	1,635	12.9	18.7
1996	1,190	12.2	8.7	274	10.3	6.6	325	11.2	12.7	1,791	11.7	9.2

[a] WCT=wild cutthroat trout; HCT = hatchery cutthroat trout; WRB = wild rainbow trout; HYB = wild rainbow x cutthroat hybrid trout; BRN = wild brown trout.
[b] HCT, LKT, and KOK are believed to emigrate from Palisades Reservoir and numbers are directly related to extent of drawdown.
[c] Includes lake trout (LKT) and kokanee salmon (KOK).
[d] Electrofishing conducted in early November.
[e] Only two marking and no recapture runs done due to low flows.
[f] Only 3.2 km of larger 4.9 km section was electrofished with drift boat.
[g] Only one marking and no recapture runs done due to low flows.

Appendix Table A-3. Range of flows, mean flow, and electrofishing sampling efficiencies (R/C) at the Conant section, South Fork Snake River, 1986-1996. Flows were recorded at the USGS Irwin gage. Electrofishing results are from MR4 database for all sizes of fish.

Sampling dates	Range of flows (cfs)	Mean flow (cfs)	WCT & HCT[a,b]				WRB & HYB[a]				BRN[a]				All[b,c]				Catch rate (fish/ day)[d]
			M	C	R	R/C (%)	M	C	R	R/C (%)	M	C	R	R/C (%)	M	C	R	R/C (%)	
1986: 11/ 4,5,6,7,20	3,540-3,780	3,590	1,171	546	70	13	32	17	2	12	186	107	8	7	1,393	670	80	12	413
1987: 11/5,6[e,f]	869-941	905	299	--	--	--	6	--	--	--	43	--	--	--	348	--	--	--	174
1988: 10/ 3,4,11	3,600-3,710	3,650	1,101	567	98	17	41	18	1	6	115	48	4	8	1,257	634	103	16	630
1989: 10/ 18,19,27	2,990-3,060	3,040	1,424	1,067	200	19	58	55	10	18	107	79	11	14	1,589	1,201	221	18	930
1990: 10/ 11,12,18	3,490-3,690	3,560	1,768	1,527	317	21	118	112	14	12	213	134	12	9	2,102	1,774	343	19	1,292
1991: 10/ 7,8,15	4,490-4,790	4,650	1,159	627	140	22	105	54	9	17	158	120	19	16	1,422	801	168	21	741
1992: 10/14[e]	--	2,130	598	--	--	--	34	--	--	--	87	--	--	--	719	--	--	--	719
1993: 10/ 13,14,21, 22	620-3,820	3,210	998	630	100	16	78	41	6	15	110	66	10	15	1,186	737	116	16	481
1994: 10/ 7,11,14[e]	1,220-2,440	1,850	867	--	--	--	100	--	--	--	136	--	--	--	1,104	--	--	--	368
1995: 10/ 5,6,12,13	2,570-4,090	3,290	633	565	77	14	130	143	17	12	154	117	13	11	917	825	107	13	436
1996: 10/ 3,4,10,11	3,760-3,790	3,775	714	548	72	13	165	114	5	4	216	127	18	18	1,097	789	95	12	472

[a] WCT=wild cutthroat trout; HCT = hatchery cutthroat trout; WRB = wild rainbow trout; HYB = wild rainbow x cutthroat hybrid trout; BRN = wild brown trout.

[b] HCT, LKT, and KOK are believed to emigrate from Palisades Reservoir and numbers are directly related to extent of drawdown.

[c] Includes lake trout (LKT) and kokanee salmon (KOK).

[d] Includes recaptured fish; catch rate=(M+C)/number days sampled.

[e] No recapture runs due to low flows.

[f] Only 3.2 km of larger 4.9 km section was electrofished with drift boat.

Appendix Table A-4. Estimated abundance (N) of age 1 and older (≥4 in) wild and hatchery cutthroat trout at the Conant electrofishing section, South Fork Snake River, 1986-1996. Results are from MR4 database and analysis using modified Peterson (P) and log-likelihood (L) estimators. Standard deviations are in parentheses.

First marking date	Miles	km	Ha	N/section		N/mile		N/km		N/ha		N/100 m^2	
				P	L	P	L	P	L	P	L	P	L
11/4/86	3.04	4.9	35.0	9,021	14,161 (1,005)	2,967	4,658	1,841	2,890	258	405	2.58	4.05
11/5/87	3.04	4.9	35.0	---[a]	---	---	---	---	---	---	---	---	---
10/3/88	3.04	4.9	35.0	6,249	7,306 (370)	2,056	2,403	1,275	1,491	179	209	1.79	2.09
10/18/89	3.04	4.9	35.0	7,403	7,860 (269)	2,435	2,586	1,511	1,604	212	225	2.12	2.25
10/11/90	3.04	4.9	35.0	8,304	11,416 (432)	2,732	3,755	1,695	2,330	237	326	2.37	3.26
10/7/91	3.04	4.9	35.0	5,087	6,854 (340)	1,673	2,255	1,038	1,399	145	196	1.45	1.96
10/14/92	3.04	4.9	35.0	---[a]	---	---	---	---	---	---	---	---	---
10/13/93	3.04	4.9	35.0	6,004	7,364 (374)	1,975	2,422	1,225	1,503	172	210	1.72	2.10
10/7/94	3.04	4.9	35.0	---[a]	---	---	---	---	---	---	---	---	---
10/5/95	3.04	4.9	35.0	4,399	6,029 (367)	1,447	1,983	898	1,230	126	172	1.26	1.72
10/3/96	3.04	4.9	35.0	5,324	7,361 (562)	1,751	2,421	1,087	1,502	152	210	1.52	2.10

[a] No estimate; recapture runs not made.

Appendix Table A-5. Estimated abundance (N) of age 1 and older (≥4 in) wild rainbow and hybrid trout at the Conant electrofishing section, South Fork Snake River, 1986-1996. Results are from MR4 database and analysis using modified Peterson (P) and log-likelihood (L) estimators. Standard deviations are in parentheses.

First marking date	Miles	km	Ha	N/section		N/mile		N/km		N/ha		N/100 m^2	
				P	L	P	L	P	L	P	L	P	L
11/4/86	3.04	4.9	35.0	---[a]	---	---	---	---	---	---	---	---	---
11/5/87	3.04	4.9	35.0	---[b]	---	---	---	---	---	---	---	---	---
10/3/88	3.04	4.9	35.0	---[a]	---	---	---	---	---	---	---	---	---
10/18/89	3.04	4.9	35.0	294	310 (65)	97	102	60	63	8	9	0.08	0.09
10/11/90	3.04	4.9	35.0	835	1,004 (161)	275	330	170	205	24	29	0.24	0.29
10/7/91	3.04	4.9	35.0	544	657 (135)	179	216	111	134	16	19	0.16	0.19
10/14/92	3.04	4.9	35.0	---[b]	---	---	---	---	---	---	---	---	---
10/13/93	3.04	4.9	35.0	449	538 (127)	148	177	92	110	13	15	0.13	0.15
10/7/94	3.04	4.9	35.0	---[b]	---	---	---	---	---	---	---	---	---
10/5/95	3.04	4.9	35.0	1,025	1,326 (181)	337	436	209	271	29	38	0.29	0.38
10/3/96	3.04	4.9	35.0	2,956	4,942 (1,845)	972	1,626	603	1,009	84	141	0.84	1.41

[a] Unbiased estimate not possible as R<3 (Ricker 1975).
[b] No estimate; recapture runs not made.

Appendix Table A-6. Estimated abundance (N) of age 1 and older (≥6 in) wild brown trout at the Conant electrofishing section, South Fork Snake River, 1986-1996. Results are from MR4 database and analysis using modified Peterson (P) and log-likelihood (L) estimators. Standard deviations are in parentheses.

First marking date	Miles	km	Ha	N/section		N/mile		N/km		N/ha		N/100 m^2	
				P	L	P	L	P	L	P	L	P	L
11/4/86	3.04	4.9	35.0	2,166	3,142 (632)	713	1,034	442	641	62	90	0.62	0.90
11/5/87	3.04	4.9	35.0	---[a]	---	---	---	---	---	---	---	---	---
10/3/88	3.04	4.9	35.0	1,061	1,652 (776)	349	543	217	337	30	47	0.30	0.47
10/18/89	3.04	4.9	35.0	596	936 (405)	196	308	122	191	17	27	0.17	0.27
10/11/90	3.04	4.9	35.0	1,578	1,806 (331)	519	594	322	369	45	52	0.45	0.52
10/7/91	3.04	4.9	35.0	905	954 (129)	298	314	185	195	26	27	0.26	0.27
10/14/92	3.04	4.9	35.0	---[a]	---	---	---	---	---	---	---	---	---
10/13/93	3.04	4.9	35.0	602	663 (194)	198	218	123	135	17	19	0.17	0.19
10/7/94	3.04	4.9	35.0	---[a]	---	---	---	---	---	---	---	---	---
10/5/95	3.04	4.9	35.0	1,175	1,442 (440)	387	474	240	294	34	41	0.34	0.41
10/3/96	3.04	4.9	35.0	1,400	1,538 (196)	461	506	286	314	40	44	0.40	.044

[a] No estimate; recapture runs not made.

Appendix Table A-7. Estimated abundance (N) of wild trout (≥4 in, including lake trout and kokanee salmon) at the Conant electrofishing section, South Fork Snake River, 1986-1996. Results are from MR4 database and analysis using modified Peterson (P) and log-likelihood (L) estimators. Standard deviations are in parentheses.

First marking date	Miles	km	Ha	N/section		N/mile		N/km		N/ha		N/100 m^2	
				P	L	P	L	P	L	P	L	P	L
11/4/86	3.04	4.9	35.0	11,521	13,935 608)	3,790	4,584	2,351	2,844	329	398	3.29	3.98
11/5/87	3.04	4.9	35.0	---[a]	---	---	---	---	---	---	---	---	---
10/3/88	3.04	4.9	35.0	7,601	9,005 (434)	2,500	2,962	1,551	1,838	217	257	2.17	2.57
10/18/89	3.04	4.9	35.0	8,427	8,788 (262)	2,772	2,891	1,720	1,793	241	251	2.41	2.51
10/11/90	3.04	4.9	35.0	10,596	14,633 (435)	3,486	4,813	2,162	2,986	303	418	3.03	4.18
10/7/91	3.04	4.9	35.0	6,640	7,920 (287)	2,184	2,605	1,355	1,616	190	226	1.90	2.26
10/14/92	3.04	4.9	35.0	---[a]	---	---	---	---	---	---	---	---	---
10/13/93	3.04	4.9	35.0	7,215	8,058 (324)	2,373	2,651	1,472	1,644	206	230	2.06	2.30
10/7/94	3.04	4.9	35.0	---[a]	---	---	---	---	---	---	---	---	---
10/5/95	3.04	4.9	35.0	6,785	8,349 (391)	2,232	2,746	1,385	1,704	194	239	1.94	2.39
10/3/96	3.04	4.9	35.0	8,900	11,233 (640)	2,928	3,695	1,816	2,292	254	321	2.54	3.21

[a] No estimate; recapture runs not made.

Appendix Table A-8. Total numbers and marking history of cutthroat trout stocked into Palisades Reservoir and the Salt River, Wyoming.

Year	Total stocked	Size range (in)	Mark[a]	Hatchery[b]	Comments
			Palisades Reservoir		
1992	88,648	7-8	AD	JNFH	Fall plant
	198,539	5-7	None	JNFH	Spring plant
1993			None	JNFH	
			None	JNFH	
1994			None	JNFH	
			None	JNFH	
1995	183,733	5-7	None	JNFH	
	93,651	5-7	RV	JNFH	
	3,110	14-16	LV	JNFH	
1996	200,000	5-7	RV	JNFH	
	30,000	10-12	LV	JNFH	
			Salt River, WY		
1993	6,255		None	ASFH	
	4,100		AD	JNFH	
1994	10,049		RV	JNFH	
1995	6,621		AD & LV	JNFH	From Murry north
	3,198		AD & RV	JNFH	From 238 south
	4,000		AD & VI	Wild	
1996			LV & RV	JNFH	Similar numbers as 1995

[a] AD = adipose fin clip; LV = left ventral or pelvic clip; RV = right ventral or pelvic clip; VI = visible implant tag.

[b] JNFH = Jackson National Fish Hatchery, WY; ASFH = Auburn State Fish Hatchery, WY.

Appendix Table A-9. Brown trout redd counts on the South Fork Snake River, 1979-1996.

Section	Distance (km)	12/11/79	12/16/80	12/4/81	12/8/82	12/20/83[a]	12/4/84	12/10/85	12/5/86	12/4/87[b]	12/5/88	12/18/89[c]	12/7/90	12/9/91	1992[d]	12/13/93	12/18/94	1995[e]	1996[f]
Afterbay of Palisades	0.8	50	61	69	90	49	75	179	294	70	199	117	168	111	---	40	56	---	---
Afterbay-Irwin	11.2	0	0	0	0	0	51	143	29	2	15	0	7	0	---	0	20	---	---
Irwin-Conant Valley	15.8	6	45	7	4	4	8	65	46	103	8	106	12	207	---	126	22	---	---
Conant-Burns Creek	16.2	89	104	95	120	96	37	143	311	133	216	215	171	216	---	55	109	---	---
Burns Creek-Anderson Diversion	20.6	14	23	0	57	9	51	8	62	47	39	61	127	141	---	88	53	---	---
Anderson-Heise Bridge	5.6	4	0	0	0	0	7	5	0	7	2	0	0	0	---	0	0	---	---
Heise Bridge-Mouth	30.4	2	5	21	NC	NC	23	65	67	168	66	75	81	214	---	115	46	---	---
TOTALS	100.6	177	251	216	271	154	252	608	809	530	545	574	566	889	---	424	306	---	---

[a] Counts should be considered low due to poor visibility from fog. NC = not counted.
[b] Later flights indicated fish spawned later in 1987 than in previous years. On December 14 in the afterbay, 105 redds were counted versus 70 on December 4.
[c] Late counts due to weather cancellations. Fog at dam, ice below Lorenzo.
[d] Not done in 1992 due to weather cancellations.
[e] Not done in 1995 due to unavailability of aircraft.
[f] Not done in 1996 and discontinued.

1996 ANNUAL PERFORMANCE REPORT

State of: Idaho

Program: Fisheries Management

Project I: Surveys and Inventories

Subproject I-G: Upper Snake Region

Job: c^2

Title: Rivers and Streams Investigations-Henrys Fork Snake River, Buffalo River

Contract Period: July 1, 1996 to June 30, 1997

ABSTRACT

An electrofishing survey on the Box Canyon Reach of the Henrys Fork Snake River provided a population estimate of 4,210 (1.45/100 m^2) wild rainbow trout *Oncorhynchus mykiss* over 6 inches (150 mm) in length. This represents a continued decline in numbers since fall 1993.

Angler effort on Box Canyon in 1996 was 35,970 hours with an average catch rate of 0.72 fish/h.

Angler effort on the Buffalo River was 2,466 hours with an average catch rate of 1.5 fish/h.

Authors:

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OBJECTIVES

1. Estimate abundance and size structure of wild rainbow trout *Oncorhynchus mykiss* (>6") in the Box Canyon reach of the Henrys Fork Snake River.

2. Assess angler effort, catch, and harvest in the Box Canyon reach of the Henrys Fork Snake River and in the Buffalo River.

METHODS

Henry's Fork Snake River

Box Canyon Population Estimate

Box Canyon was electrofished May 17-22 (marking event) and May 24 (recapture event). One drift boat shocker made a total of 13 passes during the marking event. All captured fish were identified, measured and given a lower caudal fin punch. Six passes were made during the recapture event. To avoid duplicate counting, fish captured during each recapture pass were given an upper caudal fin punch. Mark-recapture data were analyzed with MR4 software.

Box Canyon Creel Survey

Regional fisheries personnel and the Henrys Fork Foundation (HFF) cooperated in a survey of Box Canyon anglers. A structured roving creel survey took place from May 25 to November 30. HFF interns performed angler counts and interviews, and HFF research personnel compiled and analyzed the data.

Buffalo River

Creel Survey

Regional fisheries personnel also worked with HFF to design and implement a structured roving creel census on the Buffalo River. The survey ran from May 26 to July 24 during which HFF interns did counts and interviews, and HFF research personnel analyzed the data.

RESULTS AND DISCUSSION

Henrys Fork Snake River

Box Canyon Population Estimate

A total of 1,092 trout were sampled in marking and recapture runs combined. Species composition was comprised of wild rainbow trout (96%), hatchery rainbow trout (2%), hybrid rainbow x cutthroat trout *Oncorhynchus clarki* (1%), and brook trout *Salvelinus fontinalis* (1%).

Wild rainbow trout sampled in this reach ranged in size from <1 to 22 in (558 mm; Appendix A). Sampling efficiency increased with fish size, and was generally low for fish <11 in (Appendix B).

Estimated abundance of wild rainbow trout (6 in or 152 mm) was 3,390 fish using the modified Peterson method and 4,210 fish using the log-likelihood method (Table 1). These estimates are 51% and 71%, respectively of 1995 estimates. Abundance estimates equate to 1,413 or 1,754 fish per river mile, depending on the method of calculation. For comparison with past years the log-likelihood method estimate is reported for consistency and best probable degree of accuracy. The 1996 estimate continued the decline observed since fall of 1993 (Table 1).

Box Canyon Creel Survey

Anglers fished a total of 35,970 hours from May 25 to November 30 and caught 25,922 fish for an overall catch rate of 0.72 fish/h (Appendix C). Catch rates have remained high despite the decrease in trout population size on the last 20 years.

Buffalo River

Creel Survey

Anglers fished a total of 2,466 hours from May 26 to July 24 and caught 3,730 fish (Appendix D) for an overall catch rate of 1.5 fish/h. Harvest totaled 1,354 fish comprised of 65% brook trout, 34% hatchery rainbow trout, and 1% wild rainbow trout.

Table 1. Estimated abundance of wild rainbow trout (≥6 in or 152 mm) in the Box Canyon section, Henrys Fork Snake River, 1993-1996.

Reach name	Modified Peterson method (MPM)	Log-likelihood method (LLM)	Sample section length (mi)	Entire reach length (mi)	#/River mile by MPM (LLM)	#/reach
Box Canyon Fall 1993	~10,000		2.4	2.8	4,200	11,800
Box Canyon Spring 1994	7,234	9,359	2.4	2.8	3,014 (3,900)	8,439 (10,920)
Box Canyon Spring 1995	6,080	5,904	2.4	2.8	2,533 (2,460)	7,092 (6,888)
Box Canyon Spring 1996	3,390	4,210	2.4	2.8	1,413	3,965

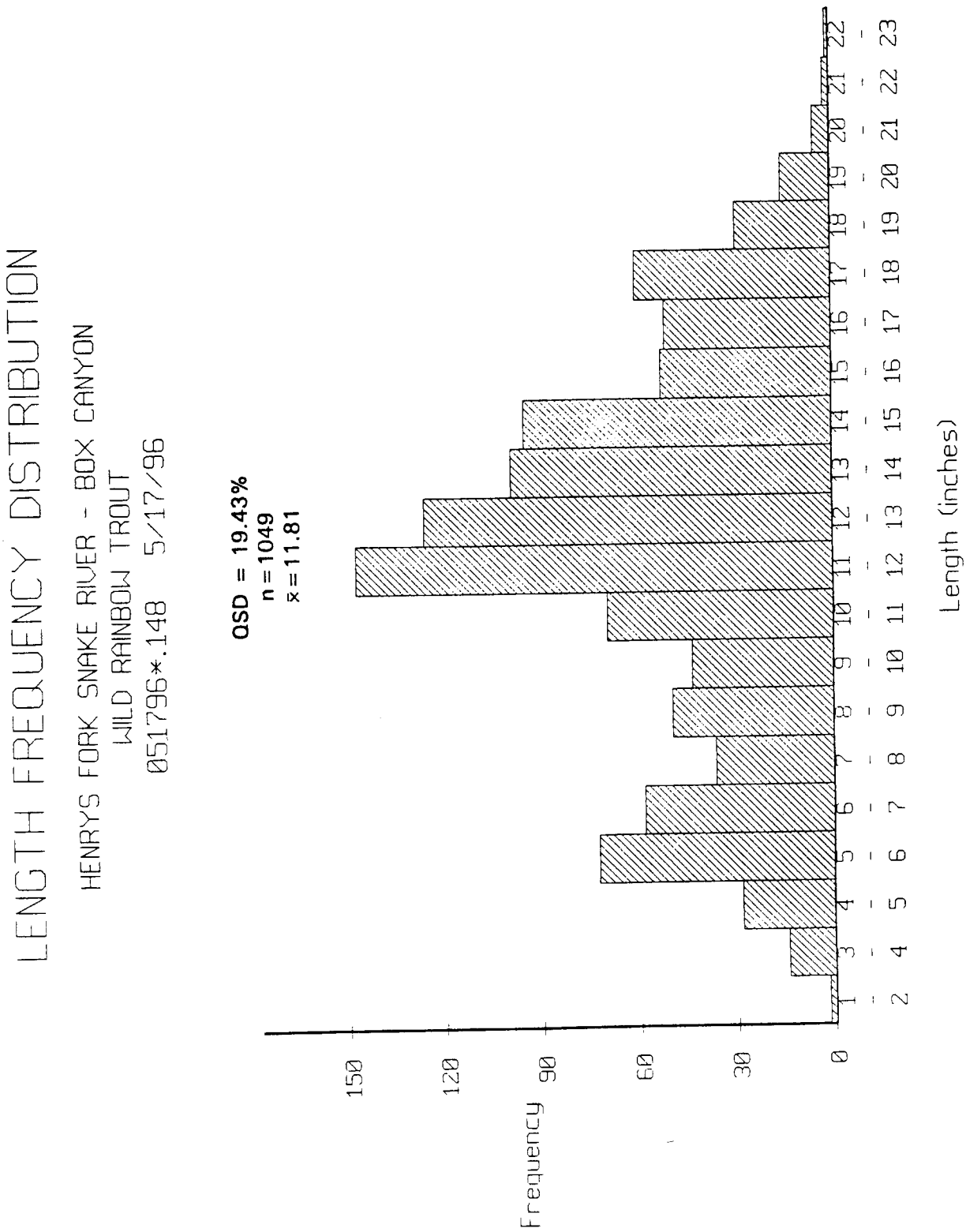
RECOMMENDATIONS

1. Continue spring estimates of wild rainbow trout in the Box Canyon reach of the Henrys Fork Snake River.

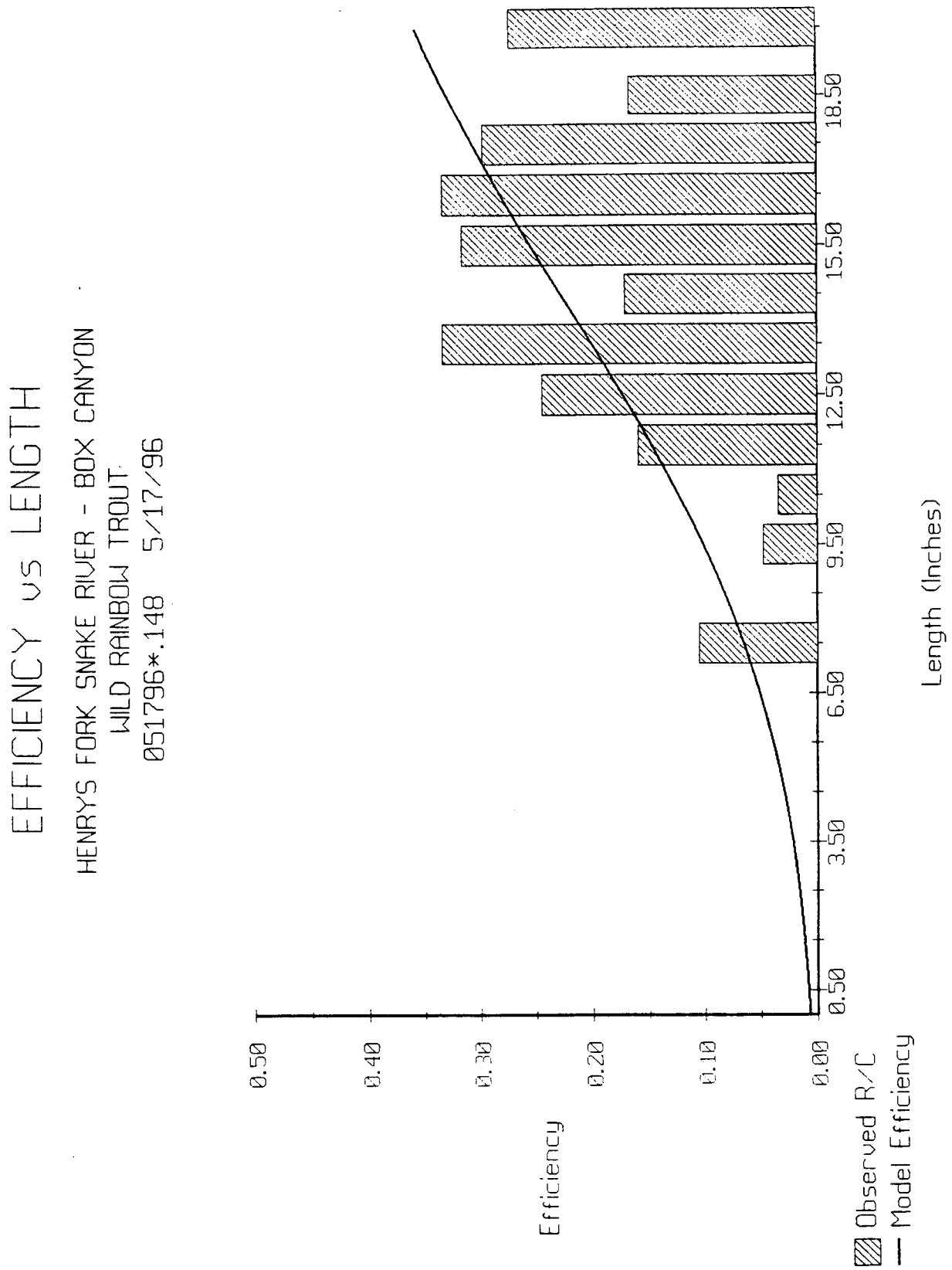
2. Continue monitoring angler effort and catch in Box Canyon and the Buffalo River to evaluate effects of the Buffalo River fish ladder.

APPENDICES

Appendix A. Length frequency of wild rainbow trout sampled during population estimates on Box Canyon, May 17-24, 1996.



Appendix B. Recapture efficiency vs. length for wild rainbow trout in Box Canyon, May 17-24, 1996.



Appendix C. Summary of creel census data, Box Canyon, 1996.

Survey Shows Box Canyon Anglers Had Good Fishing in 1996

by Rob Van Kirk

The first comprehensive survey of Box Canyon anglers in 15 years shows that despite significant declines in rainbow trout numbers, catch rates remain fairly high, and anglers generally enjoyed good fishing during the 1996 season. The survey was conducted by HFF interns Doug Hayes and Jay Didier, under the supervision of HFF and Idaho Department of Fish and Game research personnel.

Table 1. 1996 Box Canyon Creel Survey Results

	effort (angler-hours)			rainbow caught			catch rate (rbw/hr)		
time period	wade	boat	total	wade	boat	total	wade	boat	total
5/25-6/16	725	2,489	3,214	214	1,116	1,330	0.30	0.45	0.41
6/17-7/23	4,365	2,386	6,751	3,149	1,349	4,498	0.72	0.57	0.67
7/24-8/31	1,915	1,774	3,689	2,028	1,273	3,301	1.06	0.72	0.89
9/1-10/15	1,729	1,864	3,593	800	2,130	2,930	0.46	1.14	0.82
10/16-11/30	738	0	738	902	0	902	1.22	NA	1.22
season totals	9,472	8,513	17,985	7,093	5,868	12,961	0.75	0.69	0.72

The results of the survey are summarized in Table 1, which shows that total angling effort was nearly evenly divided between boat and wade anglers. Boat effort was concentrated during the early part of the season, when high water made wade angling difficult. Boat anglers enjoyed higher catch rates during the first three weeks of the season, but wade anglers generally had greater success once the water came down in late June. Catch rates averaged about 0.7 fish per hour, meaning that anglers fished nearly three hours to land two rainbows. This catch rate is generally considered to indicate good fishing in a wild trout fishery.

Anglers caught and released nearly 13,000 rainbow trout, a staggering number considering that the total number of rainbows over six inches long in the Box during the spring population count was only 4,605. While it is safe to conclude that each fish is being caught more than once during the season, it is probably not accurate to conclude that each fish was caught three times, as the raw numbers indicate. A large percentage of the fish caught after late August were six to eight inches long and thus would not have been counted in the May population count of fish over six inches.

A more accurate comparison of catch rates relative to population size is given in Table 2, which includes catch and population data collected prior to August 31 from the 1976, 1981 and 1996 seasons. This comparison shows that effort has not increased from 1981 to 1996, although the present effort is much higher than that of 1976. The number of fish harvested during each of these three years mirrors fishing regulations. In 1976, the limit was 10 fish, and the river was stocked heavily with hatchery rainbow trout. A three-under-12-one-over-20 slot limit existed in 1981, and the current regulations are catch-and-release.

Table 2. Box Canyon Creel Survey Comparison Season Opener to August 31

year	effort (ang-hrs)	rainbow harvested	rainbow released	catch rate (rbw/hr)	population size	catch efficiency
1976	8,416	4,529	8,164	1.51	20,000	0.76
1981	14,140	47	14,371	1.02	15,155	0.67
1996	13,654	0	9,127	0.67	4,605	1.45

The last three columns of Table 2 show how fishing has changed as the population size has decreased. Although catch rates have declined, they have fallen much less than the population decrease would suggest. The

continued on page 16

Box Canyon Survey *continued from page 7*

1996 population is only one fifth of what it was in 1976, yet the catch rate has fallen to only a little less than one half of its 1976 value. This information is represented by the "catch efficiency" index, which is the hourly catch rate per 10,000 fish in the population. This index shows, in relative terms, how efficient anglers are at catching the trout available to them. The 1996 Box Canyon fly angler is nearly twice as efficient as the 1976 angler, who was just as likely to sling a nightcrawler as a black rubberlegs. The 1996 efficiency is well over twice that of 1981, which is due in part to regulations at that time that prohibited fishing out of the boat prior to July 15. The rest of the increase in efficiency between the early 1980s and today is probably due to technologically advanced equipment and more effective angling methods in the hands of highly skilled anglers who have access to volumes of how-to fishing videos, books and magazines that did not exist 15 years ago.

The logical question raised by Table 2 is, "What effect is catch-and-release angling having on our already-small rainbow trout population when each fish is caught at least twice during the season?" The answer is presented in Table 3, which compares the actual 1996 Box Canyon population age/size structure with the structure that would be present in absence of any angling at all. These calculations assume that fish under six inches are not affected by angling mortality, that each fish over six inches in the population is caught twice per season and that angling mortality averages five percent each time a fish is caught and released. Research suggests that five percent is an average angling mortality figure for rainbow trout caught and released with flies tied on barbless hooks. Growth and natural mortality rates were taken from detailed studies of Henry's Fork rainbow trout funded by HFF and conducted by Jack Griffith and his graduate students in the mid- to late-1980s.

Table 3. 1996 Box Canyon rainbow trout population structure with and without angling mortality

age	size	with angling	without angling	increase factor
1	6"-10"	2,949	2,949	1.00
2	10"-14"	1,065	1,180	1.11
3	14"-17"	384	472	1.23
4	17"-19"	139	189	1.36
5	19"-21"	50	75	1.50
6	21"-23"	18	30	1.67
population totals		4,605	4,895	1.06

Table 3 shows that although angling mortality has little impact on total population size, it does limit the number of fish that live long enough to exceed 21 inches. The number of six-year old fish in the hypothetical population without angling mortality exceeds that in the actual population by 67 percent. In numbers of individual fish, however, the difference between 18 and 30 six-year old trout is not likely to be detectable to either anglers or field biologists. Thus, there is nothing in these results to suggest that angling mortality is significantly impacting the Box Canyon rainbow trout population either from an angler's or a population biologist's perspective, unless, of course, the mortality rate is significantly greater than the five percent figure used in the calculations.

In summary, the 1996 Box Canyon survey shows that while the rainbow trout population has declined significantly since 1981, angling effort has remained high, and catch rates are in the range generally considered good for a wild trout fishery. Anglers are much more efficient at catching the fish available than they were 15 years ago, and each fish in the Box Canyon is caught on average at least twice per season. Despite this high level of utilization, the rainbow trout population does not appear to be suffering significant impacts from angling mortality. ✧

Land Use Planning... *continued from previous page*

city opted to use the county plan and code, and finally decided to have the county administer their zoning ordinances by incorporating the city's plan and code into the county's.

The city adopted the following policy: "The City of Island Park should continue to be a peaceful, rustic retreat from urban life; with small-scale resorts and services for residents and visitors in appropriate locations; and abundant open space. New commercial development in the city should: • take place in designated existing commercial areas, NOT a continuous strip along U.S. Highway 20; • be compatible in scale with existing commercial uses and compatible with other nearby uses; • fit within the capacity of the infrastructure existing at the time they are proposed, or provide their own facilities and services; • provide employee housing, as necessary; • protect water quality, scenic views, wildlife habitat, and other aspects of environmental quality; and • maintain the rustic image and appearance of the area."

Planning issues will continue to multiply and loom larger in the public consciousness as the scenic and recreational attractions of Fremont County become more widely known and more people desire to live and recreate here. In the next issue of the newsletter we will discuss the role of the HFF in this ongoing discussion. ✧

Appendix D. Summary of creel census data on the Buffalo River, 1996.

Time period	Angler type	Effort (angler hours)	WRT[a] harvested	WRT[a] released	HRT[a] harvested	HRT[a] released	BRK[a] harvested	BRK[a] released
5/26 - 6/15	bank	594	10	10	59	19	147	19
5/26 - 6/15	wade	432	0	520	408	445	334	371
6/21 - 7/24[b]	bank	1,008	0	596	0	0	396	396
6/21 - 7/24[b]	wade	432						
	Total	2,466	10	1,126	467	464	877	786

Census interval	Harvest			Released			Total landed			Total effort (hours)	Catch/hrs		
	WRT[a]	HRT[a]	BRK[a]	WRT[a]	HRT[a]	BRK[a]	WRT[a]	HRT[a]	BRK[a]		WRT[a]	HRT[a]	BRK[a]
5/26 - 6/15	10	467	481	520	464	390	530	931	871	1,026	0.516	0.907	0.848
6/16 - 7/24	0	0	396	596	0	396	596	0	792	1,440	0.414	0	0.55
7/25 - 8/31	0	72	287	0	0	0	0	72	287	493	0	0.146	0.582
Total	10	539	1,164	1,116	464	786	1,126	1,003	1,950	2,959	0.38	0.338	0.659

[a] WRT = wild rainbow trout; HRT = hatchery rainbow trout; BRK = brook trout

[b] Due to low interview numbers, bank and wade angler harvest results were combined.

Appendix D. Continued.

Time Frame	Wade anglers (observed)	Trip length[a]	Angler Hours /day	Total effort	CPUE[b]	Total harvest
5/26 - 6/15						
(9) weekend days	27	12	162	1,458	5.09	7,421
(14) weekdays	18	12	108	1,512	2.47	3,735
Total	45			2,970		11,156
6/21 - 7/24						
(10) weekend days	16	12	96	960	2	1,920
(24) weekdays	10	12	60	1,440	24	34,560
Total	26			2,400		36,480

Time Frame	Bank anglers (observed)	Trip length[a]	Angler hours/ day	Total effort	CPUE[b]	Total harvest
5/26 - 6/15						
(9) weekend days	21	12	126	1,134	0.481	545
(14) weekdays	11	12	66	924	1.12	1,035
Total	32			2,058		1,580
6/21 - 7/24						
(10) weekend days	30	12	180	1,800	0.31	558
(24) weekdays	27	12	162	3,888	0.565	2,197
Total	57			5,688		2,755

[a] Trip length based on a 12 hour fishing day.
[b] CPUE = fish per hour.

1996 ANNUAL PERFORMANCE REPORT

State of: Idaho

Program: Fish Management

Project II: Technical Guidance

Subproject II-G: Upper Snake Region

Contract Period: July 1, 1996 to June 31, 1997

ABSTRACT

Technical assistance 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 fishery management staff provided technical assistance and guidance to the following government agency and private groups:

Bonneville County
Buffalo Hydro, Inc.
City of Idaho Falls
City of Rexburg
Cornell University
Eagle Rock Bass Masters
Fremont County
Friends of the Big Wood River
Henrys Fork Foundation
Henrys Fork Watershed Council
Henrys Lake Foundation
Idaho Department of Parks and Recreation
Idaho Department of Water Resources
Idaho Department of Lands
Idaho National Engin. & Envir. Laboratory (INEEL)
Idaho Water Resource Board
Island Park Sportsmen Association
U.S. Jackson National Fish Hatchery
Sheridan Creek Restoration Committee
Snake River Fly Fishers
South Fork Watershed Council
The Nature Conservancy Trout Unlimited
U.S. Fish and Wildlife Service
U.S. Forest Service
U.S. Bureau of Land Management
U.S. Bureau of Reclamation
Wyoming Game and Fish Department

Regional fishery management personnel contributed over 100 person-days to technical guidance requests in 1996.

Author:

Mark Gamblin
Regional Fishery Manager

1996 ANNUAL PERFORMANCE REPORT

State of: Idaho | Program: Fisheries Management

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

Contract Period: July 1, 1996 to June 31, 1997

ABSTRACT

Regional personnel conducted routine maintenance operations on Henrys Lake riparian fence and irrigation diversion fish screens and Palisades Creek and Burns Creek irrigation diversion fish screens.

Idaho Department of Fish and Game engineering crews constructed a new fish ladder at the Slash-E Ranch irrigation diversion on Howard Creek, tributary to Henrys Lake. Over two miles of additional spawning and rearing habitat were opened to spawning migration on Howard Creek.

Regional personnel worked with Buffalo Hydro, Inc., Henrys Fork Foundation, U.S. Fish and Wildlife Service, and Targhee National Forest to develop a cooperative agreement that led to construction of a fish ladder at the Buffalo hydro diversion dam on the Buffalo River. Fish passage for Henrys Fork rainbow trout *Oncorhynchus mykiss* to the Buffalo River is now secure for the first time in over 50 years.

Author:

Mark Gamblin
Regional Fishery Manager

OBJECTIVES

1. Maintain existing riparian fence and irrigation diversion fish screen investments.

2. Open access to over two miles of additional spawning and rearing habitat to Henrys Lake trout spawners on Howard Creek.

3. Encourage and facilitate the creation of fish passage around the Buffalo River Hydro project diversion dam to allow for Henrys Fork rainbow trout *Oncorhynchus mykiss* spawning in the Buffalo River.

METHODS

Maintenance of Existing Riparian Fence and Fish Screen Projects

Riparian fence and fish screens on the Henrys Lake project were managed under standard maintenance schedules by temporary personnel at the Henrys Lake hatchery. The Palisades and Burns creeks fish screens were maintained by regional fish management temporary personnel and canal loss research personnel. Fish screens required periodic lubrication during the irrigation season and were winterized at the end of the irrigation season.

Howard Creek Fish Ladder

The Howard Creek fish ladder project was jointly funded by the Idaho Department of Fish and Game (IDFG), Henrys Lake Foundation and The Nature Conservancy, with the cooperation of Don Salisbury, owner of the Slash-E Ranch. The fish ladder was designed and constructed by IDFG Engineering Bureau staff.

Buffalo River Fish Ladder

Upper Snake Region fish management staff worked with the Buffalo River hydro-power developer, Buffalo Hydro, Inc., Henrys Fork Foundation, U.S. Fish and Wildlife Service, and Targhee National Forest to develop a cooperative, voluntary construction and operations plan for the fish ladder. A technical report modeling the projected benefits of additional spawning and rearing habitat, made available to Henrys Fork rainbow trout spawners and which enhanced production and recruitment of rainbow trout juveniles to the Henrys Fork Snake River fishery, was jointly prepared by Upper Snake Region fish management personnel and Henrys Fork Foundation research staff (Appendix A). Project design and technical consultation was provided by IDFG Engineering Bureau personnel. Buffalo Hydro, Inc. personnel constructed the fish ladder.

RESULTS AND DISCUSSION

Howard Creek Fish Ladder

Construction of the Howard Creek fish ladder was completed in September 1996, immediately prior to brook trout *Salvelinus fontinalis* spawning activity in Howard Creek and other Henrys Lake tributaries. Henrys Lake Hatchery personnel observed brook trout escapement through the fish ladder throughout the fall spawning run on Howard Creek. The ladder is believed to be functioning as intended and will now allow access to over two miles of spawning and rearing habitat for cutthroat *Oncorhynchus clarki* and brook trout that was previously blocked by the irrigation diversion structure.

Buffalo River Fish Ladder

Construction of the Buffalo River fish ladder was completed in October 1996 and has remained open to allow movement of trout between the Henrys Fork Snake River and Buffalo River since that time. A permanent video camera monitoring system, which records all movement of fish through the fish ladder, was installed in January 1997 by the Henrys Fork Foundation and has documented escapement of over 150 Henrys Fork rainbow trout, 16 inches in length or larger, as of April 1997. The video monitoring system will provide constant documentation of Henrys Fork rainbow trout spawner escapement to the Buffalo River in future years. A screw-type smolt trap will be installed in May 1997 to monitor movement of Buffalo River juvenile rainbow trout to the Henrys Fork Snake River.

RECOMMENDATIONS

1. Continue to work with the Henrys Lake Foundation to develop funding and labor sources for the long-term operation and maintenance of existing Henrys Lake tributary riparian fences and fish screens.

2. Continue to work with U.S. Bureau of Reclamation to develop funding and labor sources for the long-term operation and maintenance of the existing Palisades Creek fish screen.

3. Facilitate a cooperative, jointly funded effort with local conservation organizations to construct a security fence around the Burns Creek fish screen.

4. Continue policy of no additional commitments to new riparian fence or irrigation diversion fish screens until new sources of operation and maintenance funding and labor are developed.

5. Continue to work cooperatively with The Nature Conservancy on fish habitat and fish population enhancements in the Henrys Lake outlet on the Flat Ranch.

6. Complete installation of the Buffalo River smolt trap for Henrys Fork Snake River recruit production monitoring and assessment. Implement the Buffalo River fish ladder monitoring and evaluation plan with local partners.

LITERATURE CITED

Angradi, T., and C. Contor. 1989. Henrys Fork fisheries investigations. Project F-71-R-12, Subproject III, Jobs 7a and 7b. Idaho Department of Fish and Game, Boise.

APPENDICES

Appendix A. Buffalo River fish ladder monitoring plan.

BUFFALO RIVER FISH LADDER MONITORING PLAN

This monitoring plan has been prepared jointly by the Idaho Department of Fish and Game and the Henrys Fork Foundation to help answer questions about the potential benefits and liabilities of the construction and operation of a fish ladder at the Buffalo Hydro diversion dam.

The Buffalo River has been isolated from the Henrys Fork Snake River for over fifty years. The hydropower generation facility, now owned by Buffalo Hydro, Inc., was constructed, owned and operated by Ponds Lodge from 1938 until 1986, when the powerhouse was destroyed by fire. The remaining facility was subsequently purchased by Buffalo Hydro, Inc. After acquiring a Federal Energy Regulatory Commission (FERC) project license, Buffalo Hydro, Inc., installed a new powerhouse and generator and put the facility into operation in the spring of 1994. Although the original diversion dam for the Buffalo hydro-generation project incorporated a crude fish ladder, effective fish passage around the diversion dam has not existed since 1938. Some fish movement occurred between 1986 and 1994 when splash boards in the diversion dam were removed. However, that movement was very limited due to the impediments imposed by the concrete sill and diversion dam spillway. Buffalo Hydro, Inc., The Henrys Fork Foundation and the Idaho Department of Fish and Game have developed a cooperative fish passage plan for the Buffalo River that will facilitate spawning escapement from the Henrys Fork Snake River beginning the spring of 1997. In the course of developing this cooperative plan, concerns about the effects of the fish ladder on the Henrys Fork Snake River fishery were expressed by local individuals and organizations.

Reestablishing the migration corridor between the Henrys Fork Snake River and the Buffalo River would be a desirable and high-priority watershed management objective under any circumstances, but current limitations to the Henrys Fork Snake River fishery give it a special urgency. The Henrys Fork Snake River fishery has suffered from reduced numbers of rainbow trout, allegedly caused by recruitment declines since the early 1980s. Research to date suggests that a combination of factors have contributed to the problem, including loss of critical overwintering habitat for young (age 0 and age I) rainbow trout, insufficient quantity of spawning habitat, and loss of movement of rainbow trout from Island Park Reservoir to the Henrys Fork Snake River. Making the spawning and rearing habitat of the Buffalo River accessible to Henrys Fork rainbow trout spawners should reduce the severity of each of the identified recruitment-limiting factors by a margin that we can predict with nominal certainty. The Buffalo River will provide over six miles of high quality spawning and rearing habitat for the production of new recruits to the Henrys Fork Snake River fishery. The high water quality, stable flow, and relatively warm temperature of the Buffalo River will likely produce recruits with higher survival rates and better physical condition than the Henrys Fork Snake River itself produces.

The concerns that have been expressed about the Buffalo River fish ladder are primarily for potential impacts to fishing on the Henrys Fork Snake River by harvest of Henrys Fork spawners in the Buffalo River during the general fishing season. The Buffalo River is managed under general regulations (6 trout possession limit, no gear or fish size restrictions) and the adjacent reach of the Henrys Fork Snake River is managed under catch and release, artificial lures with single barbless hooks regulations. Additional concerns were expressed about the potential for harvest of Henrys Fork spawners before they have spawned in the Buffalo River, and the harvest of potential Henrys Fork recruits in the Buffalo River, before they migrate to the Henrys Fork Snake River. This monitoring plan is intended to respond to those concerns to provide for:

1. The enumeration of Henrys Fork spawners escaping into the Buffalo River.
2. Estimates of the harvest of Henrys Fork Snake River spawners in the Buffalo River.
3. Modeling of the potential Henrys Fork Snake River recruit production from the Buffalo River.
4. Modeling of the potential impact to the Henrys Fork Snake River fishery of harvest of Henrys Fork rainbow trout spawners in the Buffalo River.
5. Assessment of the potential for harvest of Henrys Fork Snake River recruits in the Buffalo River fishery.

Buffalo River Spawning Escapement Monitoring

Contingent on adequate funding, an automatic video monitoring system will be installed in the fish ladder to count Henrys Fork Snake River rainbow trout spawners as they move upstream through the fish ladder. This will provide us with a reliable total count of spawners that will presumably spawn in the Buffalo River. This in turn will allow us to refine our modeling of Buffalo River production of recruits to the Henrys Fork Snake River fishery. The Henrys Fork Foundation and the Idaho Department of Fish and Game will jointly pursue opportunities to acquire, install and operate this equipment.

Buffalo River Fishery Monitoring

The Buffalo River fishery will be monitored in 1996, 1997 and future years as needed. Baseline data will be collected in 1996 with a creel survey that includes stratified, randomized angler counts (to allow for estimates of total angler effort during the survey period), and angler interviews and creel checks (to allow for estimates of catch and harvest and to assess angler attitudes toward the Buffalo River fishery). The Buffalo River creel survey will be conducted jointly by the Idaho Department of Fish and Game personnel and Henrys Fork Foundation interns from the opening of the general fishing season on Memorial Day weekend to the Labor Day weekend. The creel survey will be supervised by Bruce Rich (IDFG) and Rob VanKirk (HFF).

The creel survey will be divided into three equal intervals during which angler counts and interviews will be conducted. Angler counts will be made for a minimum number of weekday, holiday, and weekend days per interval from the Buffalo Hydro diversion dam upstream to the source of the Buffalo River. The number of angler counts and interviews per interval will be no less than the minimum necessary to estimate angler effort, catch, harvest and the size distribution of the catch with statistical certainty.

Buffalo River Recruit Production Model

Given the information available before the fish ladder is even built, it is not possible to predict with much certainty the number of Henrys Fork recruits the Buffalo River will produce from Henrys Fork spawners the first, second, third or years, etc.; nor can we predict with accuracy how many Henrys Fork spawners will use the Buffalo River after fish passage is provided. We can make

educated guesses, however in reality this is often what modeling means. As the database expands with each successive year of spawning and rainbow trout production, our ability to describe the production of Henrys Fork recruits in the Buffalo River will improve.

Recruit Production Potential

The potential for Henrys Fork recruit production (i.e. the total number of recruits the river is capable of producing) has been estimated by assuming that the Buffalo River is capable of supporting a range of densities of young rainbow trout. Additional assumptions have been made about key life history statistics that will determine how many eggs that each female spawner deposits in the Buffalo River streambed will survive until they migrate downstream to join the Henrys Fork Snake River fishery. Those key assumptions are:

1. The Buffalo River will support densities of 10 to 20 recruits per 100 m^2 of river habitat.
2. The average fecundity for Henrys Fork female spawners will be 1,500 eggs/female (assuming that females will first spawn at age 3 and 16 inches in length).
3. The survival to emergence and through the first winter of life for potential Henrys Fork recruits in the Buffalo River will be at least 30%.
4. Fifty percent of the Henrys Fork recruits produced by the Buffalo River will migrate at age 1 and 50% will migrate at age 2 (will spend either one or two winters in the Buffalo River).
5. The annual survival rate for both age 1 and age 2 Henrys Fork recruits in the Buffalo River will be at least 40%.

Each of these assumed values are based on known values for other rainbow trout populations in the Pacific Northwest. The values have been selected from populations, including some data from the Henrys Fork Snake and Buffalo rivers, believed to best apply to Buffalo River fish habitat.

To begin determining the production potential of the Buffalo River, the area of available rearing habitat was estimated. There is approximately 6.8 miles of river channel with good cross-sectional velocity, depth and substrate to rear young trout, excluding the reach of the Buffalo River between Elk Creek and the railroad trestle that is braided with narrow channels (about 1 mile of river). The river was divided, from the hydro diversion dam to the Chick Creek confluence, into three reaches, each with an average width. Multiplying the length of each reach by its average width gives an estimate of the area of each reach. Summing the surface areas of the three river reaches produces an estimate of the surface area (316,586 m^2) of suitable rearing habitat for the entire length of the Buffalo River from the diversion dam upstream to the mouth of Chick Creek.

The Buffalo River presumably has the potential to support densities of young (age 1 and age 2) rainbow trout in the range of 10 to 20 trout per 100 m^2. Applying those fish density predictions to the estimated surface area of rearing habitat available, the Buffalo River has the estimated potential to produce between 32,000 (31,658) to 63,000 (63,317) recruits to the Henrys Fork Snake River. The actual production will depend on a variety of factors, the most important of which is whether the habitat is fully seeded. That is, will there be enough spawners to produce the number of fry necessary to fill the available rearing habitat? To estimate the number of spawners necessary to fully seed available habitat and supply full habitat production potential, the above

values were used for female fecundity (eggs per female), survival to emergence (how many eggs survive to emerge from their gravel nest or redd), annual survival (the number of fish going into a calendar year that survive to the end of that year) and age at migration to the Henrys Fork Snake River to estimate how many recruits each female spawner will account for in Buffalo River production.

Fifteen hundred eggs with 30% survival to emergence and through the first winter of life produces 450 juveniles at the end of their first year of life (the following spring). With 50% of the potential recruits migrating at age 1, half of the 450 first year survivors would migrate that spring or early summer. Of the remaining 225 potential recruits, 80% (180) would survive to the next spring when they presumably will migrate as age 2 potential recruits to the Henrys Fork Snake River fishery. Each spawning female would account for a total of 305 potential recruits to the Henrys Fork Snake River fishery produced by the Buffalo River. The number of female Henrys Fork spawners necessary to fill the potential production habitat for Henrys Fork recruitment is simply the production potential (32,000 to 63,000) divided by the number of potential recruits provided per female (305). Within the assumed range of production potential, 101 to 201 Henrys Fork female spawners would be necessary to adequately seed the Buffalo River for full Henrys Fork recruitment production. The female to male ratio for resident trout spawning populations may range from 2:1 to 1:1. Within that range, the total spawner escapement from the Henrys Fork Snake River necessary to fully seed the Buffalo River would be 150 to 400 Henrys Fork rainbow trout.

Henrys Fork Snake River Fishery Impacts From Spawner Harvest

The impact of harvest of Henrys Fork Snake River rainbow trout in the Buffalo River during the spawning run on the Henrys Fork Snake River fishery has been the biggest concern expressed as we have developed this plan. Several issues need to be addressed:

1. Will spawners be vulnerable to harvest before they have spawned in the Buffalo River?

It is unlikely that harvest of Henrys Fork spawners could legally occur before the spawning is completed. Recent research on the Henrys Fork Snake River in Box Canyon has documented the timing and distribution of the Henrys Fork rainbow trout spawning run from Riverside Campground to the Island Park Dam. Spawning is known to begin approximately mid-March and to conclude in mid-May. Virtually all of the spawning activity for the above reach of the Henrys Fork Snake River takes place between the confluence with the Buffalo River and Island Park Dam. Most spawning occurs between the USGS gauging station and the dam. Because water temperature in the Buffalo River is about 5 degrees warmer than the Henrys Fork Snake River, spawning activity may occur earlier in the Buffalo than the Henrys Fork Snake River. Consequently, it is probable that spawning activity will be concluded in the Buffalo River several weeks prior to fishing activity there.

2. Will Henrys Fork spawner survivors be harvested in the Buffalo River, and what impact would any harvest have on fishing in the Henrys Fork Snake River?

Two things need to be considered here. First, not all spawners will survive the rigors of their spawning activities. Rainbow trout resemble anadromous salmonids more than other resident trout such as cutthroat trout in that they suffer significant post-spawning mortality. Post-spawning

mortality for Henrys Fork rainbows in the Buffalo River will be presumably no less than 40%. Assuming that a total escapement of 400 Henrys Fork spawners (the maximum number we estimate is necessary to fully seed the Buffalo) occurs in a given year, then 240 post-spawning survivors may be assumed to be available for harvest in the Buffalo River fishery if all remain in the Buffalo River when the fishing season opens. Some percentage of those survivors should be expected to return to the Henrys Fork Snake River after spawning, but it is possible that all could still be in the Buffalo River when the general fishing season opens on Memorial Day weekend. The exploitation rate (how fast or what percentage of a trout population is harvested over a period of time) on resident trout populations varies widely depending on the level of angler effort and the vulnerability of the trout population to the angling gear or techniques in that particular fishery. Exploitation rates of 30% are common and, in some cases, may be as high as 60 to 70%. No more than 40% of any post-spawning survivors would likely be harvested in a given year. This is probably a conservative estimate (i.e. an over-estimate). If all post-spawned Henrys Fork rainbows in the Buffalo River remained at the beginning of the fishing season, and if 40% of those fish were harvested, then the Henrys Fork Snake River fishery would lose 96 adult (16 inches or larger) rainbow trout for that following fishing season. In 1995, the rainbow trout population in Box Canyon was estimated at approximately 6,000 fish 6 inches or larger. Approximately 25% of the trout measured during the population estimate were 16 inches or larger. If that percentage applies to the true population, then the Box Canyon reach alone had 1,400 rainbow trout 16 inches or larger in spring 1995. Assuming we could maintain a similar number of large rainbow trout from year to year, the potential loss of Henrys Fork spawners in the Buffalo River fishery would account for about 7% of the total number of rainbow trout 16 inches or larger in the Henrys Fork Snake River fishery. It is unlikely that the effect of removing that percentage of trout from the Henrys Fork Snake River fishery would be detectable.

If the potential gains to the Henrys Fork Snake River fishery are compared to the loss in harvested spawners, the balance is more favorable toward Buffalo River fish passage. Henrys Fork Snake River research has estimated annual survival rates of 47% for age 2 to age 5 rainbow trout below Island Park Dam (Angradi and Contor 1989). Rainbow trout reach 16 inches in length at age 3 in Box Canyon. Potential Henrys Fork recruits produced in the Buffalo River will presumably grow to 16 inches within three years of migrating to the Henrys Fork Snake River. Age 1 recruits will need three years, and age 2 recruits will need only two years. If, as assumed, 50% of the Buffalo River recruit production migrates at age 1 and 50% at age 2, then approximately 30% of the recruitment crop from the Buffalo River to the Henrys Fork Snake River in a given year will be age 2 rainbow trout and 70% will be age 1 (difference due to additional annual mortality for age 2 migrants). Therefore, the Buffalo River annual contribution of rainbow trout 16 inches or larger to the Henrys Fork Snake River fishery is estimated to be at least:

32,000 potential recruits/year x 70% = 22,400 age 1 recruits
32,000 potential recruits/year x 30% = 9,600 age 2 recruits

If age 1 recruits require three years residence in the Henrys Fork Snake River to reach 16 inches in length, then each year's crop of age 1 Buffalo River potential recruits will provide at least 2,300 rainbow trout 16 inches or larger in three years. If age 2 potential recruits require two years residence in the Henrys Fork Snake River to grow to 16 inches, then each year's crop of age 2 Buffalo River potential will add at least 2,100 16 inch rainbow trout to the population. Once the stock-recruitment function between the Henrys Fork Snake and Buffalo rivers reaches equilibrium, there is the potential for an additional 4,400 rainbow trout 16 inches or larger in the Henrys Fork

Snake River fishery. This assumes that we are correct in estimating the minimum potential recruit production level for the Buffalo River, that the river is fully seeded with Henrys Fork spawners, that our survival estimates are approximate, and that the potential recruits migrate in equal proportions at ages 1 and 2. We will not know how realistic these projections are until we have several years of real monitoring data in hand.

Possible Harvest of Potential Recruits in the Buffalo River Fishery

Age and growth data for resident rainbow trout in the Buffalo River show that age 1 migrants will be approximately 113 mm (4.5 inches) in length, and age 2 migrants will be approximately 168 mm (6.5 inches) in length when they join the Henrys Fork rainbow trout population. Creel survey data collected from the Buffalo River fishery has shown that anglers are unwilling to keep trout less than 180 mm. We expect potential recruits from the Buffalo River to migrate before they reach that size. Consequently, it is unlikely that potential recruits will be exploited in the Buffalo River fishery.

SUMMARY

Specific concerns have been addressed regarding the potential negative and positive impacts of the Buffalo River fish ladder on the Henrys Fork Snake River fishery below Island Park Reservoir. Those concerns have focused on the monitoring of Henrys Fork spawners escaping to the Buffalo River; the impact to the Henrys Fork Snake River fishery of angler harvest of Henrys Fork spawners in the Buffalo River fishery; and the potential loss of Henrys Fork recruits to angler harvest in the Buffalo River fishery.

Accurate enumeration of Henrys Fork spawning escapement to the Buffalo River will be provided by an automated video monitoring system installed in the fish ladder.

It is estimated that harvest of Henrys Fork rainbow trout spawners (16 inches or larger) in the Buffalo River fishery will not exceed 100 fish per year. The loss of that many rainbow trout to the Henrys Fork Snake River fishery in a given year would not be detectable.

The Buffalo River has the estimated potential to annually produce 32,000 to 63,000 age 1 and age 2 recruits to the Henrys Fork Snake River fishery. This level of increased recruitment would annually provide up to 4,400 rainbow trout 16 inches or larger to the Henrys Fork Snake River fishery once the stock-recruitment relationship reaches equilibrium.

Recruits to the Henrys Fork Snake River fishery produced in the Buffalo River should migrate to the Henrys Fork Snake River before they grow to the size at which they would recruit to the Buffalo River fishery. Therefore, there will be little or no predicted loss of Henrys Fork recruits to angling in the Buffalo River.

In summary, the potential benefits of making spawning and rearing habitat in the Buffalo River available to Henrys Fork spawning rainbow trout far outweigh the probable liabilities of allowing Henrys Fork spawners to move into the Buffalo River by constructing a fish ladder at the

Buffalo River Hydro diversion dam. Again, the model described in this document is adaptive in nature. That is, it provides a basis for evaluating the pros and cons of constructing the Buffalo River Fish ladder, but there are limitations to making accurate predictions at this time. As the database is improved and expanded on spawner escapement, recruit production and the response of the Henrys Fork Snake River fishery to increased recruitment from the Buffalo River, the contributions of the Buffalo River to the Henrys Fork Snake River fishery will be described and predicted with greater accuracy and precision.

Authors:

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Idaho Department of Fish and Game

Rob VanKirk
Henrys Fork Foundation

1996 ANNUAL PERFORMANCE REPORT

State of: Idaho | Program: Fisheries Management

Project IV: Population Management | Subproject IV-G: Upper Snake Region

Contract Period: July 1, 1996 to June 30, 1997

ABSTRACT

Below Palisades Reservoir Dam, 500 to 1,000 game fish were salvaged from the stilling basin and released into the South Fork Snake River. Species salvaged and released on October 16, 1996, included cutthroat trout *Oncorhynchus clarki*, brown trout *Salmo trutta*, lake trout *Salvelinus namaycush*, kokanee salmon *O. nerka kennerlyi*, and mountain whitefish *Prosopium williamsoni*. Rainbow trout *Oncorhynchus mykiss* and hybrid cutthroat x rainbow trout were sacrificed for research. As in the past, numerous lake trout of a variety of sizes were seen, further confirming natural reproduction and survival of the species in the reservoir.

Roberts Gravel Pond was chemically treated with rotenone to eradicate nuisance populations of yellow perch *Perca flavescens*, bluegill *Lepomis macrochirus*, pumpkinseed *Lepomis gibbosus*, green sunfish *Lepomis cyanellus* and black bullhead *Ameiurus melas*. After detoxification, Roberts Gravel Pond was restocked with hatchery catchable rainbow trout in May 1996.

Eighteen mountain lakes were stocked with a total of 27,500 cutthroat trout, rainbow trout, golden trout *Oncorhynchus aguabonita* and Arctic grayling *Thymallus arcticus* fry in 1996. All fish were reared at and stocked from Idaho Department of Fish and Game Mackay and Ashton fish hatcheries.

Authors:

William C. Schrader
Senior Fishery Research Biologist

Mark Gamblin
Regional Fishery Manager

METHODS

Palisades Reservoir Stilling Basin Salvage

Annual maintenance operations at the U.S. Bureau of Reclamation Palisades Dam facility require closing the spill gates, draining the stilling basin immediately below the gates, and repairing the concrete surface of the stilling basin. This routinely traps and strands hundreds of trout and mountain whitefish *Prosopium williamsoni*. The Bureau of Reclamation staff at Palisades Dam coordinates with the Upper Snake Region to ensure salvage of those fish. We also used Idaho Department of Fish and Game (IDFG) volunteer reservists to help with the salvage on October 16, 1996.

Stranded fish were captured with backpack electrofishing gear after being crowded with a 150-foot beach seine. Captured fish were transported by hand in buckets to the main river immediately below the stilling basin and released. Captured fish were not counted or measured, although each cutthroat trout *Oncorhynchus clarki* was examined for fin clips. This marking data is reported in the lowland lakes section of this report.

Roberts Gravel Pond Renovation

Approximately 300 gallons of liquid rotenone and 75 pounds of powdered rotenone were applied by boat and shoreline-based personnel to achieve an application concentration of 3-4 ppm (Appendix A). All standard protocols outlined in the Idaho Department of Fish and Game Lake Renovation Procedures Manual (Horton 1997) were followed during this operation.

Mountain Lake Stocking

To reduce costs, and because of availability conflicts using U.S. Forest Service standby helicopters during the fire season, aircraft were not used to stock mountain lakes in 1996. Volunteers, IDFG Upper Snake Region conservation officers and staff, and IDFG Mackay and Ashton hatchery personnel stocked all mountain lakes in late August and early September. All fish were reared at and stocked from IDFG Mackay and Ashton fish hatcheries.

RESULTS AND DISCUSSION

Palisades Reservoir Stilling Basin Salvage

From 500 to 1,000 game fish were salvaged from the Palisades Reservoir stilling basin and released into the river downstream in 1996. Species salvaged and released included wild and hatchery cutthroat trout, brown trout *Salmo trutta*, lake trout *Salvelinus namaycush*, kokanee salmon *Oncorhynchus nerka kennerlyi,* and mountain whitefish. Captured rainbow trout *O. mykiss* and hybrid cutthroat x rainbow trout were sacrificed for research.

As in the past, numerous lake trout and kokanee salmon of a variety of sizes were seen, further confirming natural reproduction and survival in the reservoir. Lake trout and kokanee also migrate out of Palisades Reservoir into the South Fork Snake River where they are occasionally encountered during electrofishing. Many of the salvaged lake trout in 1996, as noted in the past few years, were young fish. We believe they are successfully reproducing in Palisades Reservoir. Lake trout supplementation from the USFWS Jackson National Fish Hatchery ceased in 1991.

Roberts Gravel Pond Renovation

Cursory post-renovation visual observations indicated that an effective eradication of the target nuisance fish populations was achieved. Cool weather and strong winds during the week following the chemical treatment thoroughly mixed the pond and provided optimum conditions for a complete or near-complete fish kill (Post-Renovation Report, Appendix A). The pond was left idle for one month following chemical treatment to allow detoxification and then restocked with standard hatchery catchable rainbow trout. Recovery of the fishery will be monitored for the next two years before considering adding additional species to the management plan for Roberts Gravel Pond.

Mountain Lake Stocking

All 13 lakes in the scheduled rotation, as well as an additional five lakes, were stocked with fry in 1996 (Table 1). Numbers of each species stocked were 14,800 cutthroat trout, 500 rainbow trout, 8,900 Arctic grayling *Thymallus arcticus*, and 3,300 golden trout *Oncorhynchus aquabonita*.

One mountain lake was stocked in the Beaverhead Mountains, three in the Centennial Mountains, two in the Lemhi Range, three in the Lost River Range, two in the White Knob Mountains, one in the Big Hole Mountains, one in the Fall River Highlands, and five in the Pioneer Mountains. In the 18 lakes, total fry planted was 27,500 (Table 1).

We stocked about 10,000 more fry than the scheduled allocation because of surplus Arctic grayling and the first available golden trout since 1990. In coordination with the U.S. Forest Service, Mackay Ranger District, golden trout were planted in four new lakes in the Pioneer Mountains (Fall Creek #1, Muldoon #5, Boulder #1 and #2). These four lakes will be evaluated in the future.

Table 1. Mountain lakes in the Upper Snake Region stocked with fry, 1996.

Lake name		IDFG Catalog #	# Stocked	Species[a]
Beaverhead Mountains				
Divide Creek		16-0127	1,000	CT
Centennial Mountains				
Aldous		16-0113	1,500	CT
Hancock		16-0115	500	CT
Salamander		16-0120	1,000	CT
Lemhi Range				
Mill Creek		15-0124	2,500	CT
Pass Creek		15-0104	1,000	CT
Lost River Range				
Upper Swauger		15-0120	3,000	CT
Lower Swauger		15-0121	1,000	CT
Big Creek		15-0122	500	RB
White Knob Mountains				
Corral		15-0181	600	CT
Grant Creek		15-0153	600	CT
Big Hole Mountains				
Packsaddle		12-0102	2,100	CT
Fall River Highlands				
Horseshoe[b]		12-0114	8,900	GR
Pioneer Mountains[c]				
Golden		15-0184	1,000	GN
Fall Creek #1[d]		15-	1,300	GN
Muldoon #5[d]		15-	500	GN
Boulder #1[d]		15	250	GN
Boulder #2[d]		15-	250	GN
	Total:	Cutthroat trout	14,800	
		Rainbow trout	500	
		Grayling trout	8,900	
		Golden trout	3,300	
		Grand Total:	28,300	

[a] CT = Cutthroat trout; RB = Rainbow trout; GR = Arctic Grayling; GN = Golden trout.
[b] Stocked with additional 6,900 GR that were leftovers.
[c] All lakes stocked with GN out of or not on three-year rotation.
[d] New lake for stocking; continue after evaluation.

RECOMMENDATIONS

1. Monitor numbers and proportions of fin-clipped trout from Palisades Reservoir in future salvage operations at the Palisades Dam stilling basin.

2. Monitor recovery of the Roberts Gravel Pond catchable trout fishery and plankton population, post-1996 rotenone renovation.

3. Evaluate demand and advisability of restocking Roberts Gravel Pond with yellow perch *Perca flavescens* over the next two years.

4. Evaluate golden trout and Arctic grayling plants in high mountain lakes.

ACKNOWLEDGMENTS

Bureau of Reclamation personnel from the Palisades Dam operations office and IDFG volunteer reservists lent valuable assistance to the salvage operation at the Palisades Reservoir stilling basin.

Steve Peterson (IDFG) and the following volunteers were instrumental in our mountain lake stocking efforts: John and Dustin Grimmett, Kent and Tate Hanson, Garth and Garrett Turpin, Lex Peterson, Greg Collister, Don Sturtevant, Travis and Roger Williams, John Brady, Bill Adams, Bobby Stevens, Jim Greenhalgh, Charlie Cox, Mountie Morris, and Bart Gammett (USFS). We also thank the following IDFG personnel: conservation officers Dave Silcock, Don Jenkins, and Lew Huddleston; Greg Losinski; Mick Hoover; Jason Rheinhardt; and Mel Sedecki.

LITERATURE CITED

Horton, William D. 1997. Lake Renovation Procedures Manual. Idaho Department of Fish and Game. IDFG 97-8, Boise.

APPENDIX

Appendix A. Roberts Gravel Pond Renovation Report.

ROBERTS GRAVEL POND FISH COMMUNITY RENOVATION PROPOSAL, 2/13/96

Problem:

Since about the mid 1980s, Roberts Gravel Pond had provided generally poor fishing opportunity despite the introduction and/or maintenance stocking of a variety of sizes and types of fish.

Fairly intensive sampling in 1994 and 1995 indicate an overabundance of smaller than satisfactory sized planktivorous fish (bluegill, pumpkinseed and yellow perch). The zooplankton (fish food) community shows obvious signs of being overgrazed by these small fish, an indication of fish community imbalance and/or unsuitability. The pond also appears to have less than optimal amounts of available nutrients for production of phytoplankton and subsequently large zooplankters (an ideal fish food). Temperature profiles indicate that the pond is too cold for most warm water species, and best suited for cool and coldwater fishes.

Because of the flexibility we enjoy through State ownership and a relatively close proximity to regional population centers, it seems imperative that we take bolder steps to make the Roberts Gravel Pond fishery as good as it can be, or at least better than it has been.

Proposed Action:

We propose removing the present fish community from Roberts Gravel Pond through chemical eradication in late winter 1996. A solution of liquid rotenone (a derivative of the naturally occurring *derris* root) would be applied to the pond in March of 1996 when dissolved oxygen levels are at the lowest point of the year and the most thorough fish removal is possible. The pond would then be fertilized with phosphorous and possibly organic material (alfalfa meal for example) to promote early spring growth of phyto and zooplankton. Catchable rainbow trout would then be stocked prior to the Memorial Day weekend fishing opener. A dual put/take and put/grow/take fishery for rainbow trout would hopefully be supported by the pond now void of many "extra mouths" to feed. After one season of seeing how the pond operates without overabundant perch and sunfish, stocking of one additional carefully chosen planktivorous fish and one predatory fish (equally carefully chosen) may be considered.

Appendix Table A-1. Fish community composition of Roberts Gravel Pond, 1982-1995.

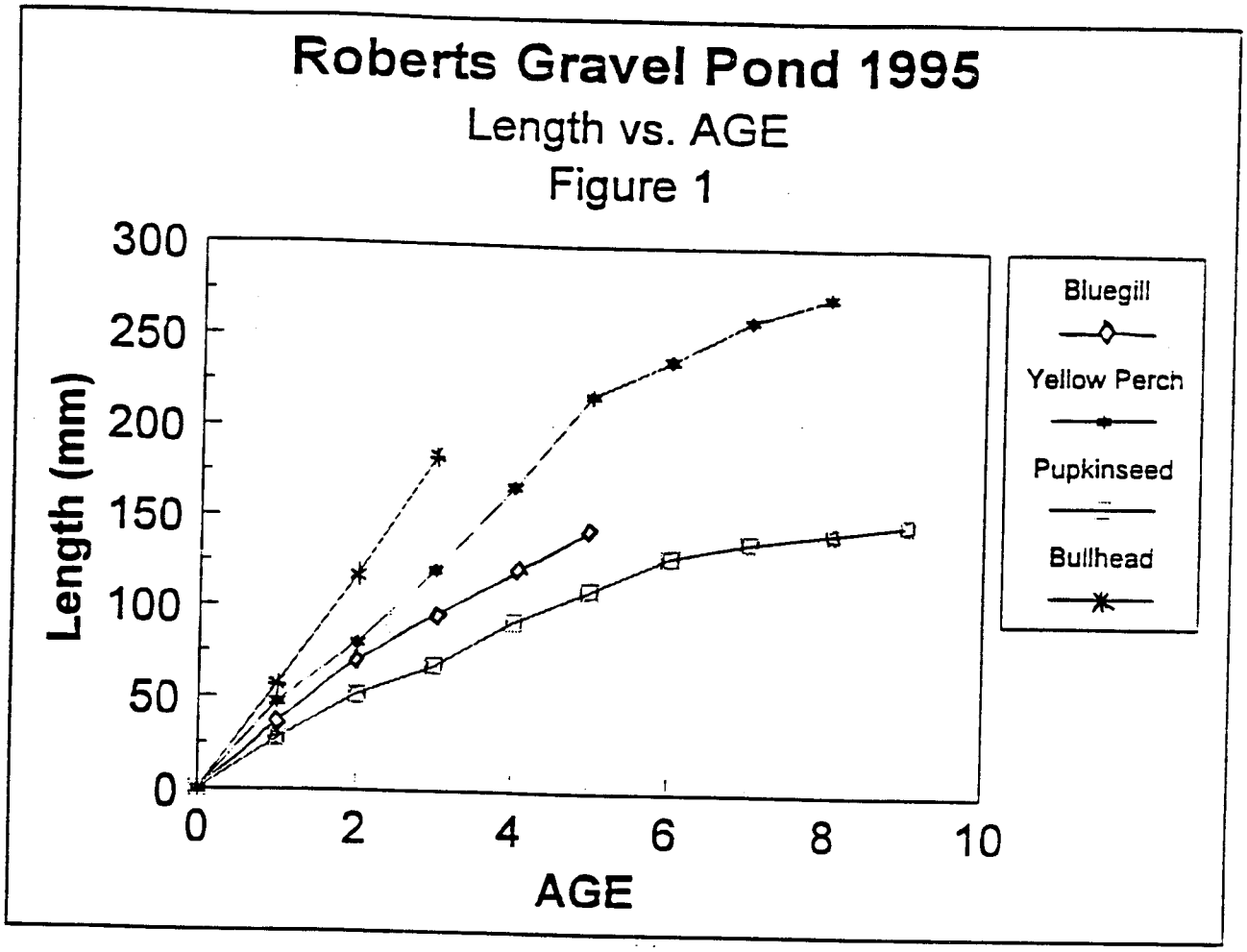
	1982	1985	1990	1991	1994	1995
BBHEAD	36.3%	3.7%	40.2%[a]	68.9%	20.6%	28.8%
CHCAT					0.4%	0.2%
BGILL		0.7%			58.1%[b]	12.7%
PSEED						26.7%
YEPERCH	53.9%	95.6%			14.5%	17.1%
HRBT				31.1%	6.4%	12.9%
LMB			59.8%			
RSS						0.2%
UTCHUB	5.5%					0.2%
UTSUCK	2.2%					
BLCARP	2.2%					

[a] Brown bullhead + channel catfish
[b] Bluegill + pumpkinseed

Appendix Table A-2. Mean total lengths (in mm) of various fish species sampled in Roberts Gravel Pond 1982-1995, conversions to inches in parentheses.

	1982	1985	1990	1991	1994	1995
BBHEAD	164 n=33	96 n=5	148 n=148[a]	170 n=31	160 n=109	157 (6.2) n=145
CHCAT					285 n=2	288 n=1
BGILL		193 n=1			113 n=308[b]	118 (4.6) n=64
PSEED						113 (4.4) n=134
YEPERCH	171 n=49	125 n=130			182 n=77	105 (4.1) n=86
HRBT				315 n=14	300 n=34	263 n=70
LMB			77 n=70			
RSS						130 n=1
UTCHUB	298 n=5					319 n=1
UTSUCK	450 n=2					
BLCARP	210 n=2					

[a] Brown bullhead + channel catfish
[b] Bluegill + pumpkinseed



Appendix Figure A-1. Average back-calculated lengths-at-age for various fish species in Roberts Gravel Pond, 1995.

Michael C. Quist - Zooplankton Summary

The average number of zooplanktons for the June 20, 1995 sample was 107.54/L. The standard deviation was 8.39.

The average number of zooplanktons for the August 11, 1995 sample was 119.57/L. The standard deviation was 2.99.

Bosmina sp. consisted of 89% of the June sample with copepods making up the other 11%.

Bosmina sp. consisted of 75% of the August sample with the other 25% being copepods.

Length frequencies - June sampling					
Body Length (mm)	0 - .25	.26 - .50	.51 - .75	.76 - 1.0	>1.0
Bosmina sp.	50.6%	46.3%	3.1%	---	---
Copepod	70.7%	12.2%	4.9%	---	---

Length frequencies - August sampling					
Body Length (mm)	0 - .25	.26 - .50	.51 - .75	.76 - 1.0	>1.0
Bosmina sp.	89.9%	8.9%	1.2%	---	---
Copepod	74.2%	21.7%	4.1%	---	---

To: Steve Huffaker
From: Don Wright
Subject: FINAL REPORT – 1996 Roberts' Gravel Pond Renovation
Date: 5/28/96
Attachments: Copy of DEQ authorization, pre-project proposal and data

A. What was done:
On Thursday March 28, 1996 personnel from the Upper Snake Regional Office eradicated the Roberts Gravel Pond fish community by application of rotenone based products, details of the eradication are as follows:

Product Type:
Emulsified (liquid) form-
NYSYN-NOXFISH
CHEMFISH (TIFA)
total ~ 300 gal.
Powdered form-
unknown brand - agricultural grade
total ~ 75 lbs.

Application Rate:
Based on a maximum estimated volume of 300 Acre feet at the time, application rate of active rotenone was at least 3 ppm or more but not above 4 ppm (depending on effectiveness of the powdered product). Products were applied with backpack pump sprayers and cavitation plate mounted venturi bailers (liquid) or broadcast along shoreline (powder).

B. Fish Species Killed:

	Numbers*:
Yellow Perch	>/= tens of thousands
Bluegill	thousands
Pumpkinseed	thousands
Bullhead	thousands
Channel Catfish	</= one hundred
Grass Carp	~ 6 (two were saved for Eagle Health Lab to test for Asian Tape Worm)

*no estimate of biomass was made

C. Ambient Conditions:

Atmospheric: Light and variable North Wind, overcast sky, drizzling rain, 45 F.

Lake: Approx. One week post ice-out, 38 F, clear.

The two weeks following treatment saw sustained high winds which completely mixed

the lake and hastened the fish kill.

D. RESULTS:

As complete of a fish kill as is probably possible was accomplished, even bullheads started dying in numbers within the first few hours. Because of low water temperatures, fish continued to die and/or wash up dead on shore for at least a week. Dead fish were left in situ, no attempt was made to remove and dispose of them. The pond was kept posted with English and Spanish signs explaining the project and warning against fish consumption until restocking with rainbow trout occurred on May 22, 1996 (after live car testing with live rainbow trout showed no toxicity).

E. Problems Encountered:

None

F. Recommendations for future projects:

Use similar bi-lingual signage

G. Other Observations:

N/A

IDAHO DEPARTMENT
OF HEALTH AND WELFARE

DIVISION OF
ENVIRONMENTAL QUALITY

900 North Skyline, Idaho Falls, ID 83402-1718, (208) 528-2650

Philip E. Batt, Governor

March 8, 1996

Mark Gamblin
Regional Fishery Manager
Idaho Department of Fish and Game
Upper Snake Region
1515 Lincoln Road
Idaho Falls, ID 83401-2198

Re: Fish eradication in Roberts Gravel Pond

Dear Mr. Gamblin:

We have reviewed your request of February 23, 1996 for a short term activities exemption from the Idaho Water Quality Standards in order to chemically eradicate the present fish community in Roberts Gravel Pond. Based on your letter, interviews, and documentation provided by the manufacturer, we understand the situation and proposed activities are as follows:

Roberts Gravel Pond is a 50 acre, abandoned sand and gravel pit which lies along the east side of I-15 just south of the town of Roberts. The Idaho Department of Fish and Game (IDFG) owns the pond and manages it as a recreational fishery. The pond has no surface water inflows or outlet. The pond has no natural fish community; all fish present are the result of earlier stocking. IDFG research indicates that the pond is over-populated with small, mostly warm water fishes (bluegill, pumpkinseed, bullhead catfish, and yellow perch). IDFG proposes to eradicate all existing fish in the pond through application of the chemical piscicide rotenone. Rotenone naturally detoxifies upon exposure to sunlight; in cold water this de-toxification may take up to one month after application. The likelihood of contaminating the groundwater in proximity to the pond from this application is considered remote. IDFG will post the area to warn the public against primary or secondary contact recreation (e.g., swimming, wading, or fishing) through this time. IDFG will test the pond for toxicity to fish by caged fish testing before reintroducing fish. Following application, the pond would be fertilized with inorganic phosphorous and possibly some organic material to stimulate phytoplankton production. IDFG expects that the pond would then be restocked with catchable rainbow trout prior to May 24, 1996.

The Department has determined the fish eradication activities are not contrary to the public interest and are unlikely to result in any permanent or long-term injury of beneficial uses of Roberts Gravel Pond. Therefore, the Department hereby authorizes the fish eradication activities to be conducted pursuant to IDAPA 16.01.02.080.02. This authorization is made on the condition that the activities are conducted as described herein and in your letter of February 23.

Sincerely,

James S. Johnston
Regional Administrator DEQ-EIRO

Prepared by:

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Approved by:

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