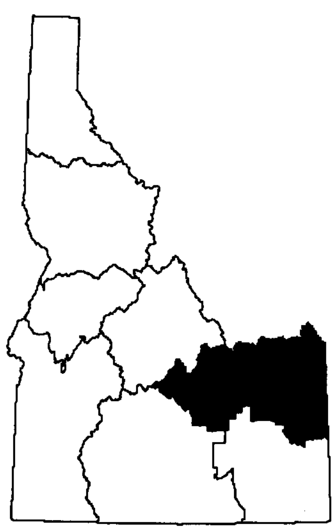
FISHERY MANAGEMENT INVESTIGATIONS

IDAHO DEPARTMENT OF FISH AND GAME

FISHERY MANAGEMENT ANNUAL REPORT

Cal Groen, Director



UPPER SNAKE REGION

2006

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March 2008
IDFG
08-102

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HENRYS LAKE

ABSTRACT

We used 48 standard experimental gill nets (24 sinking, 24 floating) to assess fish populations and relative abundance in Henrys Lake during May 2006. We captured brook trout *Salvelinus fontinalis*, Yellowstone cutthroat trout *Oncorhynchus clarkii bouvieri*, hybrid trout (rainbow trout *O. mykiss* x Yellowstone cutthroat trout) kokanee *O. nerka* and Utah chub *Gila atraria*. Gill net catch rates for all trout combined were not statistically different from levels recorded in 2005. We then separated catch rates by species and found no statistical differences in catch rates for cutthroat trout, hybrid trout or brook trout compared to 2005 catch rates. Relative weight for all trout > 200 mm exceeded 100 for all species with the exception of brook trout between 200 and 299 mm. Median catch rate for Utah chub increased from 5.5 fish per net in 2005 to 10.5 fish per net in the current year. Based on recaptures of marked stocked fish, natural reproduction appears to be low. We estimated stocking rates necessary to produce angler catch rates of 0.7 fish per hour at 1.65 million fingerling trout annually.

We also conducted spawning fish surveys in Targhee, Howard, Duck, Pittsburgh, Gillian, Kelly Springs, Timber and Wild Rose creeks to assess use in these tributaries. We documented a total of 711 adult spawning cutthroat trout in the tributaries between April 28 and June 28.

Two changes to the regulations went into effect in 2006 – the elimination of the fishing hours restriction, and extending the fishing season to the end of November. Enforcement checks were increased to ensure compliance with the new regulations, and to monitor angler use. Few anglers were observed fishing after dark, and the month-long extension saw little increase in harvest. A limited ice fishery developed during the last 8 days of November, with a minimum of 124 anglers participating. Estimated harvest was less than 200 trout.

We monitored dissolved oxygen levels to assess the possibility of a winterkill event from Dec 20 through January 20. Based on depletion estimates, we predicted dissolved oxygen would not reach critical levels (10 g/m^3) until well after ice-out at Hatchery Creek, and late April at the remainder of our monitoring sites. Therefore, we did not implement the helixor aeration system during 2006.

The 2005 spawning operations at Henrys Lake produced 1,639,515 eyed Yellowstone cutthroat trout eggs and 520,161 eyed hybrid trout eggs. Cutthroat trout in the Hatchery Creek run averaged 456 mm total length (TL), while hybrid trout averaged 572 mm TL. The percentages of adipose fin clipped Yellowstone cutthroat returning to the ladder were recorded daily throughout the 2006 spawning run and ranged from 5% to 56%. Pathology reports for viral or bacterial presence detected positive results from six families of Yellowstone cutthroat eggs, all of which were subsequently destroyed.

Riparian tributary fencing was maintained at ten locations around the lake. Nine fish diversion screens were maintained and run over the course of the year.

METHODS

Population Monitoring

As part of routine population monitoring, we collected gill net catch rate data from six standardized locations (Appendix A; Figure 1) in Henrys Lake on May 9 through May 20, 2006 for a total of 48 net nights. Gill nets consisted of either floating or sinking types measuring 46 m by 2 m, with mesh sizes of 2 cm, 2.5 cm, 3 cm, 4 cm, 5 cm and 6 cm. Nets were set at dusk and retrieved the following morning. We identified captured fish to species and recorded total lengths (TL). We calculated catch rates as fish per net night and also calculated 95% confidence intervals. We used a one-way analysis of variance (ANOVA) to detect differences in gill net catch rates among data collected from 1993 to present. We also used a Kruskal-Wallis one-way analysis of variance to analyze gill net catch rates of Utah chub *Gila atraria*.

We examined all captured Yellowstone cutthroat trout *Oncorhynchus clarkii bouvieri* and brook trout *Salvelinus fontinalis* for adipose fin clips as part of our evaluation of natural reproduction. To monitor natural reproduction we estimated the ratio of marked to unmarked fish collected in annual gill net surveys, creel surveys and in the spawning operation. Because ten percent of all stocked cutthroat trout and brook trout are marked with an adipose fin clip prior to stocking, a ratio of 10% or greater indicates low levels of natural reproduction.

We removed the saggital otoliths of all trout caught in our gill nets for age and growth analysis. After removal, all otoliths were cleaned on a paper towel and stored in individually-labeled envelopes. Ages were estimated by counting annuli under a dissecting microscope at 40x power. Otoliths were submerged in water and read in whole view when clear, distinct growth rings were present. We sectioned, polished and read otoliths in cross-section view with transmitted light when the annuli were not distinct in whole view. Aged fish were then plotted against length using a scatter plot, and any outliers were selected, re-read, and the ages corroborated by two readers.

Relative weights were calculated by dividing the actual weight of each fish (in grams) by a standard weight for the same length for that species multiplied by 100 (Anderson and Gutreuter 1983). Relative weights were then averaged for each length class (< 200 mm, 200-299 mm, 300-399 mm and fish > 399 mm). We used the formula $\log W_s = -5.194 + 3.098 \log L$ (Anderson, 1980) to calculate relative weights of hybrid trout, $W_s = -5.192 + 3.086 \log TL$ for cutthroat trout (Kruse and Hubert, 1997) and $W_s = -5.096 + 3.069 \log TL$ for brook trout (Hyatt and Hubert 2000).

We explored the relation between fingerling stocking levels and angler catch rates by using a linear regression between these two variables. We used angler catch rate data (fish per hour) from 1950 to present regressed against stocking levels from two years prior to the creel survey over the same time period. From the resulting equation (Angler catch rate = (Number stocked/1,000)*0.004-0.0153), we were able to estimate total stocking levels necessary to produce catch rates consistent with our management objective of 0.7 fish per hour.

We began an evaluation of spring vs. fall fingerling brook trout stockings by batch-marking all brook trout prior to stocking in 2005. We marked one group of brook trout with calcein by immersing fish in a 1.5% salt solution for 3.5 minutes, followed by a brief rinse in freshwater and then transfer to a 0.5% calcein solution for 3.5 minutes. We stocked 91,936 marked fingerlings in May and an additional 59,826 unmarked fingerlings in September of 2005. We collected scales and otoliths from all brook trout captured which personnel from Nampa Research will analyze for marks using fluorescent microscopy.

Tributary spawning surveys were conducted on Targhee, Duck, Howard, Pittsburgh, Wild Rose, Timber, Kelly and Gillian creeks. Counts were conducted with one staff member walking along the shoreline with polarized glasses to observe redds and spawning fish. All adult trout observed between April 28 and June 28 were recorded, as were identified redds. We surveyed the entire length of known spawning habitat on each creek to identify use, which equates to 11 km in Timber Creek, 4 km in Howard Creek, 2.5 km in Duck Creek, 1 km in Pittsburgh Creek, 0.5 km in Gillian Creek, 0.6 km in Kelly Springs Creek, 2 km in Timber Creek and 0.5 km in Wild Rose Creek.

Water Quality

We measured winter dissolved oxygen concentrations, snow depth, ice thickness and water temperatures at established sampling sites on Henrys Lake (Appendix A). Holes were drilled in the ice with a gas-powered ice auger prior to sampling. We used a YSI model 550-A oxygen probe to collect dissolved oxygen samples and estimated total g/m3 of oxygen by averaging dissolved oxygen readings at ice bottom and one meter below ice bottom, and summing readings at subsequent one-meter intervals to the bottom.

Spawning Operation

We operated the Hatchery Creek fish ladder for the spring spawning run from February 22 through May 10. Fish ascending the ladder were identified to species and counted. We measured total length for a sub-sample (10%) of each group. Yellowstone cutthroat trout were produced using ripe females spawned into seven-fish pools and fertilized with pooled milt from four to seven males. Hybrid trout were produced with Yellowstone cutthroat trout eggs and Kamloops rainbow trout milt obtained from Hayspur Hatchery. Hybrid trout were sterilized by inducing a triploid condition using pressure to shock the eggs post-fertilization. Once hybrid trout eggs reached 47 minutes and 45 seconds post-fertilization, the eggs were placed in the pressure treatment machine at 10,000 psi and held at this pressure for 5 minutes. Random samples of eggs were sent to the Eagle Fish Health Lab to test induction rates of sterilization. The remaining Hybrid trout eggs were shipped to the University of Idaho at Hagerman, Ashton and Mackay Hatcheries for hatching, rearing and subsequent release back into Henrys Lake and other Idaho waters. Yellowstone cutthroat trout eggs were shipped to Mackay and American Falls Hatcheries for hatching, rearing and release back into Henrys Lake.

We took disease samples from the spring spawning run. Ovarian fluids were collected from seven female egg pools of Yellowstone cutthroat trout during spawning. All combined batches were tested. Random viral samples were taken from 25 seven-female egg pools in the spring run. All samples were sent to the Eagle Fish Health Laboratory.

Riparian Fencing, Fish Screening and Tributary Spawning Surveys

Electric fencing has been in place at Henrys Lake since the early 1990's to protect riparian areas from grazing livestock. We stretched fencing and installed solar panels, batteries, and connections during May 2006 at ten sites on the tributaries of Henrys Lake as established in routine maintenance guidelines. We routinely checked fencing during the summer and fall for proper voltage and function.

Fish diversion screens are located at nine sites on the tributaries of Henrys Lake. Screens were routinely maintained, cleaned and checked for proper operation on a daily basis during the summer and fall months of 2006.

RESULTS

Population Monitoring

We collected 1,230 fish in 48 net nights of gill net effort. Catch composition was 22% cutthroat trout, 7% hybrid trout, 5% brook trout, and 66% Utah chub (Figure 2). Cutthroat trout ranged from 145 to 551 mm TL (Figure 3), hybrid trout 168 to 685 mm (Figure 4), and brook trout 162 to 509 mm (Figure 5). Mean length at age 3 was 432 mm, 459 mm and 407 mm for Yellowstone cutthroat trout, hybrid trout and brook trout, respectively. Mean length for all ages and trout species is presented in Table 1. Catch rates for Yellowstone cutthroat trout were not significantly different from the past five years (Figure 6). For the third year in a row, cutthroat trout catch rates are above the 14-year average. Further analysis showed that catch of age 1 and 2 Yellowstone cutthroat trout were well below the five-year mean for these age classes (Figures 7 and 8). Since 2000, hybrid trout catch rates have been declining (Figure 9), and are now significantly below catch rates found in 2004 gill net surveys ($p = 0.009$, one-way ANOVA). Brook trout catch rates in gill nets have increased slightly from last year's survey (Figure 10). The proportion of Utah chub in the gill net catch is increasing (Figure 11). Our median catch rate for Utah chub in 2006 was 10.5 fish per net night, nearly double the 5.5 median catch rate from 2005, and almost four times greater than our catch rates in 2004 (Figure 12).

Mean relative weights for fish > 200 mm for all species exceeded 100 with the exception of brook trout from 200 to 299 mm (Table 2). This suggests an abundance of available forage for trout (Flickinger and Bulow 1993). There have been no significant declines in relative weights of cutthroat trout from 2004 to 2006 in spite of an increase in Utah chub abundance (Figure 13).

Results from our fin clip information showed 20 of 269 (7.5%) Yellowstone cutthroat trout collected with gill nets were adipose-clipped fish (Table 3). Of the 2,455 fish observed during the spawning run, 944 (39%) were adipose-clipped.

We found a significant relation between angler catch rates and stocking levels from two years prior. Based on this information, stocking 1.65 million fingerlings annually should produce angler catch rates consistent with our management goals of 0.7 fish per hour +/- 0.1 fish per hour (Figure 14). Stocking densities over the past 10 years are presented in Figure 15 for comparison.

We captured ten small brook trout in our gill net surveys which we examined for calcein markings to determine if they were from our spring or fall stockings. Personnel from Nampa Research read the collected otoliths, and failed to find any markings.

Spawning surveys documented 152 fish in Targhee Creek, 30 fish in Howard Creek, 0 fish in Duck Creek, 434 fish in Pittsburg Creek, 19 fish in Gillian Creek, 24 fish in Kelly Springs Creek, five fish in Timber Creek and 47 fish in Wild Rose Creek. All fish were assumed to be Yellowstone cutthroat trout. Counts of adult trout using tributaries during spawning periods were hampered by high flows and turbid waters, and are considered minimal estimates of tributary use.

Enforcement personnel and biologists monitored the changes in regulations to ensure compliance, and found few anglers fishing into the night with the removal of fishing hours. The extended fishing season saw limited use during the first portion of November, as skim ice prevented much fishing. We estimate a minimum of 124 anglers participated in an ice fishery that developed during the last eight days of November. Total harvest was estimated at less than 200 trout.

Water Quality

We recorded oxygen profiles during December 2005 through January 2006 at three standard sites (Pittsburgh Creek, County Boat Dock and Wild Rose), as well as occasional readings at the Hatchery and Outlet. Total oxygen diminished from 46.7 g/m^3 to 32.7 g/m^3 at the Pittsburgh Creek site, 43.5 g/m^3 to 36.1 g/m^3 at the County dock, and 50.6 g/m^3 to 34.1 g/m^3 at the Wild Rose site (Table 4). Based on depletion estimates, we predicted our monitoring sites would not approach 10.0 g/m^3 (our level of concern) before late April (Figure 16). Therefore, we did not implement the Helixor aeration system during 2006.

Spawning Operation

Between February 22 and May 10, 2,685 Yellowstone cutthroat trout ascended the hatchery spawning ladder. Of these, 47% were males and 53% were females. Mean lengths were 452 and 460 mm, respectively with a combined mean length of 456 mm. Hybrid trout totaled 506 fish and consisted of 60% males and 40% females with mean lengths of 566 mm and 578 mm, respectively.

We collected 2,665,000 green eggs from 1,035 Yellowstone cutthroat trout females for a mean fecundity of 2,575 eggs per female (Table 5). Eyed Yellowstone cutthroat trout eggs totaled 1,639,515 for an overall eye-up rate of 62%. We shipped all eyed Yellowstone cutthroat trout eggs to Mackay Hatchery where they were hatched, reared, and subsequently released back into Henrys Lake in the fall of 2006 as fingerlings. We committed 11 days to Yellowstone cutthroat trout spawning.

We collected 1,001,000 green eggs from 385 female Yellowstone cutthroat trout for hybrid trout production (Table 6). Eyed hybrid trout eggs totaled 520,161 for an overall eye-up rate of 52%. We shipped 42% of all eyed hybrid trout eggs to the Mackay Hatchery for hatching, rearing, and subsequent release into Henrys Lake in the fall of 2006, while 52% of the eggs were shipped to the University of Idaho at Hagerman for later release into Salmon Falls Reservoir. The remaining 6% were shipped to the Ashton Hatchery for hatching, rearing and subsequent release into local waters. Mean sterilization rates for hybrid trout were 99% during 2006. We devoted two days to production of hybrid eggs during 2006.

Disease sampling was completed on adult spawning fish during the spring and fall runs. Complete results and discussion will be included in the resident fisheries pathologist report. Six trays of Yellowstone cutthroat trout tested positive for bacterial disease and were subsequently destroyed.

Riparian Fencing, Fish Screening and Tributary Spawning Surveys

Electric fencing functioned well during the year. Voltages remained high throughout the season and riparian infringements by cattle were rare. Fish screens functioned well on Targhee, Duck and Howard creeks.

DISCUSSION

Overall, our gill net catch rates (fish per net night) on trout from 2006 were similar to those found in 2005. The slight reduction in gill net catch rates of Yellowstone cutthroat trout between 2005 and 2006 can be attributed to fingerling trout stockings in 2004 and 2005 which were below our stocking goals. These weaker year classes were reflected in our gill net catch of age-1 and age-2 Yellowstone cutthroat trout. However, the strong year class of 2003 resulting from a 44% above average stocking likely increased angler catch rates thereby offsetting the effects of the weak year classes stocked in more recent years.

Gill net catch of hybrid trout continues on a decline that began in 2001. Hybrid trout stocking rates since 2000 have been 18% below average, and more recently (2004-2006) have been 28% below average. Another factor now influencing hybrid trout populations is our sterilization program. It is possible that hybrid trout mortality has been reduced by the sterilization process removing spawning-related stresses. Hybrid trout may be living longer and attaining larger sizes than in the past. Our standard gill nets used for monitoring trout populations has been shown to be biased against sampling larger fish (Garren et. al., 2002) possibly due to mesh size limitations. If this is the case, our hybrid trout population could be higher than we realize. Angler satisfaction with the hybrid trout fishery is high, and complaints have been negligible.

The brook trout that were analyzed for calcein markings showed no evidence of having been marked. This suggests they were from our September stocking of unmarked fish, were from wild production, or the marking and/or reading of marked fish was unsuccessful. Regardless, our sample size of ten fish is too small to draw definitive conclusions as to what season is most appropriate for stocking brook trout. Additional work towards identifying the most successful time to stock brook trout should be weighed against time constraints and costs, and implemented accordingly.

Mean catch rates for Utah chub in our gill nets continue to increase. Catch rates first began to increase in the late 1990's, following initial documentation of their presence in 1993. Results from 2004 data analysis on Utah chub suggest non-parametric methods of data analysis are a more appropriate way to look at gill net catch (Garren et. al. 2005). Median gill net catch rates for Utah chub have exceeded all previous samples and suggests an increase in abundance. Gill net catch rates on Utah chub in other water bodies have demonstrated wide fluctuations in annual catch (Island Park Reservoir – 65% decline to 460% increase between years, Mud Lake 62% decline over two years). Compared to other local water bodies with Utah chub (Mud Lake, 85 fish per net night; Island Park Reservoir, 14 fish per net night), catch rates in Henrys Lake are moderate. Although meaningful inferences on Utah chub densities are hampered by low gill net sample numbers in past years and high variability among nets, we are concerned that the population of Utah chub may be increasing and warrant close monitoring.

Results from tributary counts of spawning fish documented use in seven of eight tributaries surveyed. Because of turbid water coupled with high flows, accurate estimates of adult use were impossible. It may be more accurate to monitor contributions of natural reproduction to the lakewide population using the ongoing fin clip program as opposed to continuing the tributary monitoring program. However, adult counts on Targhee and Howard creeks may provide interesting generalizations about tributary use following the removal of two barriers to migration in 2005.

The changes to the fishing regulations that went into effect for the 2006 angling season did not have a negative effect on the fishery with regards to exploitation or compliance with regulations. However, the limited public access around Staley's Springs created the potential for trespass issues as a result of the limited ice fishery that developed at the end of the season. The area immediately outside of Staleys Springs received the majority of angler use. As a result, many anglers were parking at facilities surrounding this area without permission, creating the potential for conflict. Additionally, perceptions of overharvest may have been influenced by congregated anglers immediately outside of the restricted boundary, again creating the potential for conflict. Planning is underway to resolve these issues before they become problems.

RECOMMENDATIONS

1. Continue annual gill net samples at 50 net nights of effort.
2. Collect otolith samples from all trout species; use for cohort analysis and estimates of mortality/year class strength.
3. Continue winter dissolved oxygen monitoring, and implement aeration when necessary.
4. Monitor Utah chub densities, and continue work on determining population dynamics within the lake.
5. Continue to use fin clips on 10% of all cutthroat trout to determine natural reproduction.

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Figure 1. Spatial distribution of gill net locations used in population monitoring in Henrys Lake, Idaho.

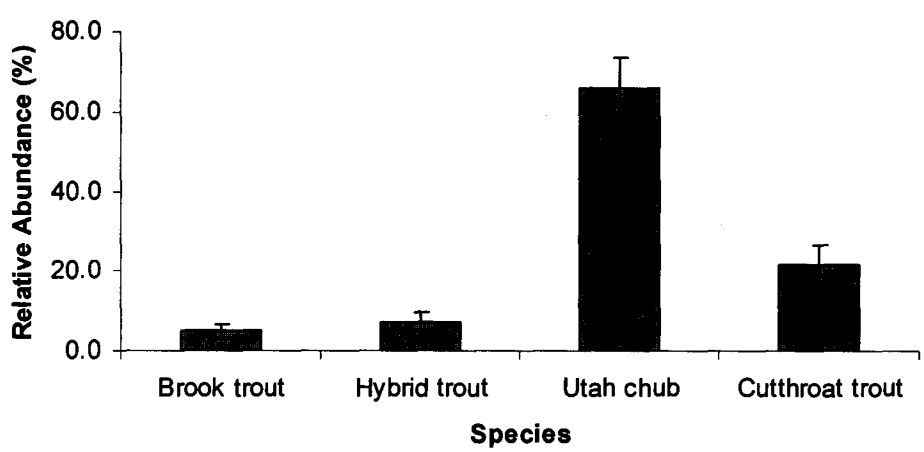

Figure 2. Relative abundance of fish caught in gill nets in Henrys Lake, 2006. Error bars represent 90% confidence intervals.

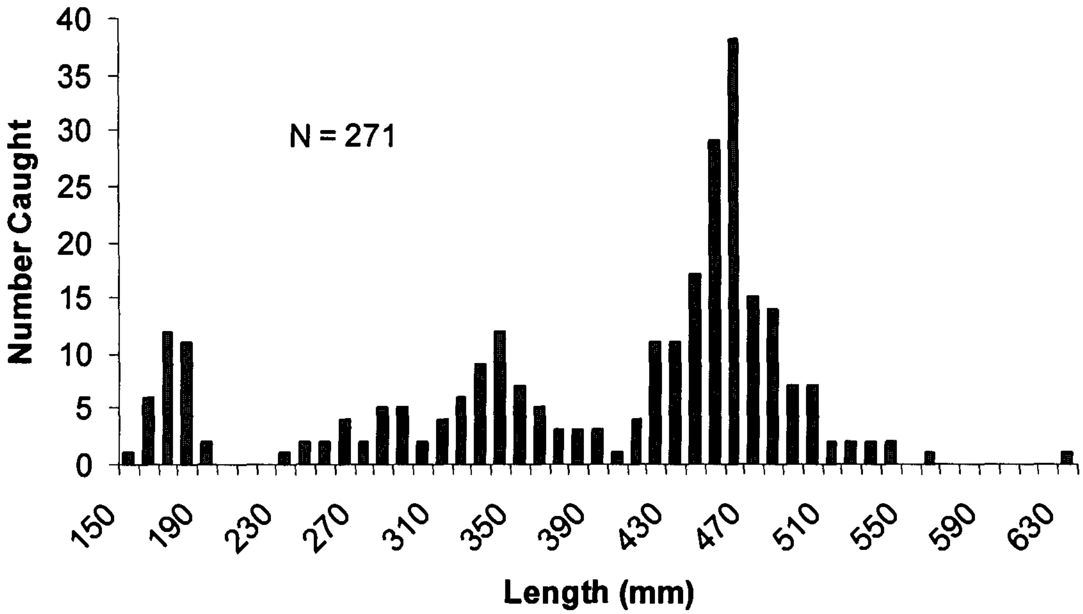

Figure 3. Yellowstone cutthroat trout length frequencies from gill nets set in Henrys Lake, Idaho, 2006.

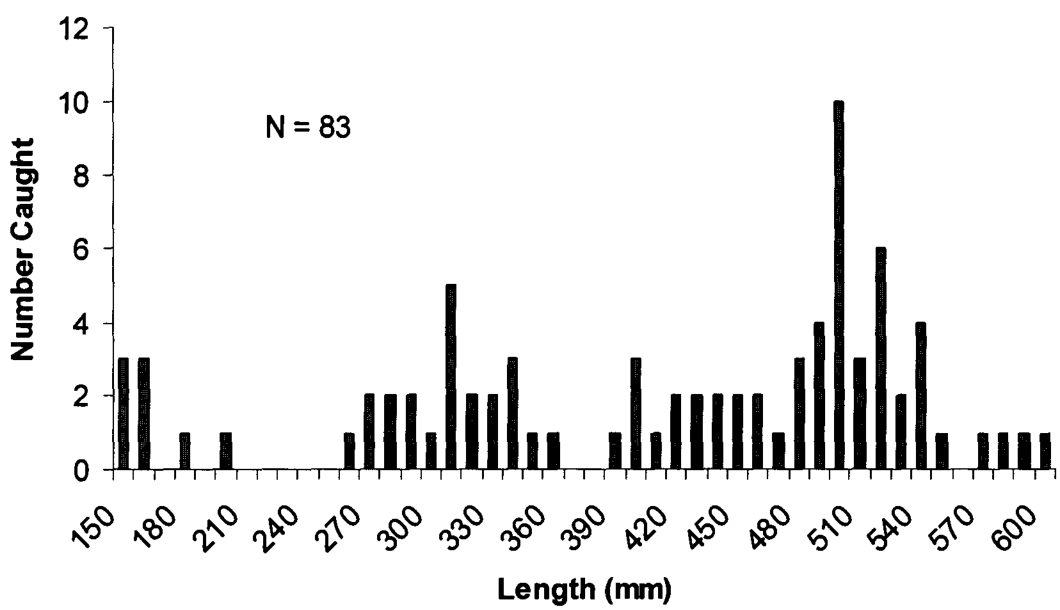

Figure 4. Hybrid trout length frequencies from gill nets set in Henrys Lake, Idaho, 2006.

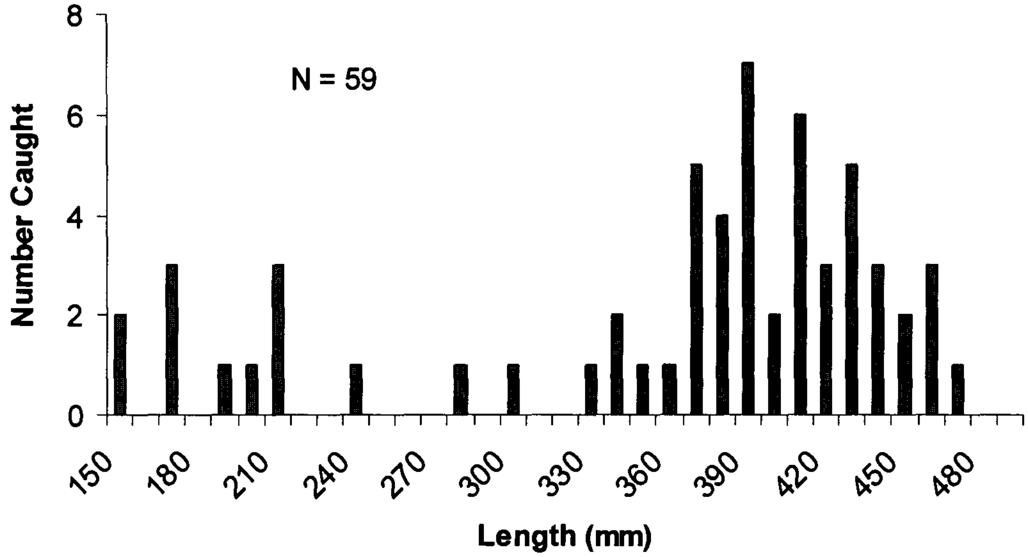

Figure 5. Brook trout length frequencies from gill nets set in Henrys Lake, Idaho, 2006.

Table 1. Mean length at age data from trout caught with gill nets in Henrys Lake, Idaho 2006. Ages were estimated using otoliths.

	Mean Length at Age (mm)					
Species	1	2	3	4	5	6
Yellowstone cutthroat trout	166	302	431	459	534	--
(No. Analyzed)	(24)	(59)	(102)	(64)	(5)	--
Hybrid trout	170	304	458	513	514	--
(No. Analyzed)	(6)	(17)	(27)	(21)	(3)	--
Brook trout	172	377	407	438	--	--
(No. Analyzed)	(2)	(8)	(30)	(5)	--	--

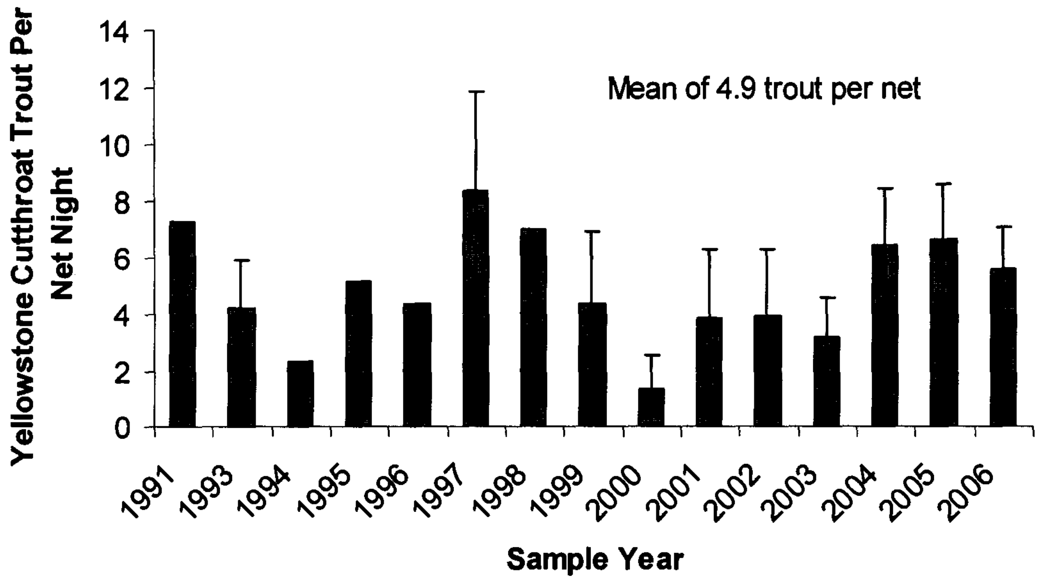

Figure 6. Yellowstone cutthroat trout catch rates in gill nets set in Henrys Lake, Idaho, 1991 to present. Error bars represent 95% confidence intervals.

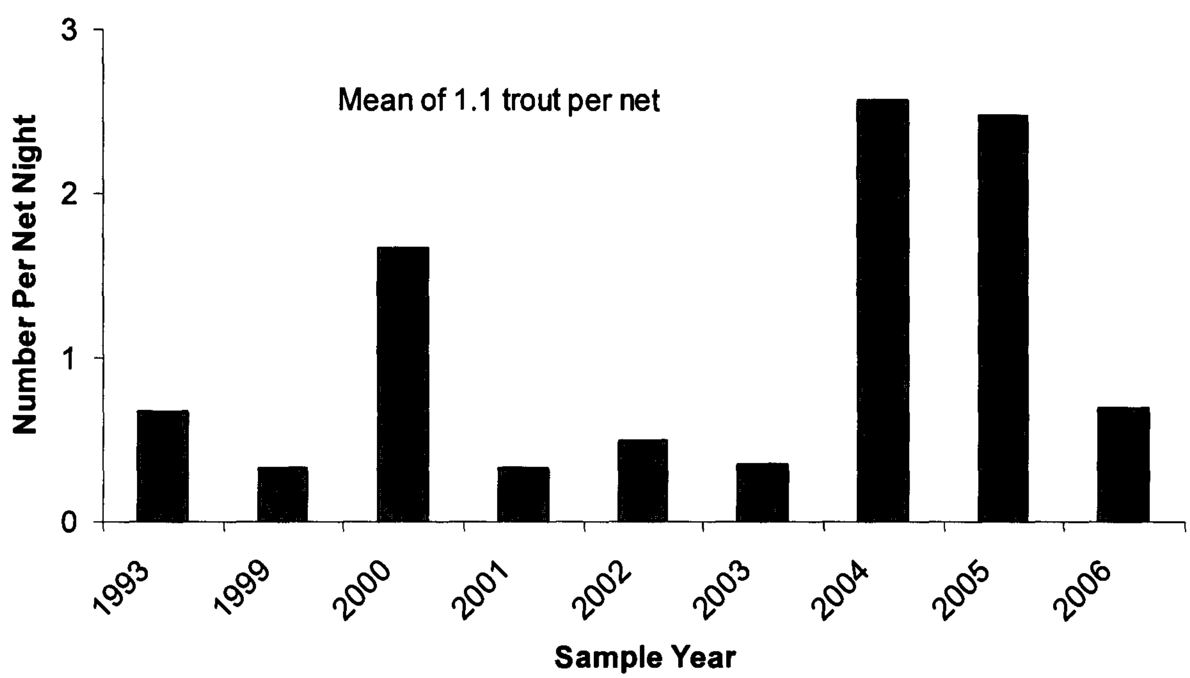

Figure 7. Catch per unit effort (number per net night) of age-1 Yellowstone cutthroat trout in Henrys Lake, Idaho.

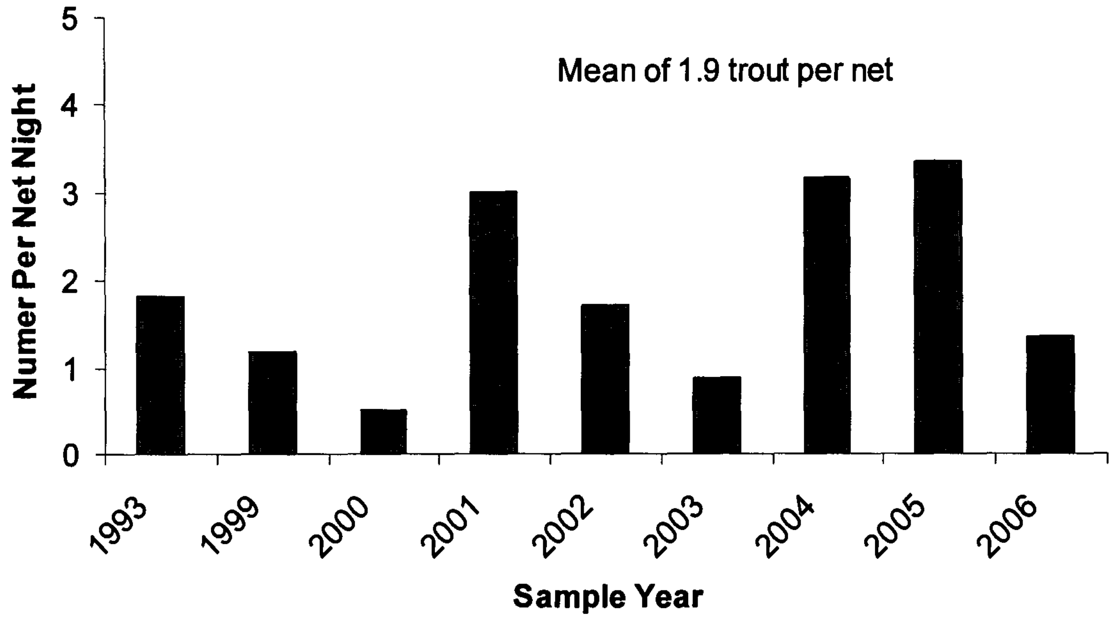

Figure 8. Catch per unit effort (number per net night) of age-2 Yellowstone cutthroat trout in Henrys Lake, Idaho.

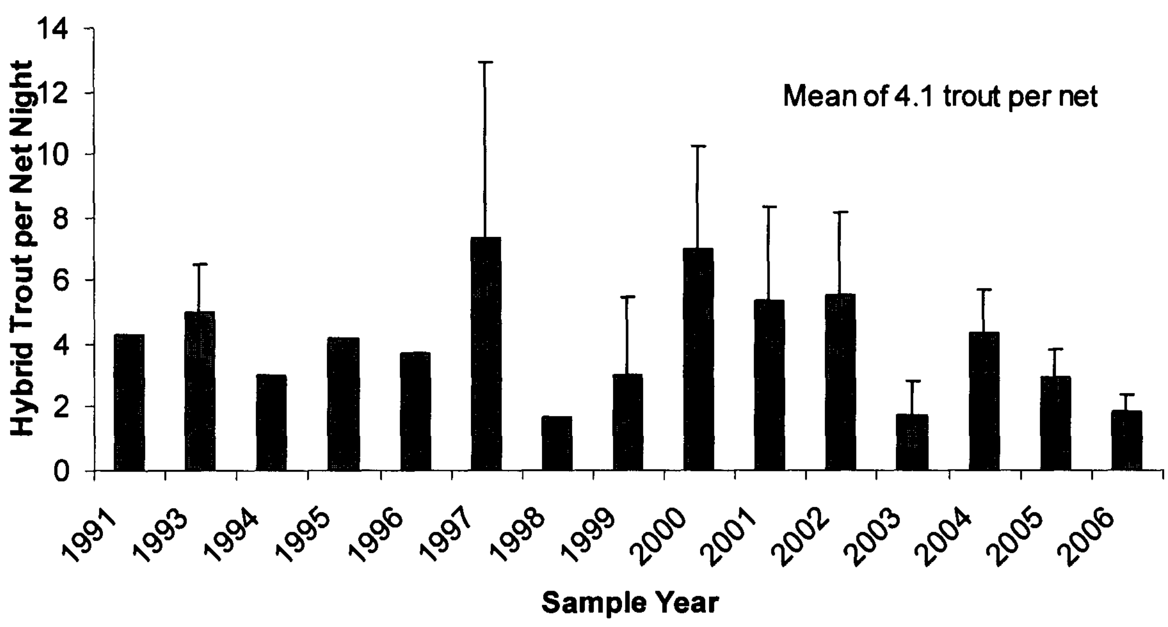

Figure 9. Hybrid trout catch rates in gill nets set in Henrys Lake, Idaho, 1991 to present. Error bars represent 95% confidence intervals.

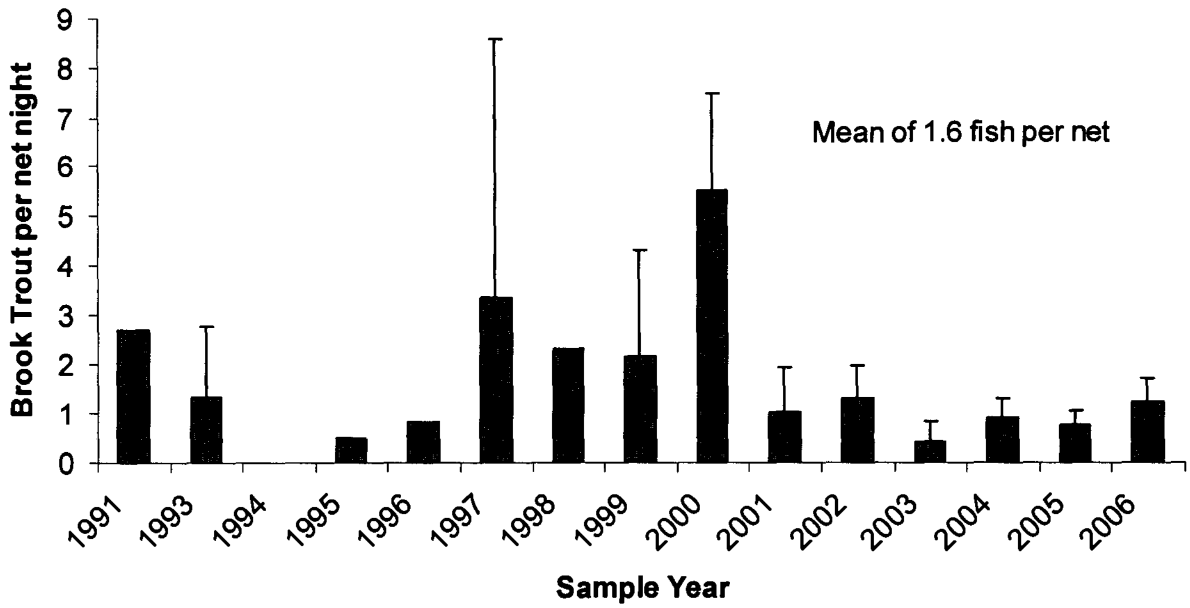

Figure 10. Brook trout catch rates in gill nets set in Henrys Lake, Idaho, 1991 to present. Error bars represent 95% confidence intervals.

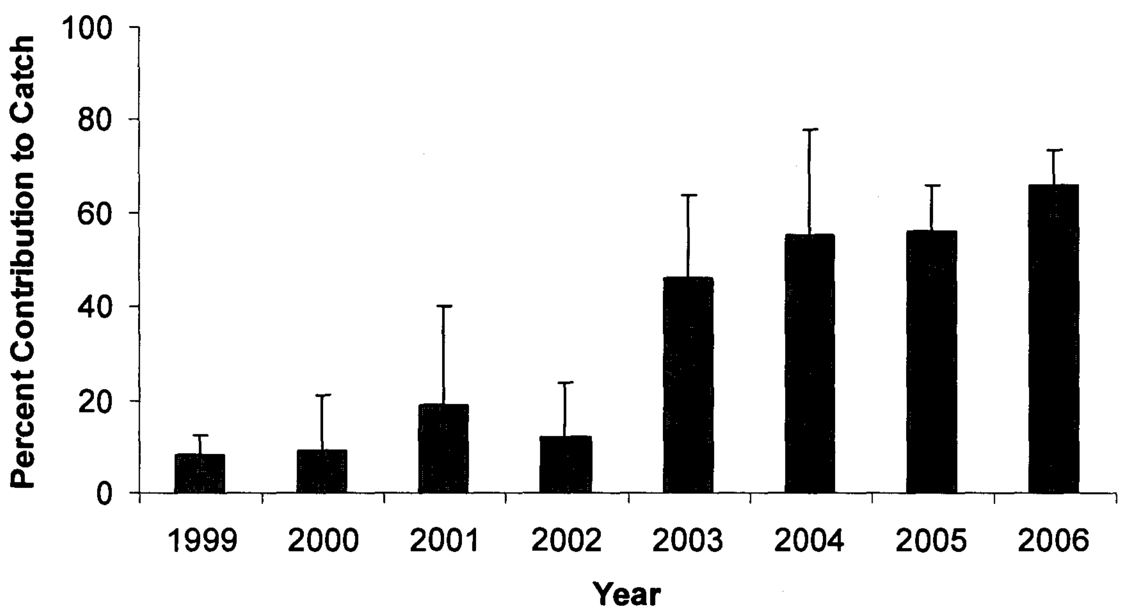

Figure 11. Relative abundance of Utah chub caught in gill nets in Henrys Lake, Idaho. Error bars represent 95% confidence intervals.

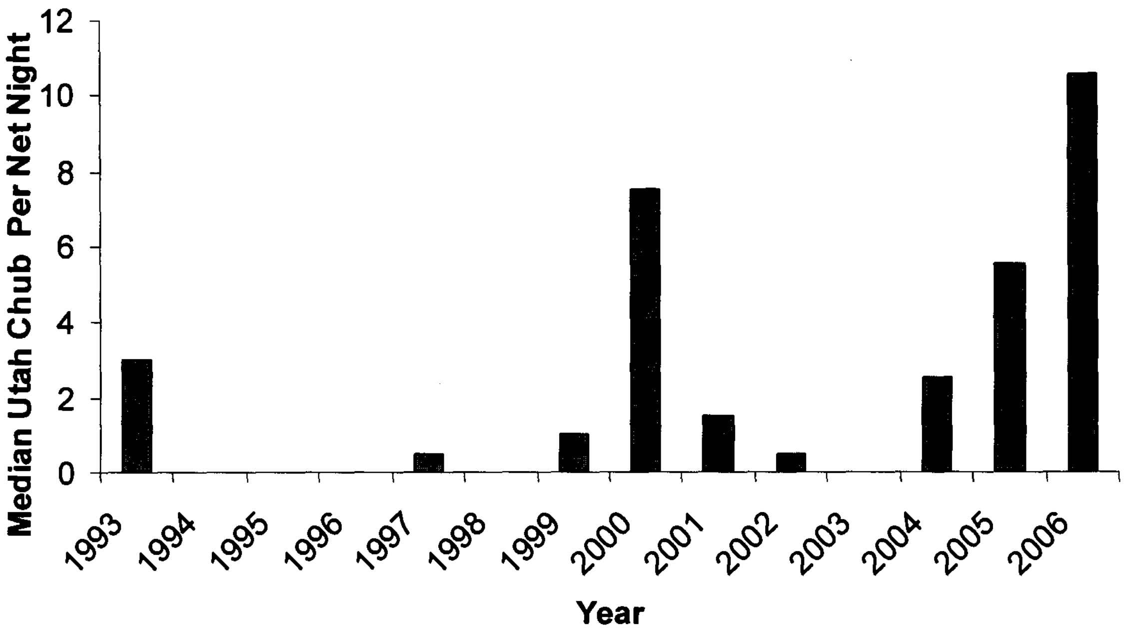

Figure 12. Median Utah chub catch rates in gill nets set in Henrys Lake, Idaho, 1991 to present.

Table 2. Relative weights for all trout species collected with gill nets in Henrys Lake, Idaho 2006.

	Mean Relative Weight			
Species	< 200 mm	200-299 mm	300-399 mm	> 399 mm
Yellowstone cutthroat trout	102	110	117	108
Hybrid trout	92	103	106	122
Brook trout	87	90	109	107

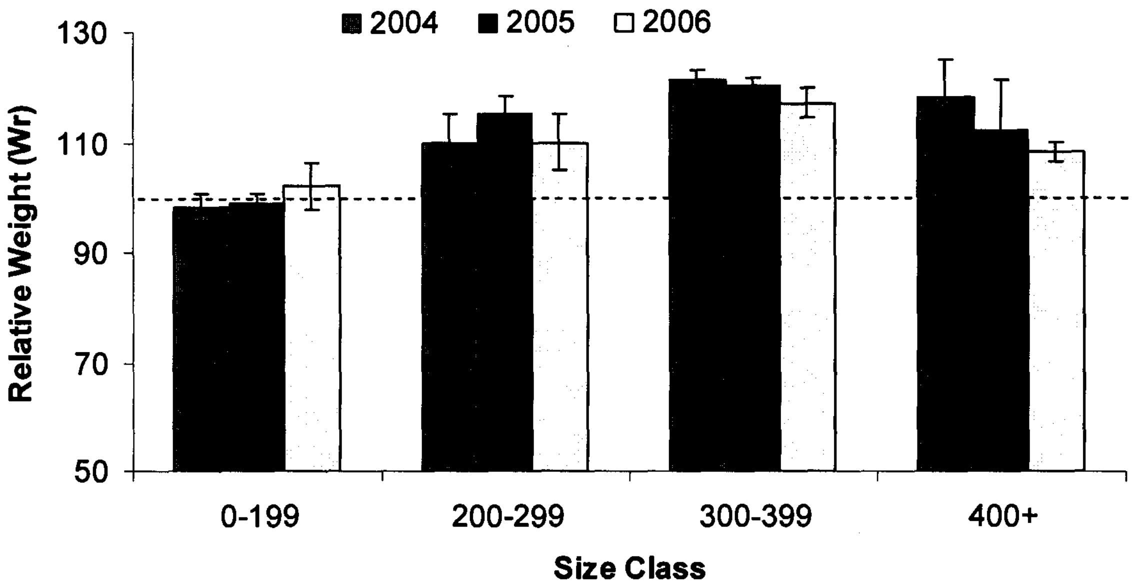

Figure 13. Relative weights for Yellowstone cutthroat trout in Henrys Lake, Idaho 2004-2006. Error bars represent 95% confidence intervals.

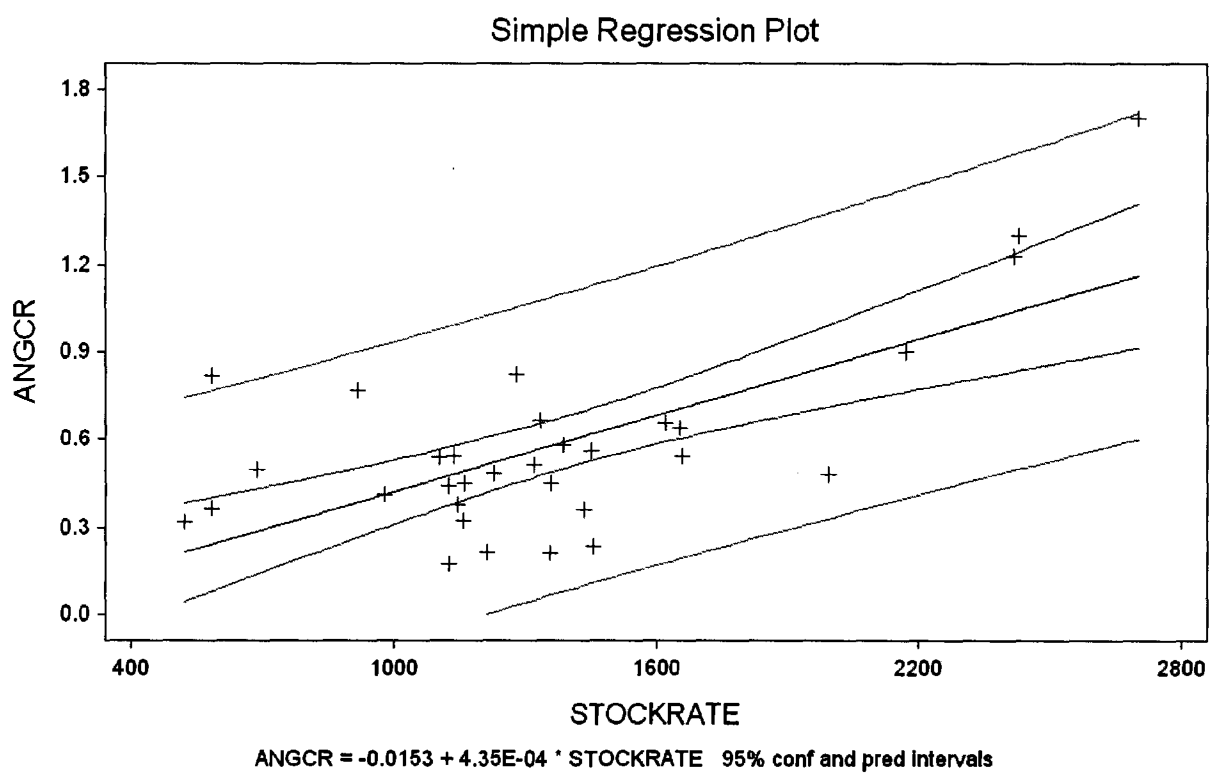

Figure 14. Regression between stocking rates (*1,000) and angler catch rates two years later. 95% confidence bounds are represented by the red lines, and upper and lower bounds are represented by the pink lines.

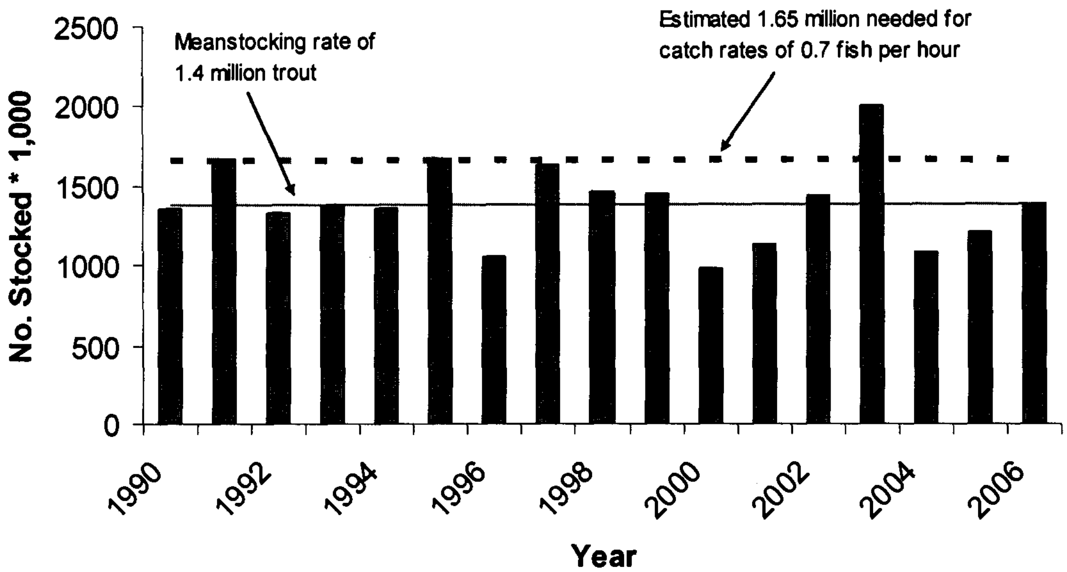

Figure 15. Trout stocking rates for Henrys Lake, Idaho 1990 to present.

Table 3. Fin clipping data from trout stocked in Henrys Lake, Idaho. Ten percent of all stocked Yellowstone cutthroat trout and brook trout receive an adipose fin clip annually (Brook trout have not been clipped since 2005).

	Yellowstone cutthroat trout				Brook trout			
Year	No. Clipped	No. of fish checked for clips	No. of clips detected	Percent clipped	No. Clipped	No. of fish checked for clips	No. of clips detected	Percent clipped
1996	100,290	--	--	--	1,961	1	0	0%
1997	123,690	178	5	3%	2,044	11	1	9%
1998	104,740	--	--	--	2,067	--	--	--
1999	124,920	160	20	13%	--	48	5	10%
2000	100,000	14	1	7%	--	3	0	0%
2001	99,110	116	22	19%	--	30	6	20%
2002	110,740	38	7	18%	--	6	2	33%
2003[b]	163,389	106	37	35%	--	--	--	--
2003[c]		273	47	17%	--	--	--	--
2004[c]	92,100	323	28	8%	98,711	45	11	24%
2005[b]	85,124	2,138	629	29%	--	--	--	--
2005[a]		508	55	11%	15,176	34	5	14
2006[a]	100000	269	20	8%	--	60	4	7%
2006[b]		2455	944	39%	--	--	--	--

[a]Obtained from gill net samples and creel survey.
[b]Fish observed in Hatchery Creek spawning run.
[c]Fish obtained from gill net samples.

Table 4. Dissolved oxygen (DO) readings (mg/l) recorded in Henrys Lake, Idaho wintertime monitoring 2005-2006.

Location	Date	Snow depth (mm)	Ice depth (mm)	DO Ice bottom	DO 1 meter	DO 2 meters	DO 3 meters	Total g/m^3
Pittsburg Creek	Dec 20	2	11	14.3	13.8	13.1	10.0	46.7
	Jan 3	8	11	14.8	14.5	13.6	9.8	46.1
	Jan 20	4	15	15.4	14.7	7.7	5.6	32.7
County Boat Dock	Dec 20	1	13	14.0	13.3	13.0	9.8	43.5
	Jan 3	11	16	15.3	14.4	12.5	9.7	40.7
	Jan 20	12	15	15.3	14.1	10.2	7.6	36.1
Wild Rose	Dec 20	3	12	14.2	13.8	13.6	12.2	50.6
	Jan 3	8	14	15.3	14.2	13.4	8.3	41.7
	Jan 20	8	15	15.3	14.4	10.1	7.1	34.1
Cabin	Dec 20	2	10	15.7	14.8	12.5	10.7	46.65
	Jan 3	11	14	14.4	11.8	11.2	7.8	41.5
	Jan 20	4	13	14.5	10.3	8.2	5.7	36.5

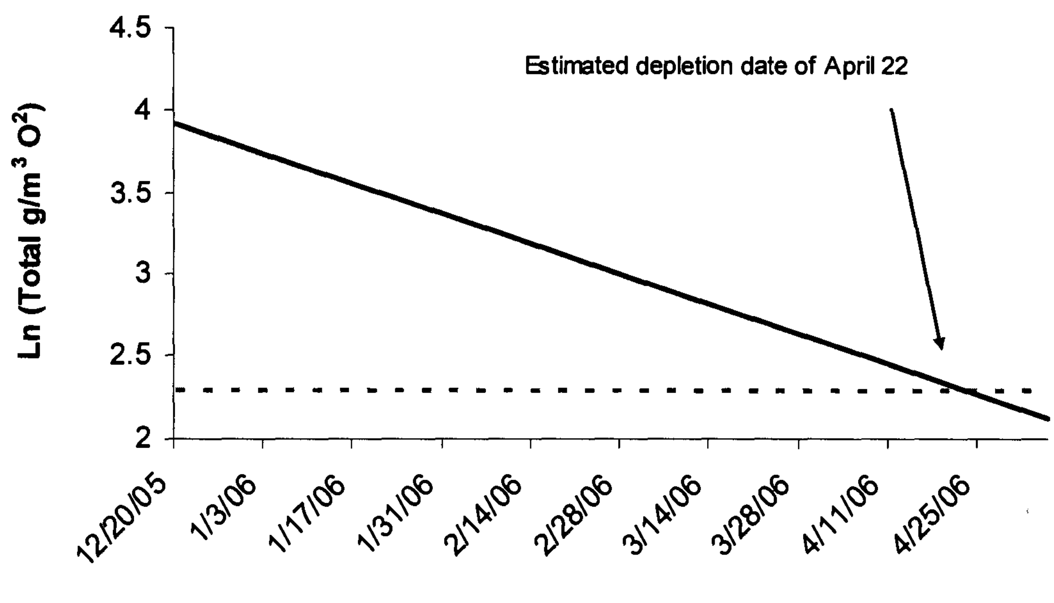

Figure 16. Oxygen depletion rate for the Wild Rose collection station, Henrys Lake, Idaho 2006. Threshold level of 10.0 g/m^3 estimated at Apr 22 based on the predicted rate of decline.

Table 5. 2006 Henrys Lake Yellowstone cutthroat trout spawning summary.

Spawn Date	Lot Number	Females Spawned	No. of Green Eggs	Mean Fecundity	No. of Eyed Eggs	Disease Status	Percent Eye-up
Mar 2	3	139	361,400	2,600	275,000	Neg.	76
Mar 6	4	161	418,600	2,600	318,548	Neg.	76
Mar 9	5	168	436,800	2,600	343,548	Neg.	79
Mar 13	6	104	270,400	2,600	201,613	Neg.	75
Mar 16	7	105	273,000	2,600	206,452	Neg.	76
Mar 20	8	60	156,000	2,600	87,097	Neg.	56
Mar 27	9	60	156,000	2,600	43,548	Pos.	28
Mar 30	10	78	202,800	2,600	89,516	Neg.	44
Apr 6	12	60	150,000	2,500	41,935	Pos	28
Apr 13	13	58	139,200	2,400	32,258	Neg.	23
Apr 24	14	42	100,800	2,400	0	Neg.	0
Total		**1,035**	**2,665,000**	**2,575**	**1,639,515**		**62**

Table 6. 2006 Henrys Lake hybrid trout spawning summary.

Spawn Date	Lot Number	No. of Females Spawned	No. of Green Eggs	Mean Fecundity	No. of Eyed Eggs	Disease Status	Percent Eye-up
Feb 24	1 S	161	418,600	2,600	201,613	Neg.	48
Feb 28	2 S	70	182,000	2,600	100,000	Neg.	55
Feb 28	2 F	70	182,000	2,600	136,290	Neg.	75
Apr 3	11 S	30	78,000	2,600	29,032	Neg.	37
Apr 3	11 F	54	140,400	2,600	53,226	Neg.	38
Total		**385**	**1,001,000**	**2,600**	**520,161**		**51**

Appendix A. Locations used in standard Henrys Lake gill net sets and standard dissolved oxygen monitoring stations. Coordinates are given as UTM's; Datum is NAD 27.

Gill Net Sites

Gill Net 1.	467,252 E	4,944,882 N	Z 12
Gill Net 2.	469,510 E	4,943,608 N	Z 12
Gill Net 3.	467,217 E	4,940,776 N	Z 12
Gill Net 4.	467,320 E	4,943,171 N	Z 12
Gill Net 5.	467,962 E	4,942,292 N	Z 12
Gill Net 6.	468,203 E	4,940,874 N	Z 12

Dissolved Oxygen Sites

County boat dock:	465,725 E	4,944,234 N	Z 12
Wild Rose:	467,751 E	4,945,816 N	Z 12
Outlet:	471,374 E	4,938,741 N	Z 12
Pittsburg Creek:	469,446 E	4,943,838 N	Z 12
Hatchery Ladder:	469,290 E	4,945,489 N	Z 12
Cliffs:	467,072 E	4,940,951 N	Z 12

ISLAND PARK RESERVOIR

ABSTRACT

We used 32 standard experimental gill nets (16 sinking, 16 floating) to assess fish populations and relative abundance in Island Park Reservoir during October 2006. We captured rainbow trout *Oncorhynchus mykiss*, brook trout *Salvelinus fontinalis*, Yellowstone cutthroat trout *O. clarkii bouvieri*, kokanee salmon *O. nerka* mountain whitefish *Prosopium williamsoni,* Utah sucker *Catostomus ardens* and Utah chub *Gila atraria*. Gill net catch rates for all trout combined have declined by 55% compared to gill net catch rates from 2005, and are at their lowest level since 1991. Nongame fish have declined 48% since 1998. Relative weight for all species of trout exceeded 100 with the exception of rainbow trout over 400 mm (W_r = 98 for rainbow trout > 400 mm), indicating an abundance of forage. Zooplankton sampling supported this observation, with an estimated Zooplankton Quality Index (ZQI) of 1.10. We estimated proportional stock density (PSD) at 64. We removed otoliths from all trout captured in our gill nets, and estimated mean length at age three for rainbow trout at 378 mm. Total annual mortality from ages two to five was 70%.

We conducted a review of historic data and past annual reports to explore management options that may improve angler catch rates. The data suggest impacts from the four past rotenone treatments (1958, 1966, 1979, 1992) have been effective in reducing nongame fish populations for an average of five years following treatments. However, we did not see an improvement in angler catch rates within that five year period when compared to angler catch rates outside of that five year window. We found a significant relation between reservoir carryover and gill net catch rates the following year with better catch rates following years where reservoir drawdown was minimal. Reservoir storage in combination with stocking rates explain the most variation in trout population densities as reflected in gill net catch rates.

INTRODUCTION

The recreational fishery at Island Park Reservoir attracts anglers throughout Idaho, Utah and nationwide. Creel data collected during the past 60 years shows the quality of the fishery to vary. Rainbow trout *Oncorhynchus mykiss* have provided the bulk of angler catch, with kokanee salmon *O. nerka*, brook trout *Salvelinus fontinalis*, mountain whitefish *Prosopium williamsoni* and Yellowstone cutthroat trout *O. clarkii bouvieri* adding to the creel. In most years, the hourly catch rate has been moderate, averaging more than two hours to catch a game fish. Utah chub *Gila atraria*, which are assumed to have been illegally introduced to the reservoir in the 1940's have been blamed for the declines in angler catch rates over the years.

Creel Surveys/Gill Net Surveys

Historically, the Idaho Department of Fish and Game (IDFG) has monitored the Island Park fishery with creel and gill net surveys. The first creel survey on Island Park Reservoir was conducted in 1950. Since then, 28 surveys have been completed. Angler effort has ranged from 41,000 hours to 176,000 hours over the past 56 years (Appendix A). Catch rates, measured in fish per hour have averaged 0.45, and have ranged from 0.14 to 0.82 from 1950-present. Rainbow trout constitute the majority of anglers catch, with occasional catches of kokanee salmon and brook trout.

Gill net surveys have been used to monitor fish densities in Island Park Reservoir since 1960. Game fish catch has averaged 16 fish per net night with the exception of three years in the 1970's, while nongame fish has averaged 56 fish per net night (Appendix B).

Stocking

Recruitment for the Island Park Reservoir fishery primarily originates from hatchery releases of rainbow trout and kokanee salmon, although some wild rainbow trout and kokanee spawning does occur in the Henrys Fork upstream of the reservoir. Trout were first stocked into Island Park Reservoir in 1938 as the reservoir filled. Since that time, trout have been planted in 62 of 68 years. Fingerling stockings have ranged from 5,900 to 2.5 million fish annually and average 579,000 fish over the past 68 years. Fingerling trout stockings can be categorized into three periods based on total numbers stocked. From 1938 to 1958, plantings averaged 90,000 trout annually; from 1959 to 1997, plantings averaged almost 900,000 trout annually, and from 1998 to 2005, plantings have averaged 360,000 fish annually. Since 2003, IDFG has stocked an average of 280,000 fingerlings and 53,000 catchable trout. This reduction in stocking is the result of drought conditions which started in 2000. As part of a statewide protocol, sterile fingerling rainbow trout were mixed with fertile rainbow trout plantings starting in 1998. By 2003, all rainbow trout stocked into the reservoir were sterile.

Rotenone and Nongame Fish

Although areas of competition between Utah chub and rainbow trout are limited and poorly defined in Island Park Reservoir, the prolific fish have become so numerous that several rotenone projects have been undertaken to reduce nongame fish abundance and improve angler catch rates. Four rotenone projects (1958, 1966, 1979 and 1992) were successful at temporarily reducing Utah chub abundance, but all treatments failed at eradicating the species. Improvements to angler catch rates have also been negligible. Following the 1979 treatment, Moore (1982) indicated that "Chemical rehabilitation of Island Park Reservoir has not been successful at improving the salmonid fishery. There is no relationship between densities of nongame fish and catch rate or growth of game fish." He went on to state that "the three chemical rehabilitations of Island Park Reservoir over the last 25 years have not been successful at permanent or long-term eradication of nongame species. The improvements in the trout fishery have been the result of increased stocking levels, especially noticeable with the large introductions of catchable rainbow. The observed declines in the rainbow trout fishery two to four years after treatment are the result of decreased levels of hatchery inputs and are not due to the increase in chub and sucker densities." Following the 1992 rotenone treatment, Rich (2002) stated that the two fishing seasons fully supported by the benefits of the renovation project (1994 and 1995) did not show the level of improvement we expected in catch rates. The 1994 season catch rate of 0.2 fish/h was no better than catch rates immediately prior to the renovation. Further, 56% of anglers interviewed in 1994 rated fishing as poor, while 76% rated the fishing no better than fair following the 1992 renovation efforts.

Compounding the disappointing results of the treatment on the fishery, the 1992 drawdown associated with the rotenone treatment resulted in an estimated 50,000 - 100,000 tons of sediment transported from the reservoir bed into the Henrys Fork channel and caused a great deal of negative publicity associated with the treatment.

Water Management

Island Park Reservoir is operated as an irrigation storage reservoir for agricultural users in Fremont and Madison Counties. Total capacity for the reservoir is in excess of 140,000 acre-feet. Reservoir storage normally begins at the close of irrigation season in October, and lasts until demand for water increases, typically in late May or early June. Minimum pool level is reached towards the end of September, and has averaged 53,000 acre-feet since 1950. The lowest storage level recorded occurred in 1992, at 270 acre-feet. Three of the 11 most severe drawdowns have occurred since 2000 as a result of the 2000-2005 drought. Recent analysis of reservoir storage indicates that gill net catch rates are related to water storage. Years following low reservoir storage typically show a reduction in sport fish densities in gill nets.

METHODS

As part of routine population monitoring, we collected gill net catch rate data from eight locations (Appendix C; Figure 1) in Island Park Reservoir on October 19, 20, 24, and 25, 2006 for a total of 32 net nights. Gill nets consisted of either floating or sinking types measuring 46 m by 2 m, with mesh sizes of 2 cm, 2.5 cm, 3 cm, 4 cm, 5 cm and 6 cm bar mesh. Nets were set at dusk and retrieved the following morning. We identified captured fish to species and recorded total lengths (TL). We calculated catch rates as fish per net night and also calculated 95% confidence intervals.

We removed the saggital otoliths of all trout caught in our gill nets for age and growth analysis. After removal, all otoliths were cleaned on a paper towel and stored in individually-labeled envelopes. Ages were estimated by counting annuli under a dissecting microscope at 40x power. Otoliths were submerged in water and read in whole view when clear and distinct growth rings were present. We sectioned, polished and read otoliths in cross-section view with transmitted light when the annuli were not distinct in whole view. Ages of fish were then plotted against length using a scatter plot, and any outliers were selected, re-read, and the ages corroborated by two readers.

Relative weights were calculated by dividing the actual weight of each fish (in grams) by a standard weight for the same length for that species multiplied by 100 (Anderson and Gutreuter 1983). Relative weights were then averaged for each length class (< 200 mm, 200-299 mm, 300-399 mm and fish > 399 mm). We used the formula $\log W_s = -5.194 + 3.098 \log L$ (Anderson 1980) to calculate relative weights of rainbow trout, $W_s = -5.192 + 3.086 \log TL$ for cutthroat trout (Kruse and Hubert 1997) and $W_s = -5.062 + 3.033 \log TL$ for brook trout (Hyatt and Hubert 2000).

We collected zooplankton samples from Island Park Reservoir on July 27 and August 17 2006. Zooplankton were collected with three nets fitted with small (153:), medium (500:) and large (750:) mesh at three locations throughout the reservoir on both sample dates. We preserved zooplankton in denatured ethyl alcohol at a concentration of 1:1 (sample volume : alcohol). After ten days in alcohol, phytoplankton were removed from the samples by re-filtering through a 153: mesh sieve. The remaining zooplankton were blotted dry with a paper towel and weighed to the nearest 0.1 g. Biomass estimates were corrected for tow depth and reported in g/m. We measured competition for food (or cropping impacts by fish) using the zooplankton productivity ratio (ZPR) which is the ratio of preferred (750 micron) to usable (500 micron) zooplankton. We also calculated the zooplankton quality index (ZQI) to account for overall abundance of zooplankton using the formula ZQI + (500 micron + 750 micron*ZPR) (Teuscher 1999).

We used gill net catch rates to determine the effects of past rotenone treatments. We calculated the mean number of nongame fish per gill net night from 1960 to present, and monitored how many years were necessary for populations to meet or exceed this mean level. Years immediately following a rotenone treatment where populations of nongame fish were below this mean level were considered to be affected by the rotenone treatment. We considered the effects of the treatments negated once nongame fish populations had exceeded this level. We used analysis of variance (ANOVA) to compare angler catch rates within the effective window of a rotenone treatment to angler catch rates outside of this range to determine rotenone treatment effects on angler success. We then used reservoir storage in acre-feet at the end of the irrigation season to reflect annual carryover, as once irrigation season ends, reservoir storage increases. We used logistic regression to compare reservoir storage and stocking rates to see if these variables were related to gill net catch rates.

RESULTS

We collected 1,813 fish in 32 net nights of gill net effort. Catch composition was 4% rainbow trout, 2% kokanee, <1% cutthroat trout, brook trout and mountain whitefish combined, 20% Utah chub and 70% Utah sucker (Figure 2). Rainbow trout ranged from 155 to 615 mm TL (Figure 3), with a mean length at age three of 378 mm. Proportional stock density (PSD) was 64, and relative stock density (RSD-400) was 28. Mean relative weights for rainbow trout > 200 mm exceeded 100 with the exception of rainbow trout in excess of 400 mm (Table 1). Total annual mortality based on catch curve analysis was estimated at 70%.

Kokanee lengths ranged from 160 to 428 mm, with a mean length at age three of 344 mm (Figure 4). Proportional stock density was 91 and RSD-400 was 61. Similar to rainbow trout, relative weights of kokanee exceeded 100 for all size classes (Table 1).

As in years past, gill net catch was dominated by nongame fish, specifically Utah sucker and Utah chub. However, catch rates for these species are well below the peak of recent abundance recorded in 1998, and show a modest 6% increase over 2005 catch rates (Figure 5).

Results from our zooplankton tows showed total production as measured by the 153 micron net to be adequate at 0.87 g/m (Table 2). We estimated cropping impacts using the ZPR and found densities in excess of 0.84 g/m. We used ZQI to adjust for overall abundance of desirable zooplankton, and again estimated zooplankton abundance sufficient to support 150-300 fingerling trout per acre.

By reviewing gill net data from 1960 to present, we were able to determine the period of influence for rotenone treatments. On average, nongame fish populations had exceeded average gill net catch rates of 56 fish per net within six years following treatments, thereby making the effective window of rotenone treatment five years. We then compared angler catch rates within five years following a rotenone treatment to angler catch rates outside of this period (Figure 6) with ANOVA to see if treatments had an effect on catch rates. Results showed no significant difference between catch rates from either group (Figure 7). We then used stocking data (Figure 8) and reservoir storage (Figure 9) from 1992 to 2005 in a logistic regression. The model was significant ($P = 0.03$), with an R^2 of 0.55. Similar regressions incorporating data back to 1975 were also significant, but had lower R^2 values (Table 3).

DISCUSSION

Gill net catch rates (fish per net night) on trout from 2006 were low and similar to those found in 2005. Gill net catch rates for rainbow trout decreased by 4.9 fish per net from 2005 to 2006. However, 2005 catch rates were biased by one net set in an area recently stocked, which was responsible for 43 of the 52 rainbow trout caught. Therefore, it's likely that the actual catch rate for rainbow trout in 2005 should have been much lower than it actually was. Regardless, rainbow trout continue to be found in low abundance. Catch rate data collected over the past several years may not accurately reflect densities in the reservoir, as the abundant sucker population saturated floating nets. Floating nets were considered ineffective, as the abundant entangled suckers weighted the nets down, making mesh unavailable to trout. These floating nets are more successful at capturing trout, and with their effectiveness reduced, capture of trout was likely reduced. Future netting efforts should incorporate sturdy, buoyant floats to keep floating nets near the surface. Sinking nets should be discontinued, as further monitoring of the sucker population is unwarranted.

Several measurements collected during 2006 indicate the reservoir can sustain additional trout biomass. Growth to age 3 was good, although it was slightly less than trout in nearby Henrys Lake. Relative weights for trout and kokanee exceeded 100 with the exception of rainbow trout > 400 mm. This suggests an abundance of available forage for trout (Flickinger and Bulow 1993). And zooplankton tows, which have been linked to the success of fall fingerling plants (Dillon 1996) exceeded benchmarks for higher stocking rates. Total production, as measured by our 153 micron net was 0.87

g/m, which is well above the 0.10 g/m that precipitates conservative stocking measures. Stocking guidelines for our ZPR estimate of 0.84 g/m are in the 150-300 fingerling trout per acre bracket, as are the measures of ZQI we found. All indications are that Island Park Reservoir can sustain additional trout biomass.

Gill net data has shown that all rotenone treatments have failed to eradicate nongame species, and that the treatments have only been successful at reducing abundances for a period of five years following treatments. Creel survey data from these two periods indicates the treatments were not successful at influencing angler catch rates. Further, comments in annual reports and statements by anglers at public meetings following these rotenone treatments indicate that biologists and the general public agreed that catch rates had not improved as a result of the treatments. As noted by Moore (1982) and supported by our research, reservoir storage during the winter seems to have a large effect on trout abundance in the following year. The number of fingerling trout stocked also plays a role in trout abundance, but may be overshadowed by reservoir storage. Therefore, prioritizing water management when possible and coupling this with increased stocking levels may be a more effective means to improve angler success in the coming years. Island Park Reservoir's primary role as an irrigation storage facility necessitates a large annual fluctuation, which may prevent the fishery from reaching its fullest potential in all but the wettest series of years.

RECOMMENDATIONS

1. Implement spring gill net surveys using floating nets to monitor trout abundances.
2. Continue fall gill net monitoring with floating nets to develop juvenile abundance and recruitment indexes.
3. Increase fingerling rainbow trout stockings to take advantage of available zooplankton forage.

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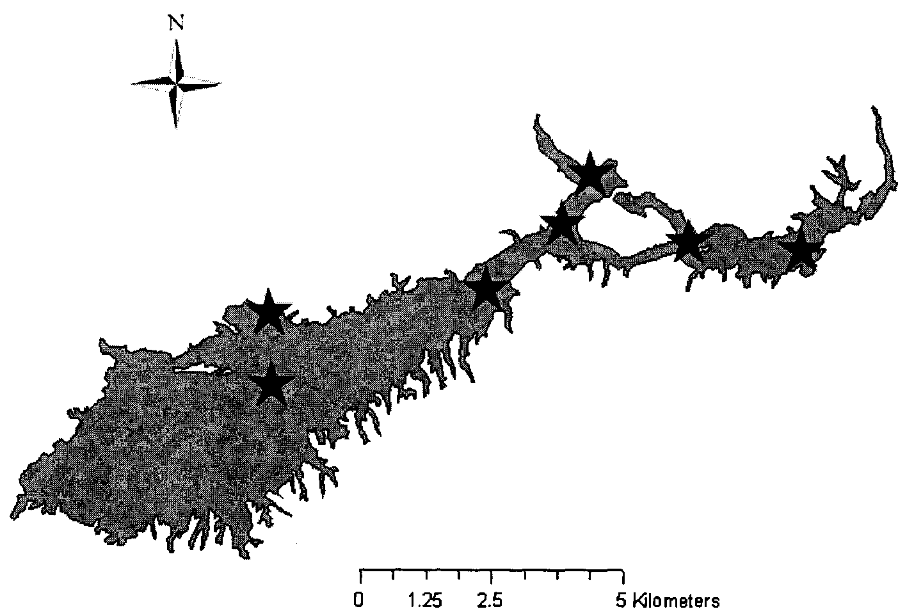

Figure 1. Spatial distribution of gill net locations used in population monitoring in Island Park Reservoir, Idaho.

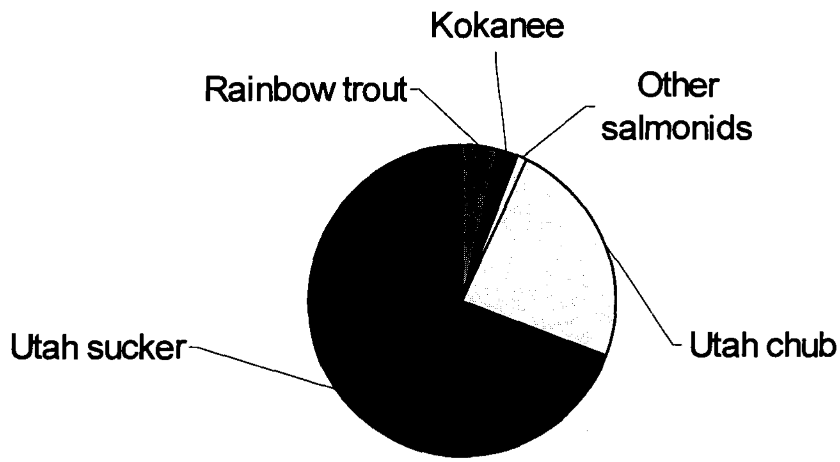

Figure 2. Species composition from gill nets set in Island Park Reservoir Idaho, 2006.

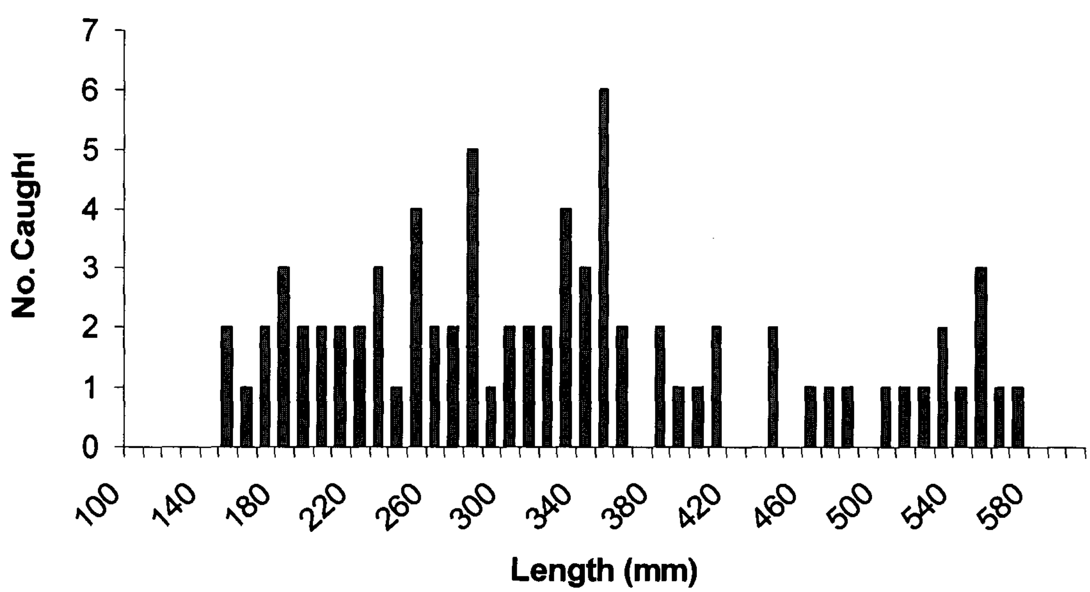

Figure 3. Length frequency for rainbow trout caught with gill nets in Island Park Reservoir, Idaho 2006.

Table 1. Relative weights for all trout species collected with gill nets in Island Park Reservoir, Idaho 2006.

	Mean Relative Weight			
Species	< 200 mm	200-299 mm	300-399 mm	> 399 mm
Rainbow trout	104	106	105	98
Kokanee salmon	110	116	110	118
Yellowstone cutthroat trout	--	--	100	109

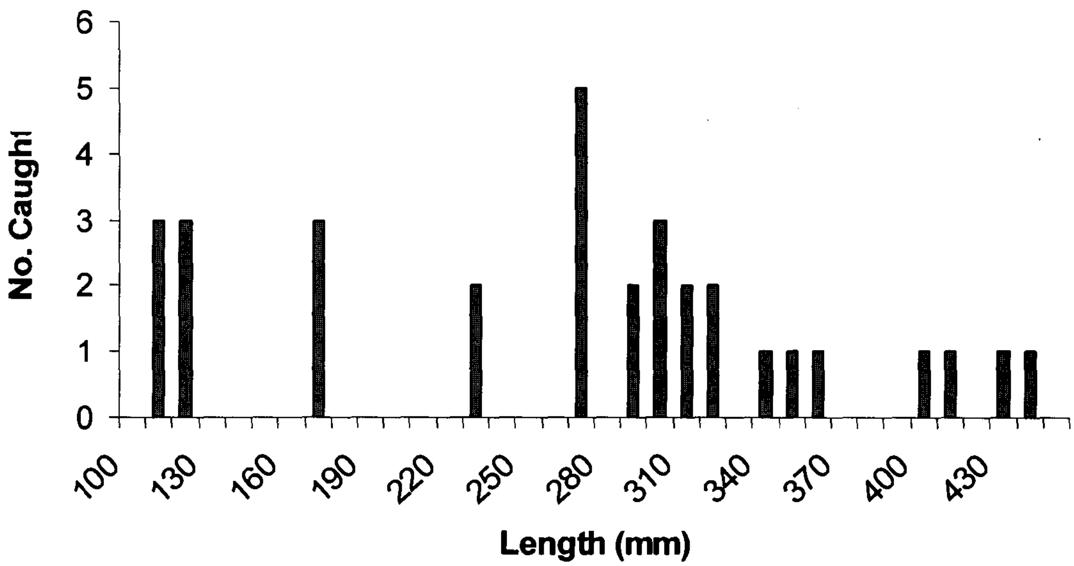

Figure 4. Length frequency distribution for kokanee salmon caught in gill nets in Island Park Reservoir, Idaho 2006.

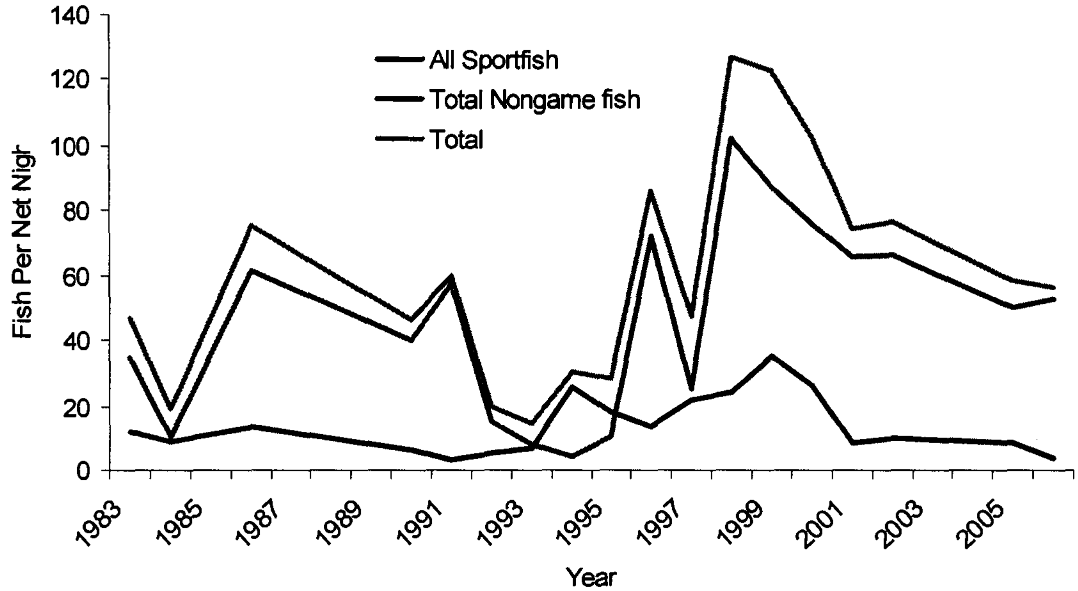

Figure 5. Gill net catch rates (fish per net night) for sportfish and nongame fish in Island Park Reservoir, Idaho 1983 - 2006.

Table 2. Zooplankton tow data for reservoirs in the Upper Snake Region of Idaho, 2006.

	Net mesh (microns)				
Lake Name	153	500	750	ZPR	ZQI
Island Park Reservoir	0.87	0.71	0.60	0.84	1.10
Mackay Reservoir	0.75	0.48	0.48	1.00	0.95
Palisades Reservoir	1.06	0.85	0.53	0.63	0.87
Ririe Reservoir	0.55	0.33	0.29	0.88	0.54
Henrys Lake	1.87	0.79	0.33	0.42	0.47

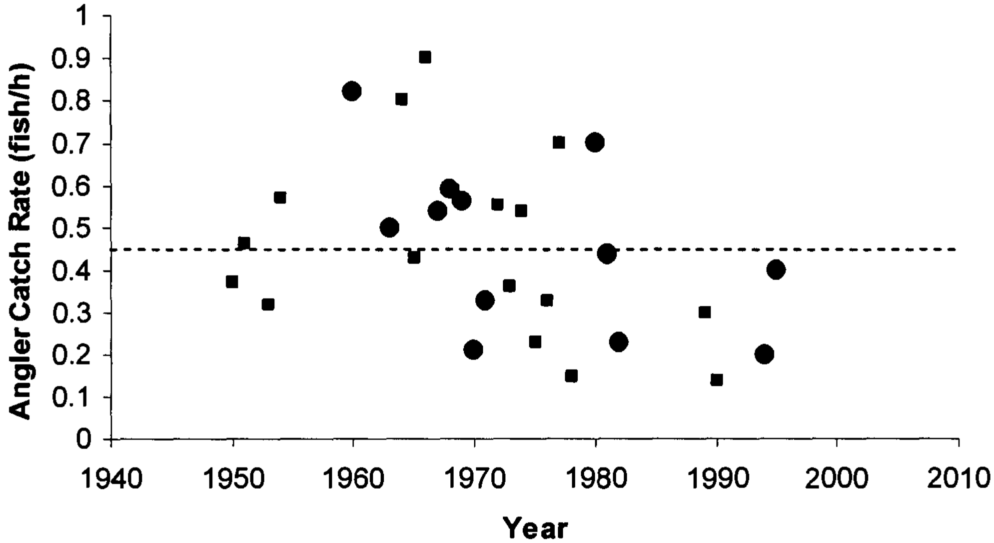

Figure 6. Angler catch rates (fish per hour) within five years following a rotenone treatment (circles) and those outside of the five year rotenone influence (squares) in Island Park Reservoir, Idaho.

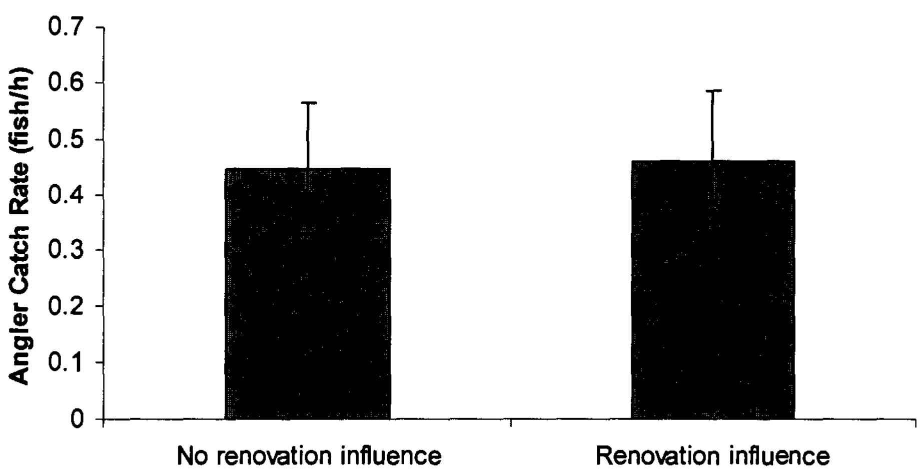

Figure 7. Mean angler catch rates within five years following a rotenone treatment (renovation influence) and those outside of this period (no renovation influence).

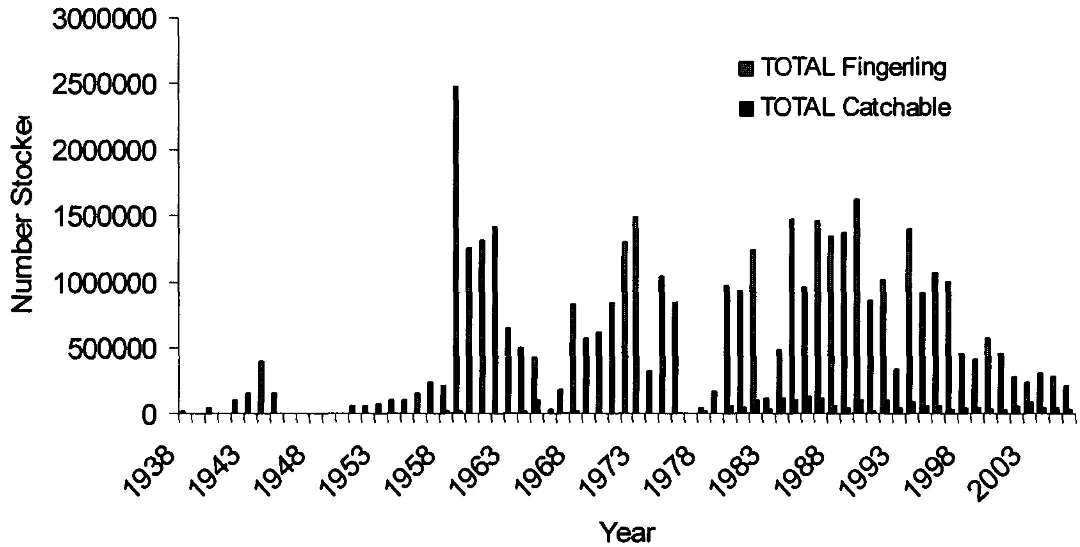

Figure 8. Stocking data for Island Park Reservoir, Idaho 1938 – 2006.

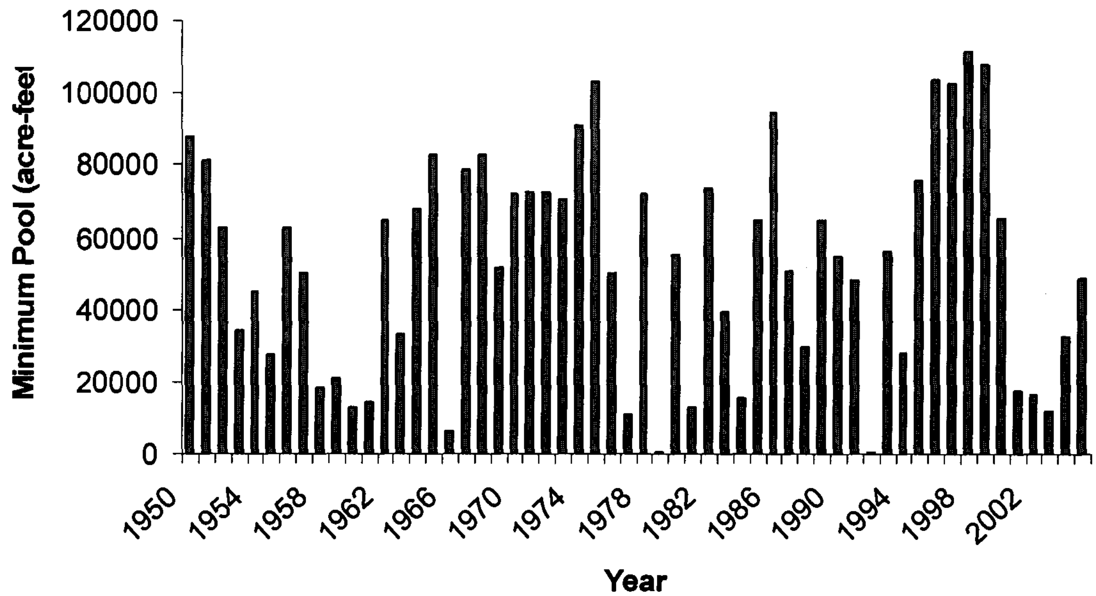

Figure 9. Minimum storage in acre-feet in Island Park Reservoir, Idaho 1950-2005.

Table 3. Regression coefficients for gill net catch rate comparisons between minimum reservoir storage one year prior to gill net survey and stocking rates (summed) for two years prior.

Timeframe	*P*-value	R^2
1992 - 2005	0.03	0.55
1982 - 2005	0.01	0.48
1975 - 2005	0.02	0.37

Appendix A. Creel survey data from Island Park Reservoir, Idaho.

Year	Effort (*1,000)	Catch	Harvest	Catch Rate	Catch Composition[b] YCT	HYB	RBT	BKT	COHO	KOK	Mean Length of RBT	Creel Timeframe
1950	47.7	--	--	0.37	5	--	87	7	0	1	--	6/4 to 8/26
1951	70.8	--	--	0.46	1	--	79	5	0	15	--	6/4 to 10/31
1953	--	--	--	0.32	2	--	89	3	0	7	--	6/4 to 7/15
1954	--	--	--	0.57	--	--	--	--	--	--	--	Jul to Oct
1958	--	--	--	--	1	--	86	9	0	4	--	--
1960	75.7	--	--	0.82	<1	--	99	1	0	<1	--	6/4 to 10/31
1961	--	--	--	--	--	--	91	1	0	8	320	--
1963	--	--	--	0.50	<1	--	96	1	0	3	--	592 hours[a]
1964	--	--	--	0.80	--	--	69	--	--	26	--	194 hours[a]
1965	107.8	--	--	0.43	1	--	84	8	0	7	326	5/29 to 10/31
1966	--	--	--	0.90	<1	--	74	12	0	13	348	1162 hours[a]
1967	93.0	--	--	0.54	0	--	93	4	3	0	304	Jun to Oct
1968	176.0	--	--	0.59	0	--	74	3	22	0	348	Jun to Oct
1969	--	--	--	0.56	1	--	43	1	39	16	--	5340 hours[a]
1970	--	--	--	0.21	2	--	54	12	20	12	--	362 hours[a]
1971	--	--	--	0.33	1	--	54	6	19	19	--	4972 hours[a]
1972	--	--	--	0.55	0	--	44	2	24	30	348	4831 hours[a]
1973	--	--	--	0.36	<1	--	66	2	12	19	--	2405 hours[a]
1974	--	--	--	0.54	1	--	29	<1	3	66	--	1104 hours[a]
1975	--	--	--	0.23	0	1	50	1	25	24	--	674 hours[a]
1976	--	--	--	0.33	0	--	48	10	27	15	--	809 hours[a]
1977	--	--	--	0.7	0	--	41	8	40	18	--	820 hours[a]
1978	--	--	--	0.15	0	--	100	0	0	0	--	207 hours[a]
1980	--	--	--	0.7	0	--	100	0	0	0	--	94 hours[a]
1981	70.8	31380	--	0.44	<1	--	91	1	8	1	344	5/23 to 10/31
1982	124.4	28536	--	0.23	0	0	89	3	4	4	345	5/28 to 9/30
1989	49.1	--	--	0.30	--	--	--	--	--	--	--	5/27 to Sept
1990	--	--	--	0.14	--	--	--	--	--	--	--	5/26 to 7/16
1994	41.3	--	--	0.20	--	--	--	--	--	--	--	5/28 to 8/20
1995	--	--	--	0.40	--	--	73	4	10	12	--	May to Jul

[a] – Creel surveys from 1969 to 1980 are spot checks – not complete surveys (1981 IDFG annual report)
[b] – Species abbreviations: YCT = Yellowstone cutthroat trout; HYB = hybrid trout; RBT = rainbow trout; BKT = brook trout; COHO = coho salmon; KOK = kokanee.

Appendix B. Gill net catch rate data for Island Park Reservoir, Idaho.

Year	Net Nights	Cutthroat trout	Rainbow trout	Brook trout	Kokanee	Whitefish	Utah sucker	Utah chub	Sportfish	Nongame fish	Total fish
1960	--	0	9.3	0.3	2.3	0	0	0.7	11.9	0.7	12.6
1961	--	0.3	18.0	0	4.7	0	0.7	3.7	23.0	4.4	27.4
1963	--	0.2	10.8	4.5	12.8	0	0	35.0	28.3	35.0	63.3
1964	--	2.0	9.6	6.8	16.5	0	0.2	113.3	34.9	113.5	148.4
1965	--	0.2	7.3	9.7	0.7	0	2.0	240.0	17.9	242.0	259.9
1966	--	0	4.8	2.3	2.3	0	1.2	39	9.4	40.2	49.6
1968	--	0	6.5	4.1	3.6	1.0	0	0	22.6	0	22.6
1971	--	0	53.0	9.0	2.0	0	0	10.0	71.0	10.0	81.0
1972	--	0	65.0	6.0	89.0	0	2.0	94.0	231.0	96.0	327.0
1973	--	0	21.0	7.0	6.0	0	3.0	21.0	39.0	24.0	63.0
1975	--	0	6.0	0	2.0	0	44.0	20.0	9.0	64.0	73.0
1976	2	0	5.5	1.5	0	0	67.0	68.0	11.0	135.0	146.0
1978	1	0	5.0	0	0	4.0	82.0	87.0	9.0	169.0	178.0
1980	2	0	10.5	2.0	0	0	2	1	12.5	3.0	15.5
1983	--	0	5.0	1.0	0	2.3	3.0	32.0	12.0	35.0	47.0
1984	3	0	5.0	1.3	0	1.0	3.3	7.0	9.0	10.3	19.3
1986	3	0.3	10.0	0.1	0	1.7	34.0	27.7	13.4	61.7	75.1
1990	3	0	5.3	0	0.3	0.7	7.0	33.3	6.3	40.3	46.6
1991	3	0	2.0	0.7	0	0.3	40.0	17.3	3.0	57.3	60.3
1992	2	0	5.0	0	0	0	5.5	9.5	5.0	15.0	20.0
1993	7	0	4.6	0	0.9	1.1	0	0	6.6	8.1	14.7
1994	8	0	26.3	0	0	0	4.4	0	26.3	4.4	30.7
1995	8	0	10.8	4.1	1.9	1.5	2.4	8.0	18.3	10.4	28.6
1996	7	0	13.7	0	0	0	18.0	54.1	13.7	72.1	85.9
1997	7	0	21.7	0	0	0	2.7	19.1	21.7	25.6	47.3
1998	7	0	18.0	2.4	2.9	1.3	8.7	88.0	24.6	102.0	126.6
1999	7	0	28.0	1.1	6.1	0.4	4.7	70.7	35.7	86.7	122.4
2000	7	0	18.6	1.7	5.9	0.4	13.0	58.3	26.6	76.0	102.6
2001	7	0.1	7.0	0.6	0.4	0.1	27.3	36.3	8.3	65.9	74.1

Year	Net Nights	Cutthroat trout	Rainbow trout	Brook trout	Kokanee	Whitefish	Utah sucker	Utah chub	Sportfish	Nongame fish	Total fish
2002	7	0	3.3	0	5.9	0.7	30.4	36.0	9.9	66.4	76.3
2005	7	0.1	7.4	0.1	0	0.6	36.1	13.9	8.3	50.0	58.3
2006	32	0.1	2.5	0	1.0	0.1	39.5	13.5	3.7	52.9	56.7

Appendix C. Locations used in standard Island Park gill net sets. Coordinates are given as UTM's; Datum is NAD 83.

Gill Net Sites

Gill Net 1.	468,971 E	4,919,703 N	Z 12
Gill Net 2.	468,433 E	4,918,720 N	Z 12
Gill Net 3.	466,300 E	4,918,972 N	Z 12
Gill Net 4.	464,469 E	4,920,331 N	Z 12
Gill Net 5.	463,900 E	4,919,400 N	Z 12
Gill Net 6.	462,399 E	4,918,199 N	Z 12
Gill Net 7.	460,063 E	4,917,929 N	Z 12
Gill Net 8	458,240 E	4,916,563 N	Z 12

HENRYS FORK

ABSTRACT

We used boat mounted electrofishing equipment to estimate trout densities and population parameters on the Box Canyon and Vernon sections of the Henrys Fork in May, 2006. We estimated rainbow trout *Oncorhynchus mykiss* densities (fish per km) at 1,618 in the Box Canyon, which is a 35% increase over our 2005 estimate. Mean and median length for rainbow trout caught was 324 mm and 319 mm respectively. Proportional stock density (PSD) was 70, while relative stock density (RSD-400) was 32. Species composition was 99% rainbow trout and 1% brook trout *Salvelinus fontinalis*. Comparisons of age groups between the 2005 survey and the 2006 survey showed a significant increase in age 1 rainbow trout and slight increases in age 2 and age 3 rainbow trout. These increases can be attributed to higher winter flow releases from Island Park Dam over the past three years.

We estimated trout densities in the Vernon reach at 648 fish per km, which is a 3% decrease from 2005. Mean and median length for rainbow trout was 362 mm and 425 mm, respectively, and 362 mm and 370 mm for brown trout *Salmo trutta*. Proportional stock density for rainbow trout was 81, while relative stock density (RSD-400) was 70, suggesting limited recruitment over the past several years. Species composition was 95% rainbow trout and 5% brown trout. Mountain whitefish *Prosopium williamsoni* densities were 276 fish per km.

METHODS

We used two drift boat mounted electrofishers to assess fish populations in two sections of the Henrys Fork in 2006. We collected fish over two days for marking (May 10 and 11) followed by a seven-day rest, and a single-day recapture event (May 17) in the Box Canyon. Two passes per boat were used on both marking days, while three passes per boat were used on the recapture day. The Box Canyon section started below Island Park Dam at the confluence with the Buffalo River and extended downstream 3.7 km to the bottom of a large pool (GPS locations in Appendix A). All trout encountered were collected, identified, measured for total length, and those exceeding 150 mm were marked with a hole punch in the caudal fin prior to release. Fish were not marked on the recapture date, but all fish previously marked were recorded as such.

We used a single collection day (May 12) followed by a six-day rest and a single recapture day (May 18) in the Vernon section. Two passes per day were used on all collection efforts in the Vernon section. This reach started immediately below the Vernon Bridge and extended downstream 4.4 km to the lowest house on river left at the start of the impounded water above Chester Dam (Appendix A). All salmonids collected during initial runs were identified, measured for total length, and trout > 150 mm and mountain whitefish *Prosopium williamsoni* > 200 mm were marked with a caudal fin hole punch before being released to the area of capture.

We estimated densities for all trout > 150 mm using the Partial Log-Likelihood method and Montana's MR5 data analysis program (MR5; Montana Department of Fish, Wildlife, and Parks 1994). For the Vernon reach, we estimated total abundance for all trout combined and partitioned out densities based on relative abundances of trout captured. We used a Modified Peterson Estimator to estimate abundance of mountain whitefish > 200 mm in the Vernon reach due to a low number of recaptures. Proportional stock densities (PSD)were calculated as the number of each species ≥ 300 mm / by the number of each species ≥ 200 mm (Ney 1993). Similarly, relative stock densities (RSD-400) used the same formula, with the numerator replaced by the number of fish > 400 mm. We did not age any trout in 2006, but did partition our population estimates into size classes based on age data collected in 2005. Size ranges for age 1, 2 and 3+ fish were 150 - 229 mm, 230 – 329 mm and 330+ mm, respectively.

RESULTS

Box Canyon

We collected 1,319 trout over three days of electrofishing in the Box Canyon. Species composition of trout handled was 99% rainbow trout *Oncorhynchus mykiss* and 1% brook trout *Salvelinus fontinalis*. We only targeted trout, and did not collect whitefish although they were present. Our efficiency rate (unadjusted for size selectivity) was 17% (Appendix B-1). Rainbow trout ranged in size from 100 mm to 640 mm (Figure 1). Proportional stock density and relative stock density (RSD-400) were 70 and 32, respectively (Appendix B-2) which is a slight decrease compared to 2005. Rainbow trout had a mean size of 324 mm and median size of 319 mm (Table 1). We captured 53 rainbow trout greater than 500 mm. We estimated 5,986 trout > 150 mm (95% CI = 5,387 – 6,585, cv = 0.05, Table 2, Appendix B-3) in the section, which equates to 1,618 fish per km (Figure 2). This represents a 35% increase in rainbow trout abundance compared to 2005 estimates. Based on ages assigned by length categories of previously aged fish (aged with otoliths) in the Box Canyon, the majority of the population increase is from age 1 trout (Figure 3).

Vernon to Chester Backwaters

We collected 510 trout in the Vernon section of the Henrys Fork during the two-day population estimate. Species composition was 95% rainbow trout and 5% brown trout *Salmo trutta*. We also collected 307 mountain whitefish. Our efficiency rate (unadjusted for size selectivity) for all trout was 11%. Rainbow trout and brown trout stock density indices were high, with a PSD and RSD-400 of 81 and 70 for rainbow trout and 89 and 63 for brown trout (Table 1). Mean and median size of rainbow trout was 362 mm and 425 mm, respectively. Mean and median size of brown trout was 362 mm and 370 mm, respectively. Rainbow trout length frequencies were skewed towards larger fish (Figure 4). We estimated 2,850 trout > 150 mm for the section (95% CI = 2,188 – 3,512; cv = 0.12), which equates to 648 fish per km (Table 2). Rainbow trout density estimates were 2,719 for the three km section (618 fish per km), while brown trout were estimated at 131 fish (30 fish per km). Estimated trout densities were approximately 3% lower than those estimates from the survey done in 2005. Increased recruitment of younger (age 1 or 2) rainbow trout was not evident based on population estimates from the past two years (Figure 5). Mountain whitefish densities were estimated at 276 fish per km, which represents a 35% decline in abundance from the 2002 estimate provided by a private consultant (Symbiotics LLC 2004).

DISCUSSION

Box Canyon population estimates show an increase in trout densities compared to our 2005 survey. The relation between winter flows and trout abundance is well documented in this reach of the Henrys Fork (Mitro 1999, Garren et. al. 2004), with higher winter flows producing stronger year classes. Recent winter (December, January and February 2006) flows from Island Park Dam of 346 cfs are a substantial increase over flows from 2002 – 2005 (mean of 147 cfs) and are likely responsible for the increased number of juvenile trout now recruiting in the upper Henrys Fork. Continued precipitation and resulting higher winter flow releases from Island Park Dam should further improve trout densities.

Population estimates in the Vernon section are very similar to estimates from 2005, and show a population dominated by larger, older fish. Few juvenile trout were caught, which suggests continued poor recruitment, or that recruitment is dependent on migrations of juvenile fish from other areas. The RSD-400 of 70 in the Vernon reach corroborates this and is indicative of a population dominated by large fish, but lacking juveniles. The decrease in the RSD-400 from 84 in 2005 to the current 70 is not indicative of an increase in recruitment, but rather a decrease in the older component of the population. The lack of recruitment may result in lower adult densities in upcoming years. We are working with the University of Idaho and the Henry's Fork Foundation to investigate the potential of recruitment originating from the Fall River to the lower Henrys Fork using otolith microchemistry to identify the natal origins of trout in the Vernon section.

RECOMMENDATIONS

1. Continue annual population surveys in the Box Canyon to quantify population response to changes in the flow regime over time.
2. Investigate potential for immigration of juvenile trout from areas outside of the Henrys Fork into the Vernon and Chester sections.

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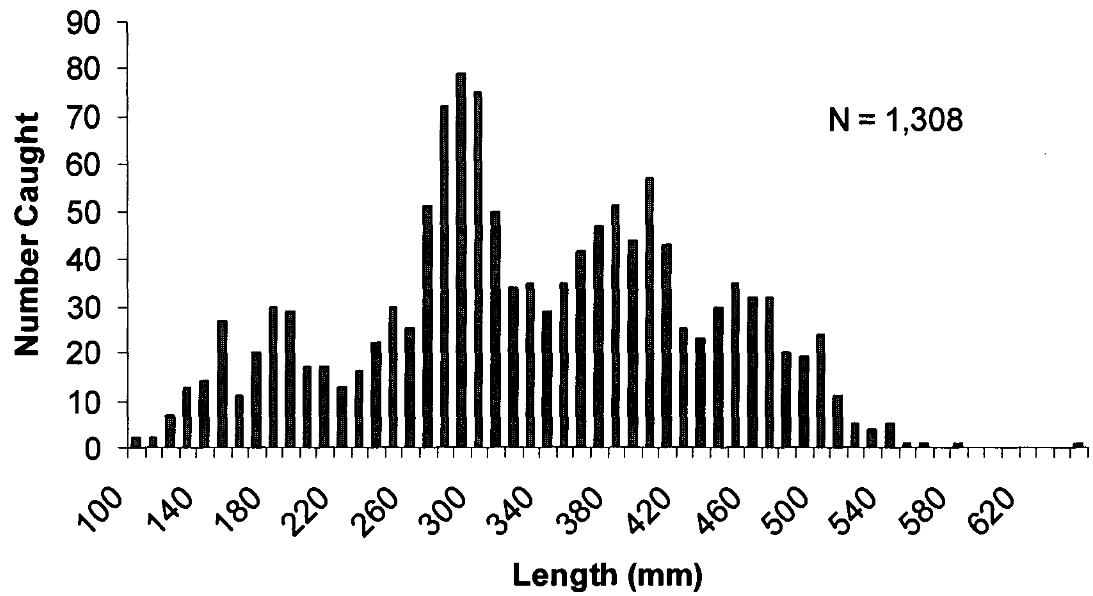

Figure 1. Length frequency distribution for rainbow trout collected by electrofishing in the Box Canyon section of the Henrys Fork, Idaho, 2006.

Table 1. Salmonid population index summaries for the Henrys Fork, Idaho 2006.

River Reach	Mean Length (mm)	Median Length (mm)	RSD-400	RSD-500	Fish per km	Percent Contribution to Catch
<u>Box Canyon</u>						
Rainbow trout	324	319	32	5	1,618	99
<u>Vernon</u>						
Rainbow trout	362	425	70	13	618	59
Brown Trout	362	370	63	37	30	3
Mountain whitefish	341	380	--	--	276	38

Table 2. Data used in population estimates from the Henrys Fork, Idaho during 2006 and flow levels during sampling.

River reach	Number Marked	Number Captured	Number Recaptured	Population Estimate	Confidence Interval (+/- 95%)	Density (No./ km)	Discharge (Q)
							1,695 cfs [a]
Box Canyon							
Rainbow trout	887	356	61	5,986	5,387-6,585	1,618	
							4,167 cfs [b]
Vernon							
Rainbow trout [c]	236	185	20	2,719		618	
Brown trout [c]	7	15	1	131		30	
All trout	243	200	21	2,850	2,188-3,512	648	
Mountain whitefish	99	145	11	1,216	622 – 1,808	276	

[a]Data obtained from USGS gauge near Island Park Dam (13042500)
[b]Data obtained from USGS gauge near Ashton Reservoir (13046000)
[c]Estimates made using all trout, with individual species partitioned out based on relative abundance in the electrofishing catch

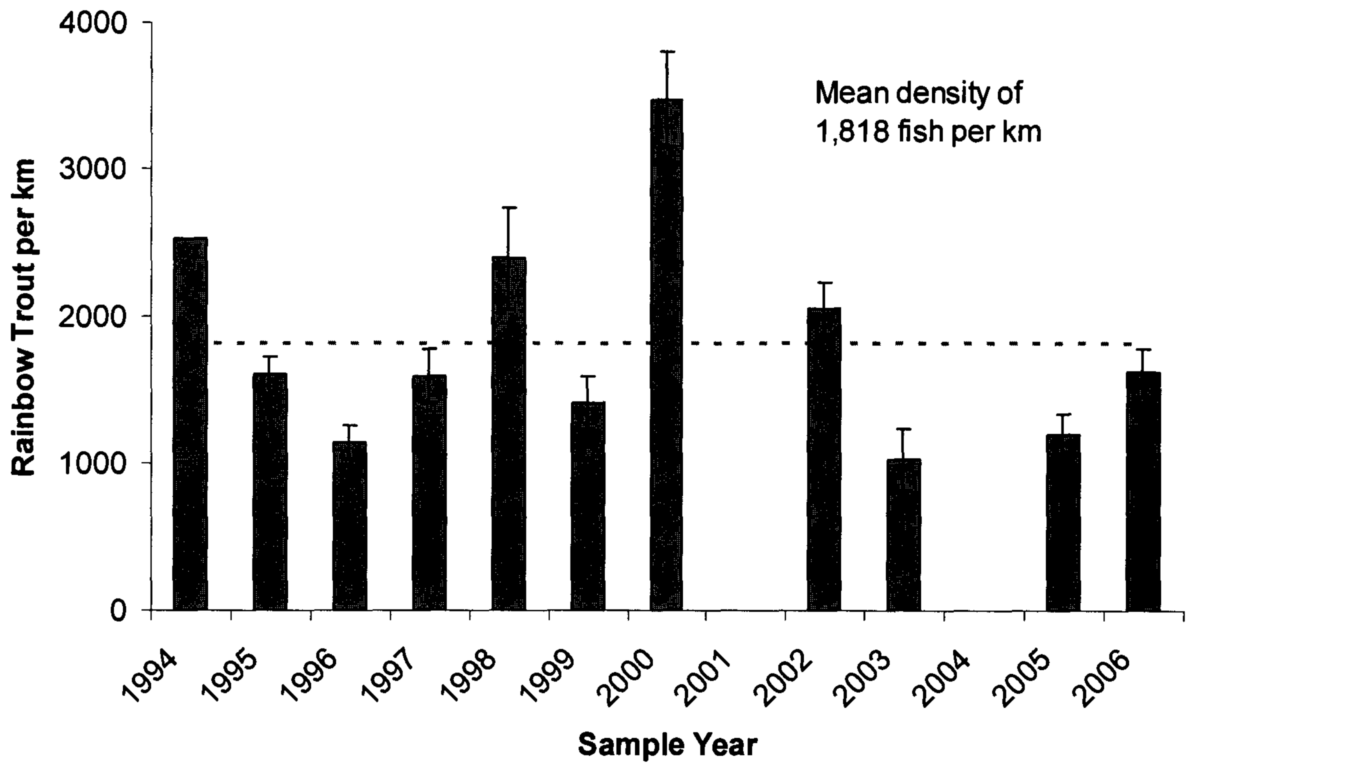

Figure 2. Population estimates for the Box Canyon section of the Henrys Fork, Idaho 1994 to present.

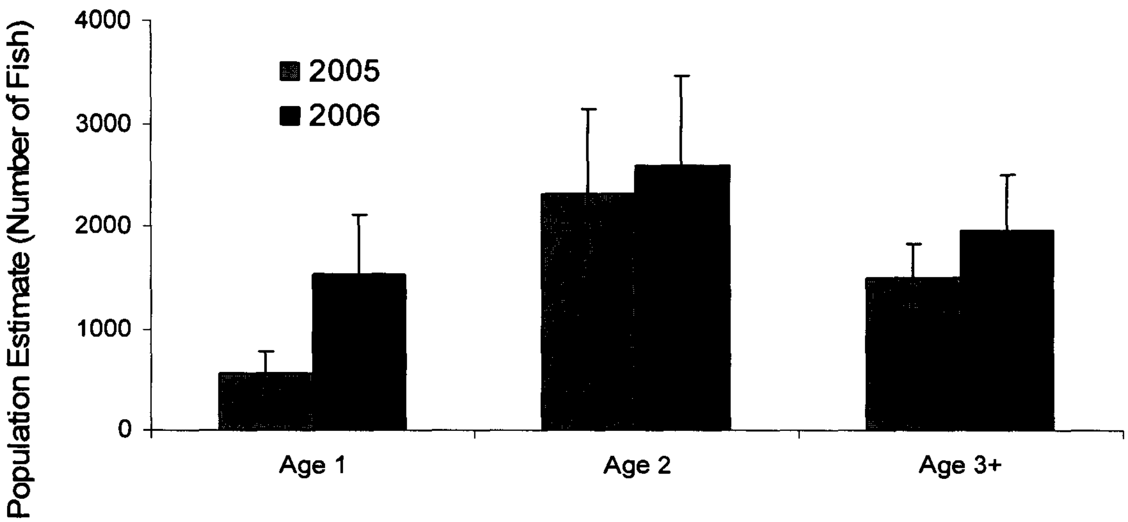

Figure 3. Population estimates of Henrys Fork rainbow trout in the Box Canyon, Idaho partitioned out by age.

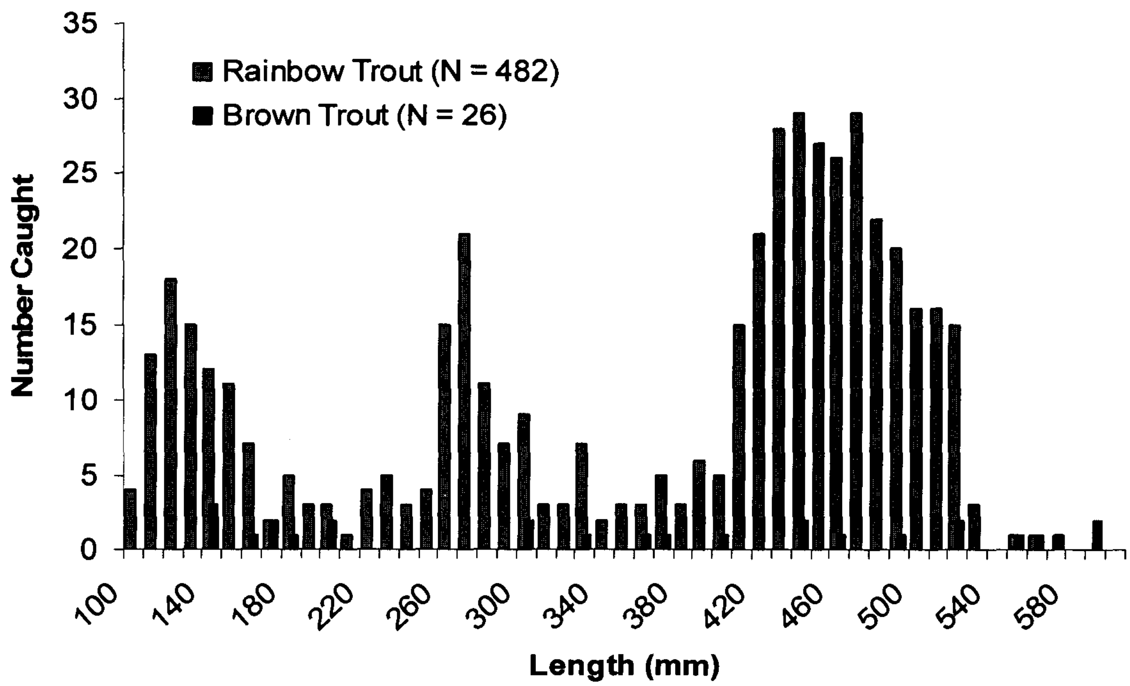

Figure 4. Length frequency distribution for brown trout and rainbow trout collected by electrofishing in the Vernon section of the Henrys Fork, Idaho, 2006.

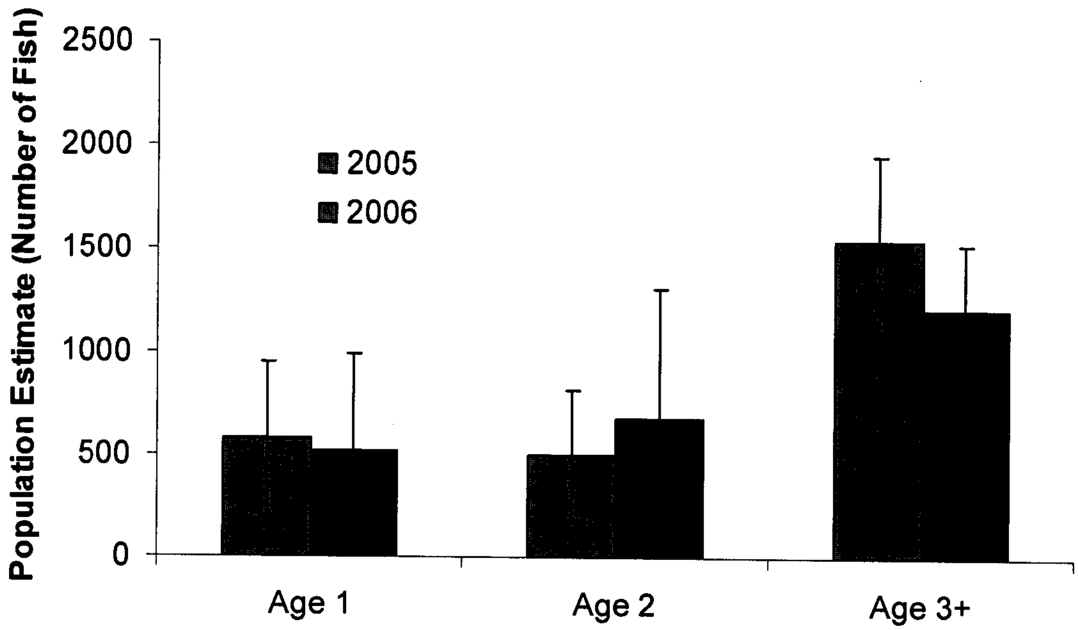

Figure 5. Population estimates of rainbow trout in the Vernon section of the Henrys Fork, Idaho partitioned out by age.

Appendix A Locations used in population surveys on the Henrys Fork Snake River, Idaho 2006. All locations used NAD-27 and are in Zone 12.

	Start		Stop	
Section	Easting	Northing	Easting	Northing
Box Canyon	468,677	4,917,703	467,701	4,914,352
Vernon	457,138	4,877,930	454,246	4,874,836

Appendix B-1. Electrofishing mark-recapture statistics for the Box Canyon section, Henrys Fork Snake River, Idaho, 1995-2006.

Year	Brook trout[a]				Rainbow trout				All trout			
	M[a]	C[a]	R[a]	R/C (%)	M	C	R	R/C (%)	M	C	R	R/C (%)
1995	--	--	--	--	982	644	104	16	982	644	104	16
1996	--	--	--	--	626	384	69	18	626	384	69	18
1997	--	--	--	--	859	424	68	16	859	424	68	16
1998	--	--	--	--	683	425	42	10	683	425	42	10
1999	--	--	--	--	595	315	38	12	595	315	38	12
2000	--	--	--	--	1,269	692	74	11	1,269	692	74	11
2002	2	0	0	0	1,050	511	81	16	1,052	511	81	16
2003	2	2	0	0	427	167	20	12	429	169	20	12
2005	0	0	0	0	735	401	90	22	735	401	90	22
2006	4	6	0	0	887	356	61	17	891	362	61	17

[a] M = number of fish marked on marking run; C = total number of fish captured on recapture run; R = number of recaptured fish on recapture run.

Appendix B-2. Mean total length and relative stock density (RSD-400) of trout captured at the Box Canyon electrofishing section, Henrys Fork Snake River, Idaho, 1995-2006. Total individual fish captured during mark (M) and recapture (C - R) runs equals n. RSD-400 = (number ≥400 mm / number ≥200 mm) x 100.

Year	Brook trout			Rainbow trout			All trout		
	n	Mean (mm)	RSD-400 (%)	n	Mean (mm)	RSD-400 (%)	n	Mean (mm)	RSD-400 (%)
1995	0	--	--	1,626	318	28	1,626	318	28
1996	0	--	--	1,010	304	20	1,010	304	20
1997	0	--	--	1,283	308	13	1,283	308	13
1998	0	--	--	1,108	272	12	1,108	272	12
1999	0	--	--	910	330	15	910	330	15
2000	0	--	--	1,961	294	10	1,961	294	10
2002	2	--	--	1,561	350	40	1,563	350	40
2003	4	194	0	594	366	45	594	366	45
2005	0	--	--	1,136	354	45	1,136	354	45
2006	11	208	0	1,308	324	32	1,319	324	32

Appendix B-3. Estimated abundance (N) of age 1 and older rainbow trout (≥150 mm) at the Box Canyon electrofishing section, Henrys Fork Snake River, Idaho, 1995-2006. Confidence intervals (±95%) are in parentheses.

First marking date	Rainbow trout		
	N/section MPM[a]	N/section LLM[b]	N/km LLM
5-16-1995	6,037 (5,043-7,031)	5,922 (5,473-6,371)	1,601 (1,479-1,722)
5-17-1996	3,456 (2,770-4,142)	4,206 (3,789-4,623)	1,137 (1,024-1,250)
5-8-1997	5,296 (4,202-6,390)	5,881 (5,217-6,545)	1,589 (1,410-1,769)
5-12-1998	6,775 (4,937-8,613)	8,846 (7,580-10,112)	2,391 (2,049-2,733)
5-27-1999	4,844 (3,484-6,204)	5,215 (4,529-5,901)	1,409 (1,224-1,595)
5-11-2000	11,734 (9,317-14,151)	12,841 (11,665-14,017)	3,471 (3,153-3,788)
5-5-2002	6,574 (5,329-7,819)	7,556 (6,882-8,230)	2,042 (1,860-2,224
5-8-2003	3,472 (2,147-4,797)	3,767 (3,005-4,529)	1,018 (812-1,224)
5-16-2005	3,250 (2,703-3,797)	4,430 (3,922-4,938)	1,197 (1,060-1,334)
5-10-2006	5,112 (4,005-6,219)	5,986 (5,387-6,585)	1,618 (1,456-1,779)

[a] Modified Peterson Estimate
[b] Log-Likelihood Method

FALL RIVER

ABSTRACT

We conducted a mark-recapture population estimate during June 2006 on one section of the Fall River to obtain fish population parameters and density estimates. Mountain whitefish *Prosopium williamsoni* and rainbow trout *Oncorhynchus mykiss* represented 74 and 26% of the catch respectively, while brook trout *Salvelinus fontinalis*, brown trout *Salmo trutta* and Yellowstone cutthroat trout *O. clarkii bouvieri* each constituted < 1% of the catch. Rainbow trout and mountain whitefish densities were 359 and 1,257 fish per km, respectively. Mean length of rainbow trout collected was 198 mm. Only 19 of 656 rainbow trout collected were greater than 400 mm. Rainbow trout PSD was 35, and mean annual mortality was estimated at 59%. Mean length of mountain whitefish was 297 mm.

METHODS

A 10 km reach of the Fall River (start at Rt 3800 bridge UTM468,152 E, 4,877,091 N Z 12; stop at Enterprise Canal UTM 460,294 E, 4,872,348 N Z 12) was sampled with two drift boat electrofishers to determine species composition and to estimate densities using a mark-recapture population estimate. We collected fish for marking on two consecutive days (June 22 and 23) followed by a six day rest and two consecutive days for recaptures. We used two drift boat electrofishers on all capture events, and attempted to collect all salmonids encountered. After capture, fish were identified to species and measured for total length (mm). All trout > 150 mm and all mountain whitefish > 200 mm were then marked with a hole punch in the caudal fin before release. We estimated densities using a Modified Peterson estimator and Montana's MR-5 data analysis program (MR-5, MDFWP 1994).

We collected a random sample of 130 rainbow trout during our last electrofishing collection date on June 30. We removed the saggital otoliths for age and growth analysis. All otoliths were removed, cleaned on a paper towel and stored in individually-labeled envelopes. Ages were estimated by counting annuli under a dissecting microscope at 40x power. Otoliths were submerged in water and read in whole view when clear, distinct growth rings were present. We sectioned, polished and read otoliths in cross-section view with transmitted light when the annuli were not distinct in whole view.

We estimated proportional stock density (PSD) indices for rainbow trout using the methods described by Ney (1993) where PSD = (Number ≥ quality size / Number ≥ stock size) * 100. Similarly, relative stock density (RSD-400) was calculated using the same formula, but quality size (300 mm) was replaced by memorable size (400 mm) in the numerator (Gablehouse, 1984). We also calculated relative weights using the equation provided by Anderson (1980) where $\log W_s = -5.194 + 3.098 * \log(\text{length})$.

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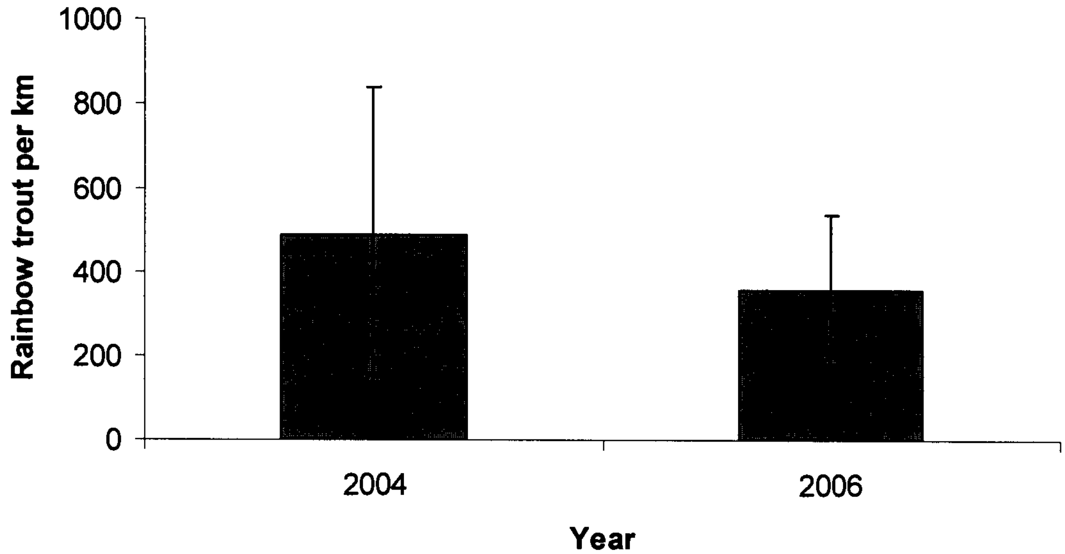


Figure 1. Density estimates (trout per km) for rainbow trout in the Fall River, Idaho.

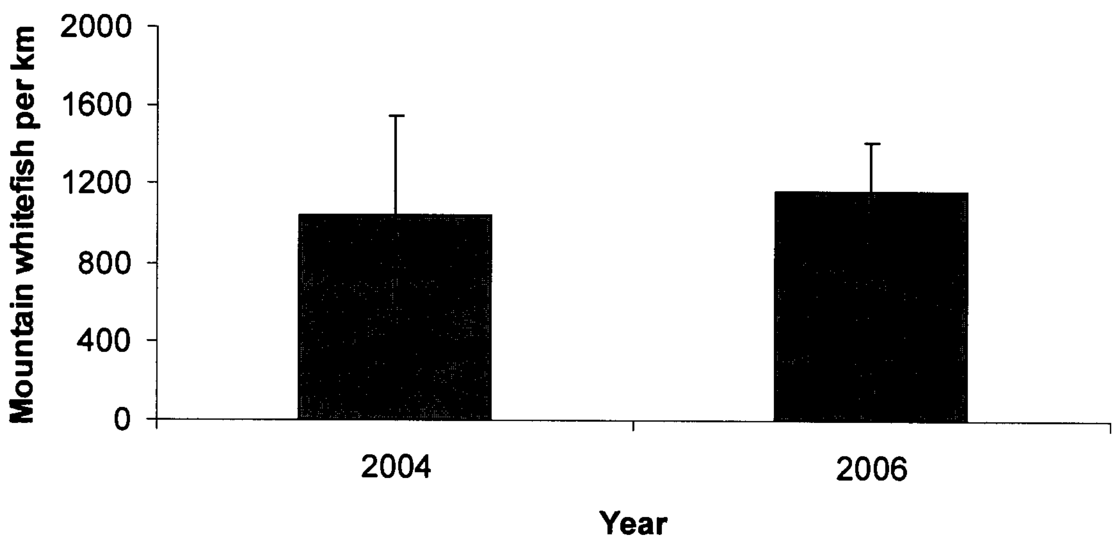
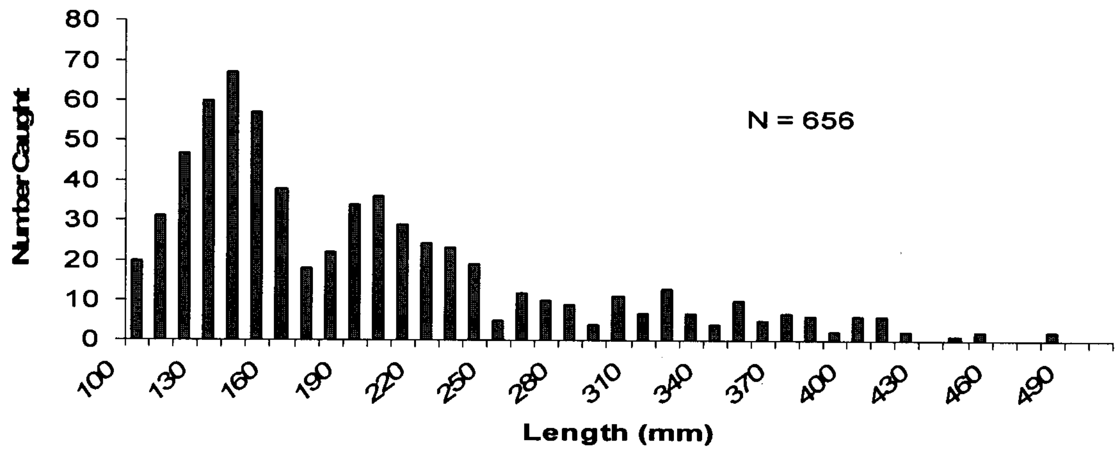


Figure 2. Density estimates (fish per km) for mountain whitefish in the Fall River, Idaho.

Table 1. Total catch and population estimates for fish collected electrofishing in Fall River, Idaho 2006. Population estimates and resulting densities were derived with a Modified Peterson Estimator (MR-5, MDFWP 1994).

Species	Mark	Capture	Recapture	Pop. Estimate (# in reach)	95% CI	Fish per km
Brook trout	0	2	0	--	--	--
Brown trout	3	0	0	--	--	--
Mountain whitefish	788	955	64	11,603	9,027-14,179	1,160
Rainbow trout	203	228	12	3,593	1,833-5,353	359
Yellowstone cutthroat trout	0	2	0	--	--	--



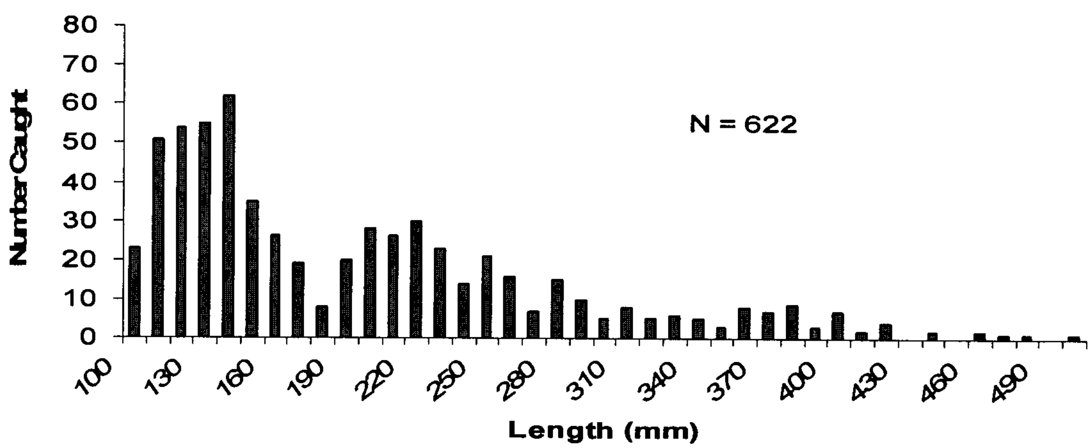


Figure 3. Length frequency distribution for rainbow trout collected electrofishing in the Fall River, Idaho 2006 (top figure) and 2004 (bottom figure).

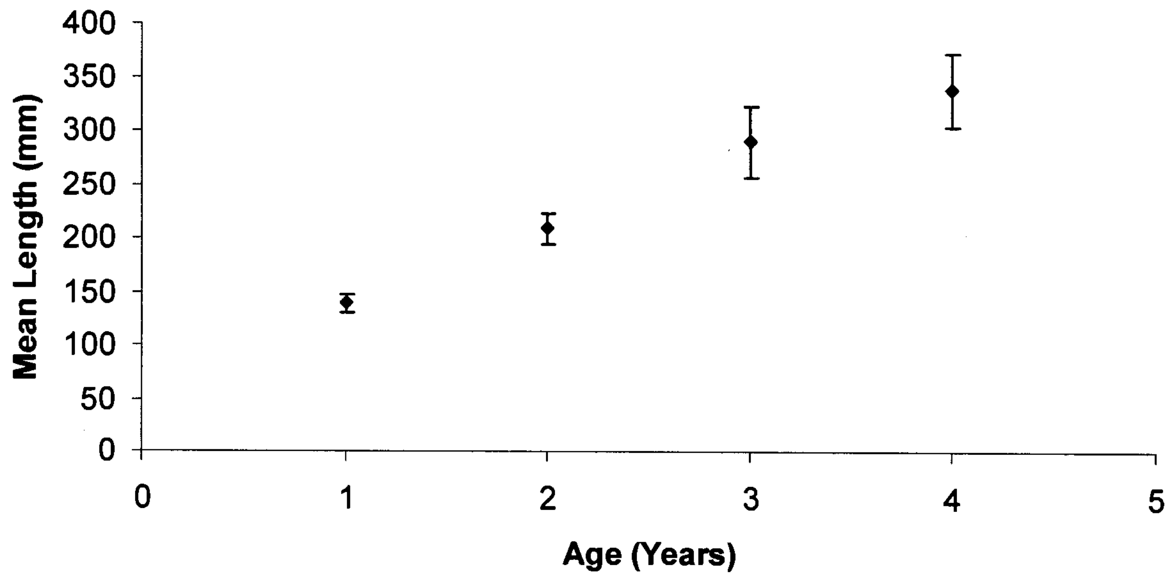


Figure 4. Mean length of rainbow trout collected in the Fall River, Idaho 2006 and associated 95% confidence bounds (error bars).

Table 2. Mortality and survival estimates for the Henrys Fork drainage, Idaho 2002-2006 based on catch curve analysis.

Reach	Year	Age Range	Mortality (%)	Survival (%)
Stone Bridge	2002	2 – 6	38	62
Stone Bridge	2003	2 - 6	16	84
Box Canyon	2002	2 - 5	20	80
Box Canyon	2003	3 - 6	25	75
Box Canyon	2005	2 - 7	39	61
Fall River	2006	2 - 4	59	41

TETON RIVER

ABSTRACT

During fall 2006, a total of 359 trout were captured during two days of electrofishing at the South Fork Teton section in the lower Teton River. Species composition and relative abundance were cutthroat trout (65.4%), rainbow trout and hybrid rainbow x cutthroat trout (23.7%), brown trout (10.6%), and brook trout (0.3%). For age 1 and older trout, estimated densities were 93 cutthroat trout/km, 31 rainbow trout/km, and 13 brown trout/km for a combined total of 137 fish/km. Too few brook trout were captured for an unbiased estimate. Mean total length was 323 mm for cutthroat trout, 299 mm for rainbow trout, 297 mm for brown trout, and 315 mm for all species combined. Quality stock density was 20.1% for cutthroat trout, 16.0% for rainbow trout, 18.9% for brown trout, and 19.0% for all species combined.

In the first kilometer of the section, we captured 439 individual game and non-game fish. Three-quarters of the total were game species, and one-quarter were non-game species. We did not enumerate longnose dace and redside shiners, which were very abundant. Of the game fish captured, 78.0% were mountain whitefish, 12.8% were cutthroat trout, 7.3% were rainbow trout, 0.9% was brown trout, and 0.3% each was brook trout, yellow perch, and smallmouth bass. Of the non-game fish captured, 92.8% were Utah suckers, 6.3% were Utah chubs, and 0.9% was bluehead suckers. For age 1 and older fish in the sub-section, estimated densities were 483 mountain whitefish/km, 48 cutthroat trout/km, and 28 rainbow trout/km. Too few fish of other species were captured for unbiased estimates.

STUDY AREA AND METHODS

We surveyed trout populations at the South Fork Teton section on August 31 and September 7, 2006 (Table 1). The entire section was 3.1 km long in 1993, the first year of sampling, and in 1999, but was increased to 3.8 km in 2006. The first 1.0 km of the section was considered a sub-section for sampling purposes in 2006. Both section and sub-section wetted widths average about 19 m (Moore and Andrews 1983).

The South Fork Teton section is the standard IDFG monitoring section in the lower Teton River below the old Teton Dam site. Other sections in the lower Teton River that have been sampled in the past, but for which estimates were poor, include the North Fork Teton and Hog Hollow (Schrader and Brenden 2004; Garren et al. 2006a). The South Fork Teton section has been adversely affected by the collapse of Teton Dam in 1976 as well as recent housing encroachment. However, the section is representative of the best remaining riverine fish habitat in the lower Teton River – generally the lower South Fork Teton River below the Highway 20 bridge at Rexburg (Schrader and Brenden 2004). Although streamflow is manipulated at the "splitter" control gates between the North Fork and South Fork Teton River, sub-surface water recharges the electrofishing section and it has perennial flow.

Fish were captured using direct-current (DC) electrofishing gear (Coffelt VVP-15 powered by a Honda 5000 W generator) mounted in a drift boat. We used pulsed DC current through two boom-and-dangler anodes fixed to the bow while floating downstream. The boat hull was the cathode. VVP settings and conductivity settings were similar to past years – 225 V, 5 A, 20% pulse width, and 80-90 Hz (pulses per second). Water conductivity was not measured.

We attempted to capture all species and sizes of fish in the sub-section. Due to large numbers of non-game fish and time constraints, we excluded non-game fish and captured only trout in the remainder of the section. After capture, fish were anesthetized, identified, and measured to the nearest millimeter (total length, TL). Age 0 fall-spawning fish (brown trout, brook trout, and mountain whitefish) less than 150 mm and spring-spawning fish (cutthroat trout, rainbow trout, and suckers) less than 100 mm were not marked as they are not efficiently recruited to the gear. Age 1 and older fish were marked with a caudal fin punch and released. Hereafter, "rainbow trout" refers to wild rainbow and hybrid trout combined.

Electrofishing data were entered and analyzed using the computer program Mark Recapture 5.0 (MR5; Montana Department of Fish, Wildlife, and Parks 1997). Additional analyses were made using Microsoft Excel. General statistical procedures were conducted according to Zar (1984).

We assumed capture probabilities did not vary with species, and relative abundance was estimated using proportions of all individual trout captured (excluding recaptures). Although capture probabilities vary with fish length (Schill 1992; Reynolds 1996), population size structures (length frequency distributions) and average fish lengths were estimated using all sizes of individual fish captured. Quality stock density (QSD; Anderson 1980) was estimated using the number of individual fish captured greater than or equal to 400 mm divided by the number greater than or equal to 200 mm, times 100. Density was estimated using one of two methods in the MR5 computer program. The log-likelihood method was preferred over the modified Peterson method if modeled efficiency curves were acceptable (termcode=1 and at least one of two chi-square p-values>0.05).

RESULTS

South Fork Teton Section

During 2006, a total of 359 trout were captured during two days of electrofishing at the South Fork Teton section. Species composition and relative abundance were cutthroat trout (65.4%), rainbow trout (23.7%), brown trout (10.6%), and brook trout (0.3%; Table 2).

A relatively strong group of age 1 cutthroat trout (about 150-300 mm) was observed (Figure 1). No age 0 cutthroat trout (less than 100 mm) were captured. Ages were approximated, but not validated, from the overall 1993-2006 frequency distribution (n = 372). Too few rainbow, brown, or brook trout were captured for meaningful length frequency distributions.

Mean total length was 323 mm for cutthroat trout, 299 mm for rainbow trout, 297 mm for brown trout, and 315 mm for all species combined (Table 3). Quality stock density was 20.1% for cutthroat trout, 16.0% for rainbow trout, 18.9% for brown trout, and 19.0% for all species combined.

Electrofishing sampling efficiencies (R/C) ranged from 56% for rainbow and brown trout to 61% for cutthroat trout (Table 4). For age 1 and older fish, estimated densities were 93 cutthroat trout/km, 31 rainbow trout/km, and 13 brown trout/km for a combined total of 137 fish/km (Table 5). Too few brook trout were captured for an unbiased estimate.

South Fork Teton Sub-section

In the first 1.0 km of the section, which we define as the sub-section, 439 individual game and non-game fish were captured during mark and recapture runs. We did not enumerate longnose dace and redside shiners, which were very abundant. Of the total, three-quarters or 328 fish were game species, and one-quarter or 111 fish were non-game species. Of the game fish captured, 78.0% were mountain whitefish, 12.8% were cutthroat trout, 7.3% were rainbow trout, 0.9% was brown trout, and 0.3% each was brook trout, yellow perch, and smallmouth bass. Of the non-game fish captured, 92.8% were Utah suckers, 6.3% were Utah chubs, and 0.9% was bluehead suckers.

Total lengths for game fish were: 77-424 mm for mountain whitefish (n=256), 204-520 mm for cutthroat trout (n=42), 195-475 mm for rainbow trout (n=24), 253-485 mm for brown trout (n=3), 233 mm for one brook trout, 151 mm for one yellow perch, and 144 mm for one smallmouth bass. Total lengths for non-game fish were: 89-542 mm for Utah suckers (n=103), 59-193 mm for Utah chubs (n=7), and 114 mm for one bluehead sucker.

One of the rainbow trout (340 mm) was believed to be of hatchery origin due to eroded fins. Most fish of all species except Utah chub had black spot disease.

For age 1 and older fish in the sub-section, estimated densities were 483 mountain whitefish/km, 48 cutthroat trout/km, and 28 rainbow trout/km. Except for Utah suckers, too few fish of other species were captured for unbiased estimates. For unknown reasons, ninety-seven Utah suckers were captured and marked on the marking run, but only seven were captured on the recapture run, one of which was a recapture.

DISCUSSION

Since 1993, cutthroat trout in the South Fork Teton section have increased significantly, whereas rainbow trout have not (Figure 2). This is in contrast to sections of the river in the Teton Valley where, in 2003 and 2005, cutthroat trout populations had declined to their lowest recorded levels and rainbow trout had increased to their highest (Garren et al. 2006b). Although overall trout densities are higher in the Teton Valley, most of the species composition there is now rainbow trout. Recent cutthroat trout densities in the South Fork Teton are several-fold higher compared to the Teton Valley.

Strong age 1 and possibly age 2 year classes were observed in the South Fork Teton in 2006, and mean lengths and QSDs have become more balanced compared to previous years. Similar results were observed in the Teton Valley in 2005 (Garren et al. 2006b). This is probably the result of improved streamflows in spawning and rearing tributaries. We cannot explain the apparent absence of age 0 fish in the South Fork Teton – where sampling efficiency has always been relatively high. It is possible juvenile fish do not move into this section of the river until they are older, although adult fish have been radio-tracked to assumed spawning beds near the electrofishing section (Schrader and Jones 2004).

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Table 1. Survey dates, location coordinates (UTM, Zone 12), and number of runs conducted at the South Fork Teton electrofishing section, Teton River, Idaho, 1993-2006, excluding years not sampled.

Year sampled	First marking run date	Last recapture run date	Lapsed days	Start UTM	Stop UTM	Total number of runs	Number of recapture runs
1993[a]	Sept 1	Sept 8	7	431,083E 4,853,185N	429,703E 4,853,927N	3[a]	1
1999[b]	Sept 1	Sept 7	6	431,083E 4,853,185N	429,703E 4,853,927N	2	1
2006[c]	Aug 31	Sept 7	7	431,083E 4,853,185N	429,517E 4,854,202N	2	1
2006[d]	Aug 31	Sept 7	7	431,083E 4,853,185N	430,392E 4,853,564N	2	1

[a] Took two days to complete one marking run due to equipment failure.
[b] From Schrader and Brenden (2004).
[c] Section length increased from 3.1 to 3.8 km.
[d] Sub-section length 1.0 km.

Table 2. Trout species composition and relative abundance (%) at the South Fork Teton electrofishing section, Teton River, Idaho, 1993-2006, excluding years not sampled. Total individual fish captured during mark and recapture runs (excluding recaptures) equals *n*.

Year	Cutthroat trout		Rainbow trout[a]		Brown trout		Brook trout		Total	
	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*
1993	52.4	43	42.7	35	4.9	4	0.0	0	100.0	82
1999[b]	82.5	94	14.9	17	2.6	3	0.0	0	100.0	114
2006[c]	65.4	235	23.7	85	10.6	38	0.3	1	100.0	359

[a] Includes hybrids.
[b] From Schrader and Brenden (2004).
[c] Section length increased from 3.1 to 3.8 km.

Table 3. Mean total length and quality stock density (QSD) of trout captured at the South Fork Teton electrofishing section, Teton River, Idaho, 1993-2006, excluding years not sampled. Total individual fish captured during mark and recapture runs (excluding recaptures) equals *n*. QSD = (number ≥400 mm / number ≥200 mm) x 100.

Year	Cutthroat trout			Rainbow trout[a]			Brown trout			All trout[b]		
	Mean (mm)	QSD (%)	*n*	Mean (mm)	QSD (%)	*n*	Mean (mm)	QSD (%)	*n*	Mean (mm)	QSD (%)	*n*
1993	379	46.5	43	281	5.7	35	243	0.0	4	331	26.8	82
1999[c]	371	46.2	94	301	28.6	17	347	33.3	3	360	43.5	114
2006[d]	323	20.1	235	299	16.0	85	297	18.9	38	315	19.0	359

[a] Includes hybrids.
[b] Includes one brook trout in 2006.
[c] From Schrader and Brenden (2004).
[d] Section length increased from 3.1 to 3.8 km.

Table 4. Mark recapture statistics for the South Fork Teton electrofishing section, Teton River, Idaho, 1993-2006, excluding years not sampled. Cases where *R*≤3 and unbiased density estimates are not possible (Ricker 1975) are in bold.

Year	Cutthroat trout ≥100 mm				Rainbow trout ≥100 mm[a]				Brown trout ≥150 mm			
	M[b]	*C*[b]	*R*[b]	*R/C* (%)	*M*	*C*	*R*	*R/C* (%)	*M*	*C*	*R*	*R/C* (%)
1993	23	28	13	46	14	25	6	24	***3***	***2***	***1***	***50***
1999[c]	55	50	19	38	***7***	***12***	***2***	***17***	***1***	***2***	***0***	***0***
2006[d]	174	155	95	61	65	41	23	56	30	16	9	56

[a] Includes hybrids.
[b] *M* = number of fish marked on marking run; *C* = total number of fish captured on recapture run; *R* = number of recaptured fish on recapture run.
[c] From Schrader and Brenden (2004).
[d] Section length increased from 3.1 to 3.8 km.

Table 5. Estimated abundance, *N*, of age 1 and older cutthroat trout ($\geq$100 mm), rainbow trout ($\geq$100 mm), and brown trout ($\geq$150 mm) at the South Fork Teton electrofishing section, Teton River, Idaho, 1993-2006, excluding years not sampled. Confidence intervals at 95% are in parentheses. Cases where $R \leq 3$ and unbiased density estimates are not possible (Ricker 1975) are in bold.

Year	Cutthroat trout		Rainbow trout[a]		Brown trout		Total	
	N/section	*N*/km	*N*/section	*N*/km	*N*/section	*N*/km	*N*/section	*N*/km
1993	80 (50)	26 (16)	63 (29)	20 (9)	***NE***[b]	***NE***	143	46
1999	249 (80)	80 (26)	***NE***	***NE***	***NE***	***NE***	249	80
2006[c]	354 (21)	93 (6)	118 (19)	31 (5)	50 (15)	13 (4)	522	137

[a] Includes hybrids.
[b] NE = no unbiased estimate possible as $R \leq 3$ (Ricker 1975).
[c] Section length increased from 3.1 to 3.8 km.

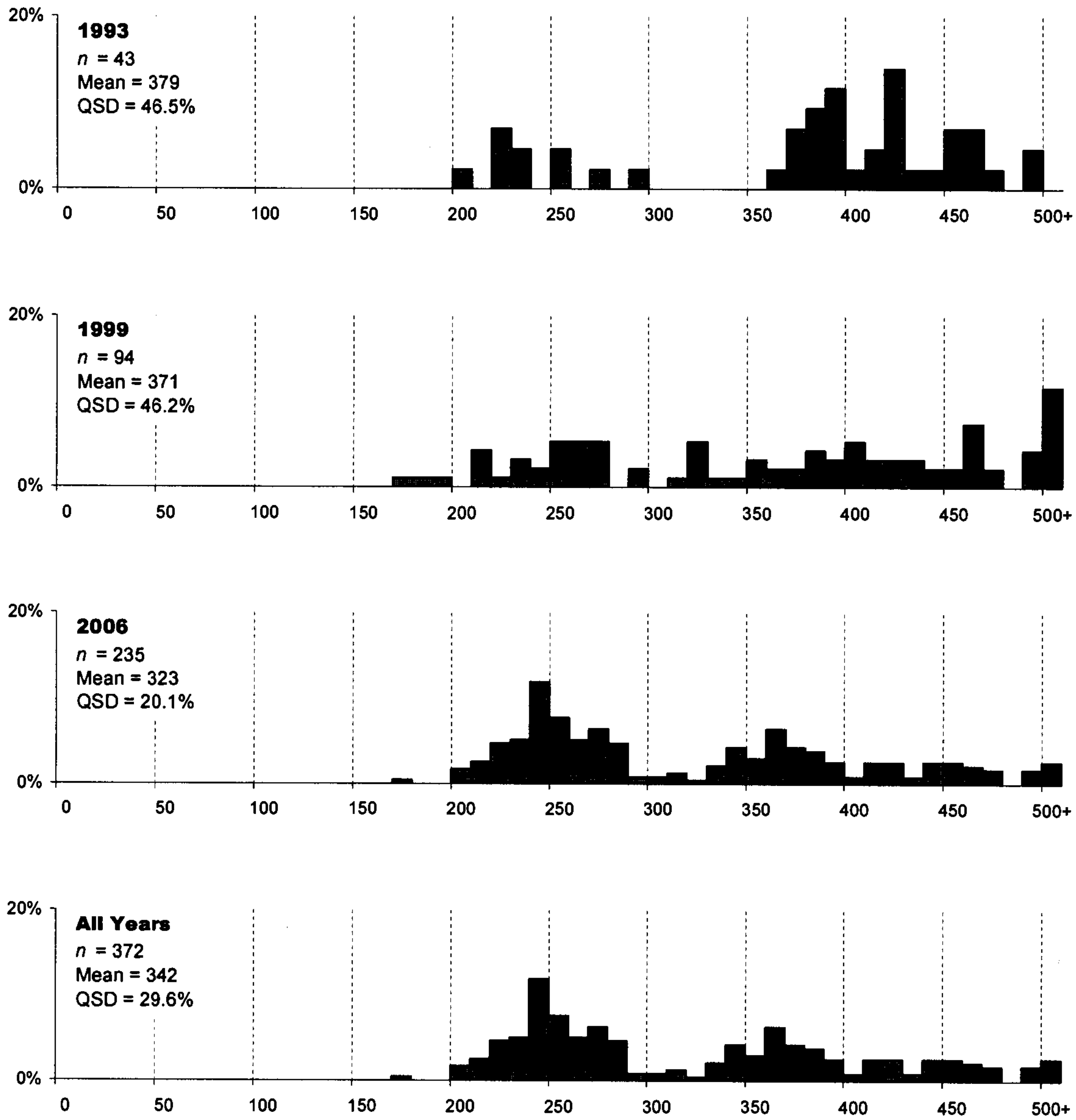
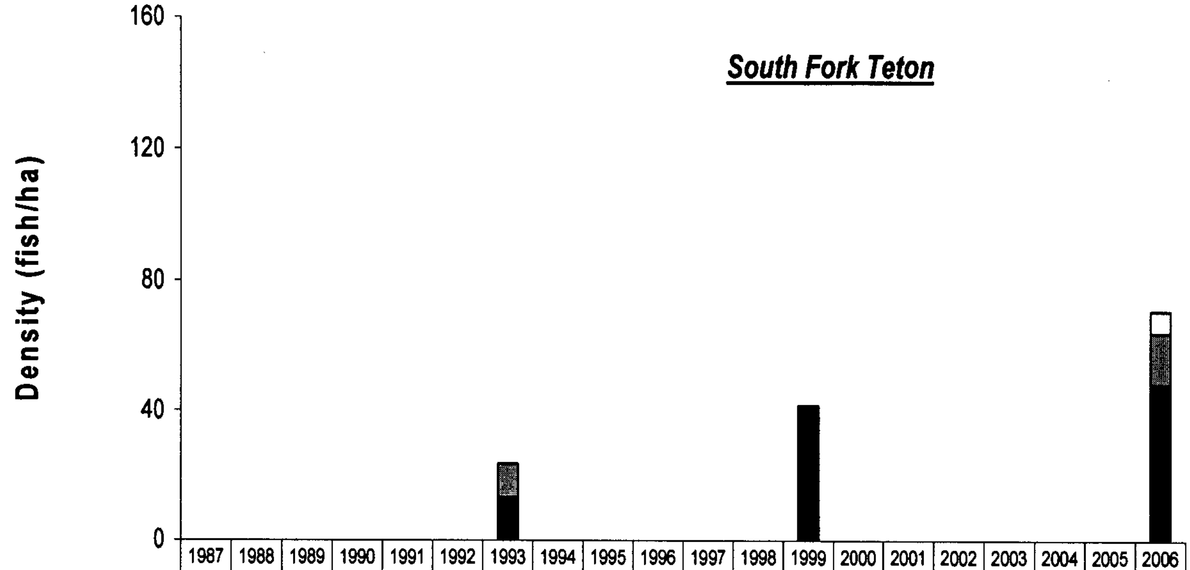
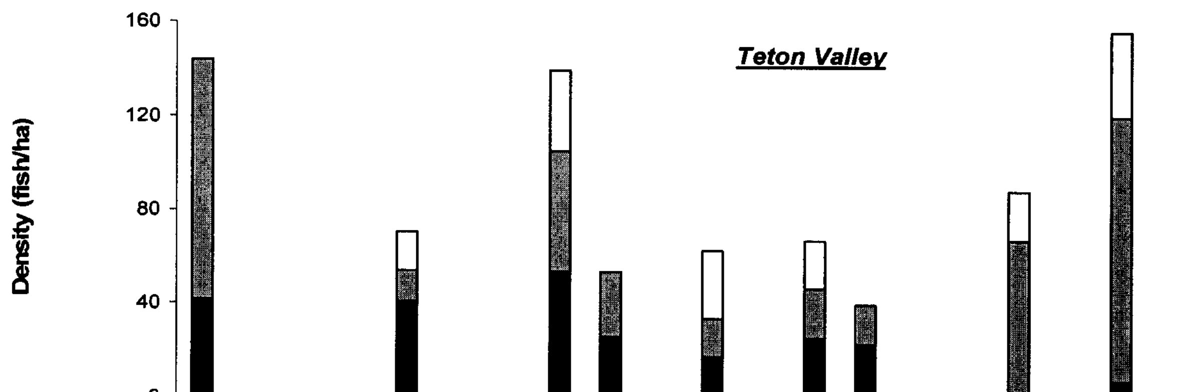


Figure 1. Length frequency distributions (TL, mm) of cutthroat trout captured at the South Fork Teton electrofishing section, Teton River, Idaho, 1993-2006, excluding years not sampled. Total individual fish captured during mark and recapture runs = *n*.



	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Brown Trout																				7
Rainbow Trout							10													16
Cutthroat Trout							13						41							48



	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Brook trout					17			35			29		20				21		36	
Rainbow trout	102				13			51	27		16		21	17			65		112	
Cutthroat trout	42				41			54	26		16		26	23			2		7	

Figure 2. Comparison of aerial density (fish/ha) trends in the South Fork Teton and Teton Valley electrofishing sections, Teton River, 1987-2006, excluding years not sampled. Values are for age 1 and older cutthroat trout (≥100 mm), rainbow trout (≥100 mm), brown trout (≥150 mm), and brook trout (≥150 mm); missing values are cases where unbiased estimates were not possible. Teton Valley densities were averaged over all sections except White Bridge.

LITTLE LOST RIVER DRAINAGE SURVEYS

ABSTRACT

We measured species composition and estimated rainbow, brook and bull trout densities in 35 locations in the Little Lost River drainage in August 2006. We found no fish in 6% of our sites while 33 sites (94%) had fish present. Either rainbow, brook or bull trout were found in all 33 sites where fish were present. We found bull trout *Salvelinus confluentus* in 18 of our sample sites, 15 of which had bull trout in combination with brook trout *Salvelinus fontinalis*, rainbow trout *O. mykiss* or bull trout x brook trout hybrids. When compared to our most recent surveys, bull trout densities have remained similar or increased in 11 sample locations and declined in seven locations. We also sampled two locations where bull trout have been found previously but were absent in the current survey. Allopatric populations of bull trout were found on Badger Creek, Wet Creek and Williams Creek. Densities of age 1 and older trout ranged from 0 – 50.5 fish per 100 m^2. When compared to past surveys, densities of age 1 and older trout have increased in 40% of the drainage, showed no change in 31% of the drainage, and have decreased in 29% of the drainage.

METHODS

Stream samples in the Little Lost River drainage conducted in 2006 were a cooperative effort between the Upper Snake Regional fisheries staff, Bureau of Land Management and the United States Forest Service. The majority of sample locations were repeated sites used in long-term population monitoring by all involved agencies.

We used backpack electrofishers on August 1 and 2, during low to moderate flow conditions (after spring runoff and before the onset of winter) to facilitate effective fish capture and standardization of sampling conditions. Six sample crews consisting of two to four people used backpack electrofishers and multiple-pass depletion methods to estimate trout abundance. We identified all collected trout to species before measuring for total length and releasing at the completion of the multiple-pass collecting period. Sample reaches were 100 m in length in most instances. Population estimates and 95% confidence intervals were estimated with MicroFish (2005) where appropriate. We used all trout species combined in our population estimates, and created species-specific density estimates by proportioning out densities based on relative abundance of the various species collected at each site. Capture efforts were focused on salmonids, but at each site where they occurred, nongame fish were captured and identified to species. Survey results were compared to the most recent density estimates for each sample location. We defined a change in our density estimate as being a deviation in excess of 20% over the most recent survey preceding our 2006 effort.

RESULTS

A total of 35 stream surveys were completed in the Little Lost River drainage (Figure 1). Of the sites sampled in 2006, bull trout *Salvelinus confluentus* were present at 18 (51%) of our sites (Table 1). Allopatric populations of bull trout were found in sample from Badger Creek 2-A, Wet Creek #9 and Williams Creek. Bull trout were found in combination with brook trout in Squaw Creek and Warm Creek, and with brook trout and rainbow trout in Mill Creek, Sawmill Creek #4 and #5 and Wet Creek #7. Bull trout were found in combination with rainbow trout in Badger Creek #1 and #3, Iron Creek, Sawmill Creek #2 and #6, Smithie Fork, Timber Creek and Wet Creek #3 and #6. Hybrid trout (bull trout x brook trout) were found in samples from Sawmill #4, Smithie Fork and Timber Creek, although no brook trout were found in any of these locations. Bull trout densities have increased or remained similar to past surveys in 12 sample locations and have declined in abundance in six locations (Table 2).

Overall trout densities (fish per 100m^2) ranged from 0.0 to 50.5 (Table 3). When compared to past surveys, 40% of sample locations showed an increase in abundance of age 1 and older trout while 31% showed no change in abundance, and 29% showed a decline in abundance (Appendix A).

Because multiple agencies have conducted electrofishing surveys in the Little Lost River drainage over the course of the past 20 years, many discrepancies exist in the names of identical sampling locations. Many locations have different names for the same sample location depending on the sampling agency. Many of these sampling locations were created before the implementation of Global Positioning System technology, and did not contain adequate site descriptions to replicate sampling. We attempted to standardize the site name for each sampling location, and verify the starting position with UTM coordinates. We created a table summarizing current sampling locations and other names for the same site that have been used in the past to aid in deciphering previously collected data (Appendix B).

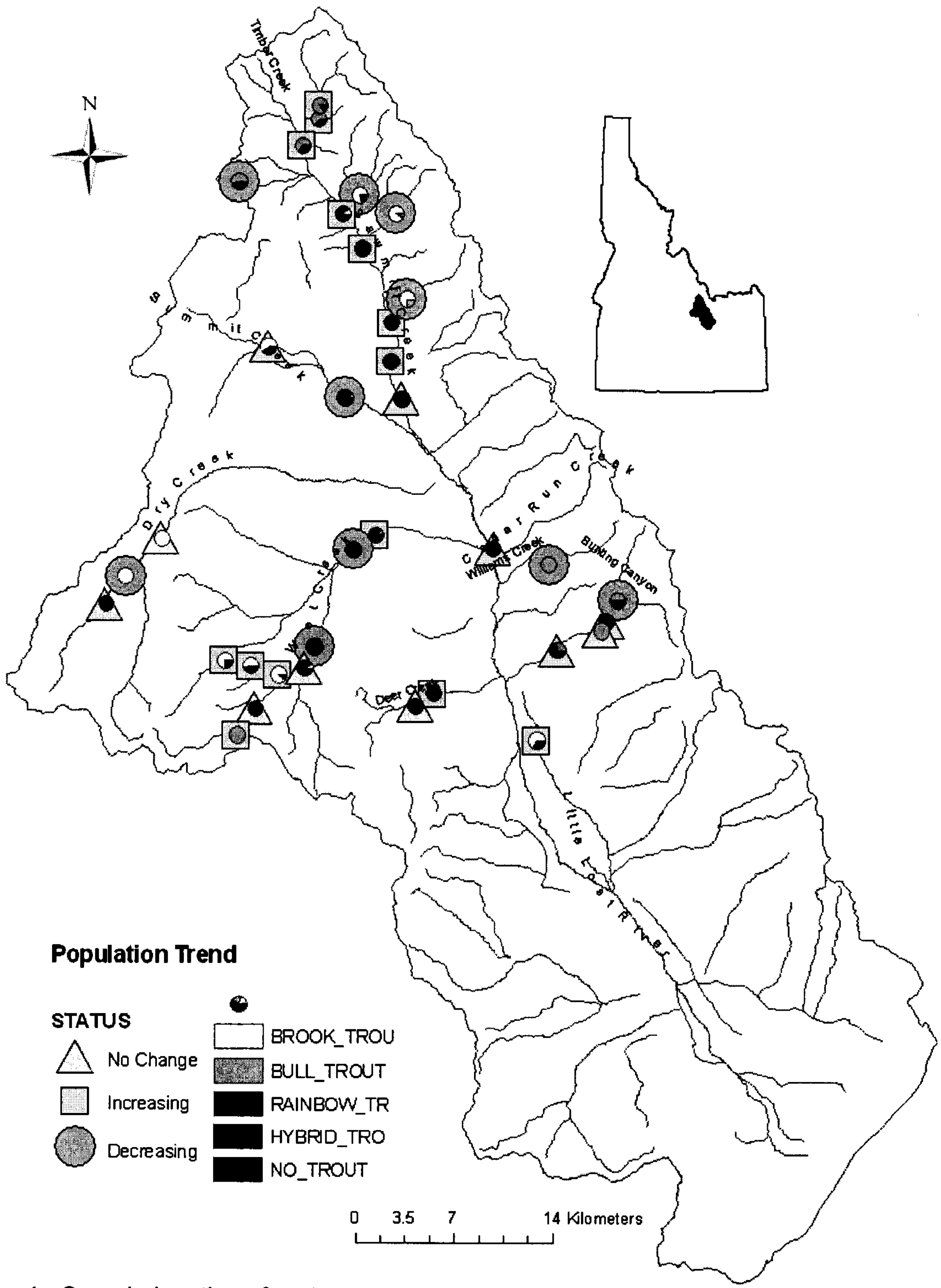


Figure 1. Sample locations for stream surveys conducted in 2006 in the Little Lost River drainage, Idaho.

Table 1. Summary statistics for streams sampled in the Little Lost River Drainage, Idaho 2006.

Minor Drainage	No. Sites Sampled	No Fish	Fish Present	Trout Present	Native[a] and Nonnative Trout	Native[a] Trout Only	Density[b] (age 1 trout/100m^2)	Population Trend
Sawmill Canyon	12	0	12	12	10	0	4.2 – 27.2	7 sites increasing 4 sites decreasing 1 site no change
Summit Creek	2	0	2	2	0	0	5.6 – 14.1	1 site no info[c] 1 site decreasing
Dry Creek	3	1	2	2	0	0	0.0 – 0.2	1 site no change 1 site no info[c] 1 site decreasing
Wet Creek	9	1	8	8	3	1	0.0 – 6.1	5 sites increasing, 2 sites decreasing, 2 sites no change
Badger Creek	4	0	4	4	2	1	1.1 – 8.4	1 site no change 2 sites no info[c] 1 site decreasing
Deer Creek	2	0	2	2	0	0	28.0 – 50.5	1 site increasing 1 site no change
Mainstem Little Lost	1	0	1	1	0	0	3.8	1 site no change
Big Springs Creek	1	0	1	1	0	0	14.3	1 site increasing
Williams Creek	1	0	1	1	0	1	4.5	1 site decreasing

[a] – Native trout are defined as bull trout in the Little Lost River drainage.
[b] – Density estimates are for age 1 and older trout, which are defined as all trout 70 mm in length or greater.
[c] – No density information from previous survey

Table 2. Bull trout abundance and population trend from the Little Lost River, Idaho 2006.

Stream Location	Percent abundance bull trout	Percent abundance all other trout	Density[a] all trout	Bull trout density[a]	Bull trout density[a] from most recent study (pre 2006)	Percent change from most recent survey (pre 2006)
Badger Creek 1	27	73	8.4	2.3	0.8	+287%
Badger Creek 2-B	100	0	1.1	1.1	1.1	0
Badger Creek 3	33	67	4.4	1.5	0	UNK[b]
Iron Creek	54	46	4.3	2.3	14.0	-84%
Little Lost River 3	0	100	3.8	0	0.4	-100%
Mill Creek	5	95	12.3	0.6	0.8	-25%
Sawmill Creek 1	0	100	4.2	0	0.8	-100%
Sawmill Creek 2	3	97	9.2	0.3	0.7	-57%
Sawmill Creek 4	4	96	15.1	0.6	0.2	+300%
Sawmill Creek 5	2	98	18.6	0.4	0.1	+400%
Sawmill Creek 6	64	36	14.6	9.3	7.1	+30
Smithie Fork	84	16	27.2	22.9	19.5	+17%
Squaw Creek	11	89	9.4	1.0	2.7	-63%
Timber Creek	66	34	12.0	7.9	5.2	+52%
Warm Creek	25	75	5.3	1.3	0	+100[b]
Wet Creek 3	11	89	5.1	0.6	0	+100[b]
Wet Creek 6	8	92	4.0	0.3	0	+100[b]
Wet Creek 7	6	94	5.8	0.4	0	+100[b]
Wet Creek 9	100	0	6.1	6.1	0.3	>500%
Williams Creek	100	0	4.5	4.5	12.7	-65%

[a] – all densities are presented in fish per 100 m^2, and incorporate age 1 and older fish. In the Little Lost River drainage, 70 mm+ fish have historically been considered age 1 and older.
[b] – No bull trout in the most recent previous survey to compare current estimates with.

Table 3. Stream locations sampled in the Little Lost River drainage during 2006.

Location	Water Present	Relative abundance[a]					Abundance Estimate Age 1[b] and older (+/- 95%)	Abundance Estimate (All Trout)	Density (Age 1[b] trout per $100m^2$)
		RBT	BLT	BKT	HYB	Other			
Badger Creek # 1	Yes	73	27			SCL	37 (36-38)	48 (46-50)	8.4
Badger Creek # 2-A	Yes	100					4	4	2.1
Badger Creek # 2-B	Yes		100				2	2	1.1
Badger Creek # 3	Yes	67	33				3	3	4.4
Big Creek # 1	Yes	12		88		SCL	28 (24-32)	36 (31-41)	10.3
Big Creek # 2	Yes	47		53		SCL	36 (33-39)	39 (36-42)	15.7
Big Creek # 3	Yes	26		74		SCL	190 (182-198)	257 (247-267)	45.5
Big Springs Cr	Yes	34		66		SCL	63 (61-65)	67 (65-69)	14.3
Deer Creek # 2	Yes	100				SCL	28 (26-30)	30 (28-32)	28.0
Deer Creek # 3	Yes	100				SCL	40 (37–43)	46 (43-49)	50.5
Dry Creek #1 (Lower)	Yes			100			1	1	0.2
Dry Creek #2 (Middle)	Yes			100			1	1	0.2
Dry Creek #3 (Upper)	Yes	None					0	0	0
Iron Creek (Lower)	Yes	46	54			SCL	13	13	4.3
Little Lost River 3	Yes	100				SCL	30 (21-39)	30 (21-39)	3.8
Mill Creek (Only)	Yes	16	5	79			59 (54-64)	60 (55-65)	12.3
Sawmill Cr # 1	Yes	100				SCL	22 (21-23)	22 (21-23)	4.2
Sawmill Cr # 2	Yes	97	3			SCL	35 (26-44)	35 (26-44)	9.2
Sawmill Cr # 3	Yes	100				SCL	43 (40-46)	43 (40-46)	13.4
Sawmill Cr # 4	Yes	90	4	3	3		80 (69-91)	80 (69-91)	15.1
Sawmill Cr # 5	Yes	87	2	11		SCL	138 (129-147)	141 (132-150)	18.6
Sawmill Cr # 6	Yes	36	64			SCL	71 (66-76)	71 (66-76)	14.6
Smithie Fork	Yes	15	84		1	SCL	117 (111-123)	125 (118-132)	27.2
Squaw Cr	Yes		11	89			15 (14-16)	18 (16-20)	9.4
Summit Cr # 4	Yes	94		6		SCL	19 (15-23)	19 (15-23)	5.6
Summit Cr # 5	Yes	39	61			SCL	48 (43-53)	48 (43-53)	14.1
Timber Creek	Yes	32	66		2	SCL	49 (48-50)	56 (55-57)	12.0
Warm Creek	Yes		75	25			9 (7-11)	12 (11-13)	5.3
Wet Creek # 3	Yes	89	11			SCL	18 (17-19)	18 (17-19)	5.1
Wet Creek # 4	Yes	100				SCL	9 (8-10)	9 (8-10)	3.3
Wet Creek # 6	Yes	92	8			SCL	13 (8-18)	13 (8-18)	4.0
Wet Creek # 7	Yes	88	6	6			19 (12-26)	19 (12-26)	5.8
Wet Creek # 8	Yes	None					0	0	0
Wet Creek # 9	Yes		100				17 (14-20)	17 (14-20)	6.1
Williams Creek	Yes		100			SCL	5	6	4.5

[a] – Species definitions: BLT = bull trout; BKT = brook trout; RBT = rainbow trout; HYB = hybrid (bull x brook) trout; SCL = sculpin

[b] – Age 1 and older fish were defined as being any trout 70 mm in length or greater.

Appendix A. Historic data from the Little Lost River, Idaho. All sites located below were sampled in 2006 – however, additional historical sites throughout the drainage exist, and can be found in USFS reports, the History and Status of Fishes in the Little Lost River Drainage, Idaho 1999 and in Bureau of Land Management Documents.

			Species Composition (%)				
Site	Date	Fish/100m^2	RBT	BLT	BKT	HYB	Source
Badger Cr 1	1995	n/a	100				USFS
	1999	7.8	88	12			BLM
	2006	8.4	73	27			IDFG[b]
Badger Cr 2-A	2006	2.1	100				IDFG[b]
Badger Creek 2-B	1987	26.3	96	4			IDFG
	1995	n/a	92	8			USFS
	2006	1.1	0	100			IDFG[b]
Badger Creek 3	1987	33.1	100				IDFG
	1995	64.1	94	6			USFS
	1997	44.4	100				USFS
	2006	4.4	67	33			IDFG[b]
Big Creek 1	1987	14.4	100				IDFG
	1994	8.0	81		19		USFS
	1996	n/a	86		14		USFS
	2006	10.3	88		12		IDFG[b]
Big Creek 2	1996	n/a	37		63		USFS
	1999	55.6	1		99		USFS
	2002	6.0	67		33		USFS
	2006	15.7	47		53		IDFG[b]
Big Creek 3	1994	33.6	52		48		USFS
	2006	45.5	26		74		IDFG[b]
Big Springs Creek	1987	20.1	94		6		USFS
	1993	20.9	80		20		USFS
	2001	6.0	36		64		BLM
	2006	14.3	34		66		IDFG[b]
Deer Creek 2	1987	28.2	100				IDFG
	1992	20.7	100				USFS
	2006	28.0	100				IDFG[b]
Deer Creek 3	1995	42.5	100				USFS
	2006	50.5	100				IDFG[b]
Dry Creek 1	2006	0.2			100		IDFG[b]
Dry Creek 2	1987	3.9			87[c]		IDFG
	1995	8.9			100		USFS
	2000	11.4[d]			98[c]		USFS
	2006	0.2			100		IDFG[b]
Dry Creek 3	1995	0.0					USFS
	2006	0.0					IDFG[b]
Iron Creek	1987	6.6	4	96			IDFG
	1995	10.1		100			USFS
	1996	n/a		100			USFS
	2000	14.3		98		2	USFS
	2006	4.3	46	54			IDFG[b]

			Species Composition (%)				
Site	Date	Fish/100m^2	RBT	BLT	BKT	HYB	Source
Little Lost River 3	1987	28.2	95	4	1		IDFG
	1992	14.3	96	3	1		USFS
	2001	4.0	96	4			BLM
	2006	3.8	100				IDFG[b]
Mill Creek	1995	20.0	12	36	52		USFS
	1997	20.7	3	4	93		USFS
	2006	12.3	16	5	79		IDFG[b]
Sawmill 1	1984	3.0	59	29	12		IDFG
	1985	1.6	22	22	56		IDFG
	1986	1.3	64	18	18		IDFG
	1987	2.2	68	14	18		IDFG
	1993	2.0	70	10	20		USFS
	1997	2.2	75	17	8		USFS
	2001	4.9	86	11	3		BLM
	2006	4.2	100				IDFG[b]
Sawmill 2	1984	4.1	80	7	13		IDFG
	1985	4.4	50	38	12		IDFG
	1986	3.7	50	36	14		IDFG
	1987	1.5	43		57		IDFG
	1993	6.6	93	5	2		USFS
	1997	3.5	93	7			USFS
	2001	3.7	78	3	19		BLM
	2006	8.2	97	3			IDFG[b]
Sawmill 3	1984	5.7	72	17	11		IDFG
	1985	3.7	48	41	11		IDFG
	1986	3.1	72	16	12		IDFG
	1987	6.2	77	6	17		IDFG
	1993	7.0	91		9		USFS
	1997	5.7	90	3	8		USFS
	2006	13.4	100				IDFG[b]
Sawmill 4	1987	10.1	63	21	16		IDFG
	1995	8.1	93	3	4		USFS
	1997	6.4	87	3	11		USFS
	2006	15.1	90	4	3	3	IDFG[b]
Sawmill 5	1987	7.8	51	33	16		IDFG
	1995	8.8	80	6	14		USFS
	1997	9.6	65		35		USFS
	2004	6.1	75	2	16	7	USFS
	2006	18.6	87	2	11		IDFG[b]
Sawmill 6	1987	3.9		100			IDFG
	1995	4.6	26	74			USFS
	1997	8.1	13	87			USFS
	2006	14.6	36	64			IDFG[b]
Smithie Fork	1995	28.4	7	93			USFS
	1997	20.1	3	97			USFS
	2006	27.2	15	84		1	IDFG[b]

			Species Composition (%)				
Site	Date	Fish/100m^2	RBT	BLT	BKT	HYB	Source
Squaw Creek	1995	12.3	23	19	67		USFS
	1997	24.1	41	11	48		USFS
	2006	9.4		11	89		IDFG[b]
Summit Creek 4	1987	26.4	82		18		BLM
	1992	16.0	91		9		BLM
	2006	5.6	94		6		IDFG[b]
Summit Creek 5	2006	14.1	39		61		IDFG[b]
Timber Creek	1987	7.5		100			IDFG
	1995	5.0	17	83			USFS
	1997	7.0	5	95			USFS
	2000	16.2	13	87			USFS
	2001	16.5	12	88			USFS
	2004	6.5	20	80			USFS
	2006	12.0	32	66		2	IDFG[b]
Warm Creek	1995	6.7	100				USFS
	2006	5.3		75	25		IDFG[b]
Wet Creek 3	1987	6.9	97	3			IDFG
	1992	5.1	96	4			USFS
	2001	0.5	100				BLM
	2006	5.1	89	11			IDFG[b]
Wet Creek 4	1987	5.5	96	4			IDFG
	1992	5.9	100				USFS
	2001	4.9	95			1	BLM
	2006	3.3	100				IDFG[b]
Wet Creek 6	1987	14.3	100				IDFG
	1992	5.2	100				USFS
	2001	5.7	100				BLM
	2006	4.0	92	8			IDFG[b]
Wet Creek 7	1987	10.9	100				IDFG
	1992	5.7	100				USFS
	2006	5.8	88	6	6		IDFG[b]
Wet Creek 8	1996	n/a	73	27			USFS
	2006	0.0					IDFG[b]
Wet Creek 9	1995	11.3	30	70			USFS
	1996	11.4	28	72			USFS
	1999	12.5	9	91			USFS
	2001	6.9		100			USFS
	2002	1.6		100			USFS
	2004	0.3		100			USFS
	2006	6.1		100			IDFG[b]
Williams Creek	1995	10.4		100			USFS
	2000	4.5		100			USFS
	2004	12.7		100			USFS
	2006	4.5		100			IDFG[b]

[a] – includes estimates of all trout age 1 and older (70 mm and larger)
[b] - Sampling was a joint effort with IDFG, USFS and BLM
[c] – Yellowstone cutthroat trout present in survey
[d] – density estimated using length and width from current (2006) survey

Appendix B. Stream sample locations (UTM NAD 83, Z 12) and other names used to describe locations reported previously in IDFG, USFS and BLM reports in the Little Lost River, Idaho.

Sample Location	UTM Easting	UTM Northing	Previous Names
Badger Creek 1	324901	4882932	Lower, BLM 3.2 km above LLR
Badger Creek 2-A	328451	4884775	New sample location
Badger Creek 2-B	328052	4884163	USFS lower, near cabin in lower sect.
Badger Creek 3	329256	4886236	USFS in basin; 0.3 km above Bunting Cr
Big Creek 1	305064	4881910	Up from road; 0.8 km above Wet Cr
Big Creek 2	303140	4882597	At forest boundary;
Big Creek 3	301332	4883054	USFS at trailhead; Big Cr upper
Big Springs Creek	323197	4876616	Near rd crossing; 0.8 km above rd crossing
Deer Creek 2	315974	4880159	BLM #2 (old BLM #3); 1.6 km below USFS boundary
Deer Creek 3	314705	4879306	At USFS boundary;
Dry Creek 1	297204	4891787	Dry Creek on BLM
Dry Creek 2	294562	4889179	150 m above USFS boundary
Dry Creek 3	293076	4887270	0.4 km above falls
Iron Creek	303565	4916549	@ 0.5 km from mouth; Just above road
Little Lost R. 3	320575	4890208	Little Lost R. at Clyde Sch; Clyde campground
Mill Creek	312037	4915322	@ Mill Creek campground
Sawmill 1	314492	4900927	BLM #3; above Mahog. Cr. Rd crossing
Sawmill 2	313812	4903602	BLM #2; lower portion of upper exclosure
Sawmill 3	313962	4906391	BLM #1; 2.4 km below Sawmill Cn Rd
Sawmill 4	312106	4911572	Sawmill @ Guard Station;
Sawmill 5	310796	4914062	Above Mill Creek; at Bear Creek
Sawmill 6	309340	4920711	Sawmill at Moonshine Creek
Smithie Fork	309432	4921692	Just above Sawmill Rd. Bridge
Squaw Creek	314568	4913948	4.0 km above Sawmill Rd.
Summit Creek 4	310454	4901155	BLM 4; Summit above Sawmill Rd
Summit Creek 5	305188	4904969	Summit Cr Campground
Timber Creek	308144	4918911	0.8 km above Little Lost River
Warm Creek	315100	4907991	0.4 km above Little Lost River
Wet Creek 3	312270	4891470	BLM 5; 3.6 km below Squaw Creek
Wet Creek 4	310679	4890502	BLM 4; BLM 20; 2.0 km below Squaw Cr
Wet Creek 6	307694	4883802	BLM 2; BLM 4; 0.8 km below BLM 1
Wet Creek 7	306942	4882287	BLM 1; 2.4 km below FS boundary
Wet Creek 8	303369	4879542	USFS above Coal Creek
Wet Creek 9	302016	4877726	0.5 km above Hilts Creek
Williams Creek	324481	4888936	Closest to 1.6 km above USFS boundary

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