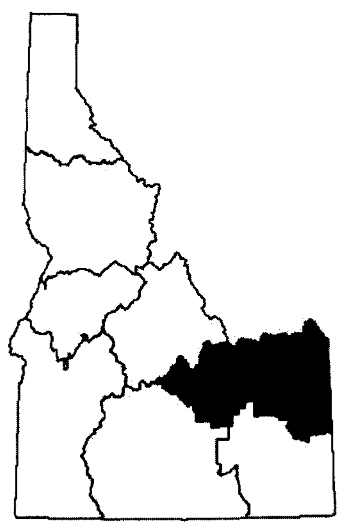
FISHERY MANAGEMENT INVESTIGATIONS

IDAHO DEPARTMENT OF FISH AND GAME

FISHERY MANAGEMENT ANNUAL REPORT

Cal Groen, Director



UPPER SNAKE REGION

2007

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2007 Upper Snake Region Fishery Management Report

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2007 Upper Snake Region Fishery Management Report

HENRYS LAKE

ABSTRACT

We used 44 standard experimental gill nets to assess fish populations and relative abundance in Henrys Lake during May 2007. We found statistically significant increases in catch rates for brook trout, hybrid trout, and Yellowstone cutthroat trout compared to 2006. Relative weight for all trout >200 mm exceeded 100 for all species. Median catch rate for Utah chub increased from 10.5 fish per net in 2006 to 13 fish per net in the current year suggesting further expansion of this population. We placed transmitters in nine brook trout, four hybrid trout and 29 Yellowstone cutthroat trout during January 2007 to determine spatial distributions and winter movements. Trout were distributed throughout the lake during the winter while the lake was ice covered. Movements of trout varied, but it was apparent that the majority of fish used at least 25% of the shoreline or more during the winter. Those that remained stationary were typically found around a spring or tributary mouth. Two significant implications can be drawn from this – first, when environmental conditions become stressful, trout are likely to move and find areas with more favorable conditions thereby increasing their chance for survival; and second, trout do not congregate in a few discrete locations, which could make them more vulnerable to degrading environmental conditions or angler harvest. Two changes to the regulations went into effect in 2006 – the elimination of the fishing hour restriction, and extension of the fishing season to the end of November. Few anglers were observed fishing after dark, and we estimated 1,338 trout harvested in November 2007. A limited ice fishery developed during the last two weeks of November and produced catch rates of 1.28 trout per hour, with a modest harvest of 451 trout.

METHODS

Population Monitoring

As part of routine population monitoring, we calculated gill net catch rate data from six standardized locations (Appendix A; Figure 1) in Henrys Lake on April 30 through May 18, 2007 for a total of 44 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 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,* as this species demonstrates schooling behavior, and are likely not randomly distributed.

We examined all captured Yellowstone cutthroat trout *Oncorhynchus clarkii bouvierii* 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 and in the spawning operation. Because ten percent of all stocked Yellowstone 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 sagittal 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 $\log Ws = -5.194 + 3.098 \log L$ (Anderson, 1980) to calculate relative weights of hybrid trout (rainbow trout *O. mykiss* x Yellowstone cutthroat trout), $Ws = -5.192 + 3.086 \log TL$ for cutthroat trout (Kruse and Hubert, 1997) and $Ws = -5.096 + 3.069 \log TL$ for brook trout *Salvelinus fontinalis* (Hyatt and Hubert 2000).

We conducted a tributary spawning survey on Targhee Creek during the spring migration 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, which equates to 12 km in Targhee Creek.

Radio Telemetry

We collected trout during the winter (December 2006 and January 2007) using angling techniques through the ice. We placed radio transmitters in nine brook trout (size ranged from 327 mm to 525 mm), four hybrid trout (size ranged from 422 mm to 635 mm), and 29

Yellowstone cutthroat trout (size ranged from 430 mm to 535 mm). We anaesthetized selected trout and placed the transmitter intraperitoneally using the shielded needle technique (Ross and Kleiner 1982). The gills were continuously ventilated using a submersible pump with water mixed with anesthetic throughout the tagging procedure. Incisions were closed using a combination of non-absorbable sutures and surgical staples. The sutured incisions and the antenna wounds were treated with iodine prior to placing the trout into a recovery bucket. Fish were then released back into the lake at the point of capture. The coded radio transmitters were either 148 or 151 MHz, built by Lotek Wireless, and included a motion-sensitive device with a 24 h inactivity threshold. The pulse frequency increased once the 24 h threshold of inactivity had been exceeded, thus indicating death. On average, dispersal of radio-tagged trout was monitored two times per month during mobile telemetry surveys. Snow machines were used to locate radio-tagged fish during ice-coverage (January through March), shoreline tracking using a pickup truck was used from March to May when ice conditions were unsafe for over-ice travel, and a boat was used from May through August, when the survey ended. For analytical purposes, we defined winter as January, February, and March; spring as April, May, and June; and summer as July and August. We attempted to get within 100 m of a radio tag before recording a location. However, when shoreline tracking was used, we were only able to estimate the general location of radio tags that were close to shore, which incorporated additional uncertainty in mapping transmitter locations. Once the general location of a radio-tagged trout was found during mobile surveys, the location was marked with a handheld GPS unit, and later transferred to a GIS database. All tags transmitting the increased pulse frequency were recorded as mortalities on each tracking event when possible.

We also estimated the range of a transmitter's radio signal with two boats – the first lowered a transmitter into the water to various depths while a survey crew tracked the transmitter with a second boat. We defined effective transmitter broadcast range as the distance between the boats as determined with a laser rangefinder. Distance measurements were recorded at the water surface and one meter increments thereafter.

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/m^3 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 26 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 for analysis.

Riparian Fencing and Fish Screening

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 2007 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 during the summer and fall months of 2007.

RESULTS

POPULATION MONITORING

We collected 1,884 fish in 44 net nights of gill net effort. Catch composition was 36% Yellowstone cutthroat trout, 9% hybrid trout, 7% brook trout, and 48% Utah chub (Figure 2). Yellowstone cutthroat trout ranged from 145 to 590 mm TL (Figure 3), hybrid trout 185 to 790 mm (Figure 4), and brook trout 155 to 510 mm (Figure 5). Mean length at age-3 was 444 mm, 461 mm and 411 mm for Yellowstone cutthroat trout, hybrid trout, and brook trout, respectively (Table 1). Catch rates for Yellowstone cutthroat trout were significantly greater when compared to the past five years (ANOVA, $P < 0.001$; Figure 6). Gill net catch rates were at an all-time high in the current year's sample. Hybrid trout catch rates were not significantly different when compared to the previous five years of catch rate data, but were significantly greater than catch rates from 2006 (ANOVA, $P = 0.007$; Figure 7). Brook trout catch rates in gill nets also show a significant increase over the past five years (ANOVA, $P < 0.001$; Figure 8). Results from our fin clip information showed 70 of 770 (9.1%) Yellowstone cutthroat trout collected with gill nets were adipose-clipped fish (Table 2). The proportion of Utah chub in the gill net catch is increasing (Figure 9). Our median catch rate for Utah chub in 2007 was 13 fish per net night, slightly higher than the 10.5 median catch rate from 2006 (Figure 10). Mean relative weights for fish >200 mm for all species exceeded 100 (Table 3), and we did not observe significant declines in relative weights of Yellowstone cutthroat trout from 2004 to 2006 in spite of an increase in Utah chub abundance (Figure 11).

Spawning surveys documented 62 fish in Targhee 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 hour restrictions. The extended fishing season saw an estimated 7,663 hours of effort during November, with a projected harvest of 1,338 trout, 66% of which were harvested during the open-water fishery prior to ice formation.

Radio Telemetry

We located 40 transmitters a total of 346 times between December 26 and August 16 for an average contact rate of nine locations per transmitter (range 0 to 17 locations, Table 4). We were able to locate more trout during the winter, when it appeared trout used shallower water (57% of all locations) as opposed to spring (36% of all locations) and summer (7% if all locations). Trout were distributed throughout Henrys Lake during the winter while the lake was ice covered, but were slightly more abundant in the northern half of the lake (66% of winter locations as opposed to 34% of winter locations found in southern half of the lake). This distribution changed as the seasons progressed, with 40% of locations occurring in the northern half in the spring, and only 18% originating in this area during the summer.

Movements of trout varied, but it was apparent that the majority of fish used at least 25% of the shoreline or more during the winter (73% of radio-tagged fish) as opposed to 27% that remained stationary in a relatively small area, typically around a spring or tributary mouth. We found 43% of radio-tagged fish used at least 50% or more of the lake during the winter. We found relatively few trout to migrate up tributaries, but did see one Yellowstone cutthroat trout move into Howard Creek and one Yellowstone cutthroat trout move into Hatchery Creek during the spring spawning period. Samples of specific data from each tracking event and movements by individual fish are presented in Figures 12 and 13. A complete set of figures of each date of tracking and each individual fish's movements are available at the Upper Snake Regional Office.

Several transmitters fitted with mortality sensors appeared to malfunction during the course of this study. Personnel responsible for tracking identified contacts as mortality signals for a specific fish on some days, and not necessarily on all subsequent tracking trips. Further, several fish identified as mortalities showed significant movements after being identified as mortalities on prior sampling events. Overall, we had 26 transmitters signal mortality at some point during the study. These transmitters produced 91 locations classified as mortalities. Of the 26 transmitters that displayed a mortality signal, four made substantial movements after being identified as mortalities, suggesting the mortality sensor malfunctioned.

The ability to locate transmitters was influenced by water depth occupied by a radio-tagged trout. We estimate that when fish were in water shallower than one meter, we could detect the transmitter from as far away as 400 m, but as transmitters were lowered deeper into the water column, our detection distance decreased (Figure 14). We found it difficult to detect radio-tagged trout when they were not oriented to the shoreline in shallow water, which was common as spring progressed into summer. Based on our estimates of detection distance, we would need to make between 14 and 28 passes across the lake to have a chance at detecting all the transmitters when trout were occupying deeper water in the spring, summer and fall.

Water Quality

Limnology

We recorded oxygen profiles during December 2006 through February 2007 at three standard sites (Pittsburgh Creek, Wild Rose and Cabin), as well as occasional readings at the Outlet and County Boat Dock. Total oxygen diminished from 49.2 g/m^3 to 41.2 g/m^3 at the Pittsburgh Creek site, 43.9 g/m^3 to 36.4 g/m^3 at the Wild Rose site, and 42.9 g/m^3 to 35.8 g/m^3 at the Cabin site (Table 5). Based on depletion estimates, we predicted our monitoring sites would not approach 10.0 g/m^3 (our level of concern) before ice-out (Figure 15). Therefore, we did not implement the Helixor® aeration system during 2007.

SPAWNING OPERATION

Between February 26 and May 10, 4,027 Yellowstone cutthroat trout ascended the hatchery spawning ladder. Of these, 49% were males and 51% were females. Mean lengths were 452 and 450 mm; respectively with a combined mean length of 451 mm. Hybrid trout totaled 374 fish and consisted of 57% males and 43% females with mean lengths of 545 mm and 579 mm, respectively.

We collected 2,990,180 "green" eggs from 1,154 Yellowstone cutthroat trout females for a mean fecundity of 2,591 eggs per female. Eyed Yellowstone cutthroat trout eggs totaled 1,831,452 for an overall eye-up rate of 61%. 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 2007 as fingerlings. We committed 10 days to Yellowstone cutthroat trout spawning.

We collected 998,450 "green" eggs from 379 female Yellowstone cutthroat trout for hybrid trout production. Eyed hybrid trout eggs totaled 551,613 for an overall eye-up rate of 55%. We shipped 32% of all eyed hybrid trout eggs to Mackay Hatchery for hatching, rearing, and subsequent release into Henrys Lake in the fall of 2007, while 67% of the eggs were shipped to the University of Idaho at Hagerman for later release into Salmon Falls Creek Reservoir. The remaining 1% was shipped to the Ashton Hatchery for hatching, rearing and subsequent release into local waters. Mean sterilization rates for hybrid trout were 98% during 2007. We devoted two days to production of hybrid eggs during 2007.

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. Bacterial disease sampling taken during spawning from ovarian fluids was negative for all lots and trays.

RIPARIAN FENCING AND FISH SCREENING

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, although repairs will be necessary on Duck Creek screens as they continue to age and wear.

DISCUSSION

Gill net catch rates (fish per net night) for trout from 2007 were significantly greater than those found in 2006 for all species. This increase is largely attributable to high catch rates from age-2 Yellowstone cutthroat trout. In direct opposition to our gill net catch rates, stockings from this 2005 year class were lower than in any year since 1996, which suggests factors other than the number stocked influenced this year class. Similarly, gill net catch of hybrid trout improved significantly over 2006 levels, and reversed a declining trend that started in 2000. Brook trout catch rates have also increased. The increase in abundance of our gill net catch while stocking rates remain average or depressed, suggest that rearing conditions are resulting in increased survival of trout. Winter dissolved oxygen readings during 2005/06 and 2006/07 were much higher than previous years, which may have helped overwinter survival. Additionally, the lake level was higher in these same years during the fall stocking than in previous years. These factors combined may be responsible for the increase in abundance we observed during 2007 sampling.

Median catch rates for Utah chub in our gill nets continue to increase. Catch rates first began to increase in the late 1990s, following initial documentation of their presence in 1993. 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. The current fishery reflects limited impacts from Utah chub with regards to direct competition for food resources. Relative weights for all fish and all size classes are well above 100, indicating sufficient food is present, and is not limiting growth (Flickinger and Bulow 1993).

Results from tributary counts of spawning fish documented use throughout Targhee Creek, however, turbid water and high flows limited the ability to make accurate counts. It is more useful to view our spawning fish estimates as a minimum as opposed to an absolute census. Distributions of spawning fish following the reconstruction of the Targhee Creek Bridge under Route 89 were encouraging, and demonstrate trout are able to access the upper reaches of the creek.

The changes to the fishing regulations that went into effect for the 2006 angling season do not appear to have had a negative effect on the fishery with regards to exploitation or compliance with regulations. Comments from the public during the angling season of 2007 indicate acceptance of the expanded season, including the ice fishery. Regional fishery staff has received numerous requests to increase angling opportunity further into the winter.

Results from our radio telemetry project show that trout were distributed throughout the lake during the winter, as opposed to being congregated in a few specific areas such as Staley Springs and in front of the hatchery. Further, trout did not remain stationary in one area, and moved throughout the lake over the course of the winter. Two significant implications can be drawn from this – first, when environmental conditions become stressful, trout are likely to move around, and find areas with more favorable conditions thereby increasing their chance for survival; and second, trout do not congregate in a few discrete locations, which could make them more vulnerable to degrading environmental conditions or angler harvest.

Two factors influenced our ability to address our secondary goals of understanding trout movements outside of the winter period. Unsafe ice conditions during the spring restricted tracking efforts to the shoreline. Due to the limited range of our transmitters, we could not detect trout that had moved away from the shoreline, which limited the amount of information we were able to gather aside from stating that in general, trout tended to move to off-shore habitats in the spring and summer. Additionally, the range of detecting transmitters was less than we anticipated when transmitters were in deeper water, making efficient tracking from a boat impossible. Based on our calculations of detection distances, it would have taken between four and eight days of tracking during the late spring and summer to thoroughly sample the lake for all the transmitters present. Because of these limitations, we were not able to draw more than cursory conclusions about seasonal movements, and were not able to address differential movements among species. If additional studies are warranted, techniques that employ sonic transmitters may be able to compensate for both of these limitations. A complete set of maps of telemetry tagged fish showing distributions by date and for each individual fish from this study are available at the Upper Snake Regional Office.

MANAGEMENT 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. Consider alternatives to the current fin clipping program on Yellowstone cutthroat trout.

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

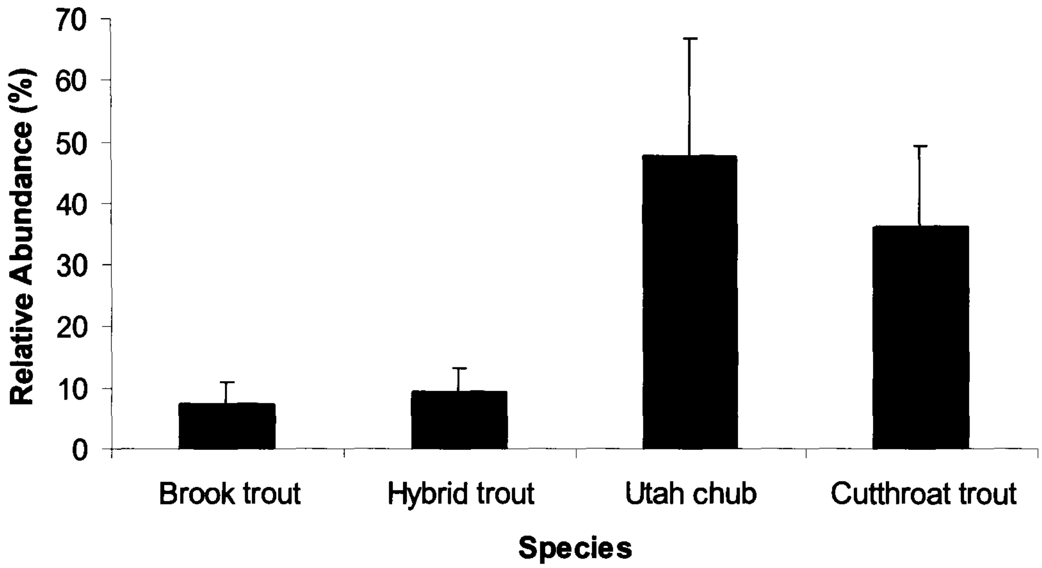


Figure 2. Relative abundance of fish caught in gill nets in Henrys Lake, 2007. Error bars represent 95% confidence intervals.

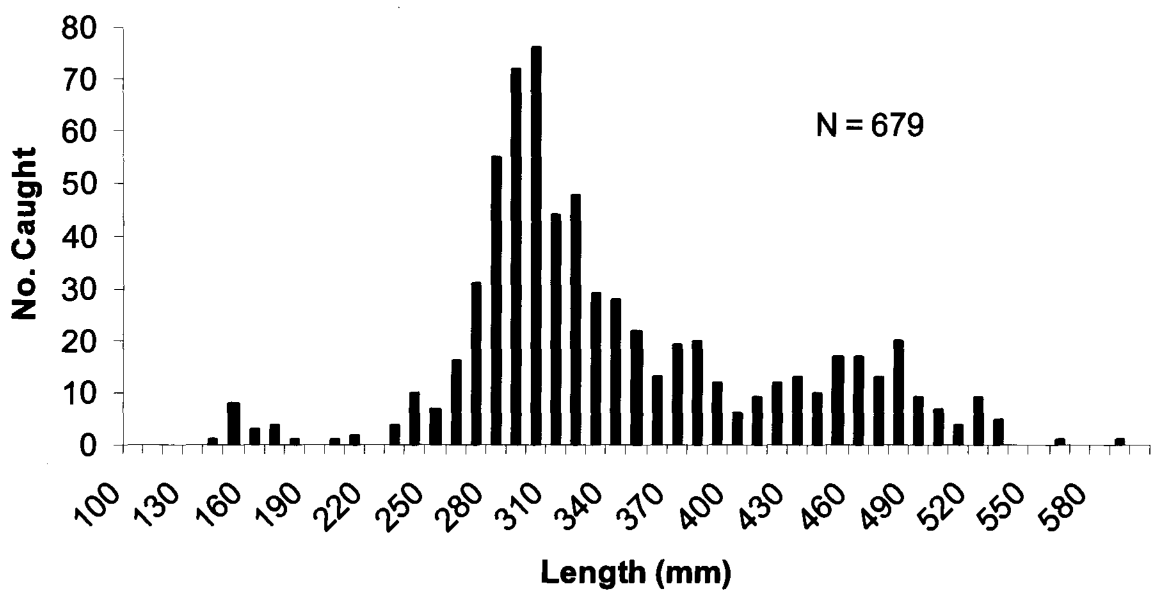


Figure 3. Yellowstone cutthroat trout length frequencies from gill nets set in Henrys Lake, Idaho, 2007.

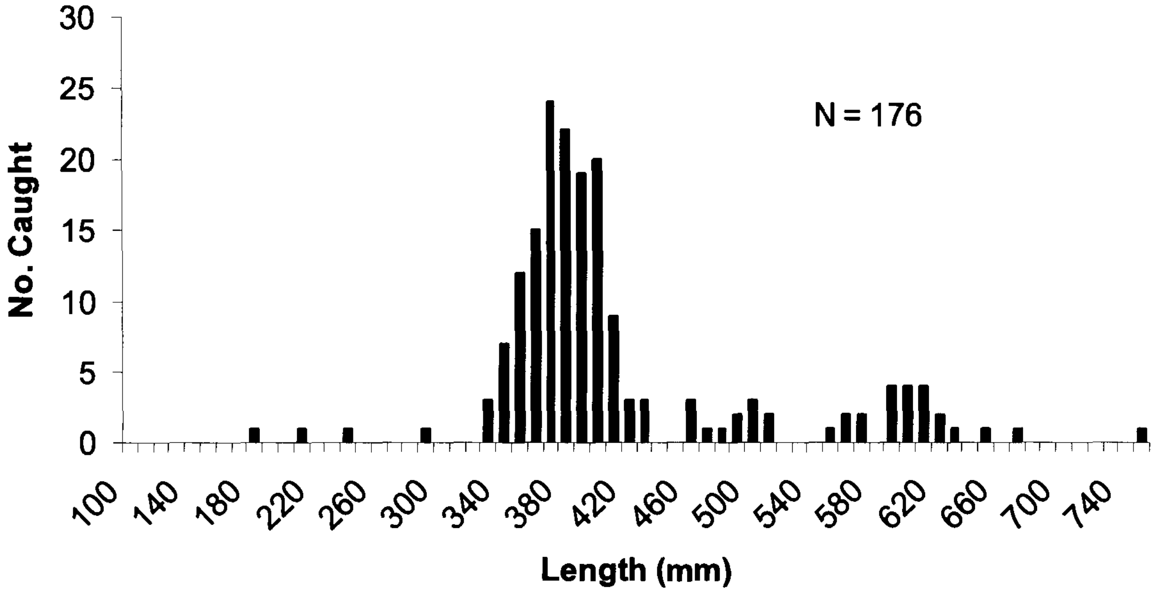


Figure 4. Hybrid trout length frequencies from gill nets set in Henrys Lake, Idaho, 2007.

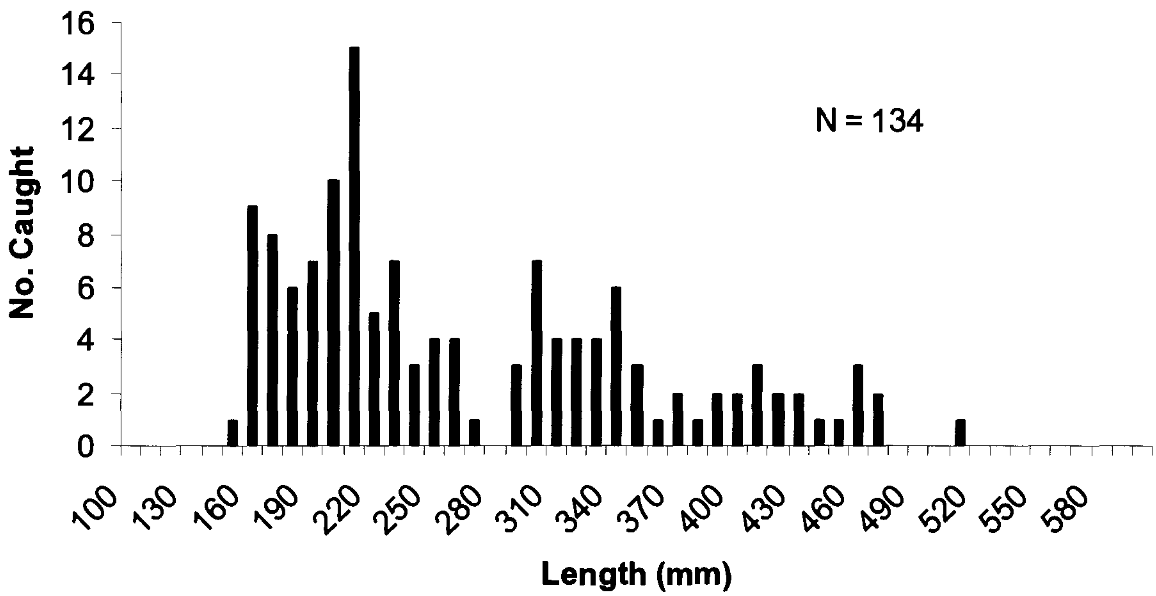


Figure 5. Brook trout length frequencies from gill nets set in Henrys Lake, Idaho, 2007.

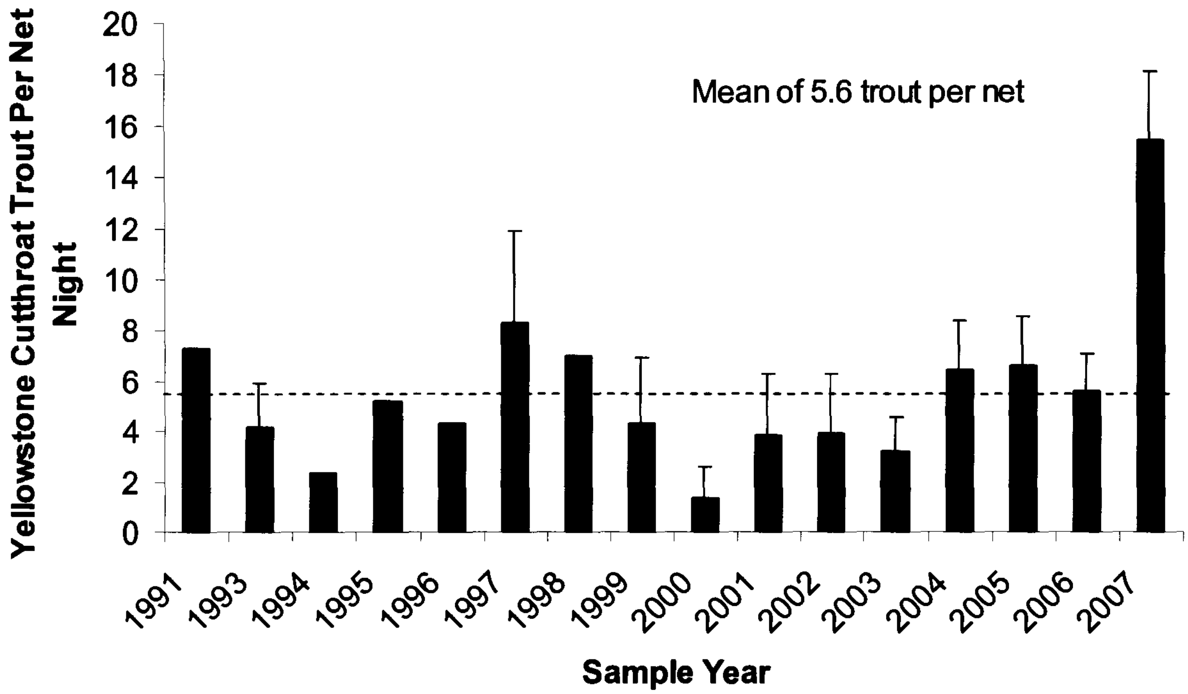


Figure 6. Yellowstone cutthroat trout catch rates in gill nets set in Henrys Lake, Idaho, 1991 to present. Error bars represent 95% confidence intervals.

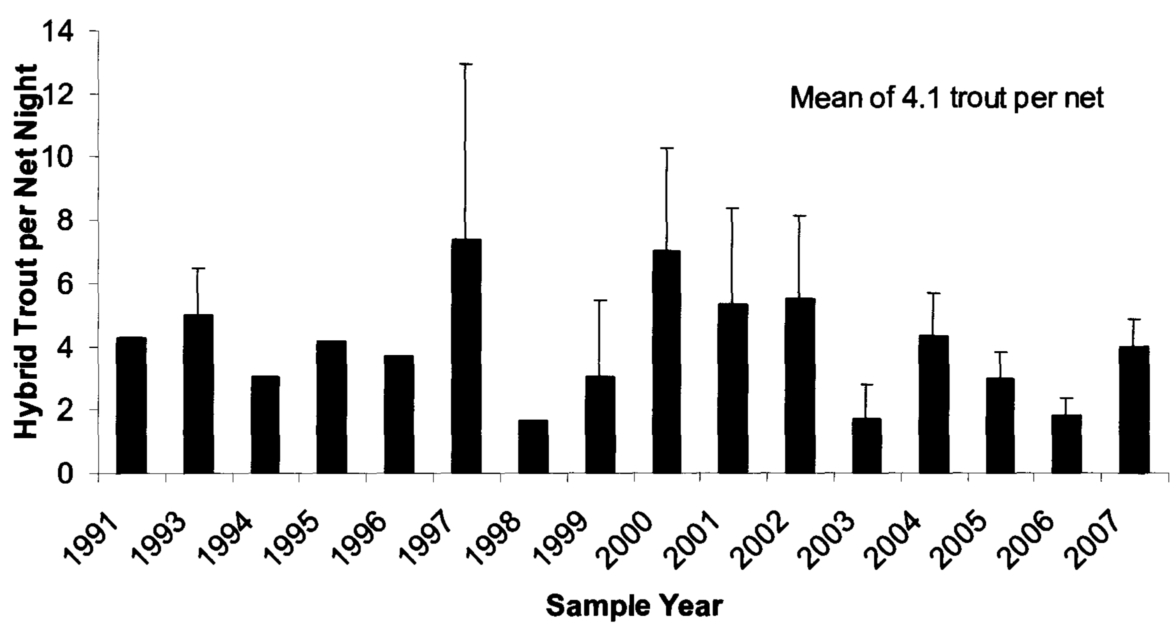


Figure 7. Hybrid trout catch rates in gill nets set in Henrys Lake, Idaho, 1991 to present. Error bars represent 95% confidence intervals.

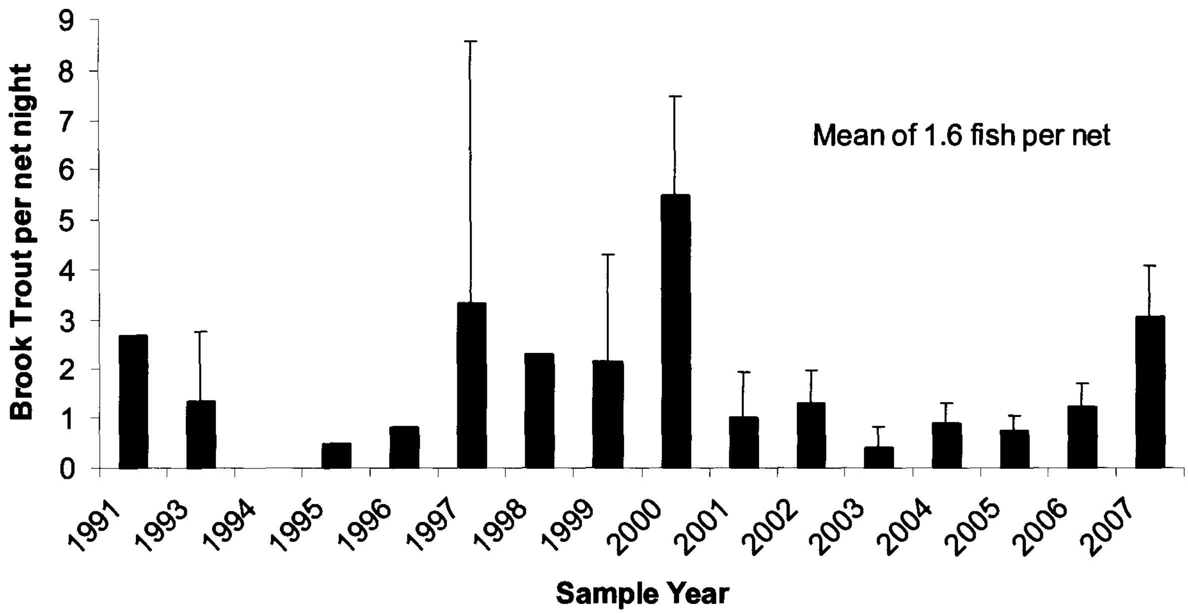


Figure 8. Brook trout catch rates in gill nets set in Henrys Lake, Idaho, 1991 to present. Error bars represent 95% confidence intervals.

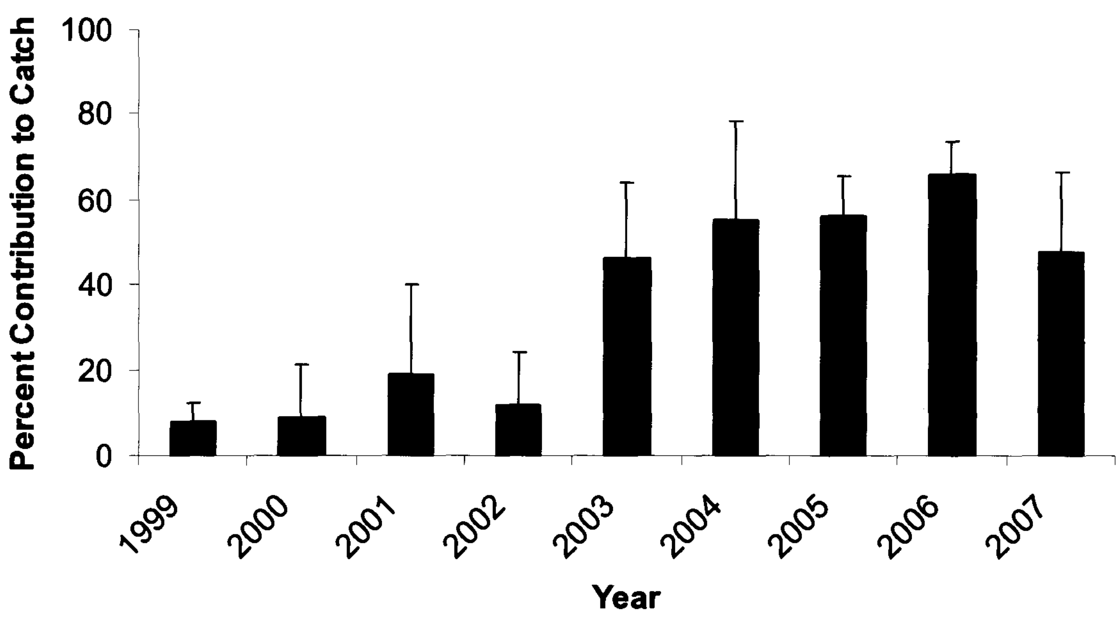


Figure 9. Relative abundance of Utah chub caught in gill nets in Henrys Lake, Idaho. Error bars represent 95% confidence intervals.

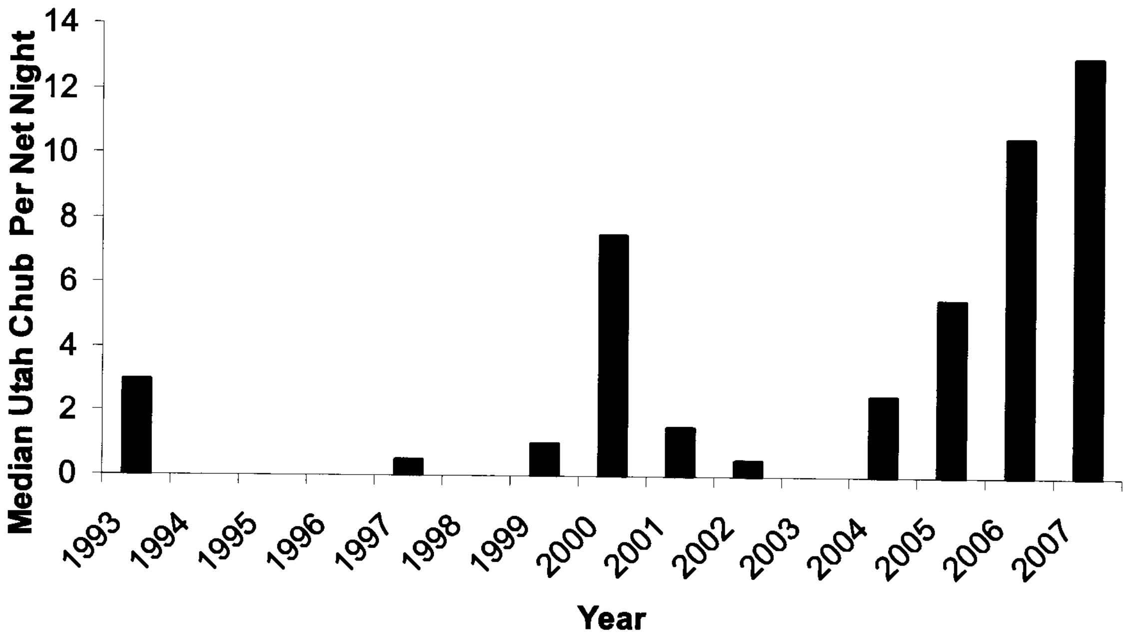


Figure 10. Median Utah chub catch rates in gill nets set in Henrys Lake, Idaho, 1993 to present.

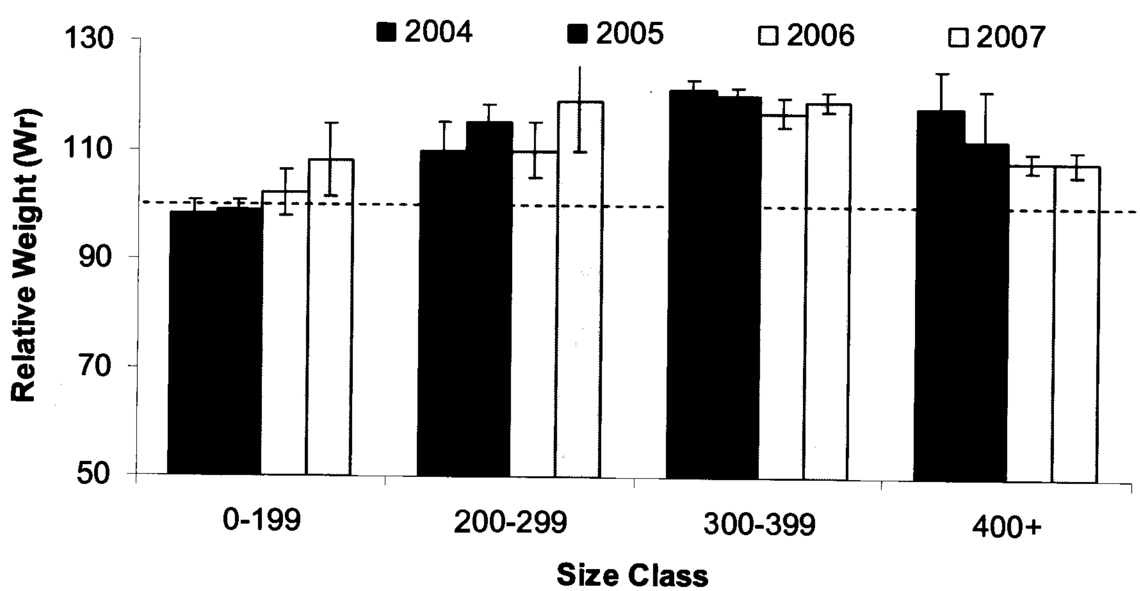


Figure 11. Relative weights for Yellowstone cutthroat trout in Henrys Lake, Idaho 2004-2007. Error bars represent 95% confidence intervals.

January 3, 2007

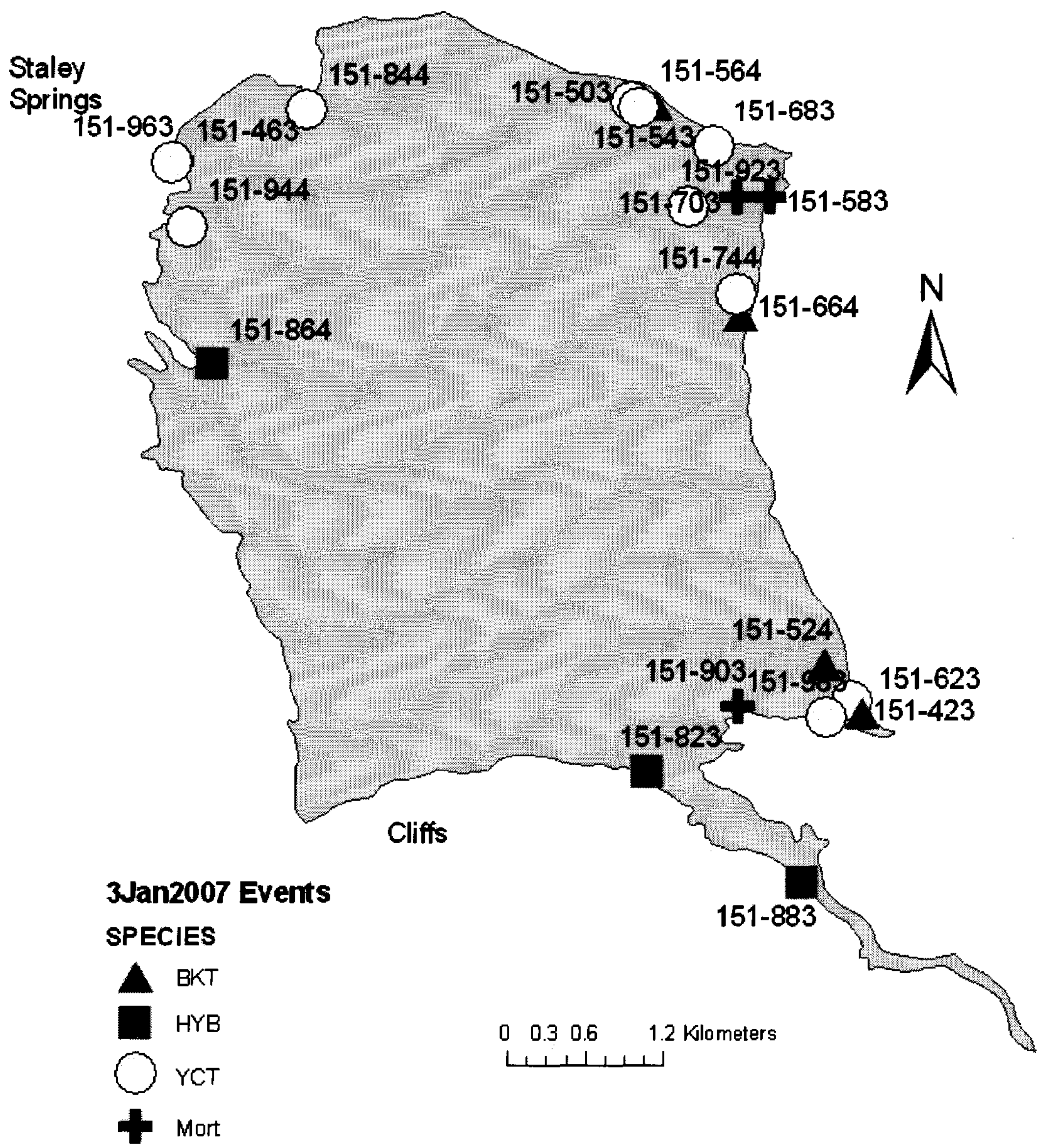


Figure 12. Typical winter distribution of radio-tagged trout in Henrys Lake, Idaho January 3, 2007.

Transmitter 151-683

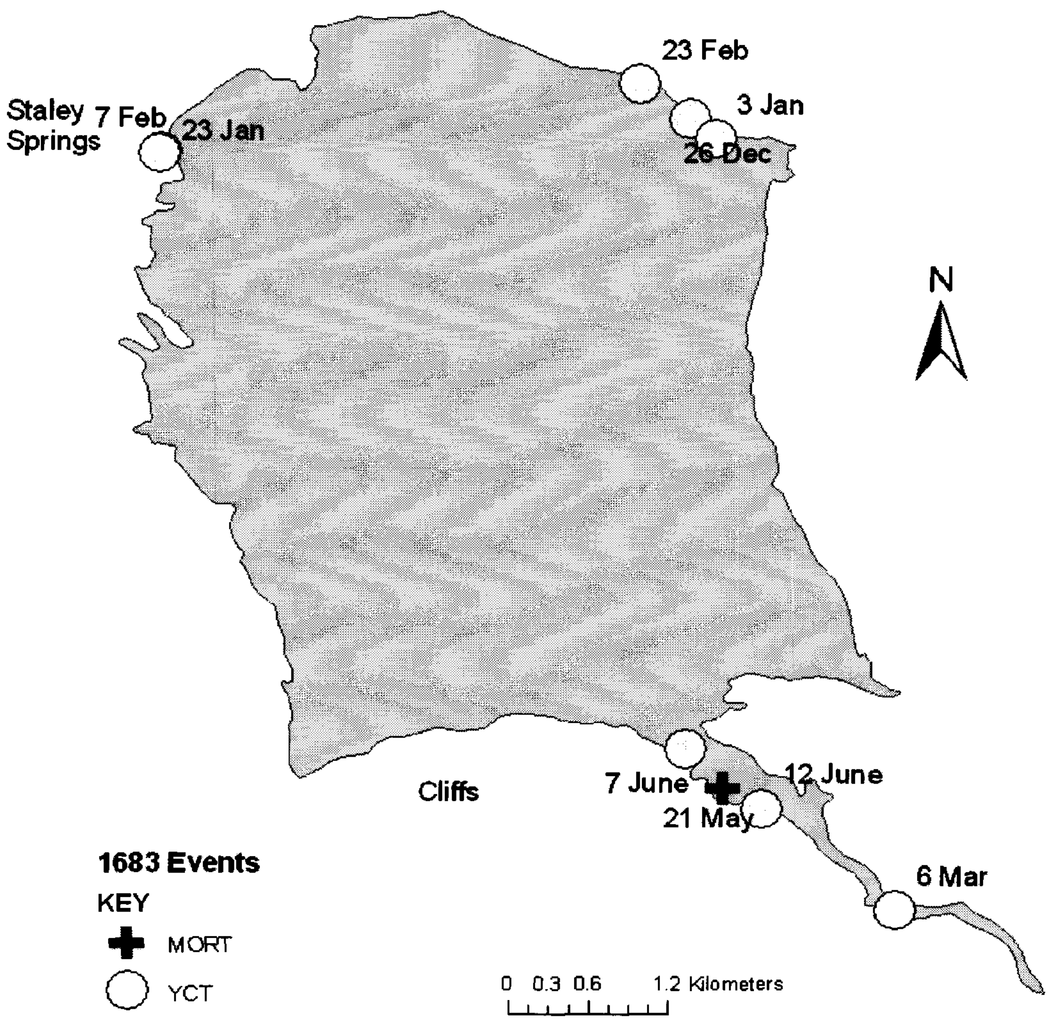


Figure 13. Movements of transmitter 151-683 implanted into a Yellowstone cutthroat trout in Henrys Lake, Idaho 2007.

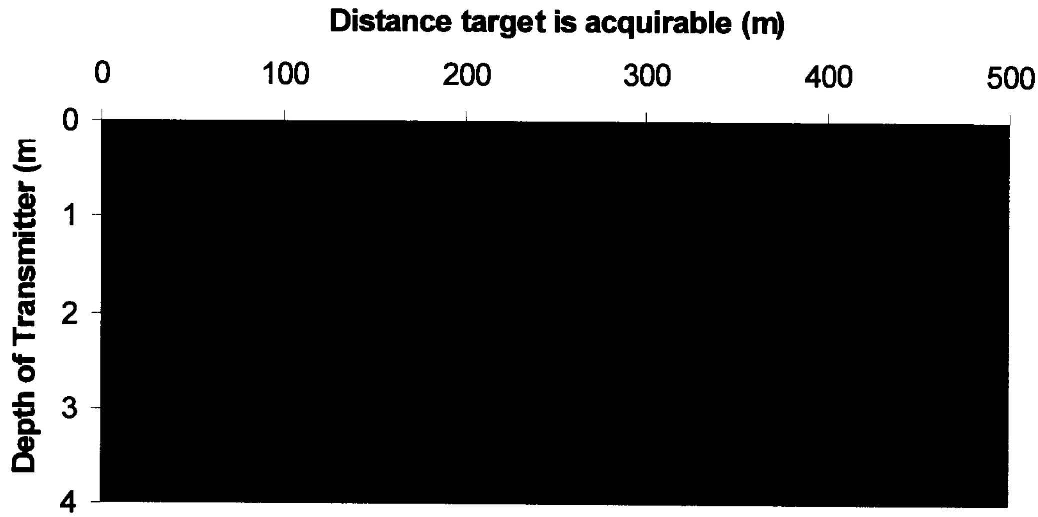


Figure 14. Estimated distance of detection as a function of depth for radio transmitters placed in Henrys Lake, Idaho 2007.

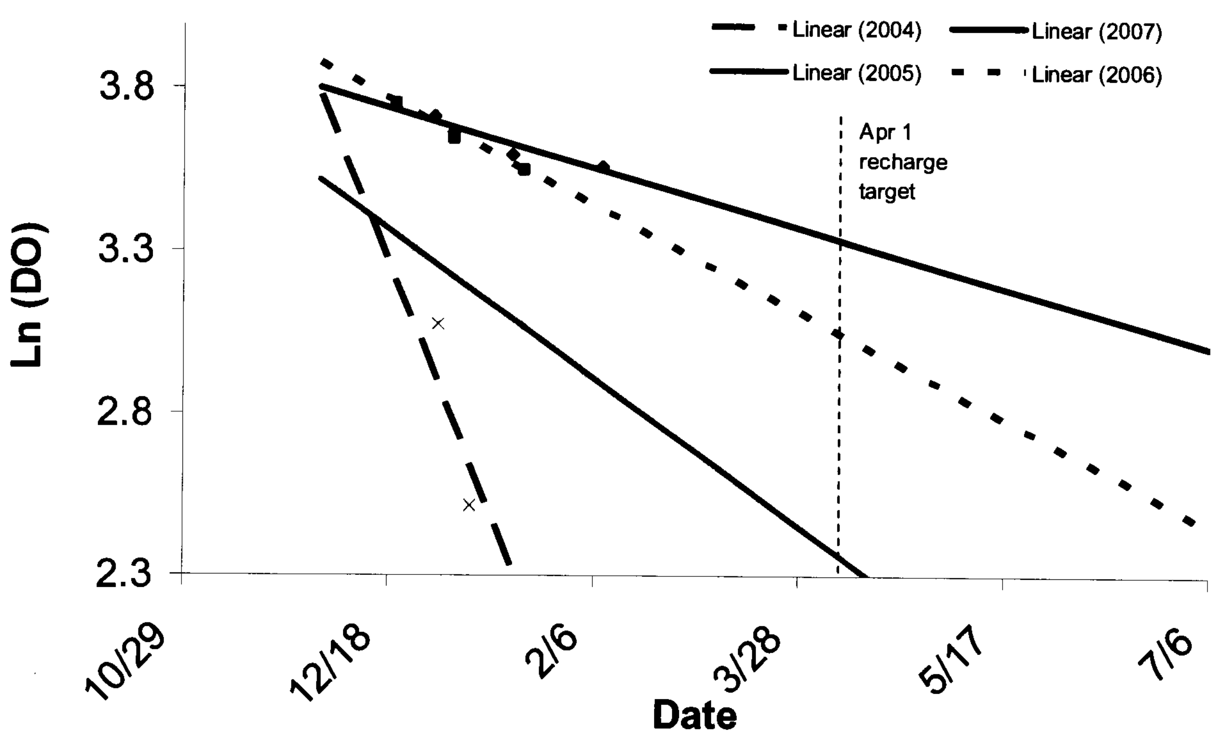


Figure 15. Comparison of oxygen depletion rates for all collection stations, Henrys Lake, Idaho. Based on 2007 data, threshold level of 2.3 g/m^3 will not be reached prior to the April 1 target date.

Table 1. Mean length at age data from trout caught with gill nets in Henrys Lake, Idaho 2007. Ages were estimated using otoliths.

	Mean Length at Age (mm)						
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Yellowstone cutthroat trout	160	314	445	484	510	--	560
(No. Analyzed)	(15)	(398)	(69)	(44)	(6)	--	(1)
Hybrid trout	228	379	461	591	602	--	635
(No. Analyzed)	(2)	(105)	(14)	(13)	(3)	--	(3)
Brook trout	198	323	411	449	--	--	--
(No. Analyzed)	(59)	(36)	(6)	(9)	--	--	--

Table 2. 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]	100,000	269	20	8%	--	60	4	7%
2006[b]		2455	944	39%	--	--	--	--
2007[c]	139,400	770	70	9.1%	--	--	--	--

[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 3. Relative weights for all trout species collected with gill nets in Henrys Lake, Idaho 2007.

	Mean Relative Weight			
Species	**<200 mm**	**200-299 mm**	**300-399 mm**	**>399 mm**
Yellowstone cutthroat trout	108	119	119	108
Hybrid trout	99	108	126	116
Brook trout	100	105	115	120

Table 4. Data from trout implanted with radio transmitters in Henrys Lake, Idaho 2007.

Transmitter Number	Implant Date	Species[a]	Length (mm)	Weight (g)	Tagging Location	No. of Locations
151-404	26-Dec	YCT	485	1191	State Ramp	8
151-423	26-Dec	YCT	520	1361	State Ramp	17
151-443	26-Dec	YCT	460	936	State Ramp	2
151-463	26-Dec	HYB	615	3232	State Ramp	10
151-482	26-Dec	YCT	493	1361	Staley's	12
151-503	26-Dec	YCT	530	1701	Staley's	15
151-524	26-Dec	BKT	403	851	Pittsburg Cr	13
151-543	26-Dec	BKT	327	482	Staley's	11
151-564	26-Dec	YCT	525	1191	State Ramp	13
151-583	26-Dec	YCT	521	1305	State Ramp	10
151-605	26-Dec	YCT	480	1134	State Ramp	0
151-623	26-Dec	BKT	443	1021	Pittsburg Cr	1
151-644	26-Dec	BKT	490	1305	Pittsburg Cr	5
151-664	26-Dec	BKT	420	964	Pittsburg Cr	5
151-683	26-Dec	YCT	475	1361	Pittsburg Cr	9
151-703	26-Dec	BKT	450	1134	Staley's	5
151-725	26-Dec	BKT	420	510	State Ramp	0
151-744	26-Dec	YCT	444	851	State Ramp	11
151-764	26-Dec	YCT	430	709	State Ramp	7
151-784	26-Dec	BKT	525	1588	Pittsburg Cr	10
151-803	26-Dec	BKT	441	964	Pittsburg Cr	5
151-823	26-Dec	HYB	454	1248	Staley's	6
151-844	26-Dec	YCT	481	1361	Staley's	13
151-864	26-Dec	HYB	422	794	Staley's	7
151-883	26-Dec	HYB	635	3289	Staley's	8
151-903	26-Dec	YCT	520	1191	Pittsburg Cr	10
151-923	26-Dec	YCT	436	794	Pittsburg Cr	12
151-944	26-Dec	YCT	451	1134	Staley's	13
151-963	26-Dec	YCT	530	1474	Staley's	11
151-983	26-Dec	YCT	535	1814	Pittsburg Cr	3
148-023	24-Jan	YCT	515	--	Howard Creek	7
148-056	24-Jan	YCT	475	--	Howard Creek	9
148-178	24-Jan	YCT	515	--	Staley's	11
148-259	24-Jan	YCT	505	--	Staley's	9
148-278	24-Jan	YCT	515	--	Staley's	9
148-335	24-Jan	YCT	545	--	Staley's	8
148-366	24-Jan	YCT	507	--	Staley's	6
148-549	24-Jan	YCT	503	--	Howard Creek	1
148-587	24-Jan	YCT	504	--	Howard Creek	8
148-609	24-Jan	YCT	540	--	Staley's	9
148-685	24-Jan	YCT	480	--	Howard Creek	10
148-894	24-Jan	YCT	486	--	Staley's	7

[a] YCT = Yellowstone cutthroat trout; HYB = hybrid trout (rainbow x cutthroat cross); BKT = brook trout.

Table 5. Dissolved oxygen (DO) readings (mg/l) recorded in Henrys Lake, Idaho wintertime monitoring 2006-2007.

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 29	6	13	15.8	14.0	12.8	12.1	49.2
	Jan 16	0	20	13.6	12.5	11.1	9.6	40.7
	Feb 8	6	20	14.5	13.0	11.0	9.5	41.2
Wild Rose	Dec 29	6	10	15.4	14.7	13.9	9.3	43.9
	Jan 16	3	18	13.4	13.0	11.6	7.8	36.1
	Feb 8	6	20	14.9	13.0	10.6	7.4	36.4
Cabin	Dec 29	2	11	15.5	14.2	11.8	10.0	42.9
	Jan 16	3	17	14.5	12.2	11.0	8.6	39.0
	Feb 8	6	20	13.8	11.2	10.0	7.9	35.8

ISLAND PARK RESERVOIR

ABSTRACT

Island Park Reservoir is an important fishery in the Upper Snake Region that has historically supported high catch rates and angling effort. During 2007, we conducted a creel survey throughout the calendar year. Total angling effort was estimated at 45,116 hours. Anglers caught an estimated 22,554 trout and kokanee. Catch rates averaged 0.5 fish/hour. The majority (98%) of the catch was rainbow trout. Most anglers were fishing from a boat (78%) and used bait (67%). Harvest rates averaged 0.3 fish/hour. We estimated 32% of the fish caught were released. We used multiple regression to investigate relationships between different stocking strategies and corresponding angler catch rates. We found a significant relationship between angler catch rates and the number for catchable rainbow trout stocked in the spring and fall, and the fingerling trout stocked the previous spring.

INTRODUCTION

Island Park Reservoir supports a popular fishery primarily targeting rainbow trout with some contributions from kokanee salmon *O. nerka,* Yellowstone cutthroat trout and brook trout. Annual angling effort has varied from as much as 176,000 hours to a low of 41,000 hours. The Idaho Department of Fish and Game (IDFG) have historically worked to supplement the Island Park Reservoir fishery using hatchery produced fish. Rainbow trout have been stocked annually since 1938 with few exceptions. The effectiveness of these efforts has been assessed using various sampling techniques including creel surveys. Since 1950, 28 creel surveys have been conducted at Island Park Reservoir. These creel surveys have documented fluctuating levels of angler effort and catch rates. From 1950 to 1995, average seasonal catch rates were 0.45 fish/hour and ranged from 0.14 to 0.90 fish/hour (Appendix B). The most recent creel surveys were conducted in 1994 and 1995, but these surveys were described as intermediate and low intensity surveys, respectively (Gamblin et al. 2002; Schrader et al. 2002). The most recent high intensity creel survey for Island Park Reservoir was conducted in 1989 (Corsi and Elle 1994).

The IDFG 2007 – 2012 Fishery Management Plan (IDFG 2007) for Island Park Reservoir has identified an angler catch rate of 0.6 fish/hour as the management goal for the fishery at Island Park Reservoir, but this goal has not been met since 1980. Mean annual catch rates for Island Park Reservoir have been 0.45 fish/hour. Possible factors negatively affecting angler catch rates include competitive interactions with Utah chub and Utah sucker *Catostomus ardens*, poor carryover of trout from one year to the next due to reservoir drawdown, and low recruitment of wild trout. Historically, management efforts focused on interspecific competition and predation between game fish and rough fish, and included several chemical renovations of the reservoir. However, significant increases in angler catch rates during the post-chemical treatment low density period for non-game fish were not observed (Moore et al. 1982; Schrader et al. 2002; Garren et al. 2008). The 2000 to 2005 drought years have compounded the effects of reservoir drawdown and limited wild trout spawning success. Drought directly affects water levels in Island Park Reservoir because the reservoir was built for irrigation storage to benefit agricultural users in Fremont and Madison counties. Drought also negatively affects stocking capabilities and natural fish production. Fewer hatchery trout were stocked during years when storage levels were low (2002-2005).

In addition to frequent low-water years, IDFG stocking practices have changed at Island Park Reservoir. Beginning in 1998, sterile triploid rainbow trout were included in trout plantings as fingerlings. Since 2003, all rainbow trout stocked into Island Park Reservoir have been sterile triploids.

The 2007 to 2012 IDFG Fishery Management Plan directs the region to monitor the effectiveness of the supplementation program using creel and gill net surveys (IDFG 2007). Our efforts during 2007 are in response to this directive and this report summarizes a comprehensive creel survey which is intended to be comparable to the last intensive creel survey conducted in 1989.

The 2007 – 2012 IDFG Fishery Management Plan also directs the stocking program for Island Park Reservoir to mimic stocking rates, locations, and time of release to stocking schedules used during years when angler catch rates were high (IDFG 2007). However, periods of relatively high catch rates for rainbow trout at Island Park Reservoir were not always associated with the same stocking strategy, i.e. differing numbers of fry, fingerlings, and catchables were stocked. Since 1970, plantings of rainbow trout were comprised of fingerlings and fry in addition to catchables. Island Park Reservoir was stocked primarily using fingerlings and fry during the 1970s while catchables and fingerlings were stocked in the 1980s. During the 1990s more fingerling rainbow trout and fewer catchable rainbow trout were stocked than during the 1980s. Both fingerling trout and catchable trout numbers were reduced during the stocking events from 2000 through 2007. We compared these differing stocking strategies relative to the catch rates they produced in order to describe how best to meet the directive of mimicking historical stocking strategies to improve catch rates.

STUDY AREA

Island Park Reservoir is located in the upper Henrys Fork watershed downstream of Henrys Lake and Big Springs situated 61 km north of Ashton, Idaho. The drainage area upstream of the dam encompasses 1,248 km^2. At full pool, the reservoir has a capacity of 17,691 ha m (143,430 acre feet) and covers 3,388 hectares. Completed in 1938, the United States Bureau of Reclamation owns the earthen Island Park Dam, which was built to provide storage of irrigation water for Fremont and Madison counties.

IDFG stocked hatchery rainbow trout into Island Park Reservoir beginning in 1938. The reservoir quickly became a popular fishery, with fishing effort averaging over 95,000 hours annually between 1950 and 1970. Harvest at Island Park Reservoir is currently managed under the statewide general bag limits, with the fishing season open year-round. Island Park Reservoir is also listed as a Family Fishing Water where no special restrictions are placed on fishing gear, harvestable length of fish, or harvestable species.

METHODS

A stratified creel survey was conducted on Island Park Reservoir from (January 21, 2007 to December 28, 2007. There were separate strata for weekdays and weekends. Holidays were included in the weekend stratum. The survey period was divided into 21 d intervals. Creel clerks conducted as many interviews as possible and counted anglers during each creel check. Six creel checks were performed during each 21 d interval (three during weekend/holidays, and three during weekdays). The creel check dates were randomly selected using the IDFG creel program version 1.7. During each interview, creel clerks identified angler type (boat, tube, or shore), resident status, whether the trip was completed, hours fished, terminal tackle used, number of fish caught, number of fish released, species of fish released, and species and lengths of fish harvested.

Estimates of angler catch rates and effort were calculated in the IDFG creel program version 1.7. Effort was estimated by averaging the number of anglers observed during each stratum within each time interval and multiplied by the average time spent fishing as obtained through angler interviews during that respective strata and time interval. Catch was estimated by averaging the number of fish reportedly caught during each strata and time interval and multiplying this average number by the number of anglers observed during that strata and time interval. The number of hours fished and number of fish caught for each strata and time interval were summed to obtain estimates for total catch and total effort. The estimate of total catch was divided by the estimate of total effort to obtain an overall catch rate approximation. We compared monthly estimates of catch rates between 1989 and 2007 and the average size of the different sport fish harvested in 1989 and 2007.

Angler catch rates of trout in Island Park Reservoir post-1970 were compared against stocking rates of rainbow trout. We investigated data post-1970 in attempt to describe the potential relationship between stocking rates and catch rates of rainbow trout during a period when catch rates were high. As stocked fingerlings and fry recruit to the fishery at different times than stocked catchables, angler catch rates from a given year were compared against the number of catchable rainbow trout stocked that year, the number of fingerling rainbow trout stocked in the spring (May through July) of the previous year, the number of fingerling rainbow trout stocked during the fall (August through October) two years previously, and the number of rainbow trout fry stocked two years previously. Fry and fingerlings typically recruit to the fishery after two years of growth in the reservoir (D. Keen, IDFG pers. communication). We used multiple linear regressions to assess the influence of different stocking densities of the above groups on angler catch rates. The full model included 6 variables (two catchable trout release quantities, one for spring and one for fall of the year of interest; two fingerling trout release quantities, one for spring one year prior to the year of interest and one for fall two years prior; and two fry trout release quantities, one for spring and one for fall two years prior to the year of interest.

RESULTS

Anglers expended an estimated 45,116 hr of effort on Island Park Reservoir from January through December of 2007 (Tables 6 and 7). The winter ice-fishery on Island Park Reservoir constituted 3% of the effort. Thus, open-water angling effort was 97% of the total or 43,754 hr in 2007.

During 2007, we estimated 22,559 fish were caught by anglers, yielding a catch rate of 0.50 fish/hr which was the highest recorded catch rate since 1980 (Appendix C). Ice fishers were effective at Island Park Reservoir with an estimated catch of 597 fish during 2007 (Jan – Feb catch rate of 0.4 fish/hr). During the open water fishery, catch rates were highest in October, but were variable the lowest catch rates in September and the highest catch rates in October (Figure 16). Anglers' catch was dominated by rainbow trout (98%) with kokanee salmon and brook trout included at <2% and <1%, respectively. The majority of anglers were fishing out of a boat (78%) with other anglers fishing from the bank (16%), ice fishing (3%), and fishing from a float boat (float tube or pontoon boat; 3%). The most popular terminal tackle was bait (67%). The second most common terminal tackle was lures (17%), followed by flies (12%), and anglers using multiple types of terminal tackle (4%).

Of the 22,559 fish caught in 2007 at Island Park Reservoir, 15,340 trout and kokanee salmon were harvested by anglers, yielding a harvest rate of 0.34 fish/hr. Overall, anglers released 32% of the trout caught. During the ice fishery, 47% of the trout caught were released and 32% of the trout caught during the open-water fishery were released during 2007.

Mean sizes of the species harvested by anglers was 428 mm for rainbow trout (Figure 17), 454 mm for kokanee salmon (Figure 18), and 270 mm for brook trout (Table 8). The percent of fish exceeding 500 mm in the harvest was 15% of the rainbow trout harvested and 17% of the kokanee salmon harvested.

Based on linear regression analysis, the number of catchable rainbow trout stocked and the number of fingerling trout stocked in the spring of the previous year, appear to have had the strongest influence on angler catch rates. The full main effects model was not significant at the $\alpha=0.05$ level ($F=3.24$, df=7, $P=0.06$), but did indicate that fry stocking two years prior and fall fingerling plants from two years prior to the year of interest had little influence on predicting catch rates. When fry stocking and fall fingerling stocking from two years prior were removed from the model, the regression had a slope significantly different than zero ($F=4.68$, $df=3$, $P=0.02$). The adjusted r^2 value was 0.42, indicating 42% of the variability observed in angler catch rates was explained by catchable trout stocking rates and fingerling stocking rates during the spring of the previous year. Of the significant independent variables (spring catchables, fall catchables, and spring fingerlings of the year prior), the number of spring catchables stocked had the largest influence on angler catch rate, as indicated by the largest beta coefficient value (Table 9).

DISCUSSION

Angling effort in 2007 was similar to the estimated angling effort expended in 1989. In 1989, 49,085 hours were expended by anglers during the summer of 1989, which was 91% of the total fishing effort for that year, and another 5,100 hours were expended in the winter ice fishery (Corsi and Elle 1994). In 2007, 43,754 hours of effort were expended during the summer, and 1,362 hours were expended during winter.

Catch rates at Island Park Reservoir during 2007 were the highest recorded since 1980. Ice fishing and open-water catch rates were 0.4 and 0.5 fish/hour in 2007 compared to 0.7 and 0.3 fish/hour in 1989 (Corsi and Elle 1994). Corsi and Elle (1994) speculated that the low catch rates observed in 1989 were likely due to reservoir drawdown during the 1983-1984 winter and the unavailability of hatchery trout during the optimal stocking time during the spring plankton bloom. Higher catch rates observed in 2007 may have been partially attributable to the same factors with opposite influence. Island Park Reservoir was not significantly drawn down in the 2006-2007 winter and hatchery rainbow trout were stocked when intended.

Harvest was lower during 2007 than during 1989 despite high catch rates. Large percentages (32%) of the fish caught were released in Island Park Reservoir. When compared with similar reservoirs which were stocked with rainbow trout, Island Park Reservoir had the highest release rates by nearly 10% (Figure 19). The mean size of rainbow trout in anglers' creel during 2007 was much larger than those in 1989. In 1989, the mean rainbow trout length was around 350 mm (415 mm for wild rainbow trout and 285 mm for hatchery catchable rainbow trout; Corsi and Elle 1994). In 2007, the overall rainbow trout length in creel was 428 mm.

The IDFG Fisheries Management Plan 2007 – 2012 directs the region to focus on returning to a stocking program consistent with the periods when the fishery achieved maximum angler catch rates (IDFG 2007). Since 1970, creel surveys have been conducted 17 times. Only 5 of the 17 years had estimated catch rates exceeding the average of 0.45 fish/hr. These years were 1972, 1974, 1977, 1980, and 2007 (Appendix B). The management objective of 0.6 fish/hr was only met in 1980. Stocking practices of hatchery rainbow trout differed among these five years. During these five years, catchable-sized rainbow trout (catchables) were stocked only in 1980 and 2007 (Appendix C). Whereas hatchery recruits to the 1972, 1974, and 1977 creel were largely from fingerling and fry stocking events. Stocking and catch rate data were incorporated into a multiple regression analysis in order to better understand the relationships between stocking numbers, fish size at stocking, and angler catch rates. The spring and fall stocked catchables, and the stocking of fingerlings the spring of the previous year, were the only statistically significant independent variables in the model. Of these, catchables that were stocked in the spring had the largest influence on angler catch rates of that year as indicated by beta coefficients. Catchables stocked in the fall, and fingerlings stocked in the previous spring both affected catch rates at a somewhat equally and substantially lesser extent.

We feel that our multiple regression analysis captured a lot of the variability among angler catch rates from year to year. Garren et al. (2006) observed that majority of the variability observed in trout densities, as indicated by gill net catches was explained by reservoir storage over the previous winter combined with stocking rates. However, the authors noted that the relationship between gill net catches and angler catch rates was only weakly correlated. Certainly other factors such as summertime reservoir levels which affect the distribution of game fish in the reservoir, wintertime drawdown's which affect survival and entrainment through the dam, and wild trout recruitment rates affect angler catch rates as well. Our simple multiple regression model only incorporated stocking data, but still captured 42% of the variability in angler catch rates. Thus, while stocking rates alone cannot fully explain observed variability among angler catch rates, it does explain a large portion of the variability. The most influential stocking practice linked to increased angler catch rates was the stocking of catchable trout, primarily in the spring. Spring fingerling plants of trout were also linked to improved angler catch rates, but not as much as catchable trout stocking. Therefore, stocking practices should continue to emphasize spring plantings of catchable rainbow trout to the extent possible, and then resources should be directed toward spring fingerling trout plants and fall catchable plants.

MANAGEMENT RECOMMENDATIONS

1. Continue stocking catchables in the spring in excess of 40,000 and spring fingerlings as available.

2. Use available resources to produce more spring rainbow trout catchables and fingerlings in combination with fry for Island Park Reservoir stocking.

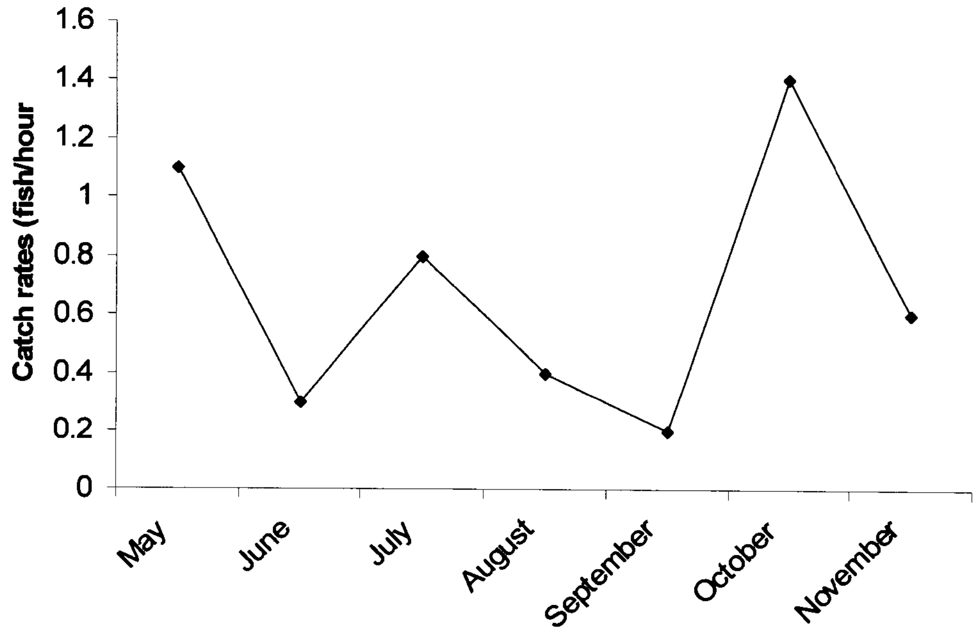


Figure 16. Monthly catch rates for Island Park Reservoir during the 2007 open water fishery.

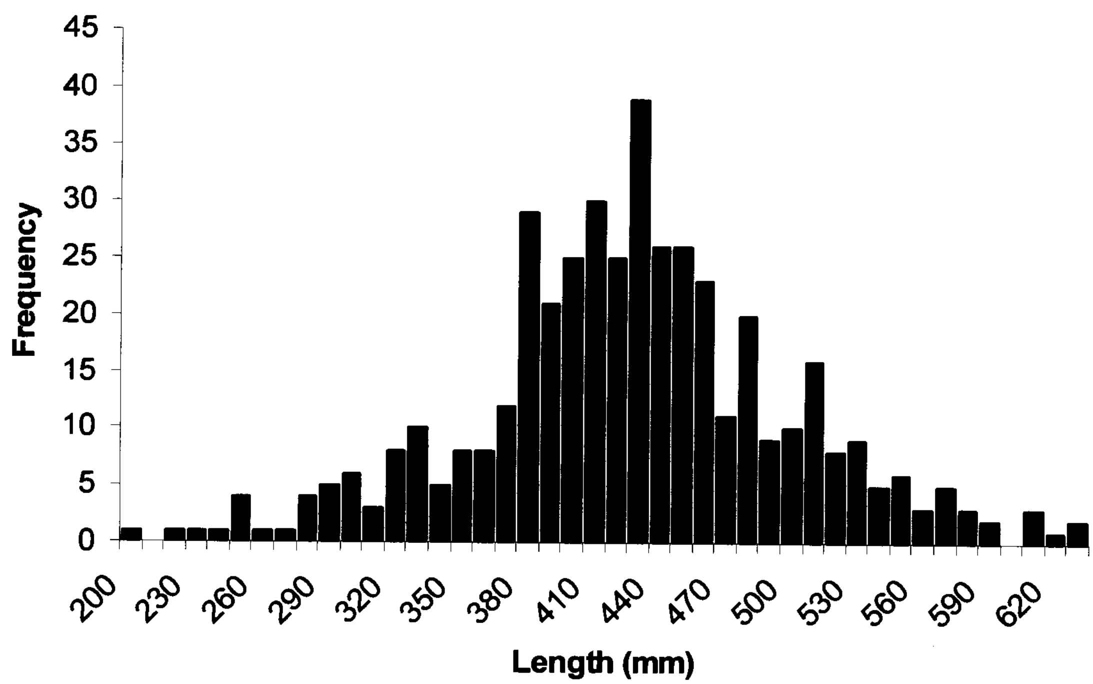


Figure 17. Length frequency distribution of rainbow trout in anglers' creel at Island Park Reservoir in 2007.

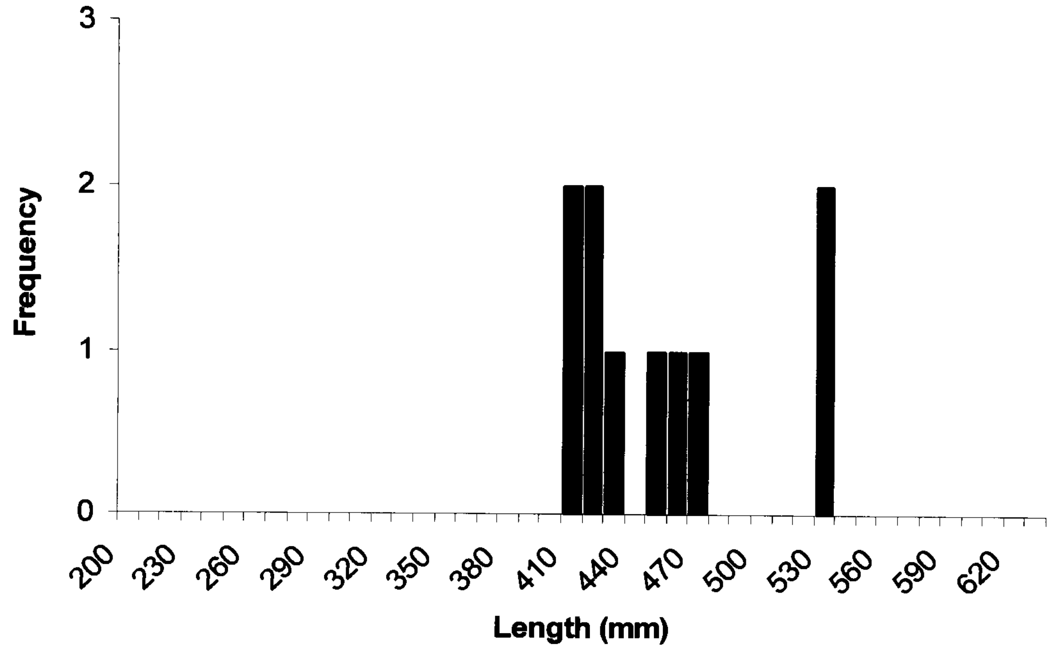


Figure 18. Length frequency distribution of kokanee salmon in anglers' creel at Island Park Reservoir in 2007.

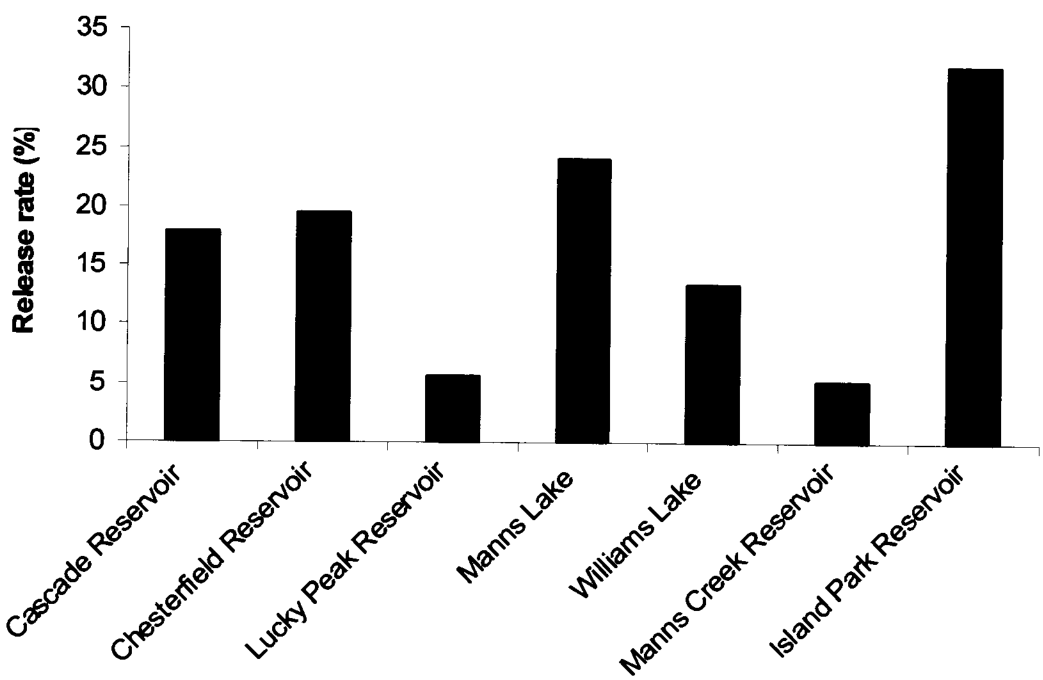


Figure 19. Release rates for rainbow trout in other Idaho water bodies stocked with rainbow trout for the years of 2006 (first 5 water bodies) and 2007 (last two water bodies; Meyer et al. In review).

Table 6. Summary statistics for the open water fishery Island Park Reservoir 1960 through 2007.

Year	Catch rate (fish/hr)	Hours fished	Census period
1960	0.82	75,668	June 4 – October
1965	0.43	107,789	May 19 – October
1967	0.54	92,949	June – October
1968	0.59	176,008	June – October
1980	0.70	N/A	July 19
1981	0.44	70,820	May 23 – October
1982	0.23	124,442	May 28 – September
1989	0.30	49,085	May 27 – September
1990	0.14	N/A	May 26 – July 16
1994	0.20	41,308	May 28 – August
1995	0.40	N/A	May – July
2007	0.50	43,754	May - October

Table 7. Summary statistics for the winter fishery on Island Park Reservoir 1980 through 2007.

Year	Catch rate (fish/hr)	Hours fished	Census period
1984	0.53	10,000	January - February
1986	1.94	14,900	January – February
1989	0.70	5,100	January – March
2007	0.42	1,362	January – March

Table 8. Sizes and numbers of different salmonid species harvested at Island Park Reservoir in 2007.

Species	n	Mean TL (mm)	Minimum TL (mm)	Maximum TL (mm)	% >500 mm TL	# >500 mm TL	Total Harvest
Rainbow trout	436	429	200	630	15.3	67	15,002
Kokanee salmon	10	454	410	535	16.6	2	238
Brook trout	1	270	270	270	0	0	--

Table 9. ANOVA table for the best model multiple regression analysis.

	df	SS	MS	F	P value
Regression	3	0.263	0.088	4.681	0.022
Residual	12	0.225	0.019		
Total	15	0.488			

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	0.303313389	0.044208439	6.860984	1.74E-05
Spring catchable	5.83441E-06	2.24479E-06	2.59909	0.023265
Fall catchabl	-1.20897E-05	3.41132E-06	-3.54399	0.004041
Prior spring fingerling	1.24574E-06	4.12327E-07	3.021248	0.010638

BIG LOST RIVER

ABSTRACT

We conducted electrofishing surveys in 27 reaches of the Big Lost River to estimate population densities, compare changes in population densities to past surveys, evaluate species composition and to obtain relative abundance data for mountain whitefish and trout populations. Overall abundance of trout in the Upper Big Lost River is similar to or better than that documented in surveys in the 1980s. Similarly, in all areas except the West Fork and it's tributaries, trout abundances have generally improved over densities found in our most recent 2003 survey. Mountain whitefish populations in the Big Lost River have shown an increase in abundance compared to population sampling conducted from 2002-2005, but in most instances, abundance remains below highs documented in the 1980s. Increases in abundance may be the result of what appears to be a strong year class of age two fish. Consistent with the Mountain Whitefish Conservation and Management Plan for the Big Lost River Drainage, Idaho (2007), several projects were completed during 2007 that may be enhancing survival and distribution of mountain whitefish, the most significant of which was the construction of a bypass channel around the Chilly Diversion. Data collected from the 2007 angler survey suggest the Big Lost River supports a popular sport fishery. Creel clerks interviewed 922 people in 406 parties from May 26 through October 31. Anglers caught an estimated 122,381 fish and harvested 19,723 for an overall release rate of 84% with 80,420 hours of angling effort. Compared to 1986, angler effort has increased by 70%, while angler catch rates increased by 8% and harvest rates have decreased by 50%.

INTRODUCTION

The Big Lost River drainage is located in central Idaho, originating in the Copper Basin area and eventually flowing southward to the sinks on the Idaho National Engineering Laboratory site. Climatic conditions in the watershed are relatively dry, with an average annual precipitation of about 25 cm. Approximately 40% of the precipitation occurs as snow. Because of the high scenic quality of the area, its numerous recreational opportunities and its proximity to the resort area of Sun Valley, the Big Lost drainage receives a considerable amount of recreational use. Fishing is one of the most popular recreational activities in the area (Corsi 1989).

Fish species present in the drainage include rainbow trout, Yellowstone cutthroat trout; brook trout, mountain whitefish *Prosopium williamsoni* and sculpin species. Additionally, Arctic grayling *Thymallus arcticus* and golden trout *O. aguabonita* inhabit several of the high lakes in the drainage, and are occasionally encountered in the streams below. Mountain whitefish are believed to be the only salmonid native to the drainage and are recognized as being genetically divergent from other mountain whitefish present in the Upper Snake Region. Populations of mountain whitefish have recently experienced a decline in abundance compared to the 1980's. Factors such as habitat alteration (channelization, grazing), irrigation (entrainment, barriers, dewatering, changes in flow regime), non-native fish interactions (competition and predation), disease and exploitation have all been identified as possible contributors to the decline in mountain whitefish. To address the decline in abundance and to expedite recovery efforts, the Idaho Department of Fish and Game (IDFG) developed the Mountain Whitefish Conservation and Management Plan for the Big Lost River Drainage, Idaho (IDFG 2007). The intent of this document is to ensure the mountain whitefish population in the Big Lost River drainage persists through natural and anthropogenic events at levels capable of providing a recreational fishery. Specific population objectives are outlined, and management actions believed to be critical to the attainment of population objectives are identified. Work identified by this plan and completed during 2007 is listed in Appendix D of this document.

METHODS

We estimated salmonid abundance at three locations below Mackay Dam using a canoe electrofisher on April 16, 17, 18, and 25. Sampling occurred during low to moderate flow conditions (prior to irrigation demand and increased releases from Mackay Dam) to facilitate effective fish capture and standardization of sampling conditions. One sample crew consisting of eight to 10 people conducted mark-recapture population estimates of salmonid abundance consistent with prior surveys in both location and technique. Sample reaches were approximately 900 to 1,000 m in length. All population estimates and 95% confidence intervals were estimated with MicroFish (2005) or the program MR5 (Montana Fish, Wildlife, and Parks 1994) as appropriate.

We also sampled five reaches in the Antelope Creek drainage and 19 reaches above Mackay Reservoir on August 8, 9 and 10. Sampling occurred 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. Four sample crews consisting of three to five people used backpack electrofishers and multiple-pass depletion methods to estimate salmonid abundance. We identified all collected salmonids to species before measuring for total length and releasing at the completion of the multiple-pass collecting period. Sample reaches ranged from 100 to 300 m in length. 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. We calculated mountain whitefish estimates separately from trout estimates as differences in capture efficiencies between these two species may have led to bias in population estimates. Capture efforts were focused on salmonids, but at each site where they occurred, nongame fish were captured and identified. Survey results were compared to prior survey results for each sample reach.

Creel Survey

We conducted a creel survey from Memorial weekend through the end of October to collect angler effort, catch and harvest information. We stratified the Big Lost River drainage into three sections to facilitate efficient interviewing and to make comparisons to prior surveys. Section one (lower section) consisted of the river reach from Mackay Dam downstream to the bridge below the Stennett Access; section two (middle section) was bounded by the Chilly Diversion on the downstream end, and the confluence with the North and East forks on the upper end and included the North Fork, Kane Creek and Summit Creek; section three (upper section) was from this confluence upstream along the East Fork to the upper end of the loop road, and included Wildhorse Creek and the West Fork (Starhope Creek). We divided day length into three strata, each approximately four hours in duration (0800 – 1200; 1200 – 1600; 1600 – 2000). We stratified the survey into two-week periods to comply with previously used methodology. We randomly chose two weekdays and two weekend days per strata. Creel clerks were assigned two randomly chosen sample locations and two randomly chosen survey times each survey day, and conducted interviews and instantaneous counts on each of these days. Instantaneous counts were done by driving the assigned route in one direction while counting all anglers encountered along the route. When anglers were not visible, but a vehicle was parked in an area frequented by angler, clerks counted cars. During analysis, each car was assigned a value of 1.61 anglers to be consistent with past methodology (Moore and Schill, 1983). Counts were generally completed within one hour. Clerks then reversed their direction of travel and intercepted anglers during their fishing trip to obtain method of fishing, time spent fishing, and number, species and length of fish both caught and released. We analyzed data using standard methodology and the program Creel Application Software (CAS Version 2.0, 2003).

RESULTS

Leslie

We collected 610 salmonids during the three-day mark recapture event in the Leslie reach of the Big Lost River. Species composition of captured fish was 67% brook trout, 25% rainbow trout and 8% mountain whitefish. Trout size structure was skewed towards smaller fish, while mountain whitefish size structure was dominated by fish between 250 mm and 340 mm (Figure 20). Population estimates for rainbow trout over 150 mm derived for this reach were 198 fish (95% CI 170 – 226; CV = 0.07) or 110 rainbow trout per ha (198 per km) a decrease of 229 rainbow trout per ha over 2002 levels. This decrease is largely the result of a lack of fish < 200 mm, a size class that was abundant in 2002. Population estimates for brook trout over 150 mm for this reach were 360 fish (95% CI 295 – 425; CV = 0.09) or 200 brook trout per ha (360 per km) – a slight decrease over the estimate of 241 brook trout per ha in 2002. Population estimates for mountain whitefish over 200 mm derived for this reach were 70 fish (95% CI 42 – 98; CV = 0.20) or 39 mountain whitefish per ha (70 per km). Mountain whitefish density estimates were greater than prior estimates (Table 10).

Huston Bridge

We collected 295 salmonids during the three-day mark recapture event in the Huston reach of the Big Lost River. Species composition of captured fish was 65% rainbow trout 26% brook trout and 9% mountain whitefish. Rainbow trout size structure was skewed towards larger fish, while mountain whitefish size structure was again dominated by fish between 250 mm and 340 mm (Figure 21). Population estimates for rainbow trout over 150 mm derived for this reach were 413 fish (95% CI 334 – 492; CV = 0.10) or 202 rainbow trout per ha (413 per km). Population estimates for brook trout over 150 mm were 125 fish (95% CI 59 – 192; CV = 0.27) or 69 brook trout per ha (125 per km). Population estimates for mountain whitefish over 200 mm derived for this reach were 32 fish (95% CI 17 – 48; CV = 0.24) or 18 mountain whitefish per ha (32 per km). Mountain whitefish density estimates were similar to the 2002 estimate (Table 11).

Campground

We collected 1,098 salmonids during the two-day mark recapture event in the Campground reach of the Big Lost River. Species composition of captured fish was 97% rainbow trout, 3% mountain whitefish and < 1% brook trout. Rainbow trout size structure was skewed towards larger fish, while mountain whitefish size structure was again dominated by fish between 250 mm and 340 mm (Figure 22). Population estimates for rainbow trout over 150 mm derived for this reach were 2,263 fish (95% CI 2,072 – 2,415; CV = 0.03) or 1,414 rainbow trout per ha (2,397 per km). We only captured four brook trout, and did not estimate populations as a result. Trout densities in the river reach below Mackay Dam was similar to densities found in prior surveys with the exception of 1987 (Table 12). Population estimates for mountain whitefish over 200 mm derived for this reach were 61 fish (95% CI 36 – 86; CV = 0.21) or 38 mountain whitefish per ha (65 per km). Although mountain whitefish have shown a 36% increase in abundance compared to 2002, densities remain below densities recorded in 1991 (Table 10).

Big Lost River at Bartlett Point

We captured 2 salmonids (one rainbow trout and one mountain whitefish) in two 158 m depletion runs at Bartlett Point. Low capture of fish made population estimates impossible. Therefore, we used total fish caught for density estimates. Total densities were lower than estimates conducted in 2002 (Table 10). Mountain whitefish densities through this section have also declined compared to previous estimates. Past estimates of 0.2 to 2.2 mountain whitefish / 100 m^2 are substantially greater than the current minimal estimate of 0.03 mountain whitefish / 100 m^2 found while electrofishing. We only caught one adult and no juvenile whitefish, suggesting poor recruitment.

Lower North Fork (North Fork Forest Boundary)

We collected 16 trout during two depletion runs in the Lower North Fork of the Big Lost River. Species composition was 38% rainbow trout, 38% cutthroat trout and 25% brook trout. We estimated trout densities in the Lower North Fork at 1.0 fish / 100 m^2, substantially less than past estimates. Densities of trout > 150 mm were low at 0.4 fish / 100 m^2 (Table 12). Rainbow trout ranged in size from 105 mm to 392 mm, with 50% being juvenile fish (< 150 mm). Brook trout were as abundant as in 1986 (0.2 fish / 100 m^2) and 2003 (0.2 fish / 100 m^2), but lower than the 1996 estimate of 10.8 fish / 100 m^2. Brook trout ranged from 72 mm to 153 mm, of which 75% were juvenile fish. Yellowstone cutthroat trout were estimated at 0.4 fish / 100 m^2, with 33% being adult fish. Cutthroat trout size ranged from 40 to 415 mm. We found no mountain whitefish in this reach although they were present in 1986 (estimated density of 3.0 fish / 100 m^2 in 1986).

Middle North Fork (Bartlett Cr to Grasshopper Cr)

We collected 612 trout in two electrofishing depletion passes on the middle reach of the North Fork in 2007. Species composition was 77% brook trout and 23% rainbow trout. Trout density estimates were higher at 37.5 fish / 100 m^2 than in 2003 (3.1 fish / 100 m^2), although densities of trout >150 mm were similar to 2003 estimates (2.1 vs. 2.6 fish / 100 m^2, respectively). Rainbow trout ranged in size from 91 mm to 365 mm, with 85% being juvenile fish. Brook trout ranged in size from 95 mm to 274 mm, with 95% being juvenile fish. No mountain whitefish or cutthroat trout were captured, and sculpin were noted as present.

Upper North Fork

We collected 57 trout in two electrofishing passes on the Upper North Fork. Similar to what was found in 1986 and 2003, species composition shifted from rainbow trout to brook trout towards the headwaters of the North Fork. Densities of all trout increased over 2003 estimates (3.6 vs. 1.6 trout per 100 m^2 respectively), but remained below the 1986 estimate of 27.6 trout per 100 m^2 and below the 1996 estimate of 5.9 per 100 m^2. Species composition was 96% brook trout and 4% rainbow trout. Ninety-two percent of all fish caught were juveniles. Length of brook trout ranged from 103 to 218 mm. No mountain whitefish were captured, although they have been found here previously.

Summit Creek (Downstream of Phi Kappa Campground)

We collected 370 trout in two electrofishing passes in the Summit Creek reach. Species composition was 94% brook trout and 6% rainbow trout. Trout densities were nearly double those recorded in 2003 (28.9 fish per 100 m^2 in 2007, compared to 14.4 fish per 100 m^2 in 2003), and were the highest on record for this reach. Densities of trout greater than 150 mm have also increased over our 2003 levels, and were estimated at 8.2 fish per 100 m^2. Brook trout ranged in size from 96 mm to 250 mm, with 71% juvenile fish. Rainbow trout ranged in size from 100 mm to 240 mm, with 48% juvenile fish. No mountain whitefish were captured, although they have been found here previously.

Kane Creek

We collected 227 trout in two electrofishing passes in the Kane Creek reach. Species composition was 89% brook trout and 11% rainbow trout. Trout densities were more than double those recorded in 2003 (12.2 fish per 100 m^2 in 2007, compared to 5.1 fish per 100 m^2 in 2003), and were the highest on record for this reach. Densities of trout greater than 150 mm have also increased since 2003, and were estimated at 4.8 fish per 100 m^2. Brook trout ranged in size from 101 mm to 261 mm, with 61% juvenile fish. Rainbow trout ranged in size from 102 mm to 270 mm, with 58% juvenile fish. As we found in 2003, no mountain whitefish were captured.

Wildhorse Creek

We collected 173 salmonids in two separate reaches in the Wildhorse Creek drainage. Overall species composition was 93% brook trout, 6% rainbow trout, 2% mountain whitefish and <1% Yellowstone cutthroat trout. Trout densities again showed an increase over levels recorded in 2003 (7.0 fish per 100 m^2 in 2007, compared to 4.4 fish per 100 m^2 in 2003), and were the highest on record for this reach. Densities of trout greater than 150 mm have also increased since 2003, and were estimated at 4.0 fish per 100 m^2. Brook trout ranged in size from 92 mm to 262 mm, with 70% juvenile fish. Rainbow trout ranged in size from 100 mm to 312 mm, with 30% juvenile fish. Overall densities of mountain whitefish >200 mm were estimated at 0.08 fish per 100 m^2, which is an increase in abundance compared to 2003 when no mountain whitefish were found.

Fall Creek

We collected 10 salmonids in two electrofishing passes in the Fall Creek reach. Species composition was 70% brook trout and 30% mountain whitefish. Trout densities were similar to those recorded in 2003 (2.1 fish per 100 m^2 in 2007, compared to 2.3 fish per 100 m^2 in 2003). Densities of trout greater than 150 mm were also similar to levels recorded in 2003, and were estimated at 1.1 fish per 100 m^2. Brook trout ranged in size from 70 mm to 275 mm, with 29% juvenile fish. Densities of mountain whitefish >200 mm were estimated at 0.14 fish per 100 m^2, which is an increase over the 2003 survey, when no mountain whitefish were found. Mountain whitefish ranged in size from 190 mm to 230 mm. Rainbow trout were found in 2003, but were absent in the current survey.

Lower East Fork (Whitworth and Fox Creek reaches)

We collected 192 salmonids in two electrofishing reaches in the Lower East Fork. Species composition was 35% rainbow trout 32% brook trout, 29% mountain whitefish, and 5% Yellowstone cutthroat trout. Trout densities increased substantially over those recorded in 2003 (5.2 fish per 100 m^2 in 2007, compared to 3.0 fish per 100 m^2 in 2003), and were the highest on record for this reach. Densities of trout greater than 150 mm have also increased, and were estimated at 3.6 fish per 100 m^2. Densities of mountain whitefish in these combined reaches averaged 1.3 fish per 100 m^2, an increase over the 2003 estimate of 0.05 for the same reach, and higher than any previous estimate with the exception of 1986. Brook trout ranged in size from 60 mm to 300 mm, with 25% juvenile fish. Rainbow trout ranged in size from 65 mm to 366 mm, with 30% juvenile fish. Mountain whitefish ranged in size from 182 mm to 310 mm, with 25% juvenile fish. Sculpin were also recorded as being present.

Upper East Fork (Burma and the Swamps reaches)

We collected 381 trout in two electrofishing reaches in the Upper East Fork (East Fork at Burma and East Fork at the Swamps). Species composition was 80% brook trout, 11% rainbow trout and 9% Yellowstone cutthroat trout. Trout densities increased substantially over those recorded in 2003 (31.6 fish per 100 m^2 in 2007, compared to 24.5 fish per 100 m^2 in 2003), and were similar to the highest recorded density estimate of 33.9 fish per 100 m^2 recorded in 1986. Densities of trout greater than 150 mm have also increased, and were estimated at 18.6 fish per 100 m^2. Brook trout ranged in size from 54 mm to 294 mm, with 56% juvenile fish. Rainbow trout ranged in size from 107 mm to 348 mm, with 84% juvenile fish. Yellowstone cutthroat trout ranged in size from 121 mm to 283 mm, with 42% juvenile fish. No mountain whitefish or sculpin were captured.

West Fork (Lower Starhope Creek and Cow Camp reaches)

We collected 157 trout in two reaches in the Lower West Fork (above the bridge on Forest Road 135 and at the Cow Camp). Species composition was 89% brook trout, 8%

rainbow trout and 4% Yellowstone cutthroat trout. Trout densities decreased slightly over those recorded in 2003 (6.4 fish per 100 m^2 in 2007, compared to 8.8 fish per 100 m^2 in 2003), and remain above the 1986 density estimate of 2.4 fish per 100 m^2. Densities of trout greater than 150 mm were also below 2003 estimates, at 0.5 fish per 100 m^2. Brook trout ranged in size from 38 mm to 253 mm, with 91% juvenile fish. Rainbow trout ranged in size from 60 mm to 295 mm, with 92% juvenile fish. Yellowstone cutthroat trout ranged in size from 65 mm to 425 mm, with 50% juvenile fish. No mountain whitefish were captured, but sculpin were noted as present.

Upper West Fork (Loop Road)

We collected 255 trout in two electrofishing passes in the Upper West Fork reach. Species composition was 91% brook trout and 9% Yellowstone cutthroat trout. Trout densities increased substantially over those recorded in 2003 (20.0 fish per 100 m^2 in 2007, compared to 14.4 fish per 100 m^2 in 2003), and were the highest on record for this reach. Densities of trout greater than 150 mm have also increased over 2003 estimates, and were 7.2 fish per 100 m^2. Brook trout ranged in size from 30 mm to 256 mm, with 66% juvenile fish. Rainbow trout ranged in size from 80 mm to 369 mm, with 9% juvenile fish. No sculpin or mountain whitefish were caught, although mountain whitefish have been found here in the past.

Broad Canyon Creek

We collected 205 trout in two electrofishing passes in Broad Canyon Creek. Species composition was 96% brook trout and 4% Yellowstone cutthroat trout. Trout densities were nearly double those recorded in 2003 (40.8 fish per 100 m^2 in 2007, compared to 24.2 fish per 100 m^2 in 2003). Densities of trout greater than 150 mm have also increased over 2003 estimates, and were 9.1 fish per 100 m^2. Brook trout ranged in size from 100 mm to 238 mm, with 75% juvenile fish. Yellowstone cutthroat trout ranged in size from approximately 100 mm to 296 mm, with 78% juvenile fish. No mountain whitefish or sculpin were captured.

Muldoon Canyon Creek

We collected 178 trout in two electrofishing passes in Muldoon Canyon Creek. Species composition was 95% brook trout and 5% Yellowstone cutthroat trout. Trout densities were slightly higher than those recorded in 2003 (21.3 fish per 100 m^2 in 2007, compared to 19.4 fish per 100 m^2 in 2003), and were the highest on record for this reach. Densities of trout greater than 150 mm were estimated at 3.0 fish per 100 m^2. Brook trout ranged in size from 40 mm to 240 mm, with 87% juvenile fish. Yellowstone cutthroat trout ranged in size from 90 mm to 359 mm, with 22% juvenile fish. No mountain whitefish or sculpin were captured.

Lake Creek

We collected 410 trout in two electrofishing passes in Lake Creek. Species composition was 99% brook trout and 1% Yellowstone cutthroat trout. Trout densities were similar to those recorded in 2003 (57.8 fish per 100 m^2 in 2007, compared to 56.6 fish per 100 m^2 in 2003), and were the highest on record for this reach. Densities of trout greater than 150 mm were lower than our 2003 estimates at 13.7 fish per 100 m^2. Brook trout ranged in size from 103 mm to 275 mm, with 75% juvenile fish. Yellowstone cutthroat trout ranged in size from approximately 100 mm to 280 mm, with 25% juvenile fish. No mountain whitefish or sculpin were captured.

Antelope Creek (Lower, Middle and Upper reaches)

We collected 410 trout in three electrofishing reaches in Antelope Creek. Species composition was 84% brook trout and 16% rainbow trout. Trout densities were 11.1 fish per 100 m^2. Densities of trout greater than 150 mm were estimated at 2.6 fish per 100 m^2. Brook trout ranged in size from 48 mm to 317 mm, with 77% juvenile fish. Rainbow trout ranged in size from 66 mm to 349 mm, with 48% juvenile fish. No mountain whitefish were captured, but sculpin were present.

Cherry Creek

We collected 136 trout in three electrofishing passes in Cherry Creek. Species composition was 88% brook trout and 12% rainbow trout. Trout densities were 45.9 fish per 100 m^2. Densities of trout greater than 150 mm were estimated at 7.1 fish per 100 m^2. Brook trout ranged in size from 43 mm to 241 mm, with 85% juvenile fish. Rainbow trout ranged in size from 47 mm to 226 mm, with 69% juvenile fish. No mountain whitefish were captured, but sculpin were present.

Iron Bog Creek

We collected 96 trout in two electrofishing passes in Iron Bog Creek. Species composition was 97% brook trout and 3% rainbow trout. Trout densities were 23.3 fish per 100 m^2. Densities of trout greater than 150 mm were estimated at 7.3 fish per 100 m^2. Brook trout ranged in size from 54 mm to 341 mm, with 67% juvenile fish. Rainbow trout ranged in size from 209 mm to 302 mm, with no juvenile fish. No mountain whitefish were captured, but sculpin were present.

Creel Survey

Creel clerks interviewed 922 people in 406 parties from May 26 through October 31. Anglers caught an estimated 122,381 fish and harvested 19,723 for an overall release rate of 84% with 80,420 hours of angling effort (Table 13). Catch composition was 61% rainbow trout, 28% brook trout and 9% Yellowstone cutthroat trout, with lesser catches of kokanee salmon and mountain whitefish. We estimated catch rates at 1.5 fish per hour for the season, with overall angler catch rates ranging from 1.4 fish per hour in the upper section to 1.7 fish per hour in the lower section. Nearly 86% of the total season effort occurred during the first three months of the season (June ,July and August). Thirty-seven percent of anglers fished with bait during 2007, while 7% used lures, 43% used flies, and 13% used a combination of these methods. Residents from 18 counties in Idaho made up 70% of the interviewed anglers, while non-residents from 25 states and two countries comprised the remaining 30%. Idaho residents were primarily from Bingham (29%), Bonneville (12%), Butte (12%), Bannock (10%), and Ada (8%) counties. Only 6% of interviewed anglers stated they used a guide on the day they were interviewed, and 3% of all anglers stated they had caught a mountain whitefish.

Compared to the most recent creel survey (1986), angling effort has increased, as have angler catch rates. Harvest, however, has decreased compared to 1986 (Table 13).

DISCUSSION

Overall abundance of trout in the Upper Big Lost River is similar to or better than that documented in surveys in the 1980s (80% of 2007 sample reaches had similar or higher densities, 20% lower), and in all areas except the river below Mackay Dam and the West Fork and it's tributaries, have improved over densities found in our most recent 2002-2003 survey (80% of 2007 sample reaches held higher densities). In particular, juvenile trout abundances have increased well above those documented in 2003. Fluctuations in trout densities throughout the drainage may be attributed to a combination of factors, including winter snow pack and precipitation, habitat improvements such as improved range management, and resulting stream temperatures.

Stockings of cutthroat trout, which began in 2000, continue to supplement the existing rainbow trout and brook trout fishery in the Upper Big Lost River. It was previously suspected that whirling disease may be suppressing trout populations, and that cutthroat trout may be more resistant to infections. Stockings have only occurred in the West Fork, but cutthroat trout are now found throughout the entire Upper Big Lost River Drainage. Natural reproduction is occurring, and may eventually aid cutthroat trout in becoming a significant component to the fishery. The persistence of all three trout species in the drainage and the abundance of juvenile fish encountered during 2007 suggest that whirling disease, which was suspected to have population level effects in the 1990s, is currently not impacting the population substantially.

Mountain whitefish populations in the Big Lost River have shown an increase in abundance compared to population sampling conducted in 2002-2005, but in most instances, abundance remains below highs documented in the 1980's. We found mountain whitefish at each of the five sites where they were found in 2003. We also found mountain whitefish in two areas they had not been found in 2003, which documents expansion in the population. Further, densities of mountain whitefish have increased in four of the five sites occupied in 2003, largely as a result of what appears to be a strong year class of age two fish. These fish, which range in size from 250 to 340 mm in length, were found in all reaches of the river, and were the most common size class of mountain whitefish encountered. In the one location where electrofishing surveys showed a decline in mountain whitefish abundance, additional sampling in partnership with Forest Service personnel and using snorkel techniques documented increased abundances of mountain whitefish (Bart Gamett, USFS unpublished data). Differences in results from these two surveys are likely the result of sampling error or random chance. Consistent with the *Mountain Whitefish Conservation and Management Plan for the Big Lost River Drainage, Idaho* (IDFG 2007), several projects have been completed during 2007 that may be enhancing survival and distribution of mountain whitefish. A table summarizing accomplishments from 2007 is included in Appendix D.

Data collected from the 2007 angler survey suggest the Big Lost River supports a popular sport fishery. Similar to 1986, anglers from across Idaho and numerous other states fish the drainage. Although the 1986 survey did not include the lower portion of the river (below Mackay Dam), it appeared angler effort has increased in the upper river. Angler catch rates remain high, and exceed one fish per hour. The IDFG stocking program was substantially reduced between the 1986 creel survey and the current survey, dropping from 19,000 catchable trout per year to the current 6,500 catchable trout. This decrease in stocking does not seem to have influenced angler catch rates, which were similar to or slightly improved over those recorded in 1986. The total number of fish caught has also increased over previous levels, while the number of fish harvested has decreased; suggesting anglers voluntarily release trout even though many of the captured fish are legally available to harvest. We estimated rainbow trout harvest at slightly over 8,000 fish above Mackay Dam, an area we currently stock 6,500 catchable rainbow trout. Although we did not distinguish hatchery trout from wild trout in the creel survey, the hatchery catchable trout likely contribute substantially to the harvest. Current harvest practices do not appear to be affecting trout populations. Of particular interest was the 1,305 mountain whitefish estimated as caught throughout the drainage. Based on angler reports, we estimate approximately 202 mountain whitefish were harvested. Although this is a small proportion of the total population, it is a situation we can address with additional education and enforcement.

MANAGEMENT RECOMMENDATIONS

1. Continue to monitor mountain whitefish populations and collect basic life history information consistent with the *Mountain Whitefish Conservation and Management Plan for the Big Lost River Drainage, Idaho* (IDFG 2007).

2. Periodically monitor salmonid populations throughout the Big Lost River to evaluate natural reproduction, distribution and contribution to the fishery. Sampling should occur every five years, with the next comprehensive survey to occur in 2012.

3. Continue to work towards restoring connectivity throughout the Big Lost River drainage by implementing fish ladders around diversions where possible.

4. Continue collaboration with partner agencies and work towards reestablishing mountain whitefish populations throughout the drainage consistent with the *Mountain Whitefish Conservation and Management Plan for the Big Lost River Drainage, Idaho* (IDFG 2007).

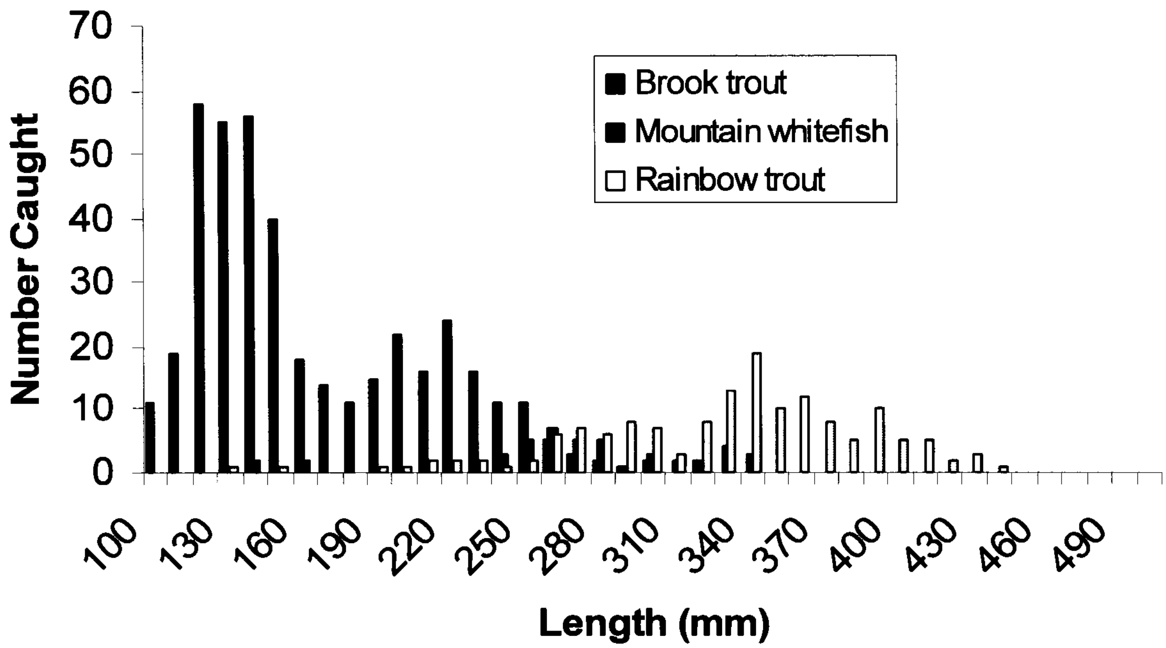


Figure 20. Length frequency of salmonids collected electrofishing in the Leslie reach of the Big Lost River, Idaho 2007.

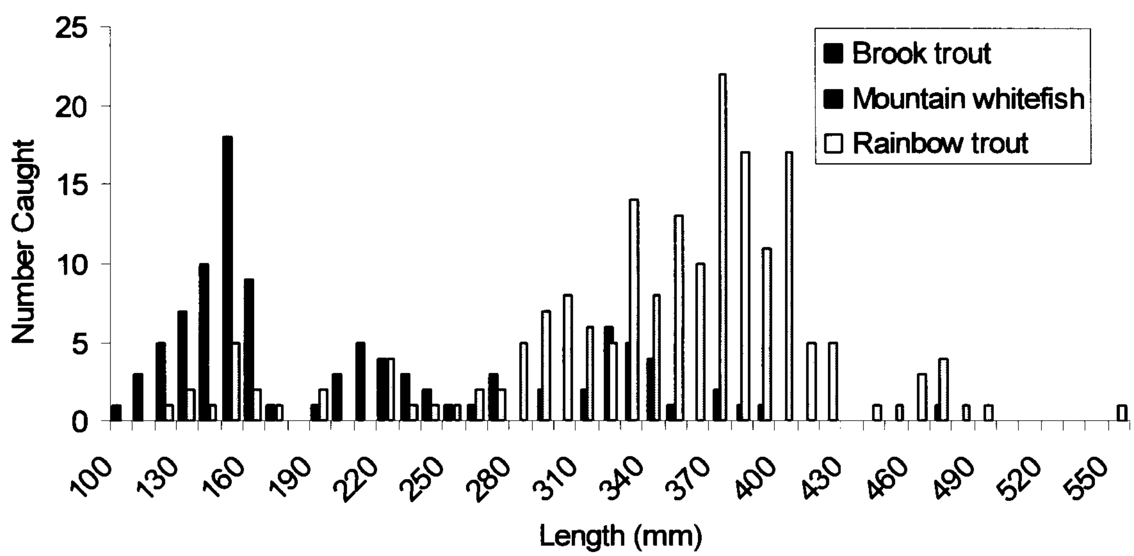


Figure 21. Length frequency of salmonids collected electrofishing in the Huston reach of the Big Lost River, Idaho 2007.

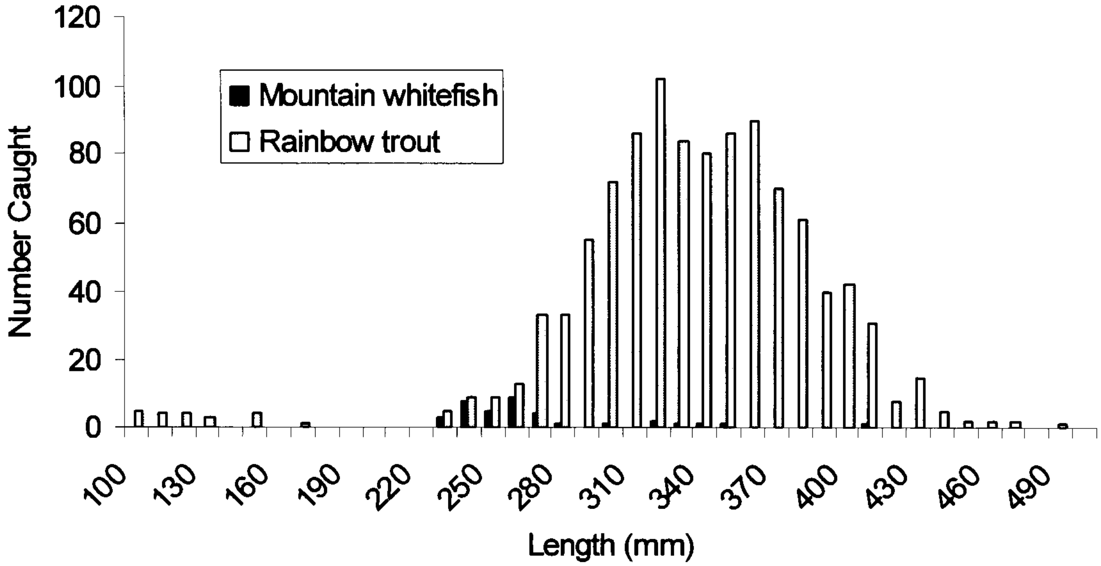


Figure 22. Length frequency of salmonids collected electrofishing in the Campground reach of the Big Lost River, Idaho 2007.

Table 10. Mountain whitefish abundance in the Big Lost River Drainage, Idaho as determined from electrofishing surveys.

Location	Year Sampled	Source	Length Sampled (meters)	Mean Width (meters)	Population estimate (fish >200 mm)	Fish / 100 m²	Fish per km
Desert	1970s	Overton					
	2003	USFS	0[1]	0[1]	0[1]	0[1]	0[1]
[redacted]							
Big Lost @ Leslie	1991	IDFG	4,000	15	48 (35-57)	0.1	12
	2002	IDFG	1,000	18	1[b]	<0.01[b]	1[b]
	2007	IDFG	1,000	18	70 (42-98)	0.39	70
[redacted]							
Big Lost @ Mackay (Campground)	1987	IDFG	1,238	24.2	NE[c]	NE[c]	NE[c]
	1991	IDFG	800	37.4	280 (176-507)	0.9	350
	2002	IDFG	1,000	20.6	45 (27-64)	0.2	45
	2007	IDFG	944	17.0	61 (36-86)	0.38	65
[redacted]							

Table 10. Continued.

Location	Year Sampled	Source	Length Sampled (meters)	Mean Width (meters)	Population estimate (fish >200 mm)	Fish / 100 m^2	Fish per km
East Fork - Whitworth	1986	IDFG	1,243	13.8	825 (617-1,162)	4.8	664
	1990	IDFG	1,375	12.4	65	0.4	47.3
	1996	IDFG	924	12.4	84	0.7	91
	2003	IDFG+USFS	115	11.2	1	0.1	8.7
	2007	IDFG	119.5	13.2	41 (39-43)	2.6	343.1
[redacted]							
West Fork – Bridge	1986	IDFG	1,364	16.1	1,480 (758-4,191)	6.7	1,085
	2003	IDFG+USFS	100	14.7	0	0	0
	2007	IDFG	211	15.4	0	0	0
[redacted]							
North Fork – Forest Boundary	1986	IDFG	1,140	10.5	362 (281-485)	3.0	318
	2003	IDFG+USFS	300	8	0	0	0
	2007	IDFG	153	10	0	0	0
[redacted]							
Wildhorse Cr (Upper Sect)	1986	IDFG	213	7	0	0	0
	2003	IDFG+USFS	200	7	0	0	0
	2007	IDFG	300	6.5	3 (No CI's)	0.15	10

Table 10. Continued.

Location	Year Sampled	Source	Length Sampled (meters)	Mean Width (meters)	Population estimate (fish >200 mm)	Fish / 100 m^2	Fish per km
[redacted]							

[a] Sampled, but no water present.
[b] Numerous fry present, but not collected.
[c] Whitefish present, but not estimated.
[d] Only completed marking run. Figures presented are actual fish present, not a population estimate (would likely be higher).
[e] No population estimate made. Figures presented are actual fish present.

Table 11. Density estimates (fish per 100 m^2) for historic sample reaches of the Big Lost River, Idaho. Density estimates presented are means for a given stream when more than one station was sampled in a given year.

			Density (fish / 100 m^2)			
Location	**Drainage**	**Sample Year**	**All trout**	**Trout >150 mm**	**RBT >150 mm**	**BKT >150 mm**
[redacted]						
Upper Big Lost River Mainstem (One site)	Main	1988	1.41	1.29	1.18	0.11
		1990	1.23	1.10	1.08	0.02
		2003	1.15	0.43	0.37	0.06
		2007	0.03	0.0	0.0	0.0
[redacted]						
Summit Creek (One site)	North Fork	1986	27.15	5.75	0.25	5.45
		1996	11.75	10.45	0	10.45
		2003	14.40	4.73	0.68	4.05
		2007	28.87	8.16	0.80	7.35
[redacted]						
Lower East Fork (Two sites)	East Fork	1986	1.85	0.35	0.26	0.09
		1990	1.46	1.46	0.73	0.73
		2003	3.01	1.92	1.28	0.64
		2007	5.19	3.64	1.77	1.76
[redacted]						
West Fork (Starhope Creek) (Three sites)	West Fork	1986	4.94	1.06	0.05	1.01
		2003	10.07	4.35	0.18	4.17
		2007	11.0	2.73	0.01	2.18
[redacted]						
Lake Creek (One site)	West Fork	1986	19.80	8.20	0.60	7.60
		1996	10.30	8.90	0	8.90
		2003	56.6	22.9	0	22.9
		2007	57.77	13.69	0	13.3

[a] Lower Big Lost River rainbow trout estimates are for trout > 200 mm to comply with previous methodology.

[b] 1987 sample only included the Mackay (Campground) section, which is the highest density.

Table 12. Salmonid densities found in the Big Lost River, Idaho during 2007 electrofishing samples.

Location	Drainage	Length (m)	Density (# per 100 m^2) All Trout	Trout >150 MM	RBT* >150 mm	BKT >150 mm	MWF >200 mm	YCT* >150 mm
Big Lost at Leslie	Main	1,000	--	3.12	1.10	2.00	0.39	0.0
Big Lost at Huston	Main	1,000	--	2.71	2.02	0.69	0.18	0.0
Big Lost at Mackay (Campground)	Main	940	--	14.17	14.14	0.03	0.38	0.0
Mainstem (Bartlett Point)	Main	158	0.03	0.0	0.0	0.0	0.03	0.0
Lower North Fork	North	154	1.04	0.39	0.19	0.06	0.0	0.13
Mid North Fork	North	294	37.51	2.07	1.06	1.01	0.0	0.0
Upper North Fork	North	299	3.64	0.30	0.0	0.30	0.0	0.0
Summit Creek	North	300	28.87	8.16	0.80	7.35	0.0	0.0
Kane Creek	North	248	12.15	4.76	0.58	4.17	0.0	0.0
Lower Wildhorse Creek	East	197	2.37	0.45	0.11	0.34	0.0	0.0
Upper Wildhorse Creek	East	300	11.69	7.44	0.76	6.53	0.15	0.15
Fall Creek	East	113	2.11	1.12	0.0	1.12	0.14	0.0
Lower East Fork (Whitworth)	East	120	3.61	2.79	1.69	0.88	2.60	0.22
Lower East Fork (Fox Creek)	East	150	6.76	4.48	1.85	2.63	0.0	0.0
East Fork @ Burma	East	171	35.77	20.30	5.26	12.27	0.0	2.77
East Fork @ Swamps	East	182	27.47	16.95	0.0	16.95	0.0	0.0
Lower Starhope Creek	West	211	1.75	0.25	0.03	0.15	0.0	0.06
Mid Starhope Creek (Cow Camp)	West	122	11.11	0.73	0.0	0.64	0.0	0.09
Upper Starhope Creek	West	266	20.04	7.21	0.0	5.74	0.0	1.47
Broad Canyon Creek	West	164	40.77	9.12	0.0	8.76	0.0	0.36
Muldoon Canyon Creek	West	150	21.25	3.02	0.0	2.29	0.0	0.73
Lake Creek	West	166	57.77	13.69	0.0	13.30	0.0	0.39
Lower Antelope Creek	Antelope	272	1.58	0.29	0.23	0.06	0.0	0.0
Middle Antelope Creek	Antelope	244	5.79	3.81	1.20	2.61	0.0	0.0
Upper Antelope Creek	Antelope	267	25.80	3.61	0.85	2.77	0.0	0.0
Cherry Creek	Antelope	103	45.90	7.06	1.53	5.53	0.0	0.0
Iron Bog Creek	Antelope	105	23.30	7.29	0.64	6.65	0.0	0.0

*Includes hatchery trout

Table 13. Data collected from angler creel survey in the Big Lost River, 2007.

	Lower River	Middle River	Upper River	Total	Upper and Middle River[a]	1986 Upper and Middle River[a]
No. Interviewed	375	331	216	922	**547**	**645**
Hours of Effort	30,340	21,458	28,621	80,420	**50,079**	**29,133**
Catch (fish per hour)	1.7	1.4	1.4	1.5	**1.4**	**1.3**
Harvest (fish per hour)	0.2	0.3	0.3	0.3	**0.3**	**0.6**
Release (fish per hour)	1.5	1.2	1.2	1.3	**1.2**	**0.7**
Number Caught	50,482	30,918	40,981	122,381	**71,899**	**37,873**
Mountain Whitefish Caught	558	489	259	1,305	**748**	**1,505**
Cutthroat Trout Caught	1,867	2,588	5,899	10,354	**8,487**	**0**
Rainbow Trout Caught	38,492	22,839	13,806	75,137	**36,645**	**28,509**
Kokanee Caught	823	0	0	823	**0**	**0**
Brook Trout Caught	8,567	4,926	21,017	34,511	**25,943**	**10,990**
Number Harvested	6,013	5,735	7,975	19,723	**13,710**	**18,708**
Mtn. Whitefish Harvested	0	45	157	202	**202**	**2,193**
Cutthroat Trout Harvested	0	231	652	882	**883**	**0**
Rainbow Trout Harvested	5,681	4,876	3,193	13,750	**8,069**	**12,440**
Kokanee Harvested	190	0	0	190	**0**	**0**
Brook Trout Harvested	125	584	3,973	4,681	**4,557**	**4,075**

[a] Upper and Middle river sections from 2007 were combined to be consistent with the 1986 survey, which did not include the river below Mackay Dam. The last two columns are the same area, and are presented for comparison.

HENRYS FORK

ABSTRACT

We used boat mounted electrofishing equipment to assess fish populations in the Mack's Inn, Box Canyon, Vernon, and Chester reaches of the Henrys Fork in May 2007. In the Mack's Inn reach, we estimated trout densities at 298 fish/km, which is a substantial increase over our 2004 estimate. Proportional stock density (PSD) was 46, while relative stock density (RSD-400) was 26. Composition of trout was 53% Yellowstone cutthroat trout, 35% rainbow trout and 12% brook trout. We estimated mountain whitefish densities at 770 fish per km, which is a 19% increase over 2002 estimates. In Box Canyon, we estimated rainbow trout densities at 2,311 fish/km, which is a 43% increase over our 2006 estimate. Increases in population abundances over the past several years are likely the result of higher winter flow releases from Island Park Dam. We estimated mountain whitefish densities at 750 fish per km, which is a 53% increase over 2003 estimates. We estimated trout densities in the Vernon reach at 580 fish per km, which is a 16% increase from 2006. PSD for rainbow trout was 78, while RSD-400 was 50. Composition was 87% rainbow trout and 13% brown trout. Mountain whitefish densities were 1,519 fish per km. We estimated trout densities in the Chester reach at 916 fish per km, which is a 63% increase over 2003. PSD for rainbow trout was 76, while RSD-400 was 41. Composition was 77% rainbow trout and 23% brown trout. Mountain whitefish densities were 1,695 fish per km, which is an increase of 74% over our 2003 estimate.

METHODS

We used two drift boat mounted electrofishing units to assess fish populations in four reaches of the Henrys Fork in 2007. The Mack's Inn reach started immediately below the confluence with the Henrys Lake Outlet, and extended downstream 3.7 km to the first set of cabins on the right (GPS locations in Appendix E). The Mack's Inn reach was sampled using a single marking run on May 16 and a single recapture run on May 23 using two boats with each boat completing two passes each day. In Box Canyon, we collected fish over two days for marking (May 8 and 9) followed by a seven-day rest, and a single-day recapture event using two boats (May 15). Two passes per boat were used on all sample days. The Box Canyon reach 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 E). The Vernon reach started immediately below the Vernon Bridge at the boat launch and extended downstream 4.4 km to the lowest house on river left at the start of the impounded water above Chester Dam with a single marking day (May 10) and a single recapture day (May 17) using two boats (GPS locations in Appendix E). The Chester reach started at the Chester boat ramp immediately below the Chester Dam, and extended downstream to the island upstream of the Fun Farm Bridge with a single marking day (May 11) and a single recapture day (May 18) using two boats (Appendix E). Two passes per boat per day were used on all marking and recapture efforts. All salmonids encountered, including rainbow trout, Yellowstone cutthroat trout, brown trout, brook trout, and mountain whitefish were collected, identified, measured for total length, and those exceeding 150 mm (200 mm for mountain whitefish) 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 estimated densities for all trout >150 mm using the Partial Log-Likelihood method and the MR5 data analysis program (MR5; Montana Department of Fish, Wildlife, and Parks 1994) when recaptures were high, and used the modified Peterson estimate when recaptures were low. For all reaches except Box Canyon, we estimated total abundance for all trout combined and partitioned out densities based on relative abundances of trout captured. 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 (Anderson and Gutreuter 1983). We did not collect any trout otoliths or conduct age and growth analysis in 2007, but did partition our population estimates from Box Canyon 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

Mack's Inn

We collected 339 trout over two days of electrofishing in the Mack's Inn reach. Species composition of trout handled was 53% Yellowstone cutthroat trout, 35% rainbow trout and 3% brook trout. We also collected 652 mountain whitefish during our survey. Our efficiency rate (unadjusted for size selectivity) was 12% (Appendix F). Cutthroat trout ranged in size from 42 mm to 545 mm (Figure 23), whereas rainbow trout ranged from 105 mm to 479 mm. PSD and RSD-400 for all trout combined were 70 and 32, respectively (Appendix G). Cutthroat trout had a mean size of 290 mm and a median size of 275 mm (Table 14). Rainbow trout had a mean size of 247 mm and median size of 222 mm. We captured 6 trout greater than 500 mm, 4 were

Yellowstone cutthroat trout and 2 were rainbow trout. We used a modified Peterson estimator, and estimated 1,423 trout > 150 mm (95% CI = 751 – 2,095, cv = 0.24, Table 15, Appendix H) in the reach, which equates to 296 fish per km (Figure 24). This represents a three-fold increase in trout abundance compared to 2004 estimates. We also used a modified Peterson estimator on mountain whitefish, and estimated 4,986 fish >200 mm (95% CI = 2,925 – 5,448, cv = 0.15, Table 15, Appendix H) in the reach, which equates to 1,239 fish per km (Figure 24).

Box Canyon

We collected 1,173 trout over three days of electrofishing in the Box Canyon. Species composition of trout handled was 97% rainbow trout and 3% brook trout. We also collected 625 mountain whitefish during our survey. Our efficiency rate (unadjusted for size selectivity) was 15% (Appendix F). Rainbow trout ranged in size from 91 mm to 553 mm (Figure 25). PSD and RSD-400 were 59 and 22, respectively (Appendix G) which is a decrease from 2006. Rainbow trout had a mean size of 312 mm and median size of 300 mm (Table 14). We captured 29 rainbow trout greater than 500 mm. We used the Log Likelihood estimator and estimated 8,549 trout >150 mm (95% CI = 7,288 – 9,810, cv = 0.08, Table 15, Appendix H) in the reach, which equates to 2,311 fish per km (Figure 26). This represents a 43% increase in rainbow trout abundance compared to 2006 estimates. We used the Log Likelihood estimator on mountain whitefish, and estimated 3,855 fish >200 mm (95% CI = 2,767 – 4,943, cv = 0.14, Table 15, Appendix H) in the reach, which equates to 1,042 fish per km (Figure 24). This represents a 49% increase in abundance compared to 2003 estimates.

Vernon to Chester Backwaters

We collected 277 trout in the Vernon reach of the Henrys Fork during the two-day population estimate. Species composition was 87% rainbow trout and 13% brown trout. We also collected 436 mountain whitefish. Our efficiency rate (unadjusted for size selectivity) for all trout was 4%. Rainbow trout and brown trout stock density indices were high, with a PSD and RSD-400 of 78 and 50 for rainbow trout and 96 and 22 for brown trout (Table 14). Mean and median size of rainbow trout was 283 mm and 280 mm, respectively. Mean and median size of brown trout was 297 mm and 332 mm, respectively. Rainbow trout length frequencies were skewed towards smaller fish (Figure 27). We estimated 2,554 trout > 150 mm for the reach (MPM; 95% CI = 754 – 4,354; cv = 0.36), which equates to 580 fish per km (Table 15). Rainbow trout density estimates were 2,130 for the 4.4 km reach (484 fish per km), while brown trout were estimated at 424 fish (96 fish per km). Estimated trout densities were approximately 15% higher than those estimates from the survey done in 2006. Abundance of age-1 and age-2 rainbow trout was low in 2005 and 2006 population estimates, but increased recruitment was evident in the current survey (Figure 28). Mountain whitefish densities were estimated at 2,475 fish per km (MPM; c.v. = 0.44), which represents a substantial increase in abundance from the 2006 estimate.

Chester Dam to Fun Farm Backwaters

We collected 573 trout in the Chester reach of the Henrys Fork during the two-day population estimate. Species composition of trout was 77% rainbow trout and 23% brown trout. We also collected 791 mountain whitefish. Our efficiency rate (unadjusted for size selectivity) for all trout was 7%. Rainbow trout and brown trout stock density indices were high, with a PSD and RSD-400 of 76 and 41 for rainbow trout and 92 and 44 for brown trout (Table 14). Mean and median size of rainbow trout was 323 mm and 340 mm, respectively. Mean and median size of brown trout were both 325 mm. Rainbow trout and brown trout length frequencies appeared balanced (Figure 29). We used a modified Peterson estimator and estimated 3,125 trout > 150 mm for the reach (95% CI = 1,955 – 4,295; cv = 0.19), which equates to 548 fish per km (Table 15). Rainbow trout density estimates were 2,375 for the 5.7 km reach (417 fish per km), whereas brown trout were estimated at 750 fish (132 fish per km). These densities were approximately 77% higher than estimates in 2003 (Figure 30). Mountain whitefish densities were estimated at 1,695 fish per km (MPM; cv = 0.26), which represents a 74% increase in abundance over the 2003 estimate.

DISCUSSION

The fisheries survey in the Mack's Inn reach of the Henrys Fork indicates that trout densities in this reach have increased substantially from the early 2000s, and now rival densities found in the 1980s and 1990s. Mountain whitefish appear to be maintaining a relatively constant abundance in this reach. Yellowstone cutthroat trout have become an important component of the trout population following initial stockings in 2003.

The Box Canyon population estimate shows a continued increase in trout densities compared to all our recent surveys, with densities reaching their highest abundance since 2000. The relation between winter flows and trout recruitment has been well documented in this reach of the Henrys Fork (Mitro 1999, Garren et. al. 2004), with higher winter flows producing stronger year classes. Recent efforts to increase winter flow releases from Island Park Dam have been successful, and the trout population appears to be benefiting. Continued precipitation and resulting higher winter flow releases from Island Park Dam should further improve trout densities.

Population densities in the Vernon reach were similar to estimates from 2005 and 2006. Prior to our most recent survey, the trout population was dominated by large, presumably old trout. Few juvenile trout were caught, which suggested poor recruitment, or that recruitment was dependent on migrations of juvenile fish from other areas. We hypothesized that this lack of recruitment may result in lower adult densities in upcoming years. Based on length frequencies from the current year's data, it appears that a substantial shift has occurred in the size structure of the population, with a reduction in abundance of older, large fish, and an increase in abundance of smaller, young fish. Overall densities remain similar to previous estimates, but anglers are likely to encounter many more small fish in the upcoming fishing season than they have in the past. In 2007, we initiated a project 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. We're using otolith microchemistry to identify the natal origins of trout in the Vernon reach and expect final results from this project during 2008.

Population estimates from the Chester reach showed a welcome increase in overall abundance of all trout when compared to prior surveys. At least some of this increase is the result of an increasing abundance of brown trout, which have gone from a relative abundance of less than 10% to nearly 25%. Length frequencies of both rainbow trout and brown trout show a much improved size structure compared to previous surveys, and suggest several consecutive year classes have recruited to the population. Mountain whitefish have also increased in abundance in this reach, suggesting that overall, conditions have improved over the drought period during the early 2000s.

MANAGEMENT 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 reaches.

3. Monitor trout population abundances in the lower river to document changes following implementation of canal screens on the Last Chance and Crosscut canals.

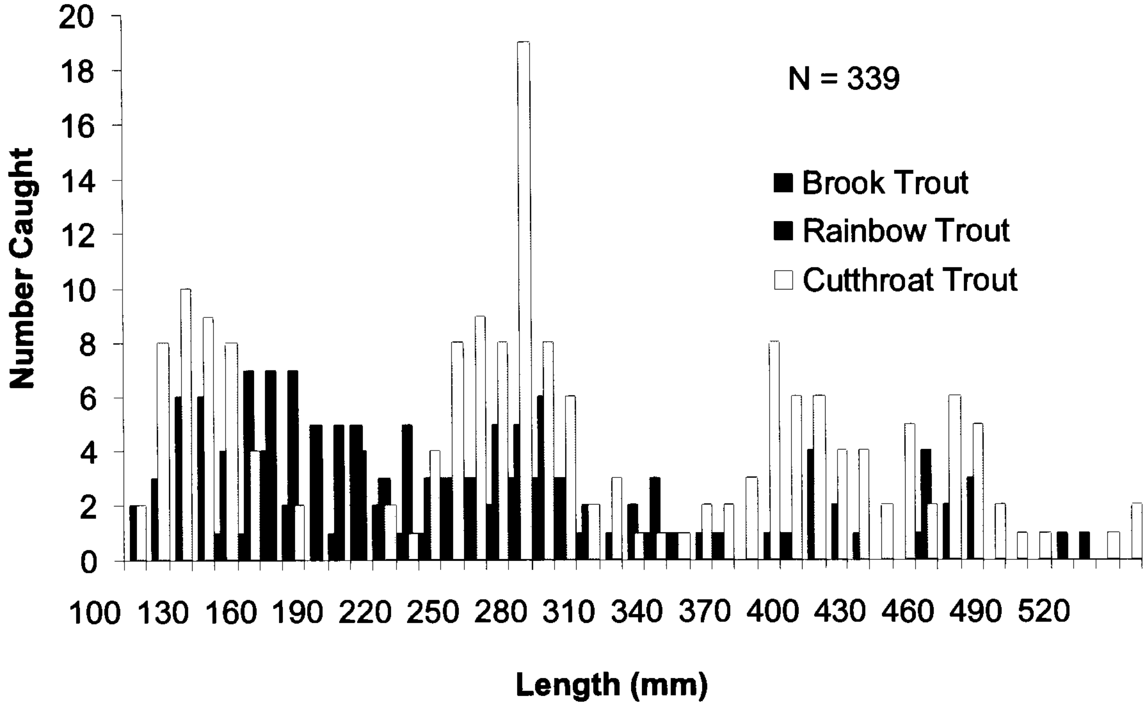


Figure 23. Length frequency distribution for trout collected electrofishing in the Mack's Inn reach of the Henrys Fork, Idaho, 2007.

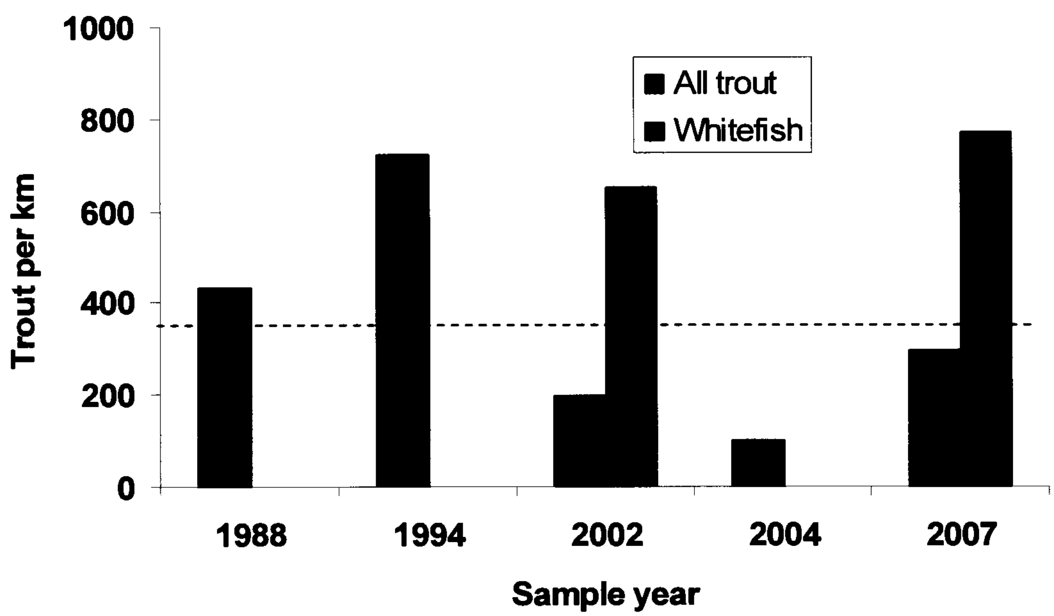


Figure 24. Salmonid densities in the Mack's Inn reach of the Henrys Fork, Idaho.

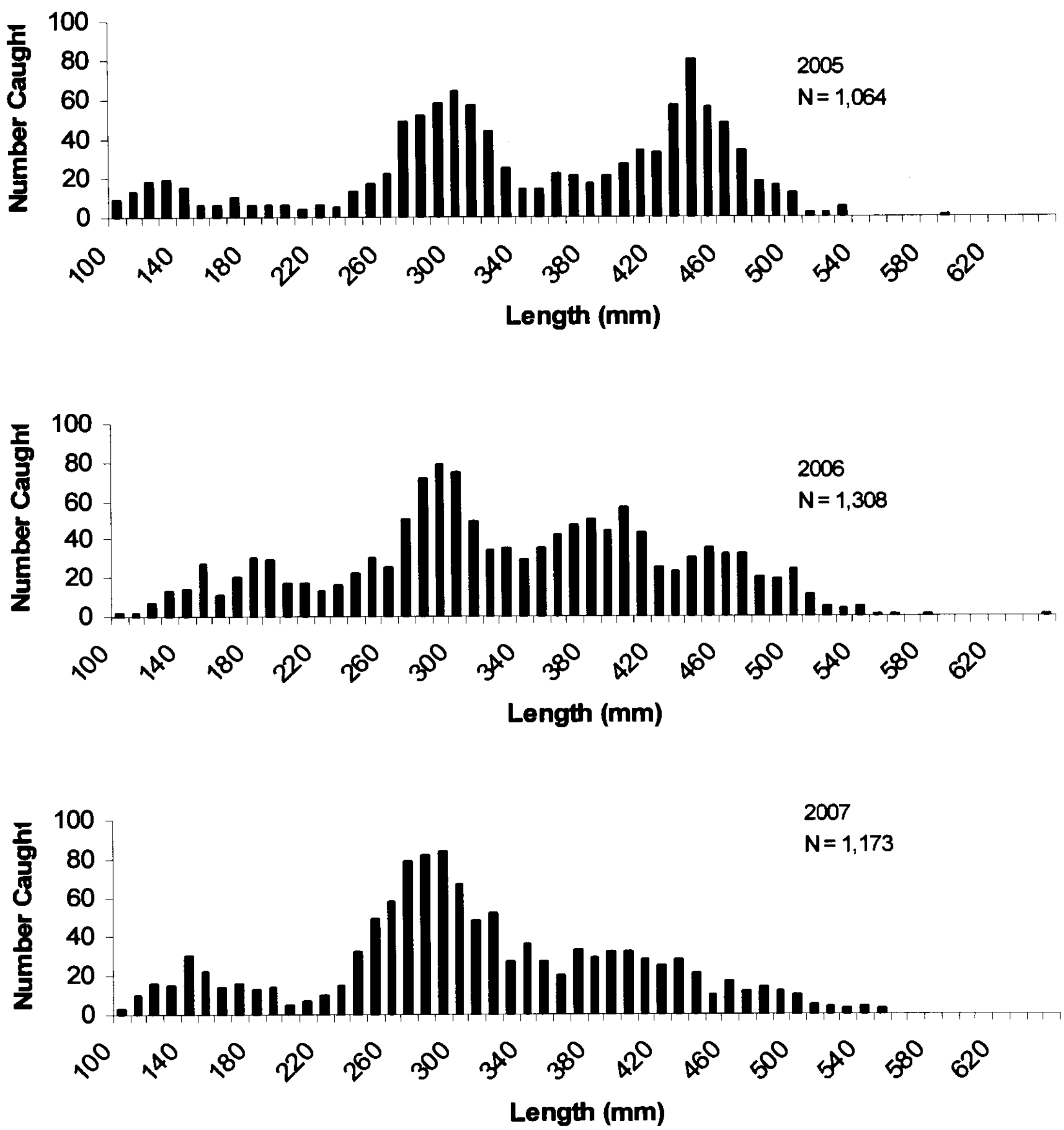


Figure 25. Length frequency distribution of rainbow trout in the Box Canyon reach of the Henrys Fork, Idaho from 2005 through 2007.

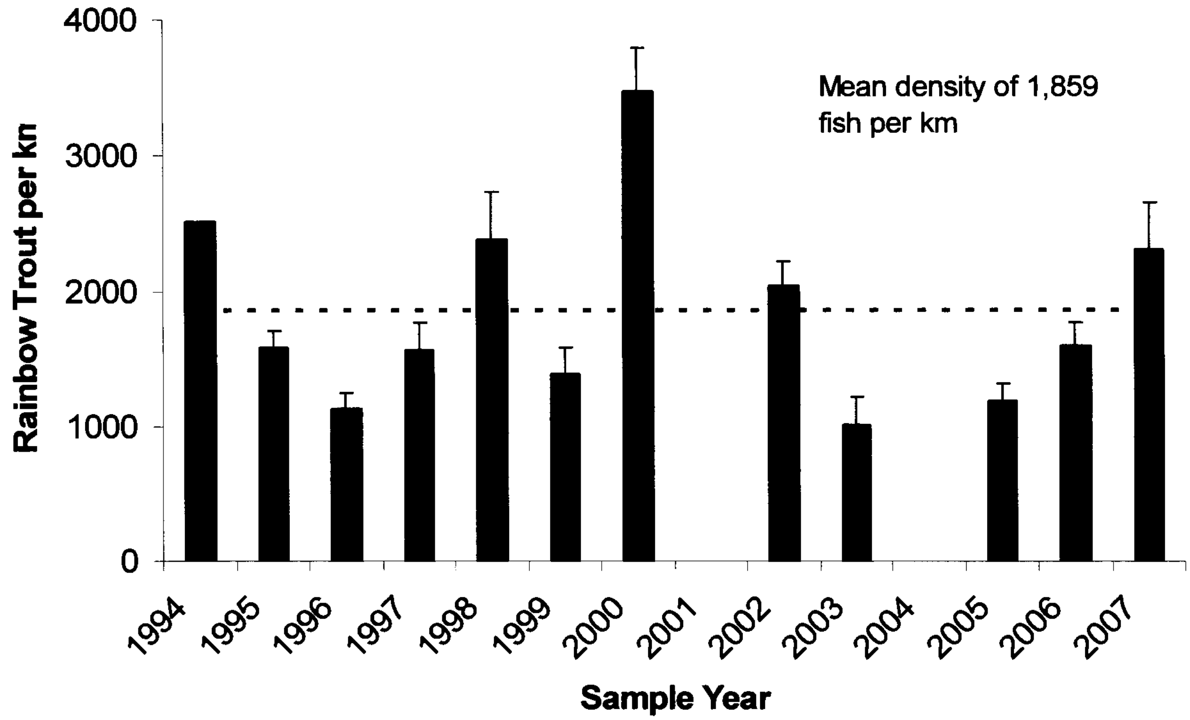


Figure 26. Population estimates for the Box Canyon reach of the Henrys Fork, Idaho 1994 to present.

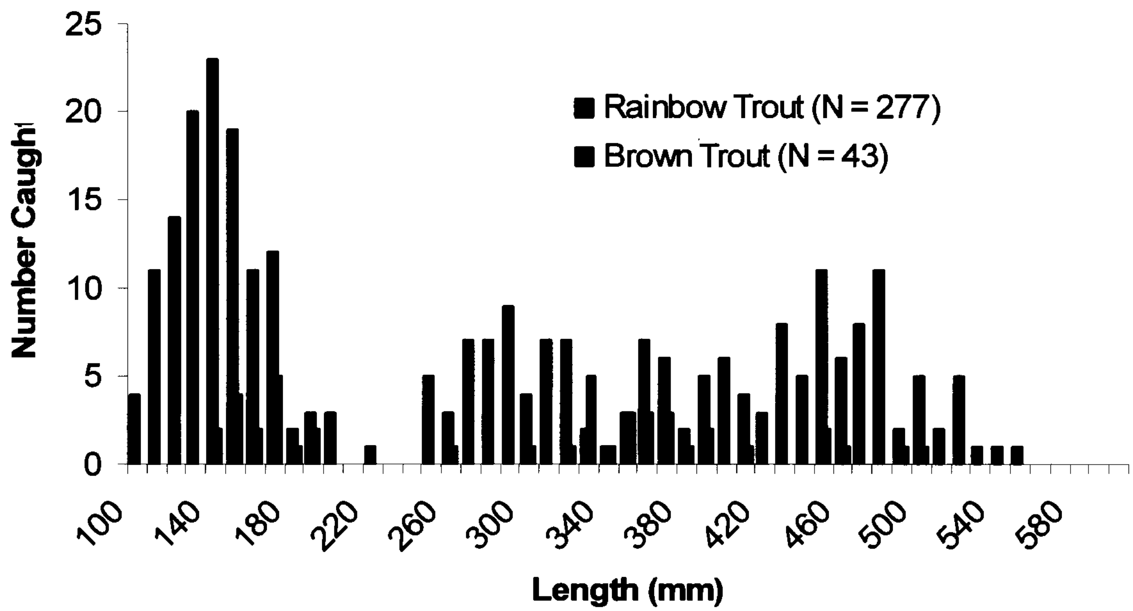


Figure 27. Length frequency distribution for brown trout and rainbow trout in the Vernon reach of the Henrys Fork, Idaho, 2007.

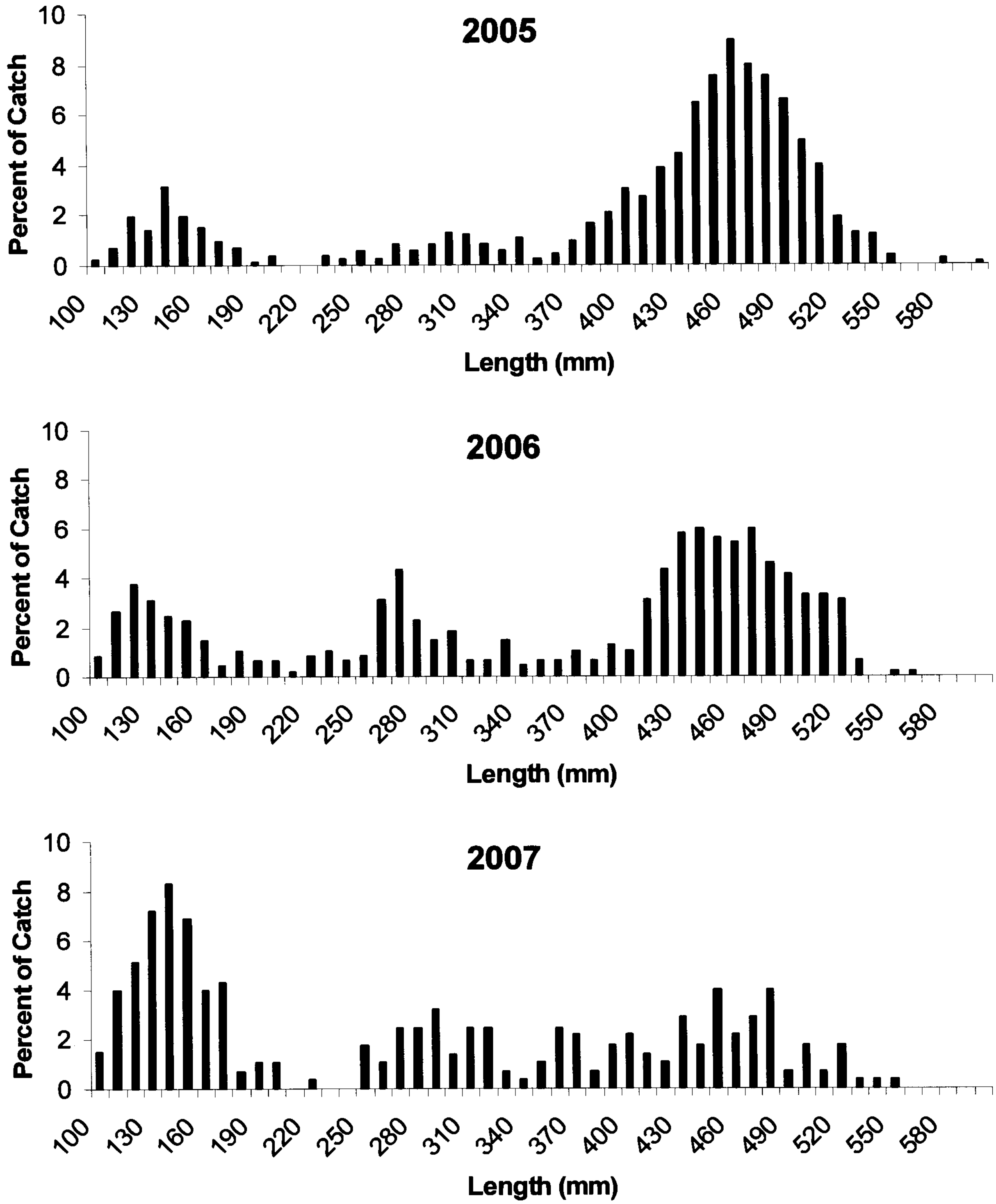


Figure 28. Length frequency distributions for rainbow trout in the Vernon reach of the Henrys Fork, Idaho.

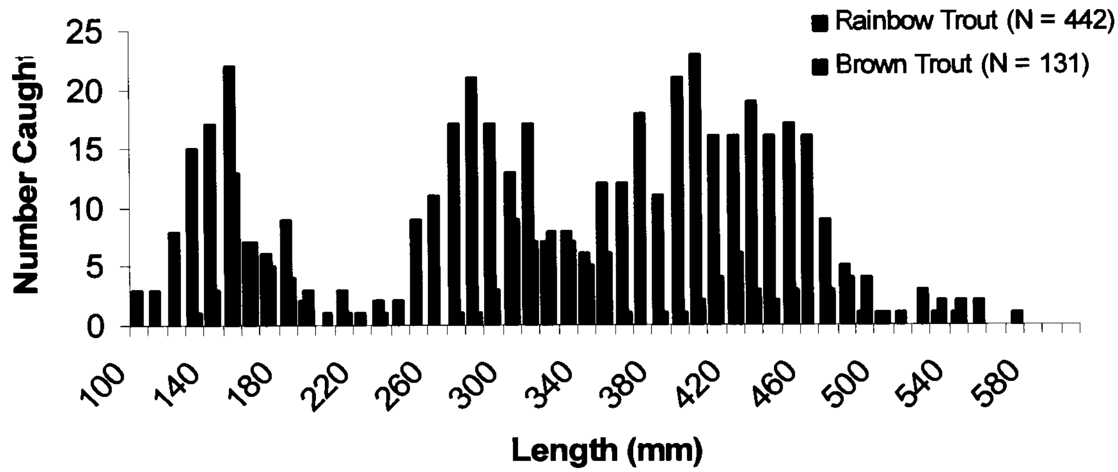


Figure 29. Length frequency distribution for rainbow and brown trout in the Chester reach of the Henrys Fork, Idaho 2007.

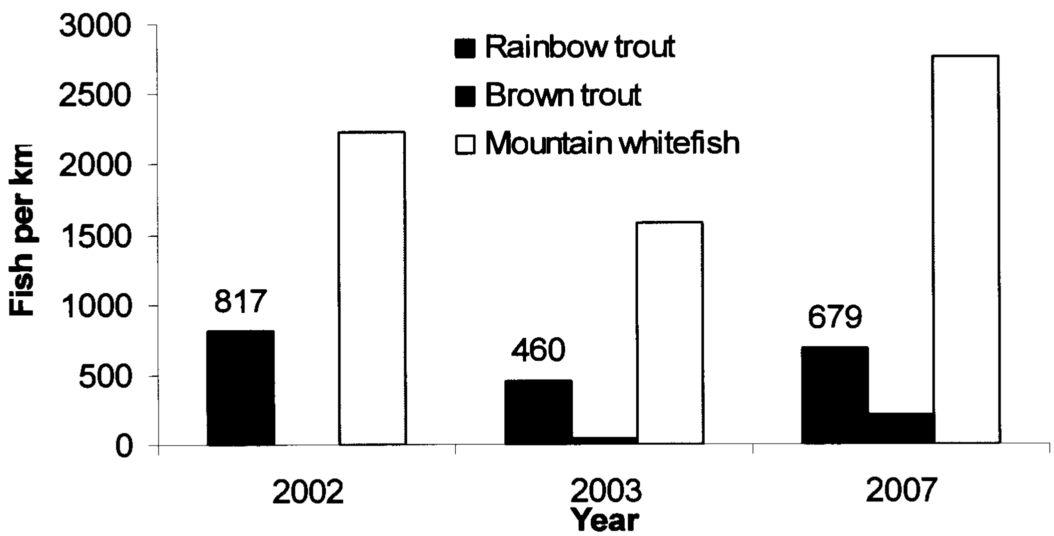


Figure 30. Population estimates for the Chester reach of the Henrys Fork Idaho, 2007.

Table 14. Salmonid population index summaries for the Henrys Fork, Idaho 2007.

River Reach	Mean Length (mm)	Median Length (mm)	RSD-400	RSD-500	Fish per km	Percent Contribution to Catch
Mack's Inn						
Yellowstone cutthroat trout	290	275	30	3	155	53
Rainbow trout	247	222	26	3	105	35
Brook trout	248	245	3	0	36	12
Mountain whitefish	372	390	49	2	770	--
Box Canyon						
Rainbow trout	312	300	22	3	2,311	97
Mountain whitefish	352	369	40	0	750	--
Vernon						
Rainbow trout	283	280	50	9	484	83
Brown Trout	297	332	22	4	96	17
Mountain whitefish	336	375	59	1	1,519	--
Chester						
Rainbow trout	323	340	41	1	417	77
Brown trout	325	325	44	12	132	23
Mountain whitefish	322	325	23	0	1,695	--

Table 15. Data used in population estimates from the Henrys Fork, Idaho during 2007 and flow levels during sampling.

River reach	Number Marked	Number Captured	Number Recaptured	Population Estimate	Confidence Interval (+/- 95%)	Density (No./ km)	Discharge (Q)
Mack's Inn							unavailable
All trout	177	103	12	1423	751-2,095	296	
Mountain whitefish	338	419	33	2850	2,925-5,448	770	
Box Canyon							540 cfs [a]
Rainbow trout	737	332	51	8,549	7,288-9810	2,311	
Mountain whitefish	304	244	26	2,787	1,857-3,717	753	
Vernon							1,750 cfs [b]
Rainbow trout [c]	108	98	4	2,130	--	484	
Brown trout [c]	22	18	1	424	--	96	
All trout	130	116	5	2,554	753-4,354	580	
Mountain whitefish							
Chester							1,750 cfs [b]
Rainbow trout [c]	195	201	9	2,375	--	417	
Brown trout [c]	46	79	12	750	--	132	
All trout	242	282	21	3,125	1,955-4,295	548	
Mountain whitefish	298	419	12	9,659	4,787-14,531	1,695	

[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.

TETON RIVER

ABSTRACT

We conducted electrofishing surveys on two reaches of the upper Teton River in September 2007 to monitor species composition and estimate densities. Relative abundance of the 830 trout handled at the Breckenridge reach was 4% cutthroat trout, 86% rainbow trout (includes hybrid rainbow x cutthroat – hereafter referred to as rainbow trout), and 10% brook trout. Brown trout comprised a small proportion of the trout abundance (<1%). Estimated densities in fish/km were 9 cutthroat trout, 379 rainbow trout, 63 brook trout, and 478 for all species combined. Mean total length was 365 mm for cutthroat trout, 274 mm for rainbow trout and 238 mm for brook trout. Relative stock density (RSD-400) was 22% for cutthroat trout and 11% for rainbow trout. Relative abundance of the 1,148 trout handled at the Nickerson reach was 11% cutthroat trout, 35% rainbow trout, 54% brook trout, and <1% brown trout. Estimated densities in fish/km were 43 cutthroat trout, 155 rainbow trout, 460 brook trout, and 691 for all species combined. Mean total length was 307 mm for cutthroat trout, 253 mm for rainbow trout and 219 mm for brook trout. Relative stock density (RSD-400) was 9% for cutthroat trout and 10% for rainbow trout. Yellowstone cutthroat trout in the Teton Valley have not rebounded from declines observed in the late 1990s. Densities of Yellowstone cutthroat trout have improved over 2003 estimates, and are similar to estimates from 2005, but remain below peak abundances. In contrast, densities of all trout combined has increased continually since the minimal estimate of 181 fish per km recorded in 1995, now estimated at 585 trout per km. Brown trout have been encountered during past electrofishing surveys in the upper Teton River, but 2007 was the first time more than a single brown trout was observed in any one location.

STUDY AREA AND METHODS

We surveyed trout populations at the Breckenridge reach on September 13 and 20 and at the Nickerson reach on September 12 and 19, 2007 (Table 16). Breckenridge and Nickerson have been the standard Idaho Department of Fish and Game (IDFG) monitoring reaches in the upper Teton River, or Teton Valley, since 1987 (Figure 31). They represent two different types of main river habitat in the Teton Valley – each responding differently to drought conditions – and they have different levels of fishing pressure. Fish population information from these two sections represents the most comprehensive and longest-running data set for the Teton River (Schrader and Brenden 2004; Garren et al. 2006). The Breckenridge section is 4.9 km long, averages 26 m wide, and is 12.7 ha in surface area. The Nickerson section is 5.8 km long, averages 42 m wide, and is about 24.4 ha in surface area.

Fish were captured using direct-current (DC) electrofishing gear (Coffelt VVP-15 powered by a Honda 5000 W generator) mounted in two drift boats. We used pulsed DC current through two boom-and-dangler anodes fixed to the bow while floating downstream. The boat hull was used as the cathode. VVP settings and conductivity readings were similar to past years (Garren et al. 2006).

We attempted to capture all trout encountered. After capture, fish were anesthetized, identified, and measured to the nearest millimeter for total length. Trout less than 150 mm (generally age-0) 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. Electrofishing data were analyzed using the computer program Mark Recapture 5.0 (MR5; Montana Department of Fish, Wildlife, and Parks 1994). 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 fish captured. Proportional stock density (PSD; Anderson 1980) was estimated using the number of individual fish captured greater than or equal to 300 mm divided by the number greater than or equal to 200 mm, multiplied by 100. Relative stock density (RSD-400) was calculated the same way with the numerator replaced by the number of fish greater than 399 mm. Density was estimated using two methods in the MR5 computer program. The log-likelihood method was preferred over the modified Peterson method if modeled efficiency curves were acceptable (term code=1 and at least one of two chi-square p-values>0.05).

RESULTS

Breckenridge

During 2007, a total of 830 trout were captured during two days of electrofishing at the Breckenridge section. Species composition and relative abundance were 4% cutthroat trout, 86% rainbow trout, 10% brook trout, and <1% brown trout (Figure 32, Table 17).

We combined the Breckenridge and Nickerson length frequency distributions due to small sample sizes of cutthroat trout. Ages were estimated based on lengths from the overall 1987-2007 frequency distributions and were not validated. For cutthroat trout, a lack of recruitment was evident by relatively weak groups of age-1 (about 100-200 mm) and age-2 (about 200-300 mm) juvenile fish (Figure 33). This is in contrast to 2005 when strong juvenile cutthroat trout age classes were observed. Similar to 2003 and 2005, strong groups of rainbow trout <300 mm were observed in 2007 (Figure 34). As with rainbow trout, brook trout length frequency distributions were similar among 2003, 2005, and 2007 (Figure 35). Mean length was 365 mm for cutthroat trout, 274 mm for rainbow trout and 238 mm for brook trout (Table 18). RSD-400 was 22% for cutthroat trout, 11% for rainbow trout and 0% for brook trout.

Electrofishing sampling efficiencies (R/C) ranged from 16% for brook trout to 41% for cutthroat trout (Table 19). Estimated densities in fish per kilometer were 9 cutthroat trout, 379 rainbow trout, 63 brook trout, and 478 for all species combined (Figure 36, Table 20).

Nickerson

A total of 1,148 trout were captured during two days of electrofishing at the Nickerson section. Relative abundance was 11% cutthroat trout, 35% rainbow trout, 54% brook trout, and <1% brown trout (Table 17, Figure 32). Four brown trout were caught in this reach.

Nickerson length frequency distributions were combined with those from Breckenridge due to small sample sizes. Results are presented in the section above. Mean TL was 307 mm for cutthroat trout, 253 mm for rainbow trout and 219 mm for brook trout (Table 18). Relative stock density - 400 was 9% for cutthroat trout, 10% for rainbow trout and 0% for brook trout. Electrofishing sampling efficiencies (R/C) ranged from 14% for brook trout to 27% for rainbow trout (Table 19). Estimated densities in fish per kilometer were 43 cutthroat trout, 155 rainbow trout, 460 brook trout, and 691 for all species combined (Figure 37, Table 20).

DISCUSSION

Teton River Yellowstone cutthroat trout populations have not rebounded from recent declines in abundance. From 1987 to 2007 the average Yellowstone cutthroat trout density was 93 trout/km (n = 10 years). In 2003, a substantial decrease in cutthroat trout populations in the Teton River was observed when densities fell to six cutthroat trout/km from 84 trout/km just three years previously (Garren et al. 2006). The 2007 estimate of 26 Yellowstone cutthroat trout per km (both reaches combined) is an improvement over 2003 estimates, but densities remain well below the long-term average. Trout populations in a riverine environment typical go through cycles of relatively low and high abundance (Meehan 1991), but cutthroat trout abundances have remained below their ten-year average in the Teton River upper valley for seven years. While an increase was observed between 2003 and 2005, no change was evident from 2005 to 2007. Recruitment of young Yellowstone cutthroat trout as evident in length frequencies of smaller fish are lacking. Mean lengths reflect this, at 319 mm in 2007 compared to the long-term average of 264 mm. It is likely that drought conditions and hydrologic alterations as irrigation moves from flood to sprinkler and farms turn to residences in the Teton Valley have impacted cutthroat trout populations (Van Kirk and Jenkins 2005) despite no-harvest regulations on cutthroat trout.

Brown trout have infrequently been observed during past surveys in the Teton Valley. In the past, these encounters have consisted of a single fish only. Therefore, the 2007 catch of five brown trout at the Breckenridge section and four brown trout at the Nickerson section were alarming. There is currently no evidence of natural reproduction, as all brown trout encountered in 2007 were adults in excess of 300 mm – no juvenile brown trout were found. IDFG has not stocked brown trout into the Teton River so brown trout have either expanded their distribution upstream from the Henrys Fork Snake River or have been illegally introduced. It is unlikely that brown trout have expanded their distribution from downstream sources, as the opportunity to do so has been present since the 1980's when brown trout were first introduced to the Henrys Fork. The upper Teton River is approximately 75 km upstream of the confluence with the Henrys Fork Snake River, and brown trout range expansion over this distance has not been documented.

Populations of other salmonid species in the upper Teton River are stable or increasing. Rainbow trout density remained high at 267 trout/km compared to the 1987-2007 average of 153 trout/km. Good recruitment as shown by a strong year class of age-0 rainbow trout was reflected in the length-frequency distribution in 2007. The continued high density of rainbow trout above their long-term average is opposite the trend of cutthroat trout and supports Van Kirk and Jenkins (2005) proposition that hydrologic alteration in the Teton Valley, particularly low maximum/minimum discharge ratios during the recent groundwater-dominated drought years, favors rainbow trout over cutthroat trout recruitment.

ACKNOWLEDGEMENTS

Steve Schmidt, Curtis Hendricks, Josh Rydalch, Rusty Robinson, and Dan Duggan helped with electrofishing. Fishery technicians Trapper Bradshaw and Nathan Fincher helped with electrofishing and entered data.

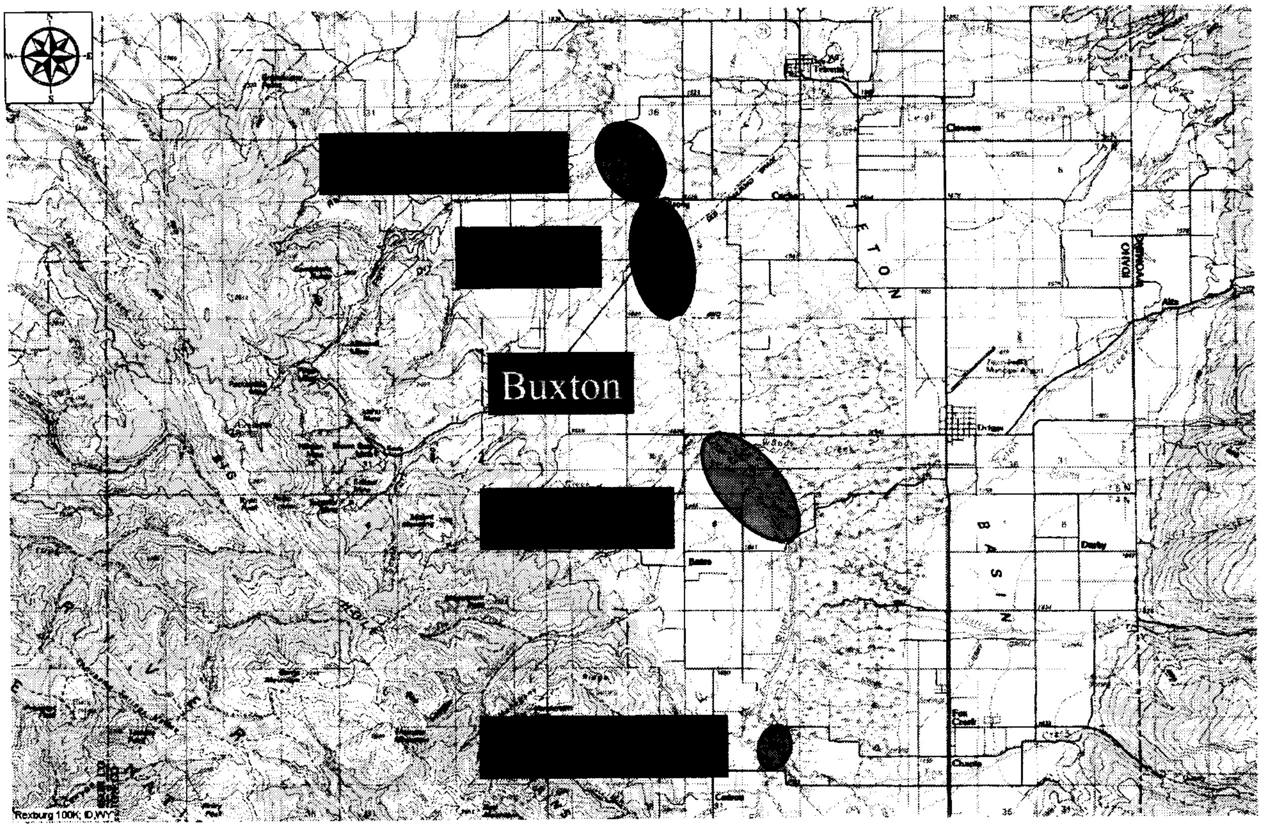
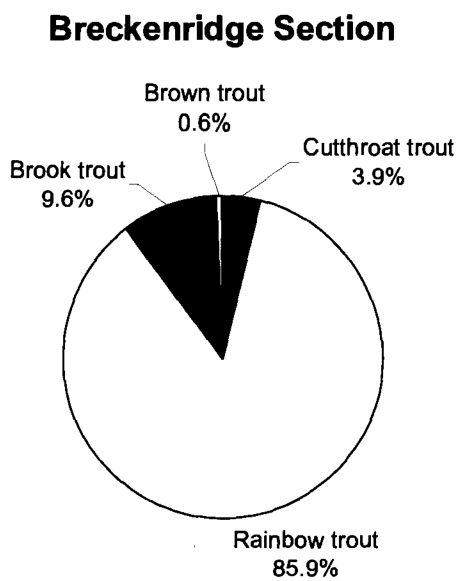


Figure 31. Map of Teton Valley showing IDFG electrofishing sections in the Teton River, Idaho.



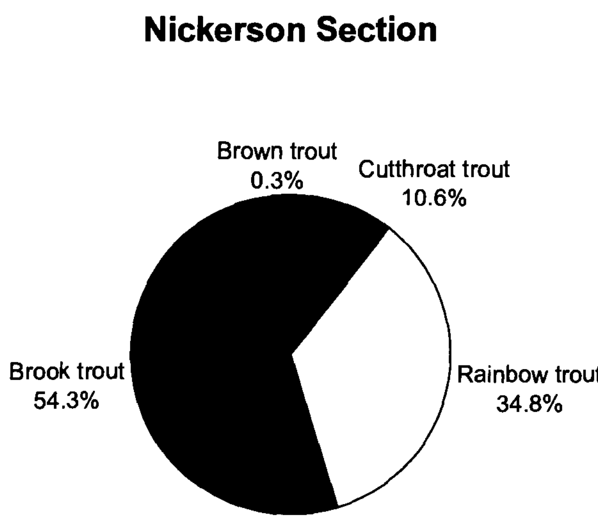


Figure 32. Trout species composition and relative abundance at the Breckenridge (top, n = 830) and Nickerson (bottom, n = 1,148) electrofishing sections, Teton River, Idaho, 2007.

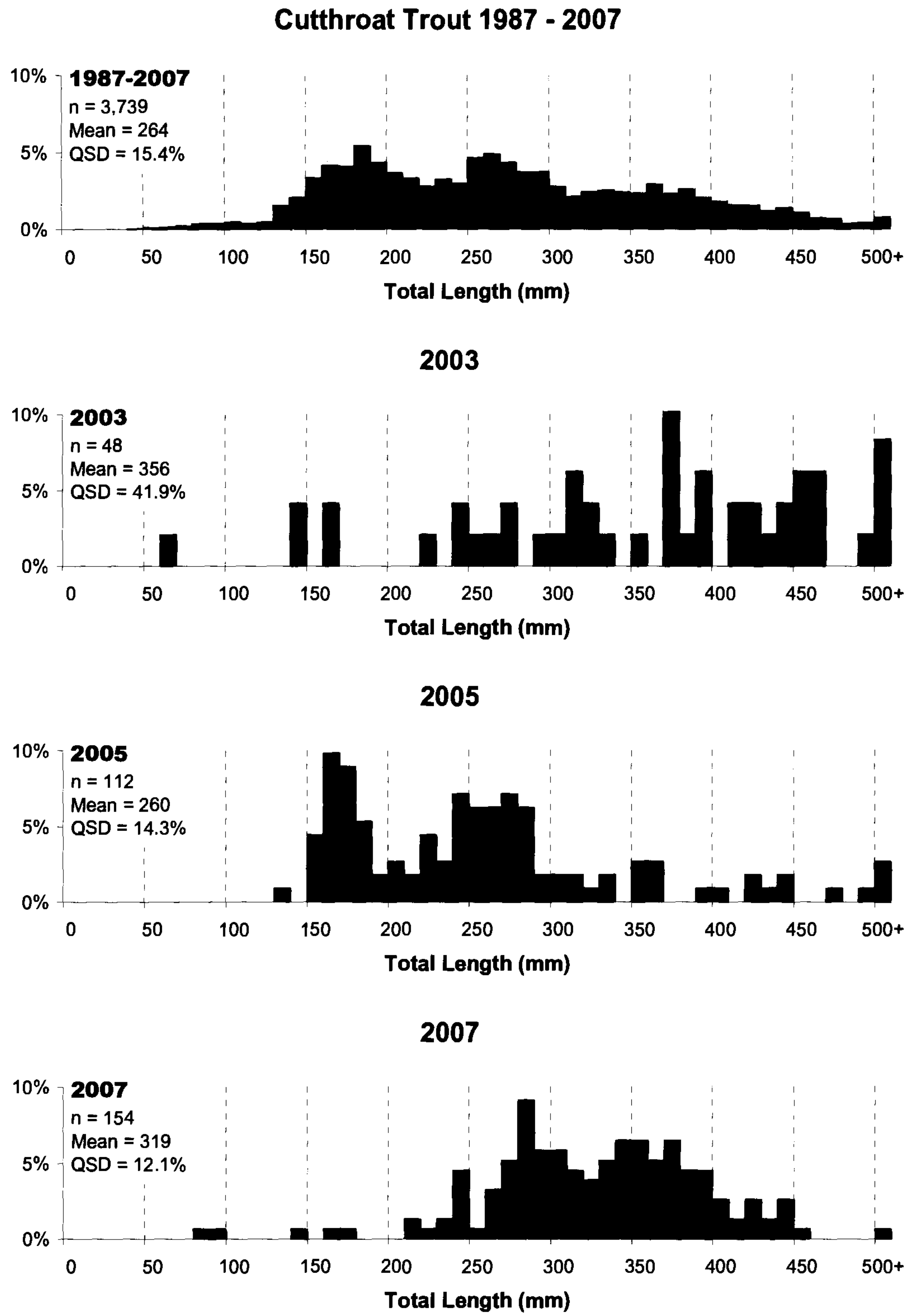


Figure 33. Length frequency distributions of cutthroat trout captured at all Teton Valley electrofishing sections combined, Teton River, Idaho, 1987-2005. Total individual fish captured during mark and recapture runs = n.

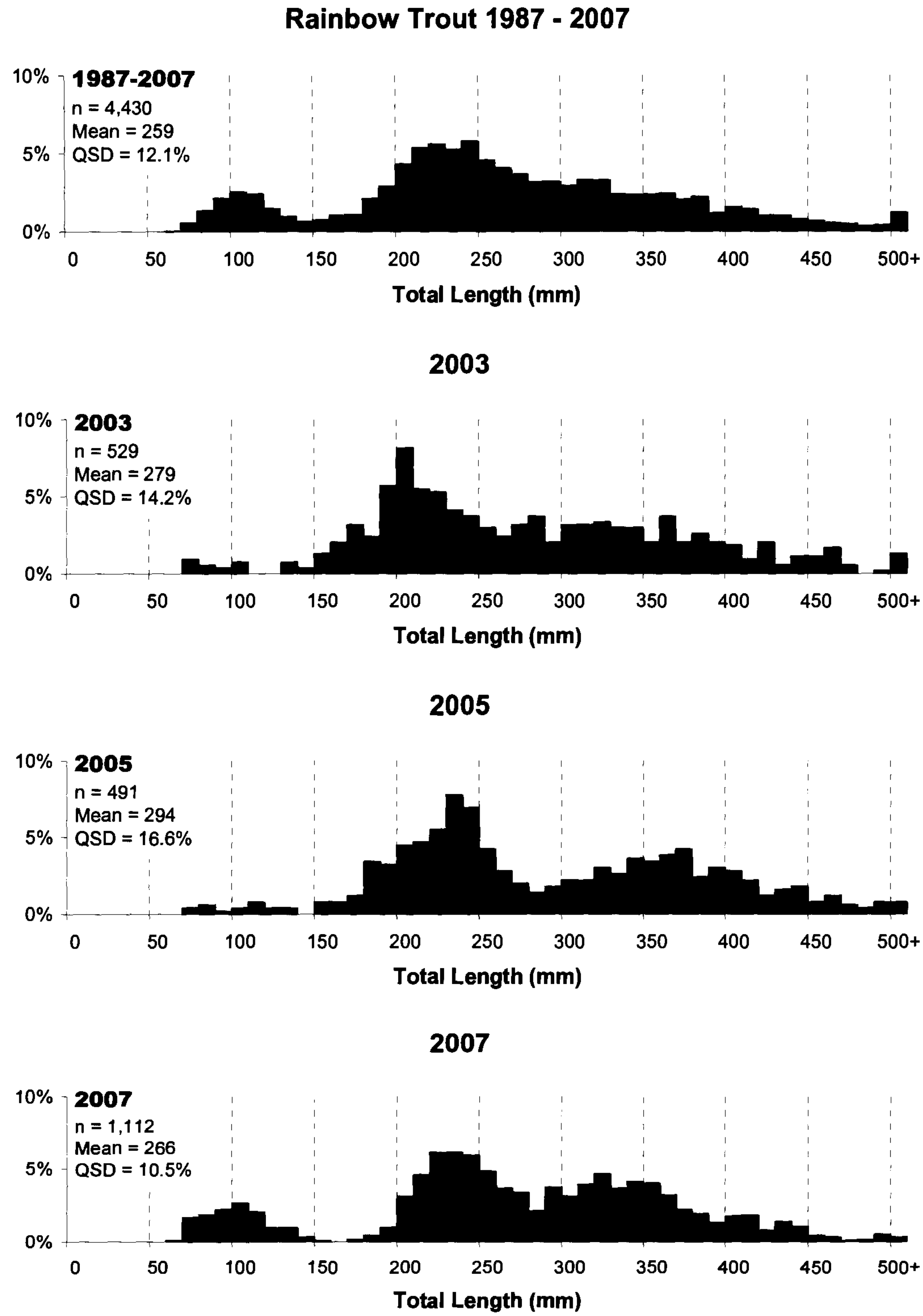


Figure 34. Length frequency distributions of rainbow trout captured at all Teton Valley electrofishing sections combined, Teton River, Idaho, 1987-2007. Total individual fish captured during mark and recapture runs = n.

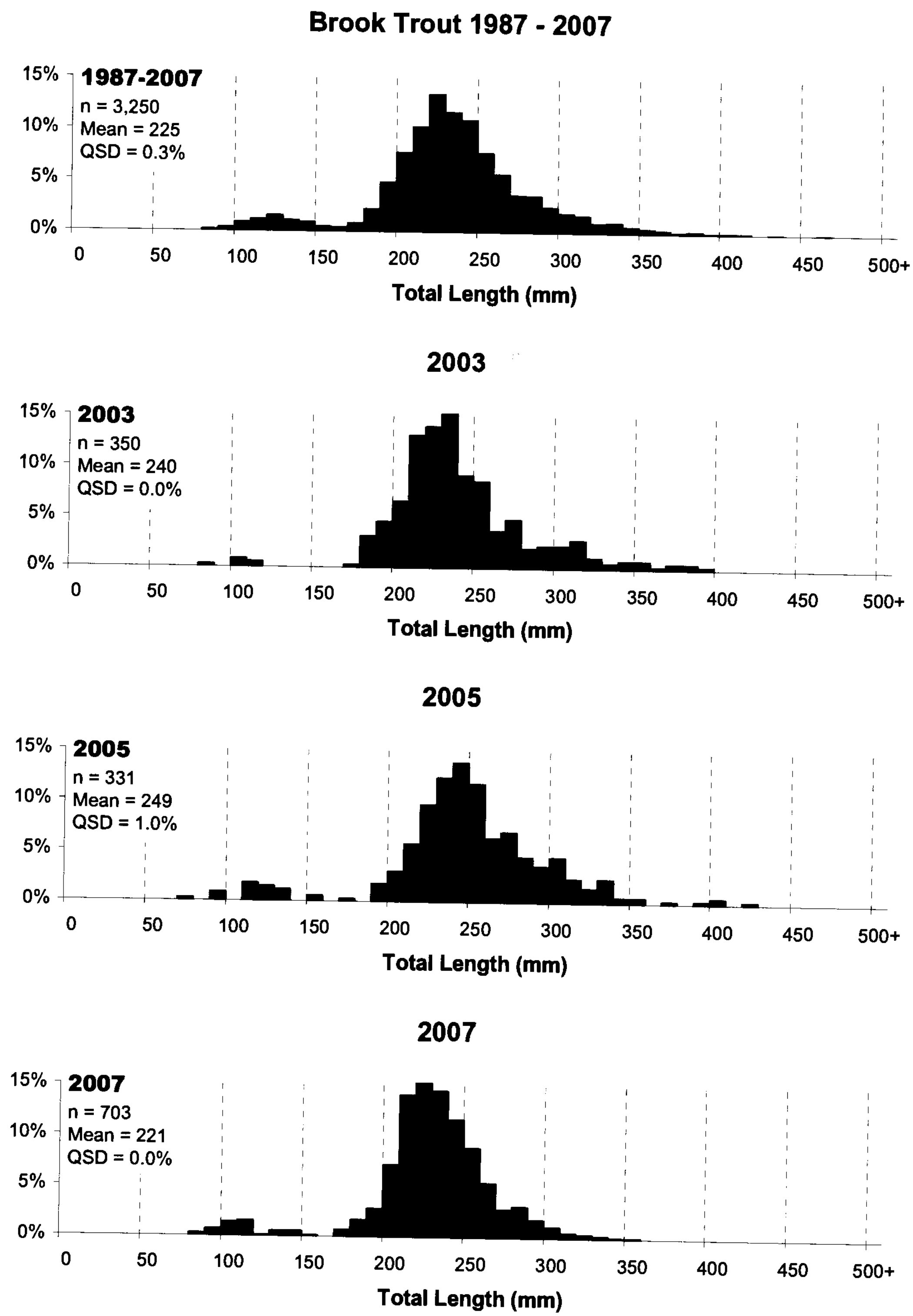


Figure 35. Length frequency distributions of brook trout captured at all Teton Valley electrofishing sections combined, Teton River, Idaho, 1987-2007. Total individual fish captured during mark and recapture runs = n.

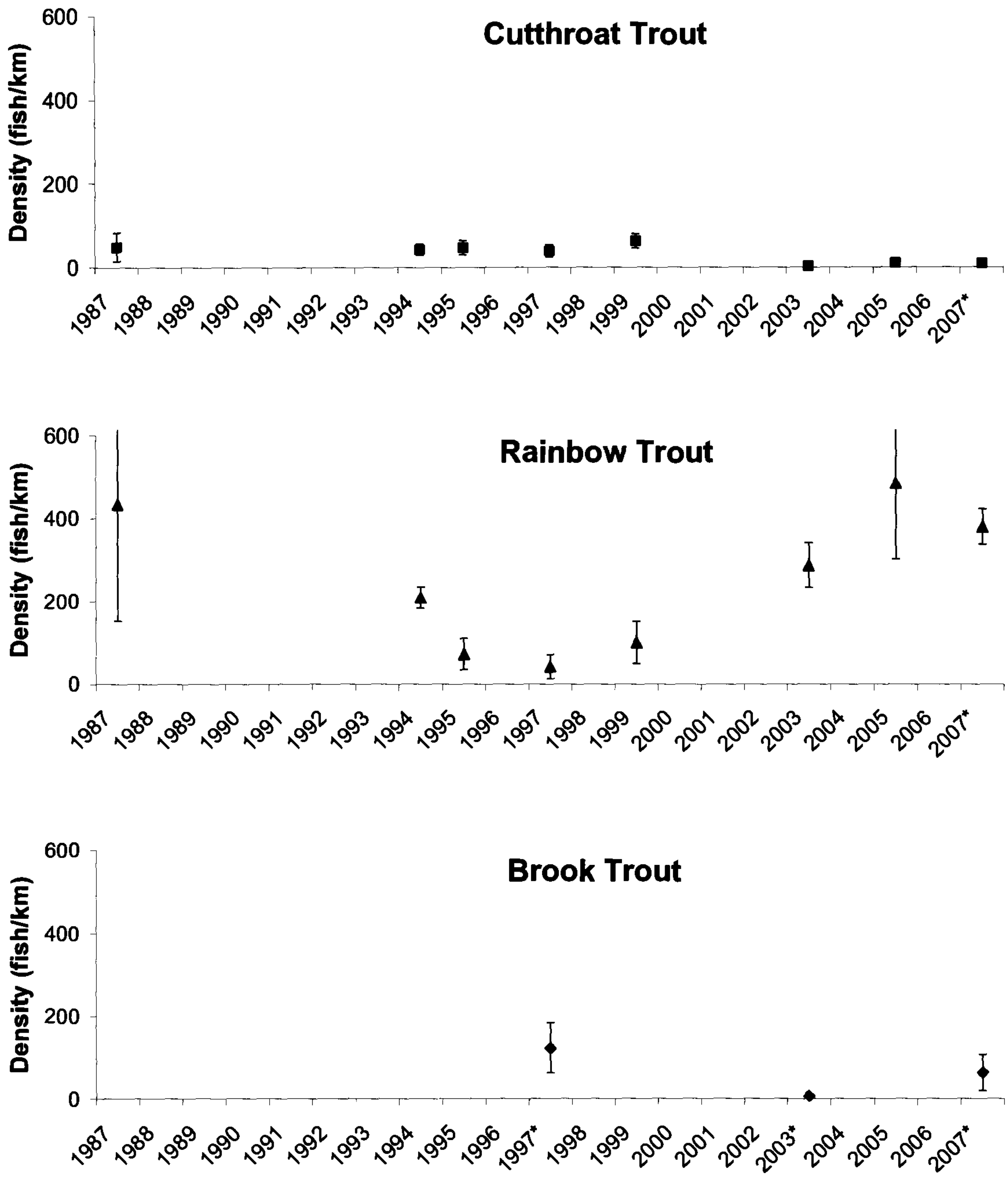


Figure 36. Estimated densities of age-1 and older cutthroat, rainbow, and brook trout at the Breckenridge electrofishing section, Teton River, Idaho, 1987-2007. Asterisks denote years when estimates were for fish 150 mm and larger.

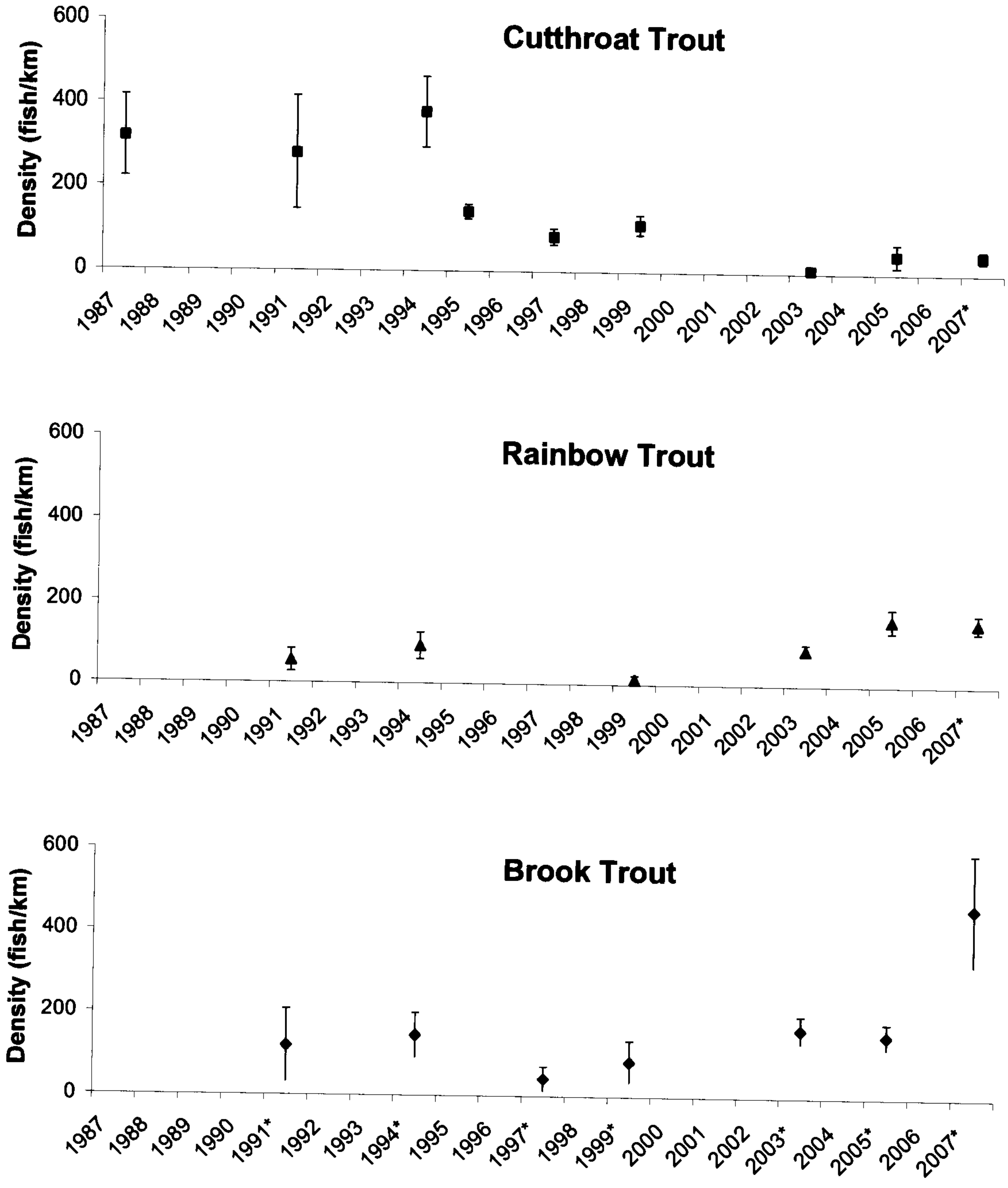


Figure 37. Estimated densities of age-1 and older cutthroat, rainbow, and brook trout at the Nickerson electrofishing section, Teton River, Idaho, 1987-2007. Asterisks denote years when estimates were for fish 150 mm and larger.

Table 16. Survey dates and number of electrofishing runs conducted at the Breckenridge and Nickerson sections, Teton River, Idaho, 1987-2007.

Section and year	First marking run date	Last recapture run date	Lapsed days	Total number of runs	Number of recapture runs
Breckenridge:					
1987	Oct 1	Oct 26	25	3	1
1991	Oct 3	---[a]	---	1	---
1994	Aug 30	Sept 14	15	3	1
1995	Sept 14	Sept 21	7	3	1
1997	Sept 23	Oct 1	8	3	1
1999	Sept 28	Oct 8	10	4	2
2003	Aug 29	Sept 4	6	4	2
2005	Sept 8	Sept 15	7	4	2
2007	Sept 13	Sept 20	7	2	1
Nickerson:					
1987	Sept 11	Sept 25	14	3	1
1991	Sept 12	Sept 20	8	2	1
1994	Sept 9	Sept 21	12	3	1
1995	Sept 27	Oct 3	6	3	1
1997	Sept 2	Sept 11	9	4	2
1999	Aug 31	Sept 9	9	3[b]	1
2003	Sept 3	Sept 9	6	4	2
2005	Sept 7	Sept 14	7	4	2
2007	Sept 12	Sept 19	7	2	1

[a] No recapture runs due to equipment failure.
[b] Took two days to complete one run due to equipment failure.

Table 17. Trout species composition and relative abundance (%) at the Breckenridge and Nickerson electrofishing sections, Teton River, Idaho, 1987-2007. Total individual fish captured during mark and recapture runs equals n.

Year	Cutthroat trout[a]		Rainbow trout[b]		Brook trout		Brown trout		Total	
	%	n	%	n	%	n	%	n	%	n
Breckenridge										
1987	15.3	66	69.9	302	14.8	64	0.0	0	100.0	432
1991	27.8	5	66.7	12	5.6	1	0.0	0	100.0	18
1994	18.3	94	76.4	392	5.3	27	0.0	0	100.0	513
1995	39.9	103	43.0	111	17.1	44	0.0	0	100.0	258
1997	29.8	77	24.8	64	45.3	117	0.0	0	100.0	258
1999	44.4	107	37.3	90	18.3	44	0.0	0	100.0	241
2003	3.4	13	90.1	344	6.5	25	0.0	0	100.0	382
2005	10.2	32	82.8	260	7.0	22	0.0	0	100.0	314
2007	3.9	32	85.9	713	9.6	80	0.6	5	100.0	830
Nickerson										
1987	52.5	307	6.7	39	40.9	239	0.0	0	100.0	585
1991	46.6	178	20.9	80	32.5	124	0.0	0	100.0	382
1994	55.6	440	19.1	151	25.3	200	0.1	1	100.0	792
1995	78.2	352	5.8	26	16.0	72	0.0	0	100.0	450
1997	63.8	166	8.1	21	28.1	73	0.0	0	100.0	260
1999	55.8	188	11.3	38	32.9	111	0.0	0	100.0	337
2003	6.4	35	33.9	185	59.6	325	0.0	0	100.0	545
2005	12.9	80	37.2	231	49.8	309	0.2	1	100.0	621
2007	10.6	122	34.8	399	54.3	623	0.3	4	100.0	1,148

[a] Includes hatchery cutthroat trout planted as fingerlings through 1991.

[b] Includes hybrids, but does not include hatchery rainbow trout planted as catchables through 1994.

Table 18. Mean total length and relative stock density (RSD) of trout captured at the Breckenridge and Nickerson electrofishing sections, Teton River, Idaho, 1987-2007. Total individual fish captured during mark and recapture runs equals n. RSD = (number ≥400 mm / number ≥200 mm) x 100.

Year	Cutthroat trout[a]			Rainbow trout[b]			Brook trout			All trout[c]		
	Mean (mm)	RSD (%)	n	Mean (mm)	RSD (%)	n	Mean (mm)	RSD (%)	n	Mean (mm)	RSD (%)	n
Breckenridge												
1987	223	8.3	66	207	4.7	302	216	2.3	64	211	4.8	432
1991	134	0.0	5	297	9.1	12	220	0.0	1	247	8.3	18
1994	268	14.7	94	247	5.1	392	208	0.0	27	249	6.8	513
1995	296	17.2	103	286	14.7	111	227	0.0	44	280	13.5	258
1997	341	50.7	77	239	27.0	64	252	0.0	117	275	21.6	258
1999	325	19.0	107	291	11.6	90	270	0.0	44	302	12.8	241
2003	400	66.7	13	265	9.8	344	247	0.0	25	269	11.6	382
2005	291	25.0	32	290	18.4	260	251	0.0	22	291	18.5	314
2007	365	21.9	32	274	11.1	713	238	0.0	80	274	10.4	830
Nickerson												
1987	208	1.4	307	246	0.0	39	193	0.0	239	204	0.6	585
1991	233	3.0	178	282	11.1	80	213	0.0	124	236	4.1	382
1994	241	7.4	440	237	11.9	151	207	0.0	200	232	6.5	792
1995	277	14.1	352	316	43.5	26	230	0.0	72	271	13.6	450
1997	304	50.4	166	311	71.4	21	256	0.0	73	291	35.7	260
1999	284	13.4	188	361	34.2	38	248	0.0	111	281	11.4	337
2003	339	32.3	35	305	21.0	185	240	0.0	325	268	9.1	545
2005	248	9.4	80	298	14.8	231	248	1.1	309	267	7.4	621
2007	307	9.4	122	253	9.5	399	219	0.0	623	240	4.2	1,148

[a] Includes hatchery cutthroat trout planted as fingerlings through 1991.

[b] Includes hybrids, but does not include hatchery rainbow trout planted as catchables through 1994.

[c] Includes brown trout.

Table 19. Mark recapture statistics for the Breckenridge and Nickerson electrofishing sections, Teton River, Idaho, 1987-2007. Cases where R≤3 and unbiased density estimates are not possible (Ricker 1975) are highlighted.

Year	Cutthroat trout[a]				Rainbow trout[b]				Brook trout				All trout[c]			
	M[d]	C[d]	R[d]	R/C (%)	M	C	R	R/C (%)	M	C	R	R/C (%)	M	C	R	R/C (%)
Breckenridge																
1987	41	29	4	14	214	94	6	6	51	13	0	0	306	136	10	7
1991	5	ND[e]	ND	ND	12	ND	ND	ND	1	ND	ND	ND	18	ND	ND	ND
1994	63	56	25	45	268	181	57	31	20	9	2	22	351	246	84	34
1995	78	37	12	32	77	41	7	17	32	15	3	20	187	93	22	24
1997	50	36	9	25	30	38	4	11	76	48	7	15	156	122	20	16
1999	66	58	17	29	55	41	6	15	29	17	2	12	150	116	25	22
2003	11	7	5	71	234	149	39	26	9	22	6	27	254	178	50	28
2005	25	12	5	42	136	137	13	9	15	8	1	13	176	157	19	12
2007	19	22	9	41	394	335	88	26	59	25	4	16	474	384	101	26
Nickerson																
1987	145	177	15	8	25	15	1	7	140	102	3	3	310	294	19	6
1991	90	96	8	8	47	39	6	15	63	65	4	6	200	200	18	9
1994	276	196	32	16	104	59	12	20	120	93	13	14	501	348	57	16
1995	241	165	54	33	23	4	1	25	58	15	1	7	322	184	56	30
1997	70	122	26	21	12	12	3	25	48	29	4	14	130	163	33	20
1999	121	98	31	32	24	19	5	26	75	43	7	16	220	160	43	27
2003	25	18	8	44	104	110	29	26	193	169	37	22	322	297	74	25
2005	24	61	5	8	107	145	21	14	150	191	32	17	282	397	58	15
2007	64	73	18	25	212	150	41	27	382	236	33	14	662	460	93	20

[a] Includes hatchery cutthroat trout planted as fingerlings through 1991.
[b] Includes hybrids, but does not include hatchery rainbow trout planted as catchables through 1994.
[c] Includes brown trout.
[d] 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.
[e] ND = no data; no recapture runs due to equipment failure.

Table 20. Estimated abundance (N) of age-1 and older cutthroat trout (≥100 mm), rainbow trout (≥100 mm), brook trout (≥150 mm), and all trout (≥100 mm) at the Breckenridge and Nickerson electrofishing sections, Teton River, Idaho, 1987-2007. Ninety-five percent confidence intervals (1.96 x SD) are in parentheses.

First marking date	Cutthroat trout[a]		Rainbow trout[b]		Brook trout		All trout[c]	
	N/section	N/km	N/section	N/km	N/section	N/km	N/section	N/km
Breckenridge								
10/1/87	245[d] (168)	50[d] (34)	2,124[d] (1,382)	433[d] (282)	NUE[e]	NUE	3,520 (1,354)	718 (276)
10/3/91	NE[f]	NE	NE	NE	NE	NE	NE	NE
8/30/94	213 (66)	43 (14)	1,023 (126)	209 (26)	NUE	NUE	1,340 (135)	273 (28)
9/14/95	235 (84)	48 (17)	349 (180)	71 (37)	NUE	NUE	744 (169)	152 (34)
9/23/97	199 (72)	41 (15)	204[d] (138)	42[d] (28)	604 (299)	123 (61)	1,357 (266)	277 (54)
9/28/99	316 (84)	64 (17)	485 (245)	99 (50)	NUE	NUE	937 (187)	191 (38)
8/29/03	15[d] (4)	3[d] (1)	1,405 (266)	287 (54)	32[d] (10)	7[d] (2)	1,364 (213)	278 (43)
9/8/05	55[d] (27)	11[d] (5)	2,375 (895)	485 (183)	NUE	NUE	2,369 (672)	483 (137)
9/13/07[g]	45[d] (15)	9[d] (3)	1,858 (209)	379 (43)	311[d] (215)	63[d] (44)	2,343 (266)	478 (54)
Nickerson								
9/11/87	1,851 (563)	319 (97)	NUE	NUE	NUE	NUE	4,985 (1,200)	859 (207)
9/12/91	1,628 (788)	281 (136)	317 (161)	55 (28)	695[d] (510)	120[d] (88)	2,879 (635)	496 (110)
9/9/94	2,200 (484)	379 (83)	533 (189)	92 (33)	849 (312)	146 (54)	3,647 (420)	629 (72)
9/27/95	814 (99)	140 (17)	NUE	NUE	NUE	NUE	1,217 (139)	210 (24)
9/2/97	479 (108)	83 (19)	NUE	NUE	253[d] (173)	44[d] (30)	996 (187)	172 (32)
8/31/99	645 (134)	111 (23)	82[d] (45)	14[d] (8)	499 (292)	86 (50)	1,133 (141)	195 (24)
9/3/03	52[d] (19)	9[d] (3)	504 (80)	87 (14)	956 (189)	165 (33)	1,569 (166)	271 (29)
9/7/05	257[d] (159)	44[d] (27)	933 (169)	161 (29)	879 (173)	152 (30)	1,960 (211)	338 (36)
9/12/07[g]	252[d] (81)	43[d] (14)	898 (130)	155 (22)	2,669 (781)	460 (135)	4,010 (466)	691 (81)

[a] Includes hatchery cutthroat trout planted as fingerlings through 1991.
[b] Includes hybrids, but does not include hatchery rainbow trout planted as catchables through 1994.
[c] Includes brown trout.
[d] Modified Peterson rather than log-likelihood estimate.
[e] NUE = no unbiased estimate possible as R≤3 (Ricker 1975).
[f] NE = no estimate; no recapture runs due to equipment failure.
[g] Estimates for fish >150 mm

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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

Appendix B. Available creel survey data since 1950 for Island Park Reservoir.

Year	Effort (*1000 h)	Catch	Harvest	Catch rate	Catch composition					
					YCT	HYB	RBT	BKT	Coho	KOK
1950	47.737			0.37	5		87	7	0	0.6
1951	70.834			0.46	1.4		79	5	0	15
1953				0.32	1.7		89	2.7	0	7
1954				0.57						
1958					1		86	9	0	4
1960	75.668			0.82	0.1		99	0.7	0	0.3
1961							91	1	0	8
1963				0.5	0.3		96	0.6	0	2.6
1964				0.8			69			26
1965	107.789			0.43	1		84	8	0	7
1966				0.9	0.4		74	12	0	13
1967	92.95			0.54	0		93	4	3	0
1968	176.01			0.59	0		74	3	22	0
1969				0.56	0.6		43	1.1	39	16
1970				0.21	2		54	12	20	12
1971				0.33	0.7		54	6	19	19
1972				0.55	0		44	2	24	30
1973				0.36	0.2		66	2	12	19
1974				0.54	1		29	0.3	3	66
1975				0.23	0	1	50	1	25	24
1976				0.33	0		48	10	27	15
1977				0.7	0		41	8	40	18
1978				0.15	0		100	0	0	0
1980				0.7	0		100	0	0	0
1981	70.82	31380		0.44	0.0002		91	1	8	0.6
1982	124.442	28536		0.23	0	0	89	3	4	4
1989	49.09			0.30						
1990				0.14						
1991										
1994	41.308			0.2						
1995				0.40						
2007	45.116	22559	15340	0.5						

YCT=Yellowstone cutthroat; HYB=rainbow x cutthroat hybrid; RBT=rainbow trout; KOK=kokanee salmon

Appendix C. Estimated catch rates and related stocking records of rainbow trout in Island Park Reservoir.

		Same year		1 yr prior	2 yr prior	3 yr prior	
Year	Catch/hr	# Spring catchables	# Fall catchables	# Spring fingerlings	# Fall fingerlings	# Spring fry	# Fall fry
1970	0.21	2,220	0	0	198,940	0	45,900
1971	0.33	0	0	0	0	66,000	92,020
1972	0.55	0	0	68,200	188,150	332,000	0
1973	0.36	0	1,000	3,950	46,900	0	190,000
1974	0.54	0	0	4,000	93,600	218,608	0
1975	0.23	0	0	0	244,914	295,450	204,800
1976	0.33	0	0	0	60,000	264,800	0
1977	0.70	0	0	302,500	0	0	0
1978	0.15	13,500	0	0	0	0	0
1980	0.70	62,500	0	0	0	0	0
1981	0.44	5,795	31,815	330,835	172,375	0	0
1982	0.23	45,010	55,970	217,240	88,525	0	0
1989	0.30	0	0	0	0	0	0
1990	0.14	12,180	30,551	276,150	0	0	0
1994	0.20	0	0	5,932	0	0	0
1995	0.40	12,000	0	0	0	0	0
2007	0.50	41,148	4,030	143,300	0	0	64,900

Appendix D. Actions identified in the Mountain Whitefish Conservation and Management Plan for the Big Lost River Drainage, Idaho that were completed during 2007.

Status of management objectives by management area and updates as of June 20, 2008.

Management Area	Objective	Status of Objective	Discussion	Progress
Above Mackay Dam	Distribution: Establish and maintain mountain whitefish in 1) the Big Lost River between the Chilly Diversion and North Fork Big Lost River and 2) at least three of the following tributaries: a) North For Big Lost River, b) East Fork Big Lost River, c) Wildhorse Creek, or d) Star Hope Creek.	Not Met	Initial sampling completed in 2003- 2005 indicated that mountain whitefish were present in the Big Lost River between the Chilly Diversion and North Fork, and the East Fork. However, mountain whitefish were not detected in North Fork of the Big Lost River, Wildhorse Creek or Star Hope Creek. After this sampling work mountain whitefish were released into the North Fork from salvage efforts. Follow up sampling indicated that small numbers of fish were again present in the North Fork. In order to achieve this objective, mountain whitefish need to remain established in the North Fork Big Lost River and be reestablished in either Wildhorse Creek or Star Hope Creek.	1. Objective met 2. Objective not met. Populations established in East Fork and Wildhorse Creek but still need one additional population in either North Fork Big Lost River or Star Hope Creek.
	Abundance: Establish and maintain at least 5,000 adult fish (>200 mm) with at least 100 adults in each occupied stream reach	Not Met	Sampling completed in 2003 - 2005 indicates that the adult abundance in this management area is approximately 2,000 fish. The adult abundance is about 1,700 fish in the Big Lost River between the Chilly Diversion and North Fork, and about 300 in the East Fork. In order to achieve this objective, overall adult abundance needs to increase by about 3,000 with at least 100 adults occurring in at least two of the following streams: Wildhorse Creek, Star Hope Creek, or the North Fork.	Have over 5,000 adult fish above Mackay Dam with at least 100 adult fish in the Big Lost River between Chilly Diversion and North Fork Big Lost River and in East Fork Big Lost River. Still need more than 100 adult fish in Wildhorse Ceek and still need one additional population in either North Fork Big Lost River or Star Hope Creek.
	Connectivity: Establish and maintain natural levels of connectivity sufficient for all age classes to make natural movements in all historically occupied habitat. In that section of the Big Lost River between the Chilly Diversion and Mackay Dam this objective does not apply to stream flows.	Not Met	Irrigation diversions create partial and/or seasonal barriers in three locations. This includes the 6X, Chilly, and Nielsen diversions. In order to meet this objective fish passage would need to be restored at these diversions.	1a. A bypass channel was constructed around the Chilly Diversion in 2006. 1b. Currently designing project for the 6X Diversion. Funding has been acquired and verbal permission granted by the land owner and ditch owner. 1c. Currently reevaluating need for passage at the Nielsen Diversion

Below Mackay Dam	Distribution: Establish and maintain mountain whitefish in 1) the Big Lost River between the Mackay Dam and Blaine Diversion and 2) at least one of the following stream reaches: a) Big Lost River between Blaine Diversion and Moore Diversion or b) Antelope Creek between Marsh Canyon and Iron Bog Creek.	Not Met	Sampling completed in 2002 indicates that mountain whitefish are present in the Big Lost River between Mackay Dam and the Blaine Diversion. Although mountain whitefish do seasonally occur in the Big Lost River between the Blaine Diversion and the Moore Diversion dewatering in recent years has prevented the fish from occupying this reach on a perennial basis. Mountain whitefish were not detected in Antelope Creek in sampling completed in 1987 (Corsi and Elle 1989) or in sampling completed in 2004. To meet this objective, mountain whitefish would need to be restored below the Blaine Diversion or in Antelope Creek.	1. Objective met 2. Population established in Big Lost River between Blaine Diversion and Moore Diversion and mountain whitefish have been reintroduced into Antelope Creek. Monitoring will occur in these areas to determine whether fish are maintained in these reaches before objective is considered met.
	Abundance: Establish and maintain at least 5,000 adult fish (>200 mm) with at least 100 adults in each occupied stream reach	Not Met	Sampling completed in 2002 indicates that the adult abundance in this management area is approximately 600 fish. All of these fish occur in the Big Lost River between the Mackay Dam and the Blaine Diversion. In order to achieve this objective, overall adult abundance needs to increase by about 4,400 with at least 100 mountain whitefish occurring in either the Big Lost River between the Blaine and Moore diversions or in Antelope Creek between Marsh Canyon and Iron Bog Creek.	Objective not met. However, monitoring indicates a significant increase in adult mountain whitefish abundance in the Big Lost River between Mackay Reservoir and the Blaine Diversion. Sampling in 2007 indicates mountain whitefish are now also present in the Big Lost River below the Blaine Diversion but abundance is not known.
	Connectivity: Establish and maintain natural levels of connectivity sufficient for all age classes to make natural movements between Mackay Dam and the Moore Diversion and in Antelope Creek between the Big Lost River and Iron Bog Creek. In that section of Antelope Creek between the Big Lost River and Marsh Canyon this objective does not apply to stream flows.	Not Met	Irrigation diversions create complete, partial, and/or seasonal barriers in five locations on the Big Lost River between the Mackay Dam and the Moore Diversion. This includes the Swauger, Darlington, Burnett, Blaine, and Lower Burnett diversions. The status of connectivity in Antelope Creek is unknown.	1a. Construction of a bypass is planned for the Swauger Diversion in the fall of 2008 1b. A bypass was constructed in the Darlington Diversion in the fall of 2007 1c. Currently designing a bypass project for the Burnett Diversion 1d. Construction of a bypass is planned for the Blaine Diversion in the fall of 2008 1e. Currently reevaluating need for passage at the Lower Burnett Diversion

Potential reasons for not meeting management objectives by management area and management actions needed to achieve management objectives as well as actions accomplished during 2007.

Management Area	Potential Reasons for Not Meeting Objectives	Management Actions	Progress
Above Mackay Dam	1. Reduced flows from drought/diversion	1. Work with IDWR to support diversion monitoring and enforcement of water rights 2. Work to prevent any additional reduction in stream flows 3. Seek opportunities to increase surface water flow where it can be done in a collaborative manner	1. Developed work window recommendations for the Lost River drainage to protect mountain whitefish 2. No new reductions in stream flows have occurred 3. No progress during 2007
	2. Habitat alteration	1. Evaluate East Fork Big Lost River, North Fork Big Lost River, Wildhorse Creek, and Star Hope Creek to determine why populations have declined in these areas. If necessary, develop and implement measures to correct problems sufficient to achieve the distribution and abundance objectives. 2. Evaluate ability of Wildhorse Creek and Star Hope Creek to support mountain whitefish. If potential exists, reintroduce mountain whitefish into these streams. 3. Continue efforts to reintroduce mountain whitefish into North Fork Big Lost River. 4. Evaluate fish habitat in the Big Lost River between the Chilly Diversion and North Fork Big Lost River to determine whether anthropogenic influences have reduced the ability of this stream to support mountain whitefish. If necessary, identify and implement actions that will reduce these impacts. 5. Monitor stream alteration and work with IDWR and USACE to prevent illegal stream alteration and discourage channelization and bank rip-rapping. 6. As appropriate, protect private lands through easements, exchanges, cost sharing, etc. 7. Support implementation of the Salmon-Challis National Forest grazing strategy on all national forest lands where there is a potential for livestock grazing to impact historic mountain whitefish habitat.	1a. Stocked mountain whitefish salvaged from canals and dewatered sections of rivers into each of these reaches and evaluated each reach in 2007 to determine if fish were present 1b. Additional evaluations will be completed in these reaches in the future 2a. These two streams were evaluated and were believed to have the potential to support mountain whitefish. Mountain whitefish were reintroduced into these streams in 2006 and the streams were evaluated in 2007. Mountain whitefish were present in Wildhorse Creek but not in Star Hope Creek. Additional introductions will occur in Wildhorse in 2008. Additional evaluations will be made in Star Hope Creek to determine why the reintroductions were not successful. 3. Mountain whitefish were reintroduced into North Fork Big Lost River in 2004, 2005, and 2006 4. No progress during 2007 5a. Monitoring is ongoing 5b. Providing comments to IDWR on stream channel alteration permit applications 6. No progress during 2007 7. The Salmon-Challis National Forest anticipates adopting the strategy in 2008 and incorporating the strategy into all upcoming grazing NEPA involving allotments in the Big Lost River basin

	3. Entrainment in irrigation canals	1. Evaluate fish entrainment at diversions. If necessary, develop and implement measures to minimize entrainment	1. Currently conducting an intensive fish entrainment study in partnership with Utah State University, the Bureau of Land Management, and the USDA Forest Service. Anticipate completing the study in 2010 at which time we will prioritize and implement measures to minimize entrainment where appropriate.
	4. Entrainment in Big Lost River between Chilly Diversion and Mackay Reservoir when reach is dewatered	1. Evaluate the impact of entrainment in the Big Lost River below the Chilly Diversion on mountain whitefish distribution and abundance in the management area. If necessary, develop and implement measures to correct problems. In the interim, annually salvage mountain whitefish in the Big Lost River from the Chilly Diversion downstream 2 km when the stream is dewatered and transport fish to suitable waters. Continue this work until the evaluation is completed and any required measures are implemented or until distribution and abundance objectives are met in the management area.	1a. Evaluation is in progress 1b. Annual salvage was conducted in target reach in 2004, 2005, 2006, and 2007 and fish transported to suitable waters 1c. Mountain whitefish bypass channel was constructed around the Chilly Diversion in 2006. 1d. An evaluation of the bypass and its effects on entrainment was initiated in 2007 and will be completed in 2008.
	5. Competition and predation from non-native species	1. Evaluate effect of competition and predation from non-native species on mountain whitefish. If necessary, develop and implement measures to correct problems.	1. Evaluation planned for 2008
	6. Interference with life history movements by the Chilly, 6X, and Nielsen diversions.	1. Provide a level of fish passage sufficient for all age classes to make natural movements around these diversions.	1a. A bypass channel was constructed around the Chilly Diversion in 2006. 1b. Currently designing project for the 6X Diversion. Funding has been acquired and verbal permission granted by the land owner and ditch owner. 1c. Further evaluation suggests that mountain whitefish may be able to pass around the Nielsen Diversion. Currently reevaluating need for a bypass at this structure.
	7. Fishing	1. Maintain no harvest rule until distribution and abundance objectives are met. Evaluate feasibility of harvest once these objectives are met. 2. Evaluate effect of fishing (e.g. - illegal harvest, hooking mortality, etc.). If necessary, develop and implement measures to correct problems (e.g. - angler education, enforcement, revision of regulations).	1. Maintaining no harvest rule. Feasibility of harvest will be evaluated when distribution and abundance objectives are met. 2a. Creel survey completed in 2007. 2b. Some illegal harvest is occurring. Education and enforcement of no harvest rule will increase. 2c. Hooking mortality appears to have minimal effect on population. No additional work relating to hooking mortality is planned.

	8. Disease	1. Evaluate potential effects of whirling disease on mountain whitefish populations.	1. Whirling disease studies on mountain whitefish in the Big Lost River in 2004 failed to show any infection of *M. cerebralis* or any other pathogen
Below Mackay Dam	1. Reduction in annual or seasonal flows	1. Work with IDWR to support diversion monitoring and enforcement of water rights 2. Work to prevent any additional reduction in stream flows 3. Seek opportunities to increase surface water flow where it can be done in a collaborative manner 4. Evaluate whether winter flows affect juvenile survival and limit recruitment. Work with water managers to augment winter flows if flow-related survival is believed to prevent population objectives.	1. Developed work window recommendations for the Lost River drainage to protect mountain whitefish 2. No new reductions in stream flows have occurred 3a. Working with Darlington Sinks working group to evaluate feasibility of restoring the river channel between the Blaine Diversion and the Moore Diversion thereby improving surface flows 3b. Working with local irrigators, landowners, government agencies, and other non-governmental organizations to better regulate flows in the Antelope Creek drainage. A new diversion structure that allows for better regulation of streams flows into the North and South channels will be constructed in the fall of 2008. 4. No progress during 2007
	2. Habitat alteration	1. Improve or provide year-round flows in the Big Lost River between the Blaine Diversion and the Moore Diversion. 2. Evaluate fish habitat in Antelope Creek to determine how anthropogenic influences have reduced the ability of this stream to support mountain whitefish. If necessary, identify and implement actions that will reduce these impacts. 3. Evaluate fish habitat in the Big Lost River between Mackay Dam and the Moore Diversion to determine how anthropogenic influences have reduced the ability of this stream to support mountain whitefish. If necessary, identify and implement actions that will reduce these impacts. 4. Monitor stream alteration and work with IDWR and USACE to prevent illegal stream alteration and discourage channelization and bank rip-rapping. 5. As appropriate, protect private lands through easements, exchanges, cost sharing, etc. 6. Support implementation of the Salmon-Challis National Forest grazing strategy on all national forest lands where there is a potential for livestock grazing to impact historic mountain whitefish	1. Working with Darlington Sinks working group to evaluate feasibility of restoring the river channel between the Blaine Diversion and the Moore Diversion thereby improving surface flows 2. Barrier survey has been completed on all historically occupied habitat in Antelope Creek. Projects are in various stages of development to provide passage at the lower three barriers to mountain whitefish movement in the South Channel. Additional upstream barriers are currently being evaluated. 3. Specific actions include a) working with Darlington Sinks working group to determine how anthropogenic influences have impacted the Big Lost River between the Blaine Diversion and the Moore Diversion and identify restoration opportunities and b) initiated an evaluation of winter flows in the Big Lost River below Mackay Reservoir. 4a. Monitoring is ongoing 4b. Providing comments to IDWR on stream channel alteration permit applications 5. No progress during 2007 6. The Salmon-Challis National Forest anticipates adopting the strategy in 2008 and incorporating the

		habitat. 7. Evaluate ability of Antelope Creek to currently support mountain whitefish. If potential exists, reintroduce mountain whitefish into the stream.	strategy into all upcoming grazing NEPA involving allotments in the Big Lost River basin 7. Initial evaluation completed in 2007 and it was determined that Antelope Creek may be capable of supporting mountain whitefish. Mountain whitefish were reintroduced into Antelope Creek in the fall of 2007. Evaluation of the success of the introduction will begin in 2008.
	3. Entrainment in irrigation canals	1. Evaluate fish entrainment at diversions. If necessary, develop and implement measures to correct problems	1. Currently conducting an intensive fish entrainment study in partnership with Utah State University, the Bureau of Land Management, and the USDA Forest Service. Anticipate completing the study in 2010 at which time we will prioritize and implement measures to minimize entrainment where appropriate.
	4. Entrainment in Big Lost River below Blaine Diversion when reach is dewatered	1. Evaluate the impact of entrainment in the Big Lost River below the Blaine Diversion on mountain whitefish distribution and abundance in the management area. If necessary, develop and implement measures to correct problems. In the interim, annually salvage mountain whitefish in the Big Lost River from the Blaine Diversion to Highway 93 when the stream is dewatered and transport fish to suitable waters. Continue this work until the evaluation is completed and any required measures are implemented or until distribution and abundance objectives are met in the management area.	1a. Evaluation is in progress. The need for a bypass at the Blaine Diversion to allow fish to move upstream past the diversion and prevent entrainment in the river below the diversion has been identified. 1b. Salvage was conducted in portions of target reach in 2004 and 2007 and fish transported to suitable waters 1c. Mountain whitefish bypass channel is planned for construction in fall of 2008. An evaluation of the bypass and its effects on entrainment will be conducted once the bypass is completed.
	5. Competition and predation from non-native species	1. Evaluate effect of competition and predation from non-native species on mountain whitefish. If necessary, develop and implement measures to correct problems.	1. Evaluation planned for 2008
	6. Interference with life history movements by Swauger, Darlington, Burnett, Blaine, and Lower Burnett diversions	1. Provide a level of fish passage sufficient for all age classes to make natural movements around these diversions.	1a. Construction of a bypass is planned for the Swauger Diversion in the fall of 2008 1b. A bypass was constructed in the Darlington Diversion in the fall of 2007 1c. Currently designing a bypass project for the Burnett Diversion 1d. Construction of a bypass is planned for the Blaine Diversion in the fall of 2008 1e. Further evaluation suggests that mountain whitefish may be able to pass around the Lower Burnett Diversion. Currently reevaluating need for a bypass at this structure.

	7. Fishing	1. Maintain no harvest rule until distribution and abundance objectives are met. Evaluate feasibility of harvest once these objectives are met. 2. Evaluate effect of fishing (e.g. - illegal harvest, hooking mortality, etc.). If necessary, develop and implement measures to correct problems (e.g. - angler education, enforcement, revision of regulations).	1. Maintaining no harvest rule. Feasibility of harvest will be evaluated when distribution and abundance objectives are met. 2a. Creel survey completed in 2007. 2b. Some illegal harvest is occurring. Education and enforcement of no harvest rule will increase. 2c. Hooking mortality appears to have minimal effect on population. No additional work relating to hooking mortality is planned.
	8. Disease	1. Evaluate potential effects of whirling disease on mountain whitefish populations.	1. Whirling disease studies on mountain whitefish in the Big Lost River in 2004 failed to show any infection of *M. cerebralis* or any other pathogen

Appendix E Locations used in population surveys on the Henrys Fork Snake River, Idaho 2007. All locations used NAD-27 and are in Zone 12.

	Start		Stop	
Reach	Easting	Northing	Easting	Northing
Mack's Inn	477,573	4,926,579	475,132	4,927,379
Box Canyon	468,677	4,917,703	467,701	4,914,352
Vernon	457,138	4,877,930	454,246	4,874,836
Chester	453,203	4,874,011	450,188	4,870,265

Appendix F. Electrofishing mark-recapture statistics for the Box Canyon reach, Henrys Fork Snake River, Idaho, 1995-2007.

	Brook trout[a]				Rainbow trout				All trout			
Year	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
2007	15	4	1	25	737	332	51	15	752	336	52	16

[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 G Mean total length and relative stock density (RSD-400) of trout captured at the Box Canyon electrofishing reach, Henrys Fork Snake River, Idaho, 1995-2007. Total individual fish captured during mark (M) and recapture (C - R) runs equals n. RSD-400 = (number ≥400 mm / number ≥200 mm) x 100.

	Brook trout			Rainbow trout			All trout		
Year	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
2007	27	183	0	1,173	312	22	1,200	309	21

Appendix H. Estimated abundance (N) of age 1 and older rainbow trout (≥150 mm) at the Box Canyon electrofishing reach, Henrys Fork Snake River, Idaho, 1995-2007. Confidence intervals (±95%) are in parentheses.

First marking date	Rainbow trout		
	N/reach MPM[a]	N/reach 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)
5-8-2007	4,725 (3,598-5,852)	8,549 (7,2889,810)	2,311 (1,970-2,652)

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

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