

**LIFE HISTORY AND POPULATION STATUS OF MIGRATORY BULL TROUT (*Salvelinus confluentus*)
IN ARROWROCK RESERVOIR, IDAHO**

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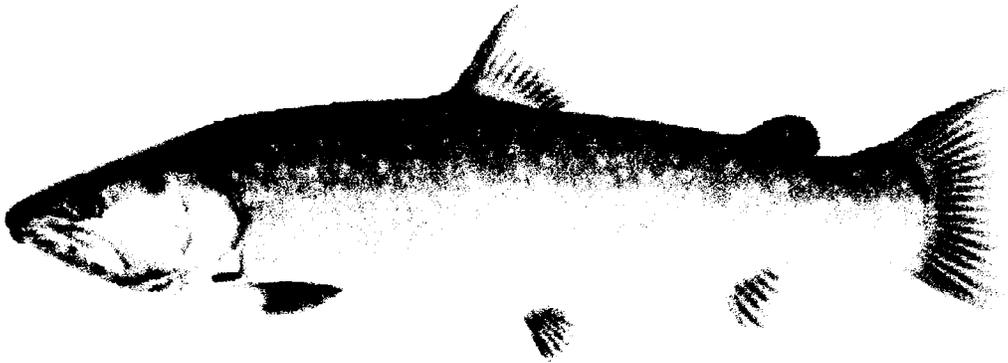
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Life History and Population Status of Migratory Bull Trout (*Salvelinus confluentus*) in Arrowrock Reservoir, Idaho



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ABSTRACT

Between October 1996 and May 1997 intensive sampling for bull trout (*Salvelinus confluentus*) was conducted in Arrowrock and Lucky Peak Reservoirs. A total of 411 bull trout was captured in Arrowrock Reservoir in 3,446 hours of sampling with trap nets and gill nets. Lucky Peak was sampled for 270 hours resulting in a catch of 76 bull trout. Fourteen of these had been originally tagged in Arrowrock, and moved downstream across Arrowrock Dam. Twenty-two bull trout captured in Arrowrock between 400 and 660 mm were surgically implanted with radio transmitters. Eight fish from Lucky Peak, ranging from 470 to 660 mm in length, were implanted with radio transmitters and released in Arrowrock Reservoir. Seventeen fish migrated up the North Fork of the Boise River, six migrated up the Middle Fork, and one migrated up the South Fork. Radio-tagged fish generally left Arrowrock Reservoir by mid-June, entered summer residence tributaries between late-July and early-August, exited tributaries by the second week in September, and returned to the reservoir between the second week in September and the third week in October. Fish transported to Arrowrock from Lucky Peak generally used the same areas for summer residence as Arrowrock fish, and migrated at approximately the same time. Based on the data from this project, it is estimated there are approximately 471 (95% CI = 389-590) bull trout in Arrowrock 300 mm or greater in length.

INTRODUCTION

Bull trout are currently a federal candidate species under consideration by the U.S. Fish and Wildlife Service for listing as a threatened or endangered species under the Endangered Species Act. As a result, the State of Idaho has developed the State of Idaho Bull Trout Conservation Plan (Batt 1996) to facilitate bull trout population recovery and prevent further declines. This plan has identified fifty-nine key watersheds in which conservation measures could facilitate reaching the desired objectives of the State of Idaho. Arrowrock Reservoir and associated tributaries have been identified as key bull trout watersheds in the southwestern Idaho basin. Prior to this project there had been no detailed life history study of bull trout in this key watershed.

Bull trout have been recently sampled in routine lake surveys of Arrowrock Reservoir and downstream in Lucky Peak Reservoir by the Idaho Department of Fish and Game (IDFG) (IDFG file data). Stream surveys document bull trout populations in several tributaries upstream of Arrowrock. None have been found in tributaries draining into Lucky Peak (IDFG and U. S. Forest Service file data). Although six-thousand bull trout were planted in Lucky Peak in 1992 (IDFG file data), size of bull trout sampled in Lucky Peak suggests movement of bull trout into Lucky Peak from Arrowrock Reservoir occurs. Arrowrock Dam is a barrier to all upstream migrating fish. As a result, Lucky Peak bull trout are not able to migrate to upper drainage spawning areas because no fish passage was provided at Arrowrock Dam.

Adfluvial bull trout are relatively common in the western U.S. and have been extensively studied in Oregon (Ratliff et al. 1996), Montana (Fralely and Shepard 1989), and Canada (Stelfox and Egan 1995). Bull trout utilizing lakes and reservoirs generally grow to a large size and have been found capable of migrating up to 140 miles to complete spawning (Shepard et al. 1984). Preliminary radio tag data from bull trout in Arrowrock indicated an adfluvial population exists in Arrowrock (Allen et al. 1996, in press).

In an effort to address the lack of detailed life history information concerning Boise River basin bull trout, IDFG and the Bureau of Reclamation (BOR) combined resources to study the bull trout found in Arrowrock and Lucky Peak Reservoirs (hereafter referred to as Arrowrock and Lucky Peak).

OBJECTIVES

- (1) Document the timing and magnitude of bull trout movement between Arrowrock Reservoir and upstream tributaries
- (2) Estimate the bull trout population size in Arrowrock and document age and growth
- (3) Document entrainment loss of bull trout across Arrowrock Dam into Lucky Peak

STUDY AREA

The Boise River Basin is located in southwestern Idaho and is one of the major tributaries of the Snake River. In 1915 Arrowrock Dam was constructed on the Boise River at river mile 75.4 (Figure 1). Arrowrock Dam creates a 3,150 acre multipurpose reservoir primarily managed for flood control and irrigation purposes. The full pool elevation and storage capacity of Arrowrock are 3,216 feet and 286,600 acre feet, respectively (U.S. Army Corps of Engineers 1983). There are two main tributaries to Arrowrock Reservoir, the South Fork (SFBR) and the Middle Fork Boise River (MFBR). The upper Boise River watershed extends up to 10,600 feet in elevation. There is no upstream fish passage provided at Arrowrock Dam. Upstream fish passage from Arrowrock Reservoir into the SFBR is blocked by Anderson Ranch Dam, 49 river miles upstream from Arrowrock Dam (Figure 1). The Boise basin drainage area above Arrowrock, which includes the MFBR and SFBR below Anderson Ranch Dam, is 2,230 square miles.

Lucky Peak Dam is located at river mile 63.8, which is 11.6 river miles downstream from Arrowrock Dam and 9 miles southeast of Boise, Idaho (Figure 1). At full pool Lucky Peak backs water onto the base of Arrowrock Dam. Lucky Peak Dam was completed in 1954 and creates a 2,820 acre reservoir providing flood control, irrigation, hydropower, recreation, and water for fish and wildlife. The full pool elevation and storage capacity of Lucky Peak Reservoir are 3,055 feet and 264,371 acre feet, respectively (U.S. Army Corps of Engineers 1983). The main tributary to Lucky Peak, Mores Creek, provides 90% of Lucky Peak's 470 square mile drainage area.

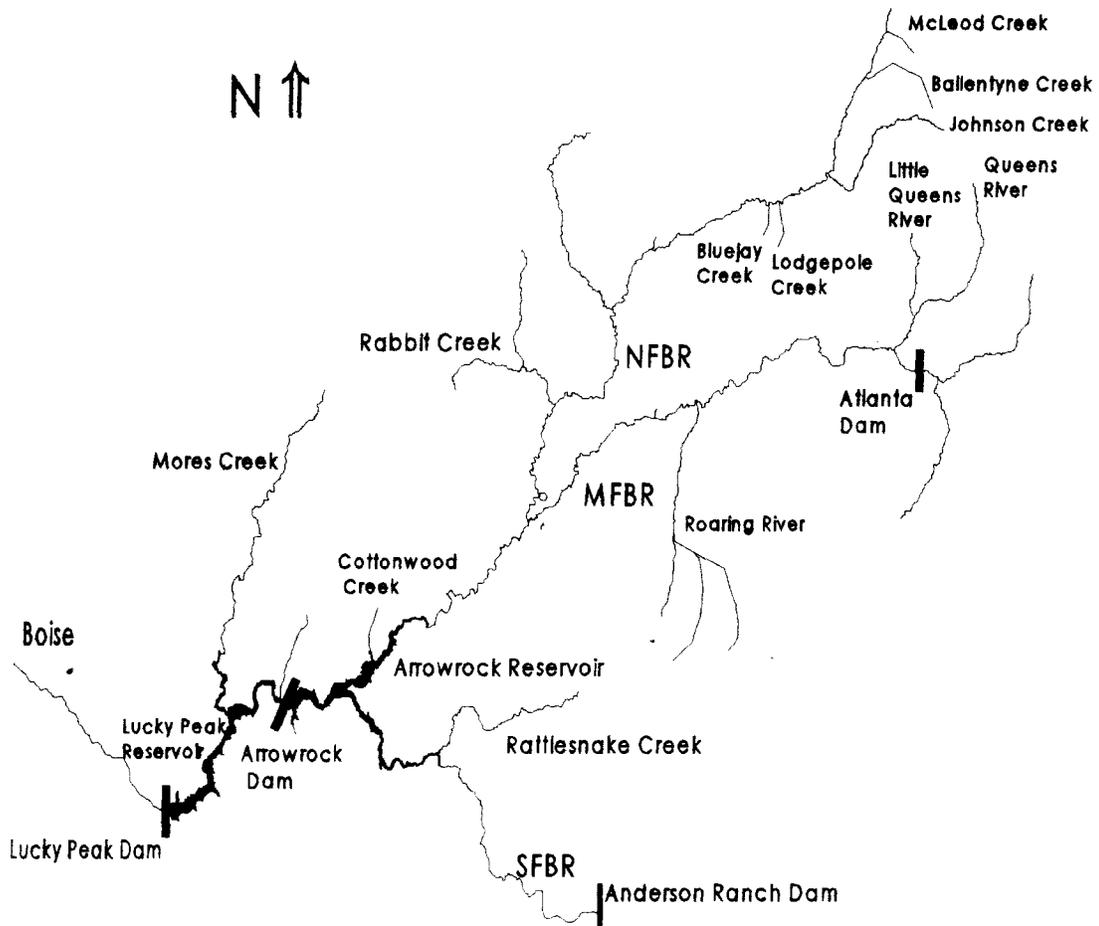


Figure 1. Map of Boise River Basin study area.

METHODS

Arrowrock Reservoir

Arrowrock was partitioned into three sampling strata (Figure 2) to divide the sampling effort and to provide relative locations for recording catch and movement within the reservoir. Sampling began in the fall of 1996 and was completed in the spring of 1997. Sampling with gill nets occurred October 1996 - May 1997, trap net sampling occurred March - April 1997.

Lucky Peak Reservoir

In the spring of 1997 sampling in Lucky Peak was conducted in the 2 mile reach downstream of Arrowrock Dam. All bull trout were inspected for adipose fin clips which would, in conjunction with PIT tag data, be used to document entrainment losses through Arrowrock Dam into Lucky Peak. Gill net sampling occurred March - April 1997, trap net sampling occurred in May 1997.

Gill netting

Experimental monofilament sinking gill nets were utilized to capture bull trout. Each net was 150 ft long, 6 ft deep, and contained six equal size mesh panels (%, 1, 1 ¼, 1 ½, 2, and 2½ in square mesh). Four nets were utilized each sampling day. Gill netting began typically at 0830 and continued until 1630 each day. Time between gill net set and retrieval was approximately 30 min. Approximately 24 gill net sets were made each sampling day.

Nets were generally placed perpendicular to banks, with one end of the net within 6 ft of the shoreline. Nets were set alternating the size of mesh (small mesh and large mesh) nearest shore. Gentle sloping shorelines, points, and beaches were the primary habitats sampled. Nets were held in place with 25 lb weights attached to each end. Upon pulling nets, bull trout and other game fish were removed and placed in a recirculating aerated 85 gallon livewell and held for processing at the end of the sampling day. Nongame species were held in large tubs until weighed and measured after all bull trout and game fish had been processed.

Overall gill net catch rates were calculated by dividing total bull trout caught by total gill net effort. Recaptures were included in catch rate calculations. Gill net catch rates between strata and reservoirs were tested using the Pearson Chi-square test statistic (Zar 1984). Handling mortality rates were calculated by dividing the total number of bull trout which died in the sampling process by the combined total bull trout catch for all sampling gear types.

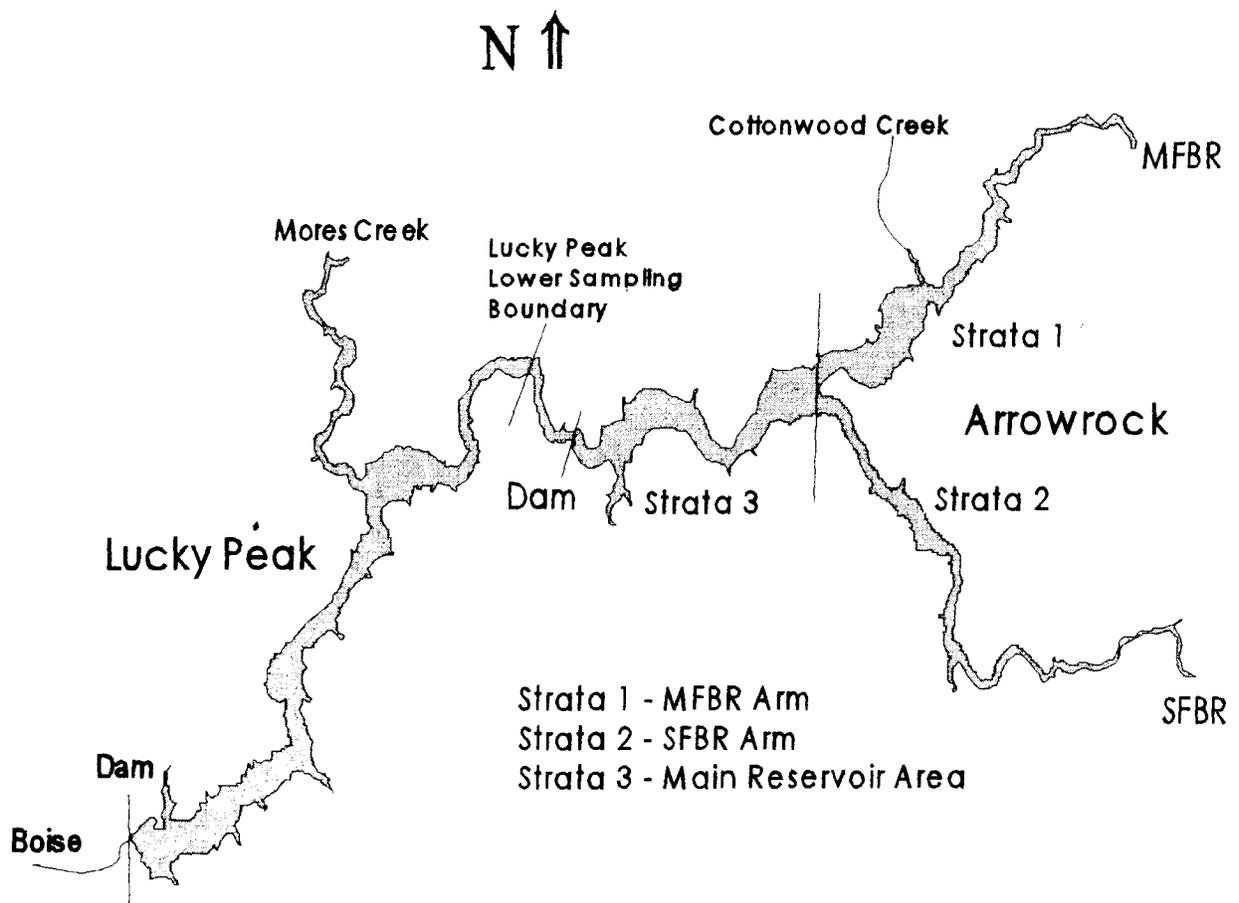


Figure 2. Arrowrock and Lucky Peak study areas.

Average length, weight and condition factor ($CF = Wt/L^3 \times 10^5$, Everhart et al. 1975), were calculated separately for Arrowrock and Lucky Peak.

Trap netting

Each trap net contained a front box maze of two 4 x 6 foot steel frames with center braces, five 30 in diameter hoops with crowfoot throats on first and third hoops, and 50 x 4 ft #9 treated twine lead with polycore floats and lead lines. Three-quarter inch square netting was used throughout.

Trap nets were set next to the shoreline in shallow areas with trap net boxes set at least 20 ft off shore and the lead extending perpendicular to shore. The top of the box frames were within 12 in of the water surface. Each trap was anchored to the shore and the hoop end was anchored with a 25 lb weight. Trap nets were typically set before dark, fished overnight, and pulled the following morning. Bull trout were removed from the nets and placed in the livewell until processing at the end of the day. Nontarget species were counted and immediately released. Bull trout caught in trap nets and gill nets were not kept separate for processing.

Trap net catch rates for all sampling days combined were calculated by dividing total bull trout caught by total trap net effort.

Bull Trout Processing

After netting was completed, bull trout were placed in a 20 gal plastic tub and anesthetized with MS222 (tricaine methanesulfonate). Fish were weighed to the nearest g and were measured to the nearest mm. A small scale sample was removed from each bull trout between the lateral line and the posterior insertion of the dorsal fin for age estimation. Scale samples were placed in envelopes for processing later.

Each bull trout was marked with a passive integrated transponder (PIT) tag containing a unique 10-digit alphanumeric code and fin clipped for later identification. PIT tags were inserted into the body cavity near the pelvic girdle. Two sizes of tags were utilized depending on the size of the fish (12 x 2.1 mm for bull trout <410 mm, and 14 x 2.1 mm for bull trout >_410 mm). Two Destron (Destron-ID, Inc., Boulder, CO) MP500 PIT tag readers were used for tag identification. Arrowrock bull trout received adipose fin clips, and Lucky Peak fish received pectoral fin clips.

After anesthetizing in a 60mg/l MS222 solution, 30 bull trout were surgically implanted with either model 10-35 or 5955 ATS (Advanced Telemetry Systems, Inc. Insanti, MN) trailing antennae radios (13 mm x 56 mm and 17 mm x 46 mm, respectively). Two sizes of radio transmitters were used, 10 g and 20 g, depending on the size of the bull trout. Bull trout weighing 1 100 g or less received 10 g radios, and those greater than 1100 g

received 20 g radios. We used 2% (or less) of body mass as a guide to determine the appropriate radio size for each bull trout (Marty and Summerfelt 1986). Ten 10 g radios and twenty 20 g radios were implanted.

Each radio transmitted on a unique frequency in the 151 MHz band. The battery life of each Lithium powered transmitter was life-optimized by the manufacturer by lowering the pulse rate to 40 pulses a minute and programming the microprocessor duty cycle to transmit for only 12 hours each day. Each radio was activated to transmit between 0830 and 2030 (MST). These settings theoretically provide 500 days of battery life (in the 20 g radios), allowing the opportunity to follow bull trout with 20 g radios through two summer rearing cycles.

The surgery methodology followed was a modification of the shielded needle technique (Ross and Kleiner, 1982). A small incision (approximately 1 in) was made parallel to the linea alba and the radio transmitter was inserted lengthwise into the peritoneal cavity. The antennae left the body cavity approximately 1 in posterior to the pelvic fins along the ventral midline. Antennae were trimmed flush with the trailing edge of the caudal fin. Prior to closing the incision with a 3-0 Dermalon suture (Davis+Geck, Wayne,NJ), each fish was PIT tagged. Arrowrock bull trout were released near their original capture locations after being allowed to recuperate 15 minutes from anesthesia. Following radio transmitter implantation, selected fish caught in Lucky Peak Reservoir were placed in an 85 gallon recirculating aerated livewell, transported to Arrowrock Reservoir and released near Cottonwood Creek (Figure 2).

Bull Trout Age Determination

Collected scales were mounted on 4 x 6 x 0.02 in clear acetate sheets and pressed with a Carver Heat Press (10,000 PSI, 230°F, 35 seconds) to generate readable impressions. A microfiche reader was then used to project scale impressions onto a screen. The locations of the focus, annuli, and margin of the scale were recorded by marking on a strip of paper held next to the projected scale image. Focus to annulus distance measurements were digitized using a Texas Instruments Highpad Plus digitizing board. Only Arrowrock bull trout scales were evaluated for age.

Back calculated lengths-at-age were made using DisBCal 89 Vi .0 software (Missouri Department of Conservation 1989). DisBCal provides two options (fall or spring) to choose from when back calculating lengths-at-age. These choices are based on when the scale samples were taken. When the spring option is chosen, any growth past the annulus is plus growth. The fall option considers growth past the annulus another year and the radius is assumed to be the location of the next annulus. Bull trout scales collected between October 23, 1996 and January 11, 1997 were considered fall samples, those taken between March 19, 1997 and May 2, 1997 were considered spring samples. The squamation constant used to back calculate length-at-age was 45 mm.

One individual estimated age from 255 prepared scales. A subsample was read by two additional readers to determine agreement on estimated age between readers. The subsample consisted of 45 total scales - five scales from nine size groups (250, 300, 350, 400, 450, 500, 550, 600, and 650 mm) of bull trout. Percent agreement was calculated by number of scales three readers agreed on divided by 45.

Population Estimate For Arrowrock Reservoir

The bull trout population size was estimated using the Schnabel estimator (Ricker, 1975). Recaptured bull trout were identified using adipose fin clips. To address the possibility of a selection bias created by our sampling gear, bull trout less than 300 mm were not included in the estimate.

Radio Tracking

Radio implanted bull trout were tracked with a Lotek SRX 400 radio receiver (Lotek Engineering Inc., Ontario, Canada). Telemetry was conducted twice a week from the ground while the bull trout were in areas accessible by roads. When they entered roadless areas, they were tracked approximately bimonthly from fixed winged aircraft. Bull trout were assumed to have spawned if tracked to headwater tributaries known to contain juvenile bull trout populations.

ARROWROCK RESULTS

Sampling

Species of game fish collected included: bull trout (*Salvelinus confluentus*); brown bullhead (*Ictalurus nebulosus*); chinook salmon (*Oncorhynchus tshawytscha*); hatchery rainbow trout (*Oncorhynchus mykiss*); kokanee salmon (*Oncorhynchus nerka*); mountain whitefish (*Prosopium williamsoni*); redband trout (*Oncorhynchus mykiss gairdneri*); smallmouth bass (*Micropterus dolomieu*); westslope cutthroat (*Oncorhynchus clarki lewisi*); and yellow perch (*Perca flavescens*).

Gill netting and/or trap netting was conducted for 46 days between October 18, 1996 and May 2, 1997. A total of 411 bull trout were captured. April was the heaviest sampled month, with 17 days (Table 1).

Table 1. Arrowrock Reservoir sampling effort, catch, and recaptures by month.

Month (10/18/96 - 5/21/97)	Oct	Nov	Dec	Jan	Mar	Apr	May	Total
# sampling	5	8	3	4	7	17	2	46
Hours of gill netting	78	154	41.5	57	85.5	188.5	16	620.5
Hours of trap netting	183	0	0	0	398	2118	128	2826
# bull trout caught in gill nets	25	81	12	17	36	62	7	240
# bull trout caught in trap nets	0	0	0	0	61	107	3	171
Total bull trout caught	25	81	12	17	79	187	10	411 ^a
Number recaptured once	0	6	0	1	10	65	5	87
Number recaptured twice	0	0	0	0	0	13	0	13
Number recaptured three times	0	0	0	0	0	0	2	2
Total recaptures	0	6	0	1	10	78	7	102 ^b

^a Nineteen of the 411 bull trout died while being processed, three of which were recaptures. The handling mortality rate for all gear types combined was 4.6%. In November one fish was released alive but not marked due to questionable health.

^b Includes three mortalities

No sampling was conducted in February due to ice cover on the reservoir. Gill nets were set for a total of 620.5 h and caught 240 bull trout. The overall gill net catch rate was 0.39 (SE = 0.055) bull trout/hour. The gill net bull trout catch rates by strata were 0.41, 0.32, and 0.33 bull trout/hour. There was no statistical difference ($P > 0.3729$) between gill net catch rates in the three strata ($\chi^2 = 1.9727$, 2 df). Trap netting was conducted for 2,826 h, yielding 171 bull trout. The overall trap net catch rate was 0.06 (SE = 0.009) bull trout/hour (Table 2).

The average length, weight, and CF for Arrowrock bull trout were 405 mm (SE= 4.2), 656 grams (SE = 26.86), 0.84 (SE = 0.006), respectively. Data for other captured species are located in Appendices A, B, and C.

Two hundred and ninety bull trout were marked, of which, 102 were subsequently recaptured. PIT tag reader malfunctions and/or lost tags contributed to our inability to read 18.6% (19 out of 102) of the PIT tags in recaptured bull trout. Adipose fin clips were used to identify recaptures when PIT tags were not read. Multiple recaptures were relatively common: 2 were recaptured 3 times, and 13 were recaptured twice (Table 1). A total of 18 and 1 bull trout died following capture in gill and trap nets, respectively. The handling mortality rate for all bull trout was 4.6%.

Twenty-two bull trout were implanted with radios between April 1, 1997 and April 18, 1997. Bull trout implanted with 20 g radios averaged 556 mm and 1,778 g. Those implanted with 10 g radios averaged 428 mm and 724 g (Table 3).

Reservoir levels, season of the year and weather, appeared to influence bull trout behavior. Sandy beaches or shallow points were the most productive areas for sampling. Bull trout were commonly caught in pairs (in the same net) during early spring and early fall. During the months of December and January, bull trout were usually very difficult to capture, with daily catches of only one or two bull trout common. Occasional heavy runoff periods experienced in January due to snowmelt were the exception. On several occasions when the reservoir was full and water was passing over the spillway, bull trout appeared to be traveling in schools in shallow water. On one occasion, eight bull trout were caught in one gill net set near Arrowrock Dam. None of these eight were recaptured in either Arrowrock or Lucky Peak.

Sampling in Strata 2 was relatively productive until drawdowns dewatered a majority of the suitable sampling areas. Drawdowns appeared to influence catch rates in Strata 2 more than the other areas of the reservoir. Sampling areas that remained in Strata 2 after drawdown were very unproductive for species commonly encountered during higher water levels, including bull trout. Sampling in other areas indicated that some bull trout had moved out of Strata 2. PIT tag recaptures indicated 50% of the Strata 2 recaptured fish (three out of six) moved to Strata 1, and 33% (2 out of 6) passed through Arrowrock Dam into Lucky Peak (Table 4). We were unable to catch a Strata 2 fish large enough to implant with a radio during the time period we conducted surgeries.

Table 2. Arrowrock Reservoir sampling effort and catch rates for bull trout by gear type.

	GUI net hours	Gill net catch	Bull trout/hour
Strata 1	441	182	0.41
Strata 2	72.5	23	0.32
Strata 3	107	35	0.33
Overall	620.5	240	0.39

	Trap net hours	Trap net catch	Bull trout/hour
Strata. 1	2492	170	0.07
Strata.2	318	1	0.003
Strata 3	16	0	0
Overall	2826	171	0.06

	Total sampling hours	Total catch	Combined gear bull trout/hour
Strata 1	2933	352	0.12
Strata 2	390.5	24	0.06
Strata 3	123	35	0.28
Overall	3446.5	411	0.12

Table 3. Summary of bull trout lengths, weights, PIT tag numbers, and radio frequencies.

length (mm)	Weight (g)	PET Tag #	Radio as % of body weight	Radio Frequency	Implant date ^d
410	575	2000072138	1.8 s	151.103	4/1/97
430	765	7F7D367909	1.3 s	151.153	4/1/97
442	1005	200E281A10	1.0 s	151.162	4/1/97
425	695	200B397626	1.5 s	151.173	4/1/97
439	695	200978500F	1.5 s	151.183	4/1/97
422	675	200C176558	1.5 s	151.203	4/1/97
431	655	1F7E723C35	1.6 s	151.213	4/1/97
476	1005	1F7639555D	1.0 s	151.222	4/1/97
400	585	1F75465452	1.8 s	151.233	4/1/97
405	585	200O0F4104	1.8 s	151.243	4/1/97
502	1 150	1F770D0756	1.5 B	151.274	4/10/97
482	1205	1F72075B0D	1.4 B	151.282	4/1/97
604	2185	7F7D772311 ?	0.8 B	151.303	4/1/97
566	1720	7F7B0B144A	1.0 B	151.333	4/9/97
560	2190	7F7D772311 ?	0.8 B	151.344	4/18/97
583	1890	1F7E762944	0.9 B	151.593	4/24/97
593	2030	7F7D7D2707	0.8 B	151.603	4/1/97
4.90	1 105	1 F63180D59	1.6 B	151.622	4/1/97
570	1600	7F7D572F1D	1.1 B	151.633	4/4/97
550	1905	7F7B0C3865	0.9 B	151.643	4/1/97
659	2905	7F7D7A1D26	0.6 B	151.663	4/1/97
520	1455	1F6849723E	1.2 B	151.683	4/1 /97

Table 3. Continued.

Length (mm)	Weight (g)	PIT Tag #	Radio as % of body weight ^a	Radio Frequency	Implant Date ^d
660	3400	200B483D50	0.5 B	151.293 LP>ARR ^b	5/8/97
467	1050	7F7D390065	1.6 B	151.323 ARR>LP>ARR ^c	5/8/97
660	2700	1 F7F5F4D36	0.6 B	151.353 LP>ARR ^b	5/8/97
528	1300	1 F646E731 C	1.3 B	151.363 LP>ARR ^b	5/12/97
652	2700	2000073815	0.6 B	151.372 LP>ARR ^b	5/8/97
496	1080	1 F63127A72	1.6 B	151.383 ARR>LP>ARR ^c	5/13/97
541	1450	20084357313	1.2 B	151.613 LP>ARR ^b	5/13/97
537	1475	7F7B0B 162E	1.2 B	151.703 ARR>LP>ARR ^o	5/8/97

^a 10.4 g. tags (s) used in fish 1005 g.
17.4 g. tags (B) used in fish 1050 g.
Mean % of body Wt. = 1.2

^b Fish caught in Lucky Peak Reservoir, implanted radio and released near mouth of Middle Fork Boise River in Arrowrock Reservoir

^c Fish were originally caught in Arrowrock Reservoir and marked, then passed through Arrowrock Dam into Lucky Peak Reservoir where they were recaptured and implanted with radios, then released near the mouth of the Middle Fork Boise River in Arrowrock Reservoir

^d All radios launched March 30, 1997 at 0830 MST

Table 4. Movements of bull trout marked in Arrowrock Reservoir.

Movements of Marked Arrowrock Bull Trout¹			
	STR1	STR2	STR3
Total PIT tagged fish	232	18	29
Total recaptured fish	60	6	10
# of marked fish recaptured in STR 1	48	3	4
% of marked fish recaptured in STR 1	80	50	40
# of marked fish recaptured in STR2	0	1	1
% of marked fish recaptured in STR2	0	17	10
# of marked fish recaptured in STR3	6	0	2
% of marked fish recaptured in STR3	8.7	0	20

¹ Recaptures with readable PIT tags only, multiple recaptured fish are only counted once when recaptured multiple times in same strata.

Movements of Marked Arrowrock Bull Trout¹

	STR1	STR2	STR3
# of marked fish recaptured in Lucky Peak Reservoir	6	2	1
% of marked fish recaptured in Lucky Peak Reservoir	10	33	10

¹ Recaptures with readable PIT tags only, multiple recaptured fish are only counted once when recaptured multiple times in same strata.

Aging

Of the 255 Arrowrock bull trout scales aged, 108 were collected in the fall and 147 were collected in the spring. We estimated the majority of the aged bull trout collected in the fall and spring were between 5 and 9, and 4+ and 7+ years of age, respectively. The back-calculated lengths for all age classes can be found in Tables 5 and 6. The agreement between the three readers on the 45 fish subsample were: 250 mm bull trout = 67% average agreement between the five samples; 300 mm bull trout = 67% average agreement between the five samples; 350 mm bull trout = 27% average agreement between the five samples; 400 mm bull trout = 40% average agreement between the five samples; 450 mm bull trout = 40% average agreement between the five samples; 500 mm bull trout = 54% average agreement between the five samples; 550 mm bull trout = 27% average agreement between the five samples; 600 mm bull trout = 13% average agreement between the five samples; 650 mm bull trout = 54% average agreement between the five samples. In 64.4% of the scales in the subsample (29 out of 45), two out of three readers were in agreement. There was no agreement between all three readers on any particular fish, indicating ages of bull trout by scale reading have a degree of error associated with them.

Population Estimate

The Arrowrock population estimate was calculated using bull trout collected between October 10, 1996 and April 30, 1997. The population estimate of bull trout (300 mm or larger) was 471 fish (95% CI = 389-590)(Table 7). Only seventeen bull trout less than 300 mm were captured (Appendix D). None of the 17 were recaptured.

LUCKY PEAK RESULTS

Sampling

Species of game fish collected included: bull trout; chinook salmon; hatchery rainbow trout; kokanee salmon; mountain whitefish; redband trout; smallmouth bass; westslope cutthroat; and yellow perch.

Sampling was conducted on 14 days between March 6, 1997 and May 19, 1997 (Table 8). Due to a lack of suitable trap net sampling areas, gill nets were primarily used. Gill nets were set for 182.5 h (Table 9), catching 74 bull trout (Table 10). A comparison of the Lucky Peak and Arrowrock bull trout length frequencies can be found in Figure 3. The gill net catch rate was 0.40 (SE = 0.102) bull trout/hour. Trap nets were set 87 hours. No bull trout were captured in trap nets. There was no statistical difference ($P > 0.7642$) between Lucky Peak and Arrowrock gill net catch rates ($\chi^2 = 0.090$, 1 df).

Table 5. Average back-calculated lengths for all age classes of bull trout caught in Arrowrock Reservoir in the fall of 1996 (October 23, 1996 - January 11, 1997).

Age of bull trout	Average length in mm for captured bull trout in all age classes (SE)	Number of bull trout captured n = 108
1	115	0
2	164	0
3	214	0
4	267	1
5	318 (14.12)	8
6	369 (7.05)	32
7	434 (19.05)	43
8	507 (19.08)	15
9	578 (11.76)	6
10	583 (4.5)	2
11	645	1

Table 6. Average back-calculated lengths for all age classes of bull trout caught in Arrowrock Reservoir in the spring of 1997 (March 17, 1997 - May 26, 1997).

Age of bull trout	Average length in mm for captured bull trout in all age classes (SE)	Number of bull trout captured n = 147
1+	105	0
2+	151	0
3+	198	1
4+	246 (13.45)	11
5+	293 (5.0)	53
6+	352 (5.97)	56
7+	418 (15.52)	22
8+	471 (50.5)	2
9+	495 (23.0)	2

Table 7. Arrowrock Reservoir population estimate of fish 300 mm or greater in length.

Month (t)	Total # of fish caught in sample (C _t)	Number of Recaptures ^a (R _t)	Number of newly marked fish (less morts) ^b	Number of marked fish before sample ^c (M _t)
October	23	0	22	0
November	80	6	64	22
December	12	0	11	86
January	17	1	16	97
March	76	10	65	113
April	178	78	96	178

^a Number of fish already marked when taken from nets, 276 bull trout > 300 mm were marked in Arrowrock between October 1996 and April of 1997

^b Recapture deaths - One in November, two in April
 Unmarked fish deaths - One in October, eight in November, one in December, one in March, four in April, one fish was released alive without marking in November

^c Number of marked fish alive in the lake in the instant just before sample t is taken

The population estimate (N[^]) was based on the formula:
$$N^{\wedge} = \frac{\sum(C_t M_t)}{R_t}$$

Results:

N[^] = 471
 95% C.I.
 Lower = 389
 Upper = 590

Table 8. Lucky Peak Reservoir sampling effort, bull trout catch, and bull trout recaptures by month.

Month (3/6/97- 5/19/97)	Number of sampling days	Number of gill net hours	Total bull trout	Bull trout recaptured once	Bull trout recaptured twice
March	5	90	9	0	0
April	2	22	9	1	0
May	8	70.5	56	3	0
Total	15	182.5	74	4 ¹	0

¹Only includes fish marked in Lucky Peak, Arrowrock recaptures not included

Table 9. Lucky Peak Reservoir sampling effort and catch rates for bull trout by gear type.

	Hours	Catch ¹	~ Bull trout/hour
Sinking Gill nets	182.5	74	0.40
Trap nets	87	0	0
Total	269.5	74	0.19

¹ Includes Arrowrock recaptures

Table 10. Composition of bull trout catch in Lucky Peak Reservoir.

	Total	Processed and released alive in Lucky Peak	Mortalities	Moved to Arrowrock Reservoir	% of total bull trout catch (n=76)
Lucky Peak Recaptures	4	3	1 ^a	0	5.4 ^f
Arrowrock Recaptures	15 ^d	7	2	4 ^e	19.7
Not previously caught	57	48	4	5 ^b	75.0
Total	76	58	7 ^c	9	100

^a Bull trout was killed during lowland lake sampling in a net set for 12 hours (overnight)

^b Implanted with radios and released near the mouth of the MFBR, in Arrowrock Reservoir

^c Handling mortality rate was 9.4% (n=74)

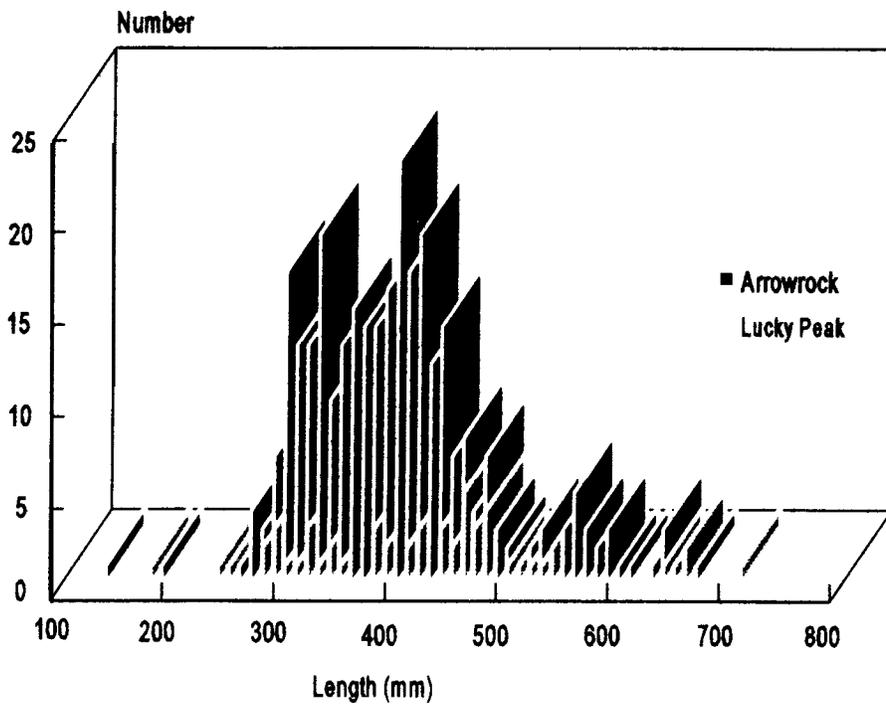
^d Includes a fish that was recaptured twice, and two fish implanted with raaios in Arrowrock Reservoir that passed through Arrowrock Dam and were located with telemetry in Lucky Peak

^e Includes 3 bull trout implanted with radios and released near mouth of the MFBR in Arrowrock Reservoir

^f Did not include two bull trout that were located with telemetry (n=74)

Arrowrock and Lucky Peak Bull Trout

Gill Net and Trap Net Catch Combined



recaptures not included

Figure 3. Length frequency of Arrowrock and Lucky Peak bull trout captured between October 18, 1996 and May 19, 1997.

The average length, weight, and CF for Lucky Peak bull trout were 418 mm (SE= 11.20), 801 g (SE = 78.33), and 0.86 (SE = 0.01), respectively. Length and weight data for other species captured are located in Appendices A and E.

Fifty-eight bull trout were captured, marked and released. In Lucky Peak four were subsequently recaptured (Table 11). Fourteen bull trout originally marked in Arrowrock were captured in Lucky Peak (Table 12). Fish marked in Arrowrock accounted for 20% of all bull trout caught in Lucky Peak (this entrainment loss includes 7% of the fish implanted with radios in Arrowrock). The observed PIT tag loss for captured bull trout having traveled from Arrowrock to Lucky Peak was 25%. Two of the Arrowrock recaptures died, and 4 were transported back to Arrowrock. When available, PIT tag information was used to verify that adipose clipped bull trout caught in Lucky Peak were originally marked in Arrowrock. There were seven bull trout mortalities. The handling mortality rate for bull trout was 9.2%, which was higher than that for Arrowrock.

Eight bull trout captured in Lucky Peak were implanted with radios and transported to Arrowrock. It took approximately 1 hour to transport bull trout from Lucky Peak to Cottonwood Creek on the eastern end of Strata 1 (Figure 2). All transported bull trout were released alive and appeared to be in good health. Three of the eight implanted Lucky Peak bull trout were tagged originally in Arrowrock and recaptured in Lucky Peak (Table 3). The five implanted bull trout not previously tagged in Arrowrock averaged 608 mm and 2,310 g, those previously tagged in Arrowrock averaged 500 mm and 1,200 g each.

RADIO TRACKING

Ground tracking began May 15, 1997 and continued through November 1997. Tracking by air was conducted on 5 flights occurring between July 17, 1997 and September 12, 1997. Of the thirty total bull trout implanted with radios, seventeen entered the NFBR and six traveled up the MFBR beyond the mouth of the NFBR. This represented 74% and 26% of all bull trout migrating upstream and out of Arrowrock, respectively (Figure 4). The remaining bull trout were located either near their release location or downstream. Specifically, three remained in Arrowrock, one entered the SFBR, and two entered Lucky Peak. One radio was never located after release on April 1, 1997.

North Fork Boise River

Mcleod Creek, the furthest tributary from Arrowrock Reservoir, was used by two bull trout for summer rearing. Approximately 3.5 miles downstream, Ballentyne Creek, was the destination of six bull trout. Thirty-five percent of the bull trout entering the NFBR were tracked up Ballentyne Creek, making this tributary the most utilized in the NFBR.

Table 11. Bull trout caught in Lucky Peak Reservoir that had been previously caught and marked in Lucky Peak Reservoir.

Lucky Peak Tagging Location	Tagging Date	Recapture Date (s)	Lucky Peak Recapture Location	Comments
Between Arrowrock Dam and Mack's Creek	3/20/97	4/17/97	Between Arrowrock Dam and Mack's Creek	
Between Arrowrock Dam and Mack's Creek	Unknown	5/8/97	Between Arrowrock Dam and Mack's Creek	No PIT tag found
Between Arrowrock Dam and Mack's Creek	Unknown	5/12/97	Between Arrowrock Dam and Mack's Creek	No PIT tag found
Between Arrowrock Dam and Mack's Creek	5/9/97	5/13/97	Lower Lucky Peak Reservoir, 0.5 mile from Lucky Peak Dam	Fish was caught and killed in a net set overnight for a lowland lake survey

Table 12. Bull trout caught or located with radio telemetry in Lucky Peak Reservoir that had been previously caught and marked in Arrowrock Reservoir.

Arrowrock Res. Tagging Location	Tagging Date, PIT# (Length, Weight) ¹	Recapture Date (s)	Lucky Peak Recapture Location	Comments
STR3 - near dam	1/11/97, 7F7D2B6541 (400, 540)	3/19/97	Between Arrow. Dam and Mack's Creek	
Unknown	PIT tag not found (397, 460)	3/20/97	Between Arrow. Dam and Mack's Creek	Mortality
STR1 - near Irish Cr.	11/2/96, 1 F61294A0D (455, 840)	3/1/97, 4/15/97, 5/9/97	Twice between Arrowrock Dam and Mack's Creek	Recaptured once in Arrowrock Reservoir at confluence of STR's 1,2, and 3, caught once by angler between 4/15/97 and 5/9/97 ²
STR2 - near Willow Cr.	10/25/96, 1 F6830381 1 (337, 370)	5/7/97	Between Arrow. Dam and Mack's Creek	
STR1 - near Cottonwood Cr.	1 1/27/96, 1 F72796412 (373, 430)	5/8/97	Between Arrow. Dam and Mack's Creek	Mortality
Unknown	PIT tag not found (412, 550)	5/8/97	Between Arrow. Dam and Mack's Creek	
Unknown	PIT tag not found (436, 750)	5/16/97	Between Arrow. Dam and Mack's Creek	

Table 12. Continued.

Arrowrock Res. Tagging Location	Tagging Date, PITS (Length, Weight) ¹	Recapture Date (s)	Lucky Peak Recapture Location	Comments
STR1 - near Cottonwood Cr.	1 1/27/96 200A15271 A (490, 1050)	5/13/97	Between Arrow. Dam and Mack's Creek	Released near mouth of Middle Fork Boise River in Arrowrock Reservoir
STR1 - near Cottonwood Cr.	1 1/24/96 7F7D390065 (467, 1050)	5/8/97	Between Arrow. Dam and Mack's Creek	Implanted with radio 151.323 and released near mouth of Middle Fork Boise River in Arrowrock Reservoir
STR2 - near mouth of Willow Cr.	12/19/96 7F7B0B162E (537, 1475)	5/8/97	Between Arrow. Dam and Mack's Creek	Implanted with radial51.703 and released near mouth of Middle Fork Boise River in Arrowrock Reservoir

Table 12. Continued.

Arrowrock Res. Tagging Location	Tagging Date, PIT# (Length, Weight) ¹	Recapture Date (s)	Lucky Peak Recapture Location	Comments
SIRJ - near Irish Cr.	3/26/97 1 F63127A72 (496, 1080)	5/13/97	Between Arrow. Dam and Mack's Creek	Implanted with radiol51.383 and released near mouth of Middle Fork Boise River in Arrowrock Reservoir
STR1 - near Cottonwood Cr.	4/1/97 1 F75465452 (400, 585 - at surgery)	5/15/97	At base of Arrowrock Dam in Lucky Peak Reservoir	Located with telemetry, frequency 151.233
STR1 - near Cottonwood Cr.	11/30/97 20091D4278 (379, 390)	5/19/97	Between Arrow. Dam and Mack's Creek	
STR1 - near Cottonwood Cr.	4/1/97 200978500F (439, 695 - at surgery)	6/28/97	At base of Arrowrock Dam in Lucky Peak Reservoir on 6/28/97, at mouth of Mores Creek below Robie Creek Bridge on 7/17/97	Located with telemetry, frequency 151.183

¹ Length and weight at time of capture in Lucky Peak.

² Approximately one foot of monofilament was found attached to a hook which was embedded in the fishes throat.

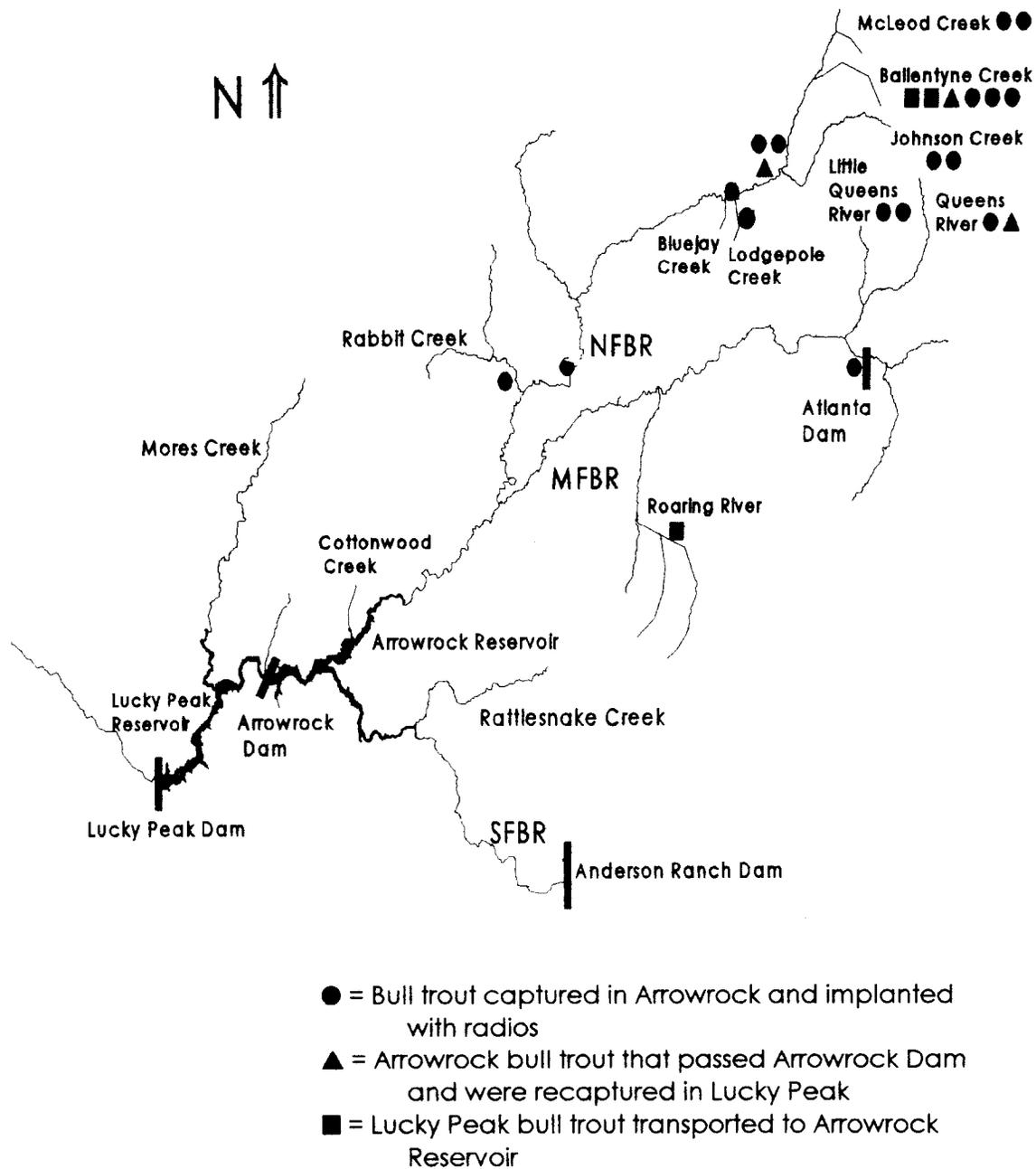


Figure 4. Radio telemetry locations of Arrowrock and Lucky Peak bull trout in the NFBR and MFBR during late July and early August 1997.

Three bull trout tracked to Ballentyne were transported out of Lucky Peak, one of the three was originally tagged in Arrowrock and subsequently captured in Lucky Peak. The lower 2 miles of Ballentyne Creek were observed by traveling afoot on August 31, 1997. This lower section was found to contain a very large (but not impassable) 7 ft tall debris dam near the confluence with the NFBR. Below the dam was a large pool in which three large bull trout were observed. Telemetry data collected from the air before and after this observation indicate bull trout had passed the barrier. Johnson Creek, approximately 5.5 miles downstream from Ballentyne Creek, was the summer rearing tributary for two bull trout. Three additional fish were located at the mouth of Johnson Creek. One of the three was originally tagged in Arrowrock and subsequently captured in Lucky Peak. We were not able to determine if these bull trout entered Johnson Creek. Lodgepole Creek, approximately 2.5 miles downstream of Johnson Creek, was used by one bull trout for summer rearing. Another fish was located near the mouth of Lodgepole Creek, but we were unable to determine if the fish entered the tributary. One bull trout was located in the NFBR between Rabbit Creek and Crooked River near Barber Flat. The summer rearing destination of this fish is unknown. One bull trout was located 0.5 mile up Rabbit Creek from the confluence with the NFBR.

Middle Fork Boise River

The Queens River drainage was used by four bull trout for summer rearing. Two swam up to the headwaters of the Little Queens River, and two were tracked up to the headwaters of the Queens River. One of the Queens River bull trout was originally marked in Arrowrock, recaptured in Lucky Peak Reservoir, and transported back to Arrowrock. One bull trout was tracked to the Atlanta Dam in mid-July, the signal remained at the base of the dam for the duration of the project. This bull trout may have died or expelled the radio transmitter. Roaring River was used by one bull trout that was captured in Lucky Peak and released in Arrowrock.

Radio Signals Remaining in Arrowrock Reservoir

Three radios were located near Cottonwood Creek in Arrowrock (Figure 5). Two were implanted in bull trout captured in Lucky Peak and transported to Arrowrock. Both radios implanted in Lucky Peak fish remained in the general area in which they were released. Because we were not able to locate radio 151.622 between April 1 and September 2, 1997, it is not known if the bull trout made any attempt to migrate out of Arrowrock. Since we never detected any movement in the two radios which remained in Arrowrock, we assumed these fish were dead or had expelled their radio transmitters.

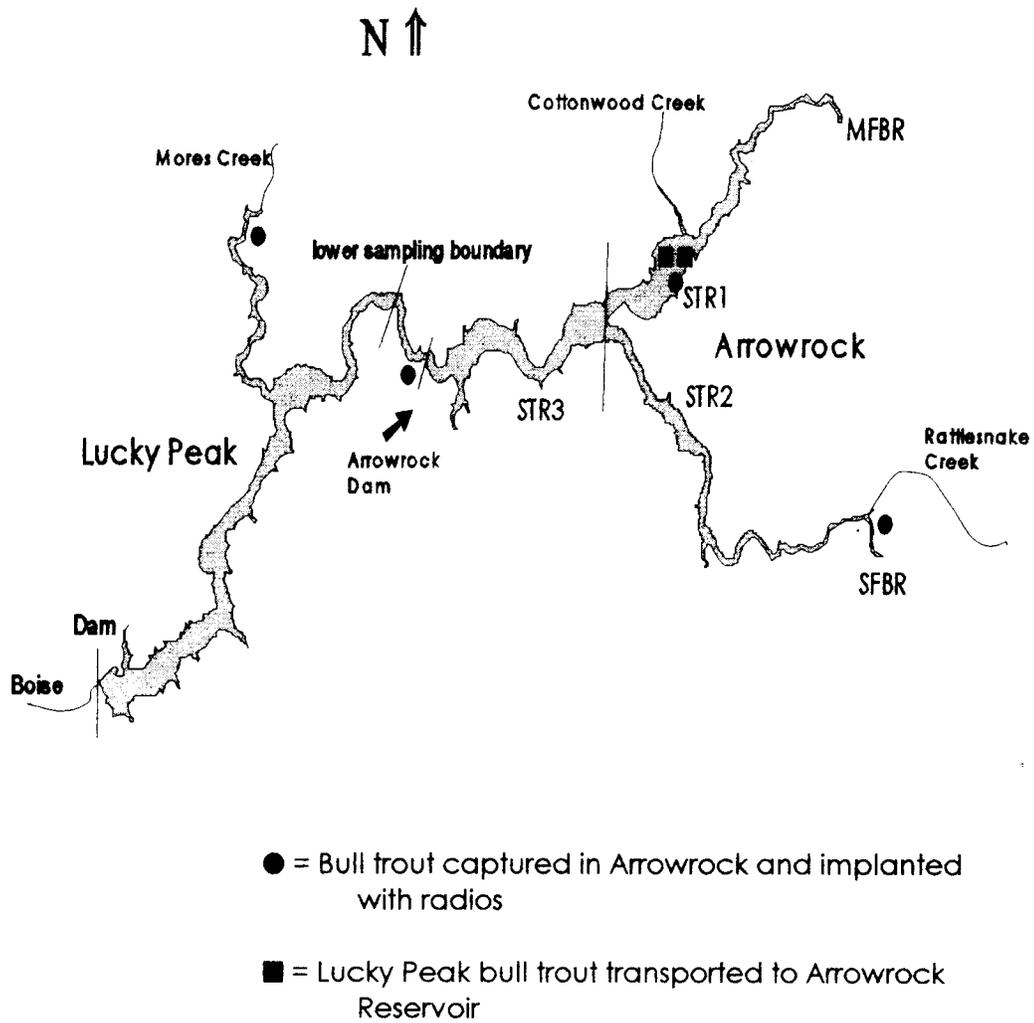


Figure 5. Locations of bull trout which traveled to Lucky Peak, the SFBR, or remained in Arrowrock Reservoir following release in 1997.

South Fork Boise River (SFBR)

One bull trout entered the SFBR and remained near the mouth of Rattlesnake Creek. We were unable to determine if the fish entered the tributary (Figure 5).

Radios Located in Lucky Peak Reservoir

Two radio-tagged bull trout entered Lucky Peak Reservoir, one between April 1-May 15, 1997, and the other between May 15 - June 28, 1997. The first remained near the base of Arrowrock Dam, the other moved to a location near mouth of Mores Creek, approximately 8 river-miles below Arrowrock Dam (Figure 5). The radio signal remained at this location between July 17, 1997 and September 12, 1997. We were unable to determine if this fish ever entered Mores Creek.

Timing of Migrations and Distance Traveled

Radio-tagged bull trout generally left Arrowrock Reservoir by mid-June, entered tributaries between late-July and early-August, exited tributaries by the second week in September, and returned to the reservoir between the second week in September and the third week in October (Figures 6 and 7). Migrating distances for bull trout leaving Arrowrock and located in upstream tributaries ranged from 27.5 to 67.5 miles (\bar{x} = 53 miles, SD = 9.8 miles). A complete listing of Arrowrock and Lucky Peak bull trout locations determined by radio tracking can be found in Appendices F and G.

Behavior Of Post-Spawn Bull Trout

Most bull trout returning to Arrowrock were found in the main pool of Strata 1 for several weeks before dispersing. During the month of November several bull trout returning to Arrowrock spent several weeks in large pools in the lower MFBR. These areas are known to contain mountain whitefish, rainbow trout, largescale sucker, and northern squawfish (IDFG file data). We were able to locate several bull trout which continued to travel downstream towards Arrowrock Dam after entering the reservoir between September 12 - October 10, 1997, and October 28 - November 19, 1997.

1996 Pilot Project Tracking Results Summary

In April of 1996, prior to the current IDFG-BOR project, 12 Arrowrock bull trout were implanted with radios (Allen et al. 1996, in press). Five were tracked to the MFBR and four were tracked to the NFBR. Two of the three remaining bull trout either died or expelled their radios in the MFBR, and the third was never located after release.

Migration Patterns Of Bull Trout Caught And Released In Arrowrock

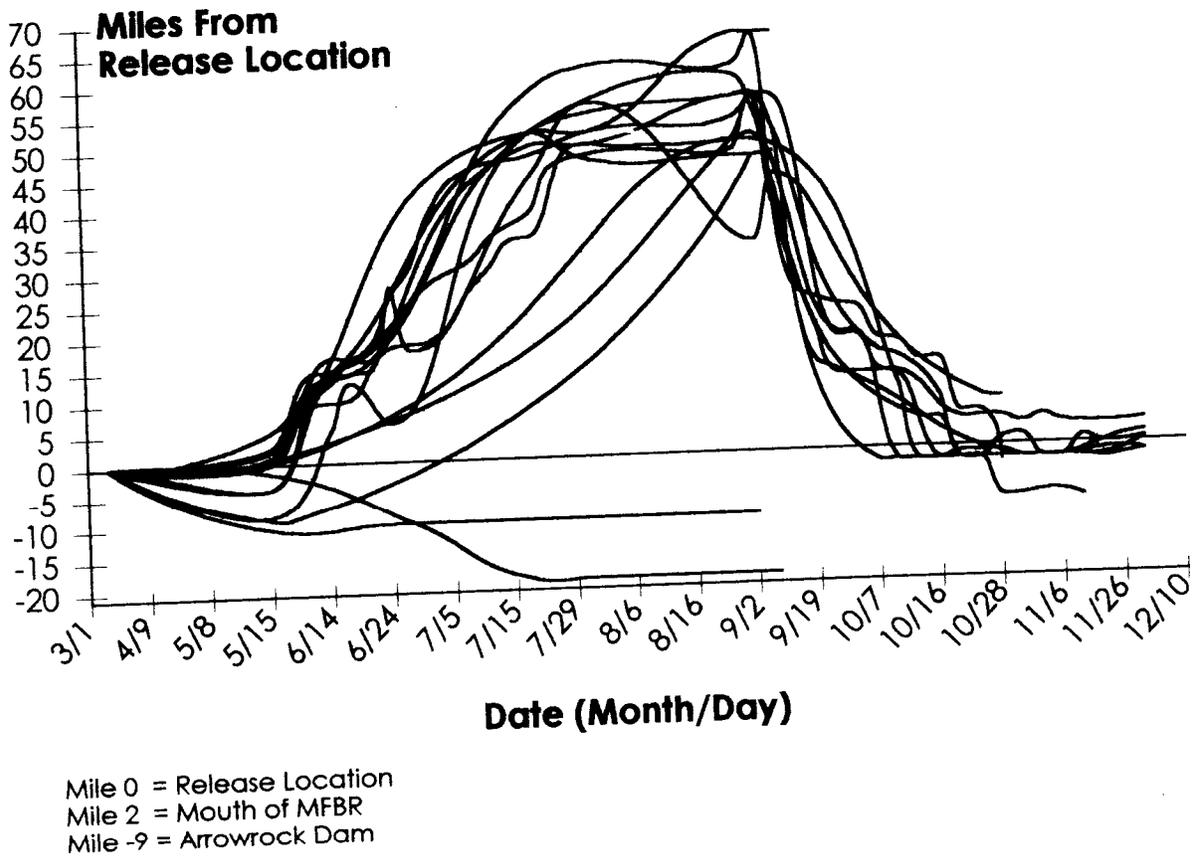
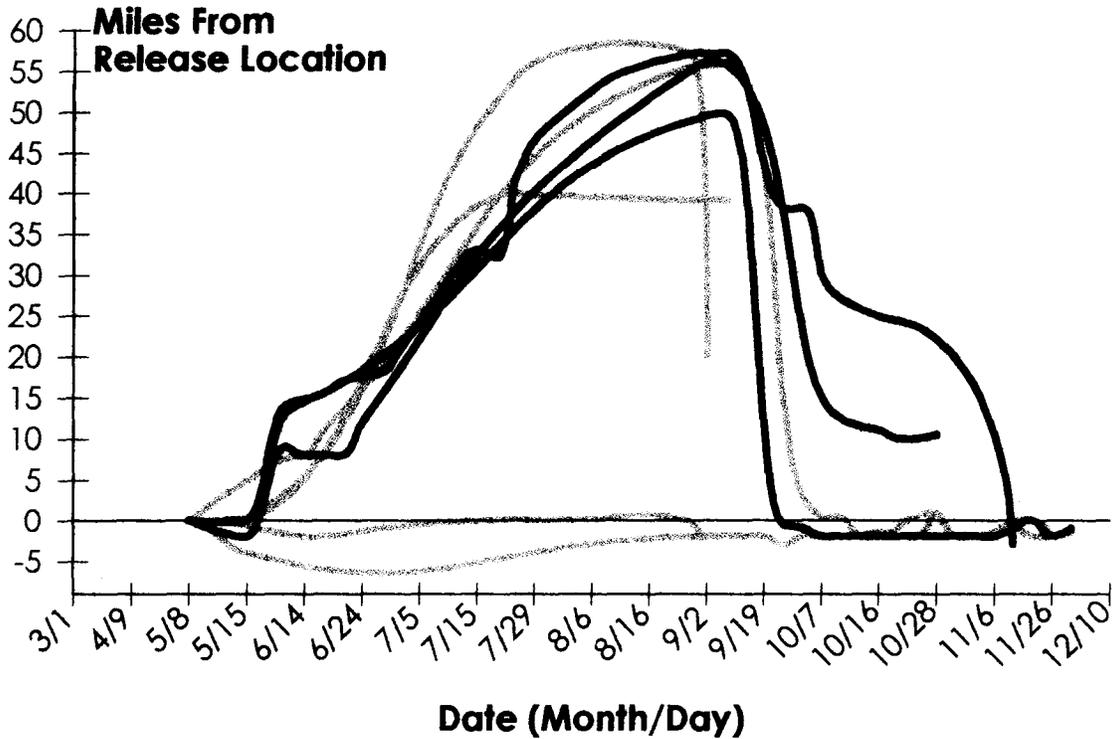


Figure 6. Migration patterns of bull trout caught and released in Arrowrock Reservoir in 1997.

Migration Patterns Of Bull Trout Caught In Lucky Peak And Released In Arrowrock



Mile 0 = Release Location
 Mile 2 = Mouth of MFBR
 Mile -9 = Arrowrock Dam

Black = Arrowrock recaptures caught in Lucky Peak
Grey = Unmarked bull trout caught in Lucky Peak

Figure 7. Migration patterns of bull trout caught in Lucky Peak and released in Arrowrock Reservoir in 1997.

Most of the radio-tagged bull trout in the pilot project left Arrowrock in early May, and by July had reached areas with suitable habitat for spawning in close proximity (Appendix H). During the spring of 1997, one of these bull trout (150.281) was recaptured and implanted with another radio (151.593). This fish was subsequently tracked up the Queens River during the current project. In the pilot project of 1996, the same bull trout was located 5.5 miles up the Queens River (Appendices F, H, and I).

DISCUSSION

Arrowrock Reservoir

Sampling

Recapture and telemetry data indicate fish movement within Arrowrock from one strata to another was common (Table 13). Regardless of original capture location within Arrowrock, a majority of marked fish were recaptured in the eastern end of the reservoir near the mouth of the MFBR in the springtime.

Aging

The differences in length-at-age between bull trout captured in the fall and spring (Tables 5 and 6) are largely due to variability associated with reading scales and the method DisBCal uses to calculate length-at-age for fall versus spring captured fish. Due to the inability of the three readers to agree on age when reading scales, the actual age of bull trout is likely greater than the age determined by scale reading. Elie (1995) agrees in that estimates of bull trout age, growth, and associated mortality should be carefully addressed when attempting to draw conclusions from bull trout aging work. We had intended to verify scale readings with surface ageing of otoliths, but chose not to due to similar difficulties in reading otoliths (Brown 1984) and time constraints. However, we feel the results of our efforts generally indicate the approximate age of bull trout sampled.

Population Estimate

The susceptibility of PIT tag reading equipment to moisture related failures created problems in identifying individually tagged fish. This problem coupled with assumed tag loss prevented determining original tagging dates and locations of 18.6% of the recaptured fish.

Table 13. Capture locations of Arrowrock bull trout recaptured on more than one occasion.

Arrowrock Multiple Recaptures – Capture Locations					
PIT tag #	Marking location and date	First recapture location and date	Second recapture location and date	Third recapture location and date	Comments
7F7D7D2707	11/2/96 captured-STR1	1 1/27/96 STR1	4/1/97 SIR1		originally released at boat ramp STR3 - RADIO 151.603 - spawned in NFBR
1 F683D201 C	11/2/96 STR 1	3/25/97 STR 1	4/1/97 STR 1		
1 F762A5A67	10/26/96 STR2	4/2/97 STR 1	4/9/97 SIR 1		
200D152717	UNKNOWN	4/3/97 STR1	4/9/97 STR3		no tag found
7F7D2B0509	3/7/97 confl. of 1,2,3	4/1/97 STR 1	4/18/97 STR 1	5/1/97 STR 2	
1 F62752763	UNKNOWN	4/1/97 STR1	4/23/97 STR1		no tag found
200A025103	11/1/96 STR 1	4/4/97 STR 1	4/24/97 STR 1		
1 F76101249	3/28/97 STR 1	4/7/97 STR 1	4/24/97 STR 1		
7F7B0C3865	3/7/97 confl. of 1,2,3	4/1/97 STR 1	4/25/97 STR 1	5/2/97 STR3	RADIO 151.643 - spawned NFBR in Ballentyne Cr.
200B2E7F28	UNKNOWN	4/9/97 STR1	4/25/97 STR1		no tag found

Arrowrock Multiple Recaptures – Capture Locations					
PIT tag #	Marking Location and date	First recapture location and date	Second recapture location and date	Third recapture location and date	Comments
1F6659287A	11/22/96 STR1	3/31/97 STR1	4/28/97 STR1		
7F7D3F3321	11/27/96 STR1	4/2/97 STR1	4/29/97 STR1		
1F727B5420	11/24/96 STR1	4/7/97 STR1	4/25/97 STR1		

Because the Schnabel model did not require this information for recaptures, we were able to include these "unidentified" fish in calculating our estimate. If PIT tags are to be used in future projects, a more reliable PIT tag reader should be considered to avoid moisture related problems experienced during this project.

Population estimates should be considered conservative for several reasons. First, there were only seventeen bull trout under 300 mm caught in our sampling. These were not included in the estimate. This might indicate a bias for large fish created by our choice of sampling gear or a low abundance of small fish in our sampling areas. Because we were confident that bull trout 300 mm or greater were efficiently captured, they were included in our population estimate. If similar population estimates are conducted in the future, sampling equipment should include one-half inch square mesh to determine abundance of fish less than 300 mm in length. Second, the Schnabel model was designed for a closed population. Because fish were able to emigrate to Lucky Peak this assumption was violated. However, we have no reason to believe tagged fish emigrated to Lucky Peak at rates different from untagged fish. Thirdly, recapture of marked bull trout indicated they were moving throughout Arrowrock. Our limited recapture information suggests these movements were random and mixing was occurring between marked and unmarked bull trout. It should be noted however, although there was an inferred bull trout preference for shallow points and beaches, some areas of the reservoir were not sampled in equal proportion to others. This was largely due to the limitations of our sampling equipment on boulder strewn shorelines and the vertical basalt walls commonly found around Arrowrock.

Lucky Peak

Our results, based on limited entrainment data, suggests a significant portion of the Arrowrock population moved into Lucky Peak during normal dam operations between October 25, 1996 and June 28, 1997. Bull trout identified as having traveled through the dam (by PIT tag data) appeared to be in good general body condition and, as our telemetry data indicates, capable of migrating to summer rearing areas if returned to Arrowrock Reservoir. In the absence of an estimate of recruitment into Arrowrock and an adequate appraisal of entrainment losses under different hydrological conditions, the consequences of annual losses on the Arrowrock population is unknown.

In October of 1992, the IDFG planted 6,000 six inch bull trout in Lucky Peak. Based on the length-at-age of bull trout caught in Arrowrock in the spring of 1997, the bull trout planted in Lucky Peak would approximately be 400-500 mm in length. Forty-two percent (24/57) of the unmarked bull trout captured in Lucky Peak were within this size range. We were unable to visually determine if any bull trout we handled were of hatchery origin. However, a comparison of relative length frequency, catch rates, and migratory behavior, suggests that many bull trout within Lucky Peak may have originated upstream of Arrowrock Dam. Our telemetry data supports this suggestion.

Telemetry Results

Eighty percent of bull trout implanted with radios exhibited an adfluvial life history pattern. We were unable to determine if the bull trout whose radio signals remained in Strata 1 indicated mortality, radios that had been expelled, or failure of the fish to migrate. There was no apparent correlation between distance traveled or spawning tributary selection with fish size or reservoir of origin. Telemetry results indicate the NFBR and MFBR are used as the primary summer rearing locations for Arrowrock bull trout. Study results document adult bull trout using McLeod, Ballentyne, Johnson, Lodgepole, Rabbit Creek, Roaring River, Queens and Little Queens Rivers, as well as the North, Middle, and South Forks of the Boise River for summer rearing. Bull trout transported to Arrowrock from Lucky Peak were generally found in the same areas as Arrowrock bull trout (Ballentyne Creek and the Queens River Drainage) during anticipated spawning times, and migrated at approximately the same time.

Prior to this project in April of 1996, twelve Arrowrock bull trout were radio tagged (Appendices H and I). Comparison of 1996 and 1997 radio tagging information indicated summer rearing stream fidelity to the Queens River drainage by one adfluvial migrant. Although the fish was captured at approximately the same time and location in Arrowrock, entrance to the tributary was several weeks later in 1997. This was the only fish from the spring 1996 project recaptured and re-implanted with a radio in 1997. When captured in the spring of 1996, this bull trout weighed 1,850 g and was 547 mm in length. When recaptured in the spring of 1997, this bull trout had grown to 1,890 g and 583 mm in length. Another bull trout implanted in the spring of 1996 (frequency 150.692) was captured in the spring of 1997 but was determined to be in too poor body condition to re-implant with a radio. The old radio was removed and the bull trout was released. At the time of capture in the spring of 1996, this fish weighed 2350 grams and was 553 mm in length. In the spring of 1997, the same fish weighed 1,095 grams less and was 11 mm shorter in total length.

Atlanta Dam is a migration barrier to adfluvial bull trout migrants traveling up the MFBR. The USFS has indicated that bull trout focal habitats exist above the Atlanta Dam. If passage around this dam were provided, the Arrowrock adfluvial bull trout population would have access to 39% more focal habitat in the MFBR (Scott Grunder, IDFG, personal communication).

Although historical IDFG and USFS electrofishing work has documented bull trout in the SFBR below Anderson Ranch Dam and Rattlesnake Creek, we were unable to determine if any fish included in this project spawned in the SFBR or its tributaries.

CONCLUSION

Based on our results, there are 471 (95% CI = 389 - 590) bull trout greater than 300 mm in Arrowrock Reservoir. Radio telemetry suggests this population is largely adfluvial and on average travels 53 miles (SD = 9.8 mi) to summer rearing areas in the MFBR and NFBR tributaries. Twenty percent of our Lucky Peak bull trout catch consisted of fish originating from Arrowrock Reservoir. When bull trout from Lucky Peak were placed in Arrowrock their migration and summer rearing patterns were similar to Arrowrock bull trout. We suspect most Lucky Peak bull trout originated from tributaries above Arrowrock.

Our efforts in Arrowrock and Lucky Peak have provided insight towards a better understanding of the life history of bull trout in the Boise River basin, but questions addressing the magnitude of summer rearing tributary use, recruitment to Arrowrock, and the impact of bull trout emigration to Lucky Peak on bull trout populations above Arrowrock remain. In the absence of this information, determining the significance of continued losses of Boise River basin migratory bull trout to Lucky Peak will be very difficult to assess.

RECOMMENDATIONS

1. Quantify bull trout recruitment from tributaries and Anderson Ranch Reservoir to Arrowrock Reservoir.
2. Continue to quantify magnitude of entrainment loss of bull trout to Lucky Peak Reservoir and relate to Arrowrock Reservoir water level and time of year. Determine the impact of entrainment loss on bull trout populations upstream from Arrowrock Dam.
3. Determine feasibility of using bull trout redd surveys to monitor bull trout population trends.
4. Survey NFBR and MFBR tributaries during documented summer rearing periods to determine tributary use by adfluvial bull trout.
5. Radio tag more bull trout in Strata 2 (SFBR). Determine if their movement patterns are similar to Strata land 3 tagged bull trout.

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Appendices A - I

Appendix A. Species composition of Arrowrock and Lucky Peak sampling occurring between October 18, 1996 - May 2, 1997, and March 6, 1997 - May 19, 1997, respectively.

Lucky Peak Population Composition		Arrowrock Population Composition	
Genus species common name	Percent of Catch ¹ (Number)	Genus species common name	Percent of Catch ¹ (Number)
<i>Salvelinus confluentus</i> bull trout	2.9% (74)	<i>Salvelinus confluentus</i> bull trout	3.61 % (411)
<i>Catostomus macrocheilus</i> largescale sucker	31.1 (782)	<i>Catostomus macrocheilus</i> largescale sucker	24.3 (2,766)
<i>Catostomus columbianus</i> bridgelip sucker	6.36 (160)	<i>Catostomus columbianus</i> bridgelip sucker	10.3 (1,167)
<i>Ptychocheilus oregonensis</i> northern squawfish	35.3 (887)	<i>Ptychocheilus oregonensis</i> northern squawfish	8.64 (983)
<i>Prosopium williamsoni</i> mountain whitefish	10.5 (264)	<i>Prosopium williamsoni</i> mountain whitefish	20.8 (2,362)
<i>Perca flavescens</i> yellow perch	1.03 (26)	<i>Perca flavescens</i> yellow perch	17.1 (1,948)
<i>Oncorhynchus tshawytscha</i> chinook salmon	1.11 (28)	<i>Oncorhynchus tshawytscha</i> chinook salmon	0.34 (39)
<i>Oncorhynchus clarki lewisi</i> westslope cutthroat trout	0.2 (5)	<i>Oncorhynchus clarki lewisi</i> westslope cutthroat trout	0.06 (7)
<i>Richardsonius balteatus</i> reidside shiner	1.56 (14)	<i>Richardsonius balteatus</i> reidside shiner	6.64 (756)
<i>Oncorhynchus mykiss</i> hatchery rainbow	9.3 (234)	<i>Oncorhynchus mykiss</i> hatchery rainbow	7.29 (830)
<i>Oncorhynchus mykiss</i> redband trout	1.07 (27)	<i>Oncorhynchus mykiss</i> redband trout	0.89 (101)

¹Combined catch from gill nets and trap nets

Appendix A. Continued.

Lucky Peak Population Composition

Arrowrock Population Composition

Genus species common name	Percent of Catch (Number)	Gerl.'s species common name	Percent of Catch (Number)
<i>Acrocheilus alutaceus</i> chiselmouth	0.2% (5)	<i>Acrocheilus alutaceus</i> chiselmouth	0.04% (4)
<i>Micropterus dolomieu</i> smallmouth bass	0.36 (9)	<i>Micropterus dolomieu</i> smallmouth bass	0.02 (2)
<i>Oncorhynchus nerka</i> kokanee salmon	0.04 (1)	<i>Ictalurus nebulosus</i> brown bullhead	0.02 (2)

¹Combined catch from gill nets and trap nets

Appendix B. Arrowrock Reservoir lowland lake fish sample report for sampling occurring on October 18, 1996.

Lowland Lake Fish Sample Report

Lake Name **ARROWROCK RES**

Water Number **1000000118**

Sample Date **10/18/96**

		1			
	Length	Number	Mean	Mean	Relative
Biomass	Group	Sampled	Length	Weight	Weight
	(cm)		(mm)	(g)	(kg)
BLS Bridgelip sucker					
HSGN (=number caught per hour of sinking gill net)					
	25	0.12	250	200	0.02
	31	0.36	312	297	0.11
	33	0.12	335	420	0.05
	34	0.24	343	435	0.10
	36	0.24	363	510	0.12
	37	0.12	375	590	0.07
	38	0.12	380	540	0.07
	39	0.12	395	660	0.08
	HSGN Total	1.44	340	433	0.62
	S.E.		11.5	40.3	
BLS	Total	1.44	340	433	0.62
	S.E.		11.5	40.3	
Standard Unit Catch					
% by Number 15.6 %.			% by Weight 13.8 %.		
BLT Bull trout					
HSGN (=number caught per hour of sinking gill net)					
	36	0.06	365	390	0.02
	40	0.06	400	500	0.03
	HSGN Total	0.11	383	445	0.05
	S.E.		17.5	55.0	
BLT	Total	0.11	383	445	0.05
	S.E.		17.5	55.0	
Standard Unit Catch					
% by Number 1.2 %.			% by Weight 1.1 %.		
LSS Largescale sucker					
HSGN (=number caught per hour of sinking gill net)					
	25	0.11	250	180	0.02
	26	0.11	260	190	0.02
	28	0.22	280	225	0.05
	29	0.22	293	265	0.06
	31	0.22	310	315	0.07
	33	0.22	333	395	0.09
	34	0.22	345	415	0.09

Appendix B. Continued.

	Length (cm)	¹ Number	Group (mm)	Sampled (g)	Length (mm)	Weight (g)	Weight (g)	Relative (kg)
		Biomass						
	35	0.56	353	433				0.24
	36	0.78	361	466				0.37
	37	1.01	374	511				0.52
	38	0.78	383	563				0.44
	39	0.22	393	615				0.14
	40	0.22	400	615				0.14
	41	0.34	412	650				0.22
	42	0.22	423	775				0.17
	43	0.11	435	860				0.10
	44	0.34	443	943				0.32
	46	0.11	465	1000				0.11
	47	0.22	473	1015				0.23
HSGN Total		6.28	372	540				3.39
S.E.			6.6	28.5				
LSS Total		6.28	372	540				3.39
S.E.			6.6	28.5				
Standard Unit Catch								
% by Number 67.7 %.			% by Weight 75.1 %.					
MWF Mountain whitefish								
HSGN (=number caught per hour of sinking gill net)								
	23	0.11	235	100	77.17			0.01
	25	0.11	250	120	76.74			0.01
	26	0.11	260	160	90.84			0.02
	27	0.11	275	250	119.71			0.03
	34	0.11	340	310	77.95			0.03
HSGN Total		0.56	272	188				0.10
S.E.			18.2	39.9				
MWF Total		0.56	272	188				0.10
S.E.			18.2	39.9				
Standard Unit Catch								
% by Number 6.0 %.			% by Weight 2.3 %.					
NSF Northern squawfish								
HSGN (=number caught per hour of sinking gill net)								
	31	0.11	310	290				0.03
	50	0.11	500	1120				0.12
HSGN Total		0.22	405	705				0.16
S.E.			95.0	415.0				

Appendix B. Continued.

	¹ Length Number Biomass	Group	Sampled Length (mm)	Mean Weight (g)	Mean Weight (g)	Relative (kg)
NSF	Total	0.22	405	705		0.16
	S.E.		95.0	415.0		
Standard Unit Catch						
	% by Number	2.4 %.		% by Weight	3.5 %.	
WRB	Wild (natural) rainbow/redband HSGN (=number caught per hour of sinking gill net)					
	32	0.11	320	340	92.16	0.04
	HSGN Total	0.11	320	340		0.04
	S.E.					
WRB	Total	0.11	320	340	0.04	S.E.
Standard Unit Catch						
	% by Number	1.2 %.		% by Weight	0.8 %.	
YLP	Yellow perch HSGN (=number caught per hour of sinking gill net)					
	24	0.11	240	190	94.77	0.02
	25	0.22	253	205	86.78	0.05
	26	0.11	265	260	94.16	0.03
	35	0.11	350	500	73.73	0.06
	HSGN Total	0.56	272	272		0.15
	S.E.		19.9	58.3		
YLP	Total	0.56	272	272		0.15
	S.E.		19.9	58.3		
Standard Unit Catch						
	% by Number	6.0 %.		% by Weight	3.3 %.	
	Length Number Mean Mean Relative Biomass					
	Group	Sampled Length	Weight	Weight		(kg)
	(cm)	(mm)	(g)	(g)		
Total Number	9.3 . Total Weight		4.52 kg.			

Appendix B. Continued.

Units of Effort by Geartype for this date.

**Geartype *Units of Effort* for
this Survey**

TN	4
HSGN	18

1

Number sampled is reported as total catch per unit of effort. Units of effort include: AN - Total angling catch; EF (Electrofishing) - 3600s (1 hour) of activated electrode time; FGN - (Floating Gill Net) - One 45.7 m floating gill net set overnight; GN - (Gill Nets) - 1-45.7m floating and 1-45.7m sinking gill net set overnight; SGN - (Sinking Gill Net) - One 45.7m sinking gill net set overnight; TN - (Trap Net) - One trap net set overnight; VGN - (Vertical Gill Net) - One vertical gill net set overnight.

Appendix C. Arrowrock Reservoir lowland lake fish sample report for sampling occurring on October 25, 1996.

Lowland Lake Fish Sample Report

Lake Name ARROWROCK RES
 Water Number 100000118 Sample Date 10/25/96

Length	Number ¹	Mean	Mean	Relative
Biomass Group	Sampled Length	Weight	Weight	(kg)
(cm)	(mm)	(g)		

BLS Bridgelip sucker
 HSGN (=number caught per hour of sinking gill net)

34	0.17	345	400	0.07
35	0.17	350	470	0.08
37	0.17	370	525	0.09
39	0.33	393	525	0.17
HSGN Total	0.83	370	489	0.41
S.E.		10.1	25.9	

BLS Total	0.83	370	489	0.41
S.E.		10.1	25.9	

Standard Unit Catch
 % by Number 7.6 % % by Weight 5.4 %

BLT Bull trout
 HSGN (=number caught per hour of sinking gill net)

29	0.08	290	170	0.01
30	0.08	307	220	0.02
31	0.08	315	220	0.02
34	0.08	340	320	0.03
42	0.08	422	620	0.05
48	0.08	480	882	0.07
HSGN Total	0.50	359	405	0.20
S.E.		30.8	116.1	

BLT Total	0.50	359	405	0.20
S.E.		30.8	116.1	

Standard Catch
 % by Number 4.5 % % by Weight 2.7 %

	HRB Hatc	rainbow per hour	trout of sinking		
31	0.17	315	300	85.38	0.05
34	0.33	345	415	89.10	0.14
HSGN Total	0.50	335	377		0.19
S.E.		10.0	48.0		

Appendix C. Continued.

	Length Biomass Group (cm)	Number Sampled	1		Relative (kg)
			Length (mm)	Mean Weight (g)	
HRB	Total	0.50	335	377	0.19
	S.E.		10.0	48.0	

Standard Unit Catch
% by Number 4.5 %.

% by Weight 2.5 %.

LSS	Largescale sucker				
	HSGN (=number caught per hour of sinking gill net)				
	33	0.17	330	370	0.06
	36	0.33	365	475	0.16
	37	0.17	375	560	0.09
	38	0.33	380	510	0.17
	39	0.50	390	583	0.29
	40	0.50	402	592	0.30
	41	0.33	413	725	0.24
	42	0.33	420	700	0.23
	43	0.17	430	800	0.13
	44	0.67	444	873	0.58
	45	0.17	455	900	0.15
	46	0.33	463	1075	0.36
	47	0.33	470	1000	0.33
	48	0.50	482	1110	0.56
	49	0.50	490	1150	0.57
	50	0.17	500	950	0.16
	51	0.17	515	1400	0.23
	52	0.17	520	1650	0.28
	54	0.17	540	1800	0.30
	56	0.17	560	1700	0.28
	HSGN Total	6.17	441	889	5.48
	S.E.		8.9	58.7	

LSS	Total	6.17	441	889	5.48
	S.E.		8.9	58.7	

Standard Unit Catch
% by Number 56.1 %.

% by Weight 72.7 %.

MWF	Mountain whitefish					
	HSGN (=number caught per hour of sinking gill net)					
	24	0.32	240	150	108.59	0.05
	26	0.32	260	185	105.03	0.06
	29	0.16	290	250	101.88	0.04
	31	0.16	310	290	96.52	0.05
	33	0.48	333	367	97.87	0.18

Appendix C. Continued.

	34	0.32	343	450	113.15	0.14
	40	0.16	400	660	101.32	0.11
	¹					
	Length Number		Mean	Mean		Relative
	Biomass					
	Group Sampled Length		Weight	Weight		(kg)
	(cm)		(mm)	(g)		
	HSGN Total	1.92	307	311		
	S.E.		14.3	46.7		
						0.62
MWF	Total	1.92	307	311		
	S.E.		14.3	46.7		
Standard Unit Catch						
	% by Number 17.4 %.		% by Weight 8.2 %.			
NSF Northern squawfish						
HSGN (=number caught per hour of sinking gill net)						
	34	0.15	345	425		0.06
	37	0.31	373	500		0.15
	39	0.15	395	560		0.09
	40	0.15	400	600		0.09
	52	0.15	520	1350		0.21
	HSGN Total	0.92	401	656		0.60
	S.E.		25.1	141.5		
NSF	Total	0.92	401	656		0.60
	S.E.		25.1	141.5		
Standard Unit Catch						
	% by Number 8.3 %.		% by Weight 8.0 %.			
WRB Wild (natural) rainbow/redband						
HSGN (=number caught per hour of sinking gill net)						
	29	0.17	295	220	76.72	0.04
	HSGN Total	0.17	295	220		0.04
	S.E.					
WRB	Total	0.17	295	220		0.04
	S.E.					
Standard Unit Catch						
	% by Number 1.5 %.		% by Weight 0.5 %.			
	Length Number		Mean	Mean		Relative
	Biomass					
	Group Sampled Length		Weight	Weight		(kg)
	(cm)		(mm)	(g)		

Appendix C. Continued.

Total Number **11.0 . Total Weight** **7.54 kg.**

Units of Effort by Geartype for this date.

Geartype *Units of Effort for
this Survey*

TN	4
HSGN	12

1

Number sampled is reported as total catch per unit of effort. Units of effort include: AN - Total angling catch; EF (Electrofishing) - 3600s (1 hour) of activated electrode time; FGN - (Floating Gill Net) - One 45.7 m floating gill net set overnight; GN - (Gill Nets) - 1-45.7m floating and 1-45.7m sinking gill net set overnight; SGN - (Sinking Gill Net) - One 45.7m sinking gill net set overnight; TN - (Trap Net) - One trap net set overnight; VGN - (Vertical Gill Net) - One vertical gill net set overnight.

Appendix D. Arrowrock bull trout under 300 mm - not used in Schnabel population estimate.

Date	Length	Weight	Strata	PIT Tag #
10/23/96	275	150	1	1F68674A48
10/25/96	290	170	2	1F68303811
11/1/96	270	135	1	1F6E254A04
3/26/97	270	185	1	200D52255C
3/28/97	284	185	1	2000083C1C
3/31/97	273	160	1	20023E2D 73
4/2/97	254	340	1	1F762F2C10
4/3/97	290	190	1	200915754D
4/8/97	290	190	1	1F6E2D3610
4/10/97	293	230	3	1F714D3461
4/24/97	299	210	1	2009133A0A
4/25/97	190	50	1	200B023E15
4/25/97	264	90	1	1F62580522
4/28/97	287	170	1	20001E5072
4/28/97	292	190	1	200COC1F29
5/2/97	290	190	3	1F60532E00
5/2/97	296	195	1	1F6E2D3610

Appendix E. Lucky Peak Reservoir lowland lake fish sample report for sampling occurring on March 6, 1997.

Lowland Lake Fish Sample Report

Lake Name		LUCKY PEAK RES			
Water Number		1000000115		Sample Date	316197
Length Biomass Group (cm)	Number ¹ Sampled	Length (mm)	Mean	Mean	Relative (kg)
			Weight (g)	Weight	
FCH Fall chinook salmon					
HSGN (=number caught per hour of sinking gill net)					
25	0.15	250	160		0.02
27	0.45	273	207		0.09
28	0.15	280	200		0.03
HSGN Total		0.75	270	196	0.15
S.E.			5.2	9.8	
FCH Total		0.75	270	196	0.15
S.E.			5.2	9.8	
Standard Unit Catch					
% by Number		7.1 %.		% by Weight 3.4%	
LSS Largescale sucker					
HSGN (=number caught per hour of sinking gill net)					
35	0.22	355	360		0.08
36	0.66	363	490		0.32
37	0.44	370	600		0.26
38	0.44	380	480		0.21
39	0.22	395	700		0.15
42	0.44	423	880		0.39
49	0.22	490	1100		0.24
HSGN Total		2.63	390	629	1.65
S.E.			11.2	65.1	
LSS Total		2.63	390	629	1.65
S.E.			11.2	65.1	
Standard Unit					
% by Number Catch		25.0 %.		% by Weight 38.3%	
NSF Northern squawfish					
HSGN (=number caught per hour of sinking gill net)					
29	0.23	290	220		0.05
30	0.46	303	280		0.13
31	0.69	313	307		0.21
32	2.07	322	333		0.69
33	1.84	333	340		0.63

Appendix E. Continued.

		¹			
	Length	Number	Mean	Mean	Relative
	Group	Sampled	Length	Weight	Weight
	(cm)	(mm)	(g)	(g)	(kg)
	HSGN Total	7.13	331	353	2.51
	S.E.		3.4	12.2	
NSF	Total	7.13	331	353	2.51
	S.E.		3.4	12.2	
Standard Unit Catch					
	% by Number 67.9 %.		% by Weight 58.3 %.		

Total Number 10.5 . Total Weight 4.31 kg.

Units of Effort by Geartype for this date.

*Geartype Units of Effort for
this Survey*

HSGN 16

1

Number sampled is reported as total catch per unit of effort Units of effort include: AN - Total angling catch; EF (Electrofishing) - 3600s (1 hour) of activated electrode time; FGN - (Floating Gill Net) - One 45.7 m floating gill net set overnight; GN - (Gill Nets) - 1-45.7m floating and 1-45.7m sinking gill net set overnight; SGN - (Sinking Gill Net) - One 45.7m sinking gill net set overnight; TN - (Trap Net) - One trap net set overnight; VGN - (Vertical Gill Net) - One vertical gill net set overnight.

Appendix F. Chronological summary of bull trout movements from Arrowrock Reservoir to tributaries of the MFBR.

Tagging location, date, radio frequency	Date when fish began spawning migration	Tributary and approximate entry date	Approximate date fish left tributary	Date fish returned to Arrowrock Reservoir	Comments
STR1 ^a , 4/1/97, 151.103	between 5/15 and 6/9/97	NFBR-Lodgepole Creek, between 9/2 and 9/12/97			
STR 1 ^a , 4/1/97, 151.153	between 5/15 and 6/9/97	MFBR-between 8/1 and 9/25/97 was at base of Atlanta power station			as of 11/6/97 radio located at base of Atlanta power station
STR1 ^a , 4/1/97, 151.162	between 5/15 and 6/9/97	NFBR-Rabbit Creek, between 8/1 and 8/21/97	between 8/21 and 9/2/97		
STR1 ^a , 4/1/97, 151.173	between 5/16 and 9/2/97	NFBR			NFBR between Bluejay and Lodgepole Creek's on 9/2/97, lost signal between 5/16 and 9/2/97
STR1 ^a , 4/1 /97, 151.183	between 5/15 and 6/28/97 entered Lucky Peak			last located near mouth of Mores Creek 9/12/97	recaptured 5/2/97 in STR3

Appendix F. Continued.

Tagging location, date, radio frequency	Date when fish began spawning migration	Tributary and approximate entry date	Approximate date fish left tributary	Date fish returned to Arrowrock Reservoir	Comments
STR 1 ^a , 4/1/97, 151.203	between 6/28 and 8/21/97	SFBR-Rattlesnake Creek, between 8/21 and 9/2/97 reached creek mouth			never entered Rattlesnake Cr., stayed near mouth in SFBR
STR 1 ^a , 4/1/97, 151.213	between 5/15 and 6/14/97	NFBR-Mcleod Creek, between 7/17 8/21/97	between 8/21 and 9/2/97	between 9/12 and 10/7/97	
STR 1 ^a , 4/1/97, 151.222	never located after 4/1 /97				
STR 1 ^a , 4/1/97, 151.233	between 4/1 and 5/15 entered Lucky Peak				last located at back of Arrowrock Dam on 9/2/97
STR 1 ^a , 4/1/97, 151.243	between 5/15 and 6/9/97	NFBR-located 8/21/97 near Barber Flat			Never located after 8/21/97

Appendix F. Continued.

Tagging location, date, radio frequency	Date when fish began spawning migration	Tributary and approximate entry date	Approximate date fish left tributary	Date fish returned to Arrowrock Reservoir	Comments
STR3 ^b , 4/10/97, 151.274	between 5/15 and 6/9/97	NFBR		between 9/12 and 10/24/97	traveled up the NFBR as far as Johnson Creek on 8/1/97
STR1 ^a , 4/1/97, 151.282	between 5/15 and 6/9/97	MFBR- Queens River, between 7/17 and 7/29/97, Little Queens River, between 8/21 and 9/2/97	between 9/2 and 9/23/97	between 9/25 and 10/9/97	
STR 1 ^a , 4/1/97, 151.303	between 5/15 and 6/9/97	MFBR- Queens River, between 7/25 and 8/1 /97	between 9/12 and 9/23/97	between 10/9 and 10/16/97	traveled to headwaters
STR3 ^b , 4/9/97, 151.333	between 5/15 and 6/9/97	NFBR- Mcleod Creek, between 8/21 and 9/2/97	between 9/2 and 9/12/97	between 10/9 and 10/21 /97	

Appendix F. Continued.

Tagging location, date, radio frequency	Date when fish began spawning migration	Tributary and approximate entry date	Approximate date fish left tributary	Date fish returned to Arrowrock Reservoir	Comments
STR1 ^a , 4/18/97, 151.344	between 5/15 and 6/9/97	NFBR- Johnson Creek between 717 and 8/1/97			
STR1 ^a , 4/24/97, 1151.593	between 5/15 and 6/9/97	MFBR- Little Queens River, between 7/10 and 7/17/97, (between 6/20 and 6/22/96- same fish)	between 9/2 and 9/18/97 (150.281- unknown in 1996)	between 10/24 and 10/28/97, (150.281- unknown in 1996)	followed same fish w/different radio (150.281) 5.5 miles up Queens River in 9/11/96
STR1 ^a , 4/1/97, 151.603	between 5/15 and 9/2/97	NFBR		between 10/9 and 10/14/97	located 9/2/97 in the NFBR near mouth of Johnson Creek, unknown if entered Johnson Cr.
STR 1 ^a , 4/1/97, 151.622	lost radio signal between 4/1 and 9/2/97				signal stayed in .reservoir near Irish Creek after 9/2/97

Appendix F. Continued.

Tagging location, date, radio frequency	Date when fish began spawning migration	Tributary and approximate entry date	Approximate date fish left tributary	Date fish returned to Arrowrock Reservoir	Comments
STR1 ^a , 4/4/97, 151.633	between 5/15 and 6/14/97	NFBR-Ballentyne Creek, between 8/1 and 8/21/97	between 9/2 and 9/12/97	between 10/16 and 10/21/97	
STR1 ^a , 4/1/97, 151.643	between 5/15 and 6/9/97	NFBR-Ballentyne Creek, between 8/1 and 8/21/97	between 9/2 and 9/12/97	between 9/25 and 10/31/97	recaptured three times in Arrowrock Reservoir (4/1 in STR1, 4/25 in STR1, and 5/2/97 in STR3)
STR1 ^a , 4/1/97, 151.663	between 5/15 and 8/21/97	NFBR-Ballentyne Creek between 8/21 and 9/2/97	between 9/2 and 9/12/97	between 10/16 and 10/21/97	originally caught in STR1 but PIT tagged and released in lower STR3 near lower boat ramp, lost signal between 5/15 and 8/21/97
STR1 ^a , 4/1/97, 151.683	between 5/15 and 7/17/97	NFBR-Johnson Creek, between 5/15 and 7/17/97	between 8/21 and 9/2/97		lost signal between 5/15 and 7/17/97

Appendix F. Continued.

Tagging location, date, radio frequency	Date when fish began spawning migration	Tributary and approximate entry date	Approximate date fish left tributary	Date fish returned to Arrowrock Reservoir	Comments
Lucky Peak ^c , 5/8/97, 151.293	between 5/15 and 6/9/97	NFBR- Ballentyne Creek, between 6/21 and 8/21/97	between 9/2 and 9/23/97	between 9/23 and 10/7/97	captured in Lucky Peak, transported and released in Arrowrock Reservoir with radio implanted
Lucky Peak ^c , 5/8/97, 151.323	between 5/15 and 6/9/97	MFBR- Queens River, between 7/25 and 8/1/97	between 9/2 and 9/23/97	between 10/28 and 11/19/97	Arrowrock fish recaptured in Lucky Peak, hailed back and released in Arrowrock Reservoir with radio implanted
Lucky Peak ^c , 5/8/97, 151.353	between 5/15 and 7/17/97	MFBR- Roaring River, between 5/15 and 7/17/97			captured in Lucky Peak, transported and released in Arrowrock Reservoir with radio implanted

Appendix F. Continued.

Tagging location, date, radio frequency	Date when fish began spawning migration	Tributary and approximate entry date	Approximate date fish left tributary	Date fish returned to Arrowrock Reservoir	Comments
Lucky Peak ^c , 5/12/97, 151.363	unable to find between 5/15 and 9/2/97				on 5/15 was located in upper Arrowrock Reservoir, on 9/19/97 was relocated in same position
Lucky Peak ^c , 5/8/97, 151.372	between 5/15 and 7/17/97	NFBR- Ballentyne Creek, between 7/17 and 8/1/97	between 8/21 and 9/2/97		captured in Lucky Peak, transported and released in Arrowrock Reservoir with radio implanted
Lucky Peak ^c , 5/13/97, 151.383	between 5/15 and 6/9/97	NFBR- located 9/2 and 9/21 /97 near mouth of Johnson Creek	unknown if fish ever entered Johnson Creek	between 9/12 and 9/23/97	Arrowrock fish recaptured in Lucky Peak, hauled back and released in Arrowrock Reservoir with radio implanted

Appendix F. Continued.

Tagging location, date, radio frequency	Date when fish began spawning migration	Tributary and approximate entry date	Approximate date fish left tributary	Date fish returned to Arrowrock Reservoir	Comments
Lucky Peak ^c , 5/13/97, 151.613	radio signal never left upper Arrowrock Reservoir				captured in Lucky Peak, transported and released in Arrowrock Reservoir with radio implanted
Lucky Peak ^c , 5/8/97, 151.703	between 5/15 and 6/9/97	NFBR- Ballentyne Creek, between 8/21 and 9/2/97			Arrowrock fish recaptured in Lucky Peak, transported and released in Arrowrock Reservoir with radio implanted

^a Fish were tagged and released near Cottonwood Creek in upper Arrowrock Reservoir

^b Fish were tagged and released near Arrowrock Dam in lower Arrowrock Reservoir

^c Fish were released near Cottonwood Creek in upper Arrowrock Reservoir

Appendix G. Locations of Arrowrock and Lucky Peak bull trout as identified by radio telemetry.

Frequency (150.XXX)	Date	Location	Mile ¹	Mile ²	Mile ³
103		411/97 Arrowrock Reservoir - Cottonwood Ck.	16.0	0.0	0.0
		5/15197 Arrowrock Reservoir - Cold Spring Creek	12.0	0.0	-4.0
		619/97 MFBR	26.0	0.0	10.0
		7/17/97 NFBR - In river near Graham	34.0	33.5	51.5
		81197 NFBR - Between Bluejay Cr and Lodgepole Cr in river	34.0	29.0	47.0
		82197 NFBR - Between Bluejay Cr and Lodgepole Cr in river	34.0	29.0	47.0
		912/97 NFBR - Between Bluejay Cr and Lodgepole Cr in river	34.0	29.0	47.0
		9112/97 NFBR - Lodgepole Creek	34.0	29.5	47.5
153		41197 Arrowrock Reservoir - Cottonwood Ck.	16.0	0.0	0.0
		5/15197 Arrowrock Reservoir - Mouth of South Fork Boise River	13.0	0.0	-3.0
		619/97 MFBR - Birch Creek Campground	24.0	0.0	8.0
		6117/97 MFBR - Troutdale Hot Springs	34.0	0.0	18.0
		6121197 MFBR - Repeat Creek Campground	36.5	0.0	20.5
		624197 MFBR - Alexander Creek	43.0	0.0	27.0
		612897 MFBR	45.5	0.0	29.5
		713197 MFBR - Dutch Creek Forest Service Station	53.0	0.0	37.0
		7/10197 MFBR - Half mile below Black Warrior Creek	58.0	0.0	42.0
		7/12/97 MFBR - Queens River/Campground	64.0	0.0	48.0
		7/15/97 MFBR - Atlanta power station	67.0	0.0	51.0
		7/1797 MFBR - Atlanta power station	67.0	0.0	51.0
		705197 MFBR - James Creek	66.5	0.0	50.5
		7/29197 MFBR - James Creek	66.5	0.0	50.5
		8/197 MFBR - Atlanta power station	67.0	0.0	51.0
		8/297 MFBR - Atlanta power station	67.0	0.0	51.0
		8/6/97 MFBR - Atlanta power station	67.0	0.0	51.0
		819197 MFBR - Atlanta power station	67.0	0.0	51.0
		8/14197 MFBR - Atlanta power station	67.0	0.0	51.0
		8/16197 MFBR - Atlanta power station	67.0	0.0	51.0
		8/19/97 MFBR - Atlanta power station	67.0	0.0	51.0
		8/2197 MFBR - Atlanta power station	67.0	0.0	51.0
		911897 MFBR - Atlanta power station	67.0	0.0	51.0
		9/19/97 MFBR - Atlanta power station	67.0	0.0	51.0
		92397 MFBR - Atlanta power station	67.0	0.0	51.0
		9125/97 MFBR - Atlanta power station	67.0	0.0	51.0
		10/797 MFBR - Atlanta power station	67.0	0.0	51.0
		10/9197 MFBR - Atlanta power station	67.0	0.0	51.0
		10/14/97 MFBR - Atlanta power station	67.0	0.0	51.0
		10116/97 MFBR - Atlanta power station	67.0	0.0	51.0
		10/2197 MFBR - Atlanta power station	67.0	0.0	51.0
		10/24/97 MFBR - Atlanta power station	67.0	0.0	51.0
	1028/97 MFBR - Atlanta power station	67.0	0.0	51.0	
	1013197 MFBR - Atlanta power station	67.0	0.0	51.0	
	11/4197 MFBR - Atlanta power station	67.0	0.0	51.0	
	11/6197 MFBR - Atlanta power station	67.0	0.0	51.0	
	11/1997 MFBR - Atlanta power station	67.0	0.0	51.0	
	112697 MFBR - Atlanta power station	67.0	0.0	51.0	
	112897 MFBR - Atlanta power station	67.0	0.0	51.0	
162		4/197 Arrowrock Reservoir - Cottonwood Ck.	16.0	0.0	0.0
		5/1597 Arrowrock Reservoir	17.0	0.0	1.0
		6/9/97 MFBR - Twin Springs	27.0	0.0	11.0
		6/14/97 MFBR - Twin Springs	27.0	0.0	11.0
		6/1797 MFBR - Twin Springs	27.0	0.0	11.0
		612197 MFBR	26.0	0.0	10.0

Appendix G. Continued.

Frequency (150.XXX)	Date	Location	Mile ¹	Mile ²	Mile ³
	6124197	MFBR - Logging Gulch	29.5	0.0	13.5
	7/5/97	MFBR - Troutdale Campground	33.0	0.0	17.0
	7/17/97	NFBR -1.5 miles upstream of mouth	34.0	1.5	19.5
	8/11/97	NFBR -1.5 miles upstream of mouth	34.0	1.5	19.5
	8/21/97	NFBR -0.5 mile up Rabbit Creek, near 1st Creek	34.0	9.5	27.5
	9/2/97	NFBR - Rabbit Creek Mouth	34.0	8.9	26.9
	9/12/97	NFBR - Rabbit Creek Mouth	34.0	8.9	26.9
	10/17/97	MFBR - Troutdale	32.5	0.0	16.5
	10/114/97	MFBR - Troutdale	32.5	0.0	16.5
	10/16/97	MFBR - Troutdale	32.5	0.0	16.5
	10/21/97	MFBR - Troutdale Campground	33.0	0.0	17.0
	10/24/97	MFBR - Half mile below Troutdale	32.0	0.0	16.0
	10/1/28/97	MFBR - Half mile below Troutdale	32.0	0.0	16.0
	10/131/97	MFBR - Half mile below Troutdale	32.0	0.0	16.0
	11/4/197	MFBR -Troutdale	32.5	0.0	16.5
	11/16+97	MFBR - Half mile below Troutdale	32.0	0.0	16.0
	11/19/197	MFBR - Half mile below Troutdale	32.0	0.0	16.0
	11/20/97	MFBR - Half mile below Troutdale	32.0	0.0	16.0
	11/26/197	MFBR - Half mile below Troutdale	32.0	0.0	16.0
	11/28/97	MFBR - Half mile below Troutdale	32.0	0.0	16.0 173
173	4/1/97	Arrowrock Reservoir - Cottonwood Ck.	16.0	0.0	0.0
	5/15/97	Arrowrock Reservoir	7.0	0.0	-9.0
	5/16/197	Arrowrock Reservoir	7.0	0.0	-9.0
	9/2/97	NFBR - Between Bluejay Cr and Lodgepole Cr in river	34.0	29.0	47.0 183
183	4/1/197	Arrowrock Reservoir - Cottonwood Ck.	16.0	0.0	0.0
	5/15/97	Arrowrock Reservoir - Nibbler Creek	14.5	0.0	-1.5
	6/28/97	Lucky Peak - Deer Creek, at base of Arrowrock Dam	6.0	0.0	-10.0
	7/17/97	Lucky Peak - Mouth of Mores Cr below Robie Cr Bridge	-3.5	0.0	-19.5
	8/1/97	Lucky Peak - Mouth of Mores Cr below Robie Cr Bridge	-3.5	0.0	-19.5
	8/21/97	Lucky Peak - Mouth of Mores Cr below Robie Cr Bridge	-3.5	0.0	-19.5
	9/2/97	Lucky Peak - Mouth of Mores Cr below Robie Cr Bridge	-3.5	0.0	-19.5
	9/12/97	Lucky Peak - Mouth of Mores Cr below Robie Cr Bridge	-3.5	0.0	-19.5 203
203	4/1/97	Arrowrock Reservoir - Cottonwood Ck.	16.0	0.0	0.0
	6/24/97	Arrowrock Res near dam	7.0	0.0	-9.0
	6/28/97	Arrowrock Res near dam	7.0	0.0	-9.0
	8/21/97	SFBR - 1 mile below Rattlesnake Cr.	13.0	7.5	-10.5
	9/2/97	SFBR - Near mouth of Rattlesnake in SFBR	13.0	8.5	-11.5
	9/12/97	SFBR - Near mouth of Rattlesnake in SFBR	13.0	8.5	-11.5 213
213	4/1/97	Arrowrock Reservoir - Cottonwood Ck.	16.0	0.0	0.0
	5/15/197	Arrowrock Reservoir - Grouse Creek	7.5	0.0	-8.5
	6/14/97	MFBR - Cherry Gulch	21.0	0.0	5.0
	6/17/97	MFBR	28.5	0.0	12.5
	6/24/197	MFBR - Slide Gulch	22.0	0.0	6.0
	7/17/97	NFBR - Graham Landing Strip	34.0	33.5	51.5
	8/21/97	NFBR - 1 mile up Mcleod Creek	34.0	42.0	60.0
	9/2/97	NFBR - At mouth of Ballentyne Creek	34.0	37.0	55.0
	9/12/97	NFBR - Deer Park Campground	34.0	24.5	42.5
	10/7/97	Arrowrock Res/Irish Creek	14.0	0.0	-2.0
	10/9/97	Arrowrock Res/Irish Creek	14.0	0.0	-2.0

Appendix G. Continued.

Frequency (150.XXX)	Date	Location	Mile ¹	Mile ²	Mile ³
	10/14/97	Arrowrock Res/Irish Creek	14.0	0.0	-2.0
	10/16/97	Arrowrock Res/Irish Creek	14.0	0.0	-2.0
	10/21/97	Arrowrock Res/Irish Creek	14.0	0.0	-2.0
	10/24/97	Arrowrock Res/Irish Creek	14.0	0.0	-2.0
	10/28/97	Arrowrock Reservoir - Cinch Creek	8.0	0.0	-8.0
	10/31/97	Arrowrock Reservoir - Cinch Creek	8.0	0.0	-8.0
	11/4/97	Arrowrock Reservoir	8.5	0.0	-7.5
	11/6/97	Arrowrock Reservoir	8.5	0.0	-7.5
	11/19/97	Arrowrock Reservoir - Grouse Creek	7.5	0.0	-8.5
222					
	4/11/97	Arrowrock Reservoir - Cottonwood Ck.	16.0	0.0	0.0
233					
	4/1/97	Arrowrock Reservoir - Cottonwood Ck.	16.0	0.0	0.0
	5/15/97	Lucky Peak	5.5	0.0	-10.5
	6/24/97	Lucky Peak - Deer Creek, at base of Arrowrock Dam	6.0	0.0	-10.0
	6/28/97	Lucky Peak - Deer Creek, at base of Arrowrock Dam	6.0	0.0	-10.0
	7/10/97	Lucky Peak - Deer Creek, at base of Arrowrock Dam	6.0	0.0	-10.0
	7/17/97	Lucky Peak - Deer Creek, at base of Arrowrock Dam	6.0	0.0	-10.0
	8/11/97	Lucky Peak - Deer Creek, at base of Arrowrock Dam	6.0	0.0	-10.0
	8/21/97	Lucky Peak - Deer Creek, at base of Arrowrock Dam	6.0	0.0	-10.0
	9/2/97	Lucky Peak - Deer Creek, at base of Arrowrock Dam	6.0	0.0	-10.0
243					
	4/1/97	Arrowrock Reservoir - Cottonwood Ck.	16.0	0.0	0.0
	5/15/97	Arrowrock Reservoir	17.5	0.0	1.5
	6/9/97	MFBR	20.0	0.0	4.0
	6/14/97	MFBR - Slide Gulch Bridge	22.5	0.0	6.5
	6/17/97	MFBR - Cherry Gulch	21.0	0.0	5.0
	6/21/97	MFBR - Slide Gulch	22.0	0.0	6.0
	6/24/97	MFBR - Troutdale	32.5	0.0	16.5
	7/5/97	MFBR - Slide Gulch Bridge	22.5	0.0	6.5
	7/15/97	MFBR - Birch Creek Campground	24.0	0.0	8.0
	7/17/97	MFBR - Birch Creek Campground	25.0	0.0	9.0
	8/21/97	NFBR - Barber Flat	34.0	14.5	32.5
274					
	4/11/97	Arrowrock Reservoir - Upper boat ramp	9.5	0.0	0.0
	5/15/97	Arrowrock Reservoir - Nibbler Creek	14.5	0.0	5.0
	6/19/97	MFBR - Cherry Gulch	21.0	0.0	11.5
	6/14/97	MFBR	23.0	0.0	13.5
	6/17/97	MFBR - Gaging Station	23.5	0.0	14.0
	6/21/97	MFBR - Birch Creek Campground	24.0	0.0	14.5
	6/24/97	MFBR	37.0	0.0	27.5
	6/28/97	MFBR - Twin Springs	27.0	0.0	17.5
	7/17/97	NFBR - Bear River	34.0	20.0	44.5
	8/11/97	NFBR - Johnson Creek - near mouth	34.0	31.5	56.0
	9/21/97	NFBR - Rabbit Creek Mouth	34.0	8.9	33.4
	9/12/97	NFBR - Crooked River	34.0	19.5	44.0
	10/24/97	Arrowrock Reservoir	17.5	0.0	8.0
	10/28/97	Arrowrock Reservoir	17.0	0.0	7.5
282					
	4/1/97	Arrowrock Reservoir - Cottonwood Ck.	16.0	0.0	0.0
	5/15/97	Arrowrock Reservoir	17.0	0.0	1.0
	6/9/97	MFBR - Alder Creek	26.5	0.0	10.5
	6/14/97	MFBR	28.5	0.0	12.5
	6/17/97	MFBR - Half mile below Troutdale	32.0	0.0	16.0

Appendix G. Continued.

Frequency (150.XXX)	Date	Location	Mile ¹	Mile ²	Mile ³
	6/21/97	MFBR - Half mile below Troutdale	32.0	0.0	16.0
	6/24/97	MFBR - Troutdale Hot Springs	34.0	0.0	18.0
	7/3/97	MFBR	35.0	0.0	19.0
	7/10/97	MFBR - Alexander Creek	43.0	0.0	27.0
	7/12/97	MFBR - Straight Creek	46.5	0.0	30.5
	7/15/97	MFBR - Buck Creek	50.5	0.0	34.5
	7/17/97	MFBR - Buck Creek	51.0	0.0	35.0
	7/29/97	MFBR - 1 mi up Queens River near bridge	64.0	1.0	49.0
	8/1/97	MFBR - 1.5 mi up Queens River near mouth of Little Queens	64.0	1.5	49.5
	8/2/97	MFBR - 1 mi up Queens River near bridge	64.0	1.0	49.0
	8/9/97	MFBR - 1 mi up Queens River near bridge	64.0	1.0	49.0
	8/16/97	MFBR - 1 mi up Queens River near bridge	64.0	1.0	49.0
	8/21/97	MFBR - 1.5 mi up Queens River near mouth of Little Queens	64.0	1.5	49.5
	9/2/97	MFBR -1 mile up Little Queens from confluence w/Queens River	64.0	2.5	50.5
	9/12/97	MFBR - Loftus Creek	34.5	0.0	18.5
	9/12/97	MFBR - Loftus Creek	34.5	0.0	18.5
	10/9/97	Arrowrock Res/Irish Creek	14.0	0.0	-2.0
	10/14/97	Arrowrock Res/Irish Creek	14.0	0.0	-2.0
	10/16/97	Arrowrock Res/Irish Creek	14.0	0.0	-2.0
	10/21/97	Arrowrock Reservoir	15.0	0.0	-1.0
	10/24/97	Arrowrock Reservoir	15.0	0.0	-1.0
	10/28/97	Arrowrock Reservoir	15.0	0.0	-1.0
	10/31/97	Arrowrock Res/Irish Creek	14.0	0.0	-2.0
	11/4/97	Arrowrock Res/Irish Creek	14.0	0.0	-2.0
	11/6/97	Arrowrock Res/Irish Creek	14.0	0.0	-2.0
	11/19/97	Arrowrock Reservoir	17.0	0.0	1.0
	11/20/97	Arrowrock Reservoir - Cottonwood Ck.	16.0	0.0	0.0
	11/26/97	Arrowrock Reservoir - Cottonwood Ck.	16.0	0.0	0.0
	11/28/97	Arrowrock Reservoir - Nevins Ck.	16.5	0.0	0.5
293LP					
	5/8/97	Arrowrock Reservoir - Cottonwood Ck.	16.0	0.0	0.0
	5/15/97	Arrowrock Reservoir - Nevins Ck.	16.5	0.0	0.5
	6/19/97	MFBR - Gaging Station	23.5	0.0	7.5
	6/14/97	MFBR - Birch Creek Campground	24.0	0.0	8.0
	6/17/97	MFBR - Twin Springs	27.0	0.0	11.0
	6/21/97	MFBR - Logging Gulch	29.5	0.0	13.5
	8/2/97	NFBR - 0.5 mile up Ballentyne Creek	34.0	37.5	55.5
	9/29/97	NFBR - 0.5 mile up Ballentyne Creek	34.0	37.5	55.5
	9/12/97	NFBR - 1 mile up Ballentyne Creek from mouth	34.0	38.0	56.0
	9/23/97	MFBR - Sheep Creek Hot Springs	30.5	0.0	14.5
	10/17/97	Arrowrock Reservoir - Nevins Ck.	16.5	0.0	0.5
	10/9/97	Arrowrock Reservoir - Nevins Ck.	16.5	0.0	0.5
	10/14/97	Arrowrock Res/Irish Creek	14.0	0.0	-2.0
	10/16/97	Arrowrock Res/Irish Creek	14.0	0.0	-2.0
	10/24/97	Arrowrock Reservoir - Nevins Ck.	16.5	0.0	0.5
	10/28/97	Arrowrock Reservoir	17.0	0.0	1.0
	10/31/97	Arrowrock Res/Irish Creek	14.0	0.0	-2.0
	11/14/97	Arrowrock Res/Irish Creek	14.0	0.0	-2.0
	11/20/97	Arrowrock Reservoir - Cottonwood Ck.	16.0	0.0	0.0
	11/26/97	Arrowrock Res/Irish Creek	14.0	0.0	-2.0
303					
	4/1/97	Arrowrock Reservoir - Cottonwood Ck.	16.0	0.0	0.0
	5/15/97	Arrowrock Reservoir - Trail Ck.	18.0	0.0	2.0

Appendix G. Continued.

Frequency (1 50.XXX)	Date	Location	Mite ¹	Mile ²	Mile ³
	6/9/97	MFBR - Browns Creek	28.0	0.0	12.0
	6/14/97	MFBR - Logging Gulch	29.5	0.0	13.5
	6/17/97	MFBR - Half mile below Troutdale	32.0	0.0	16.0
	6/21/97	MFBR - Troutdale Hot Springs	34.0	0.0	18.0
	6/28/97	MFBR - Idaho Outdoor Assn Campground	41.0	0.0	25.0
	7/13/97	MFBR - Browns Creek	44.0	0.0	28.0
	7/10/97	MFBR - Roaring River Bridge	47.5	0.0	31.5
	7/12/97	MFBR - Buck Creek	51.0	0.0	35.0
	7/17/97	MFBR -1 mile above Swanholm Creek	55.0	0.0	39.0
	7/25/97	MFBR - Half mile below Eagle Creek	62.0	0.0	46.0
	8/11/97	MFBR - Queens River/Campground	64.0	0.0	48.0
	8/21/97	MFBR - Queens River/Campground	64.0	0.0	48.0
	9/12/97	MFBR - Near headwaters of Queens River	64.0	8.5	56.5
	9/12/97	MFBR - Near headwaters of Queens River	64.0	8.5	56.5
	9/23/97	MFBR - Troutdale Hot Springs	340	0.0	18.0
	9/25/97	MFBR - Troutdale Hot Springs	34.0	0.0	18.0
	10/7/97	MFBR	28.5	0.0	12.5
	10/19/97	MFBR - Twin Springs	27.5	0.0	11.5
	10/16/97	Arrowrock Res/Irish Creek	14.0	0.0	-2.0
	10/21/97	Arrowrock Res/Irish Creek	14.0	0.0	-2.0
	10/24/97	Arrowrock Res/Irish Creek	14.0	0.0	-2.0
	10/28/97	Arrowrock Res/Irish Creek	14.0	0.0	-2.0
	10/31/97	Arrowrock Res/Irish Creek	14.0	0.0	-2.0
	11/4/97	Arrowrock Res/Irish Creek	14.0	0.0	-2.0
	11/6/97	Arrowrock Res/Irish Creek	14.0	0.0	-2.0
	11/19/97	Arrowrock Res/Irish Creek	14.0	0.0	-2.0
	11/20/97	Arrowrock Reservoir	13.5	0.0	-2.5
	11/26/97	Arrowrock Res/Irish Creek	14.0	0.0	-2.0
	11/28/97	Arrowrock Reservoir - Nibbler Creek	14.5	0.0	-1.5
323LP	5/8/97	Arrowrock Reservoir - Cottonwood Ck.	16.0	0.0	0.0
	5/11/97	Arrowrock Reservoir - Cottonwood Ck.	16.0	0.0	0.0
	6/19/97	MFBR - Sheep Creek	30.0	0.0	14.0
	6/17/97	MFBR - Hags Creek	31.5	0.0	15.5
	6/21/97	MFBR - Troutdale Campground	33.0	0.0	17.0
	6/28/97	MFBR - Troutdale Hot Springs	34.0	0.0	18.0
	7/3/97	MFBR	37.0	0.0	21.0
	7/10/97	MFBR	43.5	0.0	27.5
	7/12/97	MFBR - Roaring River	47.0	0.0	31.0
	7/15/97	MFBR - Lost Man Creek	49.0	0.0	33.0
	7/17/97	MFBR - Between Roaring River and Lost Man Creek	48.0	0.0	32.0
	7/25/97	MFBR - Half mile below Black Warrior Creek	58.0	0.0	42.0
	8/11/97	MFBR - 1 mi up Queens River near bridge	64.0	1.0	49.0
	8/21/97	MFBR - 1.5 miles from top of Queens River	64.0	9.0	57.0
	9/12/97	MFBR - 1.5 miles from top of Queens River	64.0	9.0	57.0
	9/12/97	MFBR - 1.5 miles from top of Queens River	64.0	9.0	57.0
	9/23/97	MFBR - Swanholm Creek	540	0.0	38.0
	9/25/97	MFBR - Swanholm Creek	54.0	0.0	38.0
	10/17/97	MFBR	45.5	0.0	29.5
	10/9/97	MFBR - Alexander Creek	43.0	0.0	27.0
	10/28/97	MFBR - Ninemeyer Creek/Campground	38.0	0.0	22.0
	11/19/97	Arrowrock Reservoir - Mouth of South Fork Boise River	13.0	0.0	-3.0

Appendix G. Continued.

Frequency (1 50.XXX)	Date	Location	Mile'	Mile ²	Mile ³
333					
	4/997	Arrowrock Reservoir - Upper boat ramp	9.5	0.0	0.0
	5/15X97	Arrowrock Reservoir - Cold Spring Creek	12.0	0.0	2.5
	6/9197	MFBR - Gaging Station	23.5	0.0	14.0
	6/14197	MFBR - Birch Creek Campground	24.0	0.0	14.5
	6121)97	MFBR - Twin Springs	27.0	0.0	17.5
	7/17197	NFBR - In river near Graham	34.0	33.5	58.0
	8/1X97	NFBR - 4 mi above Graham in rivet	34.0	37.5	62.0
	821/97	NFBR - At mouth of Ballentyne Creek	34.0	37.0	61.5
	92X97	NFBR - 1 mile up Mcleod Creek	34.0	42.0	66.5
	9/12197	NFBR - Barber Flat	34.0	14.5	39.0
	9119/97	MFBR	28.5	0.0	19.0
	923197	MFBR - Willow Creek/Campground	21.5	0.0	12.0
	9/25197	MFBR - Willow Creek/Campground	21.5	0.0	12.0
	10/1197	MFBR - Willow Creek/Campground	21.5	0.0	12.0
	10/9197	MFBR - Willow Creek/Campground	21.5	0.0	12.0
	10/21/97	Arrowrock Res/Irish Creek	14.0	0.0	4.5
	10/24197	Arrowrock Res/Irish Creek	14.0	0.0	4.5
	10/28/97	Arrowrock Res/Irish Creek	14.0	0.0	4.5
	10/31/97	Arrowrock Reservoir - Mouth of South Fork Boise River	13.0	0.0	3.5
	11/4197	Arrowrock Res/Irish Creek	14.0	0.0	4.5
	11/6197	Arrowrock Reservoir - Mouth of South Fork Boise River	13.0	0.0	3.5
	1128/97	Arrowrock Reservoir - Mouth of South Fork Boise River	13.0	0.0	3.5
344					
	414197	Arrowrock Reservoir - Cottonwood Ck.	16.0	0.0	0.0
	5/15/97	Arrowrock Reservoir - Cottonwood Ck.	16.0	0.0	0.0
	619197	MFBR - Browns Creek	28.0	0.0	12.0
	6/14197	MFBR - Sheep Creek	30.0	0.0	14.0
	7/17/97	NFBR - Graham	34.0	33.5	51.5
	8/1X97	NFBR - 2 mi up Johnson Cr	34.0	33.5	51.5
	821/97	NFBR - 3 miles from top of Johnson Creek	34.0	48.5	66.5
	92X97	NFBR - 3 miles from top of Johnson Creek	34.0	48.5	66.5
	9/12/97	NFBR - 3 miles from top of Johnson Creek	34.0	48.5	66.5
353LP					
	5/8/97	Arrowrock Reservoir - Cottonwood Ck.	16.0	0.0	0.0
	5/15/97	Arrowrock Reservoir - Cottonwood Ck.	16.0	0.0	0.0
	7/17/97	MFBR - Roaring River, 1.5 miles from top	47.0	8.5	39.5
	8/1197	MFBR - Roaring River, 1.5 miles from top	47.0	8.5	39.5
	821X97	MFBR - At mouth of East Fork Roaring River	47.0	8.0	39.0
	92/97	MFBR - At mouth of East Fork Roaring River	47.0	8.0	39.0
	9/12197	MFBR - At mouth of East Fork Roaring River	47.0	8.0	39.0
363LP					
	5/12/97	Arrowrock Reservoir - Cottonwood Ck.	16.0	0.0	0.0
	5/15197	Arrowrock Reservoir - Cold Spring Creek	12.0	0.0	-4.0
	9/2/97	Arrowrock Reservoir - Irish Creek	14.0	0.0	-2.0
	911897	Arrowrock Reservoir - Irish Creek	14.0	0.0	-2.0
	9/19/97	Arrowrock Res/Irish Creek	14.0	0.0	-2.0
372LP					
	5/8/97	Arrowrock Res - Cottonwood Ck	16.0	0.0	0.0
	5/15/97	Arrowrock Reservoir - Nevins Ck.	16.5	0.0	0.5
	7/17/97	NFBR - In river near Graham	34.0	33.5	51.5
	8/1/97	NFBR - 2 miles up Ballentyne Creek	34.0	39.0	57.0
	821X97	NFBR - 2 miles up Ballentyne Creek	34.0	39.0	57.0
	92X97	NFBR - 2 miles up from confluence of NFBR and MFBR	34.0	2.0	20.0

Appendix G. Continued.

Frequency (1 50.XXX)	Date	Location	Mile ¹	Mile ²	Mile ³
383LP	5/13/97	Arrowrock Res - Cottonwood Ck	16.0	0.0	0.0
	5/15197	Arrowrock Reservoir - Cottonwood Ck.	16.0	0.0	0.0
	69/97	MFBR	29.0	0.0	13.0
	6/14197	MFBR - Sheep Creek Hot Springs	30.5	0.0	14.5
	6/17/97	MFBR - Naga Creek	31.5	0.0	15.5
	9/2197	NFBR - Johnson Creek - near mouth	34.0	31.5	49.5
	9/1297	NFBR - Johnson Creek - near mouth	34.0	31.5	49.5
	9/23/97	Arrowrock Reservoir - Cottonwood Ck.	15.5	0.0	-0.5
	9/25/97	Arrowrock Reservoir	15.0	0.0	-1.0
	10/7/97	Arrowrock Res/Irish Creek	14.0	0.0	-2.0
	1019197	Arrowrock Res/Irish Creek	14.0	0.0	-2.0
	11/4197	Arrowrock Res/Irish Creek	14.0	0.0	-2.0
	11/6197	Arrowrock Res/Irish Creek	14.0	0.0	-2.0
	112097	Arrowrock Reservoir - Cottonwood Ck.	16.0	0.0	0.0
	1126/97	Arrowrock Res/Irish Creek	14.0	0.0	-2.0
	11/26197	Arrowrock Reservoir	15.0	0.0	-1.0
593	4/24197	Arrowrock Reservoir - Cottonwood Ck.	16.0	0.0	0.0
	51597	Arrowrock Reservoir - Cottonwood Ck.	16.0	0.0	0.0
	6/997	MFBR	29.0	0.0	13.0
	6/14/97	MFBR - Troutdale	32.5	0.0	16.5
	6/17/97	MFBR - Troutdale	32.5	0.0	16.5
	6/21/97	MFBR - Loftus Creek	34.5	0.0	18.5
	6/2497	MFBR - Dobson Gulch	42.0	0.0	26.0
	6/28/97	MFBR - Straight Creek	46.5	0.0	30.5
	7/3/97	MFBR - 1 mile above Swanholm Creek	55.0	0.0	39.0
	7/1 Q97	MFBR - Half mile below Eagle Creek	62.0	0.0	46.0
	7/1797	MFBR - Queens River/Campground	64.0	0.0	48.0
	8/197	MFBR - 2 mi up Little Queens from mouth	64.0	3.5	51.5
	82197	MFBR - 0.75 mile from top of Little Queens River	64.0	5.0	53.0
	9/2/97	MFBR - At headwaters of Little Queens River	64.0	8.5	56.5
	9/18197	MFBR - Alexander Flats	41.5	0.0	25.5
	9/19/97	MFBR	40.0	0.0	24.0
	9/23/97	MFBR - Big Five Creek	39.0	0.0	23.0
	9/25/97	MFBR - Ninemeyer Creek/Campground	38.5	0.0	22.5
	10/797	MFBR - Troutdale Hot Springs	33.5	0.0	17.5
	10997	MFBR - Troutdale Campground	33.0	0.0	17.0
	10/14/97	MFBR - Sheep Creek	30.0	0.0	14.0
	10/1697	MFBR - Sheep Creek	30.0	0.0	14.0
	102197	MFBR - Willow Creek/Campground	21.5	0.0	5.5
	10/24/97	MFBR - Willow Creek/Campground	21.5	0.0	5.5
	102897	Arrowrock Reservoir	13.5	0.0	-2.5
603	4/197	Arrowrock Reservoir - Cottonwood Ck.	16.0	0.0	0.0
	5/15/97	Arrowrock Reservoir - Cottonwood Ck.	16.0	0.0	0.0
	9297	NFBR - Johnson Creek - near mouth	34.0	31.5	49.5
	10997	MFBR	26.0	0.0	10.0
	10/14/97	Arrowrock Res/Irish Creek	14.0	0.0	-2.0
	10/1697	Arrowrock Res/Irish Creek	14.0	0.0	-2.0
	10/2197	Arrowrock Res/Irish Creek	14.0	0.0	-2.0
	10/2497	Arrowrock Res/Irish Creek	14.0	0.0	-2.0
	10/2897	Arrowrock Res/Irish Creek	14.0	0.0	-2.0
	10/3197	Arrowrock Res/Irish Creek	14.0	0.0	-2.0
	11/457	Arrowrock Res/Irish Creek	14.0	0.0	-2.0
	11/6197	Arrowrock Res/Irish Creek	14.0	0.0	-2.0

Appendix G. Continued.

Frequency (1 50.XXX)	Date	Location	Mile ¹	Mile ²	Mile ³
	1120497	Arrowrock Reservoir - Cottonwood Ck.	16.0	0.0	0.0
	11/26497	Arrowrock Reservoir	17.0	0.0	1.0
	11/28/97	Arrowrock Reservoir	17.5	0.0	1.5
613LP					
	5/13/97	Arrowrock Reservoir - Cottonwood Ck.	16.0	0.0	0.0
	6/14197	Arrowrock Res/Irish Creek	14.0	0.0	-2.0
	6/17/97	Arrowrock Res/Irish Creek	14.0	0.0	-2.0
	6/28/97	Arrowrock Reservoir	15.0	0.0	-1.0
	7/17/97	Arrowrock Reservoir - Cottonwood Ck.	16.0	0.0	0.0
	8/1/97	Arrowrock Reservoir - Cottonwood Ck.	16.0	0.0	0.0
	8/21197	Arrowrock Reservoir - Cottonwood Ck.	16.0	0.0	0.0
	9/2197	Arrowrock Res/Irish Creek	14.0	0.0	-2.0
	9/12197	Arrowrock Res/Irish Creek	14.0	0.0	-2.0
	9/18/97	Arrowrock Res/Insh Creek	14.0	0.0	-2.0
	9/19197	Arrowrock Res/Irish Creek	14.0	0.0	-2.0
	9/23197	Arrowrock Reservoir - Mouth of South Fork Boise River	13.0	0.0	-3.0
	9/25197	Arrowrock Res/Irish Creek	14.0	0.0	-2.0
	1017/97	Arrowrock Res/Irish Creek	14.0	0.0	-2.0
	10097	Arrowrock Res/Irish Creek	14.0	0.0	-2.0
	10/14/97	Arrowrock Res/Irish Creek	14.0	0.0	-2.0
	10/18197	Arrowrock Reservoir - Nibbler Creek	14.5	0.0	-1.5
	10/21/97	Arrowrock Res/Irish Creek	14.0	0.0	-2.0
	1024197	Arrowrock Res/Irish Creek	14.0	0.0	-2.0
	10/28197	Arrowrock Reservoir	17.0	0.0	1.0
	10/31197	Arrowrock Res/Irish Creek	14.0	0.0	-2.0
	11/4197	Arrowrock Res/Irish Creek	14.0	0.0	-2.0
	1116197	Arrowrock Reservoir - Nibbler Creek	14.5	0.0	-1.5
	11/19197	Arrowrock Reservoir	15.0	0.0	-1.0
	11/20197	Arrowrock Res/Irish Creek	14.0	0.0	-2.0
	1126197	Arrowrock Res/Irish Creek	14.0	0.0	-2.0
	11128497	Arrowrock Reservoir - Nibbler Creek	14.5	0.0	-1.5
622					
	4/1,97	Arrowrock Reservoir - Cottonwood Ck.	16.0	0.0	0.0
	92/97	Arrowrock Res/Irish Creek	14.0	0.0	-2.0
	9/12197	Arrowrock Res/Irish Creek	14.0	0.0	-2.0
	9/18/97	Arrowrock Res/Irish Creek	14.0	0.0	-2.0
	9/19/97	Arrowrock Res/Irish Creek	14.0	0.0	-2.0
	10/7/97	Arrowrock Res/Irish Creek	14.0	0.0	-2.0
	10/9/97	Arrowrock Res/Irish Creek	14.0	0.0	-2.0
	10/14/97	Arrowrock Res/Irish Creek	14.0	0.0	-2.0
	10/16/97	Arrowrock Reservoir - Nibbler Creek	14.5	0.0	-1.5
	10/21/97	Arrowrock Res/Irish Creek	14.0	0.0	-2.0
	10/24/97	Arrowrock Res/Irish Creek	14.0	0.0	-2.0
	10/28/97	Arrowrock Reservoir	17.0	0.0	1.0
	10/31/97	Arrowrock Res/Irish Creek	14.0	0.0	-2.0
	11/4/97	Arrowrock Res/Irish Creek	14.0	0.0	-2.0
	11/6197	Arrowrock Res/Irish Creek	14.0	0.0	-2.0
633					
	4/4197	Arrowrock Reservoir - Cottonwood Ck.	16.0	0.0	0.0
	5/15/97	Arrowrock Reservoir - Cold Spring Creek	12.0	0.0	-4.0
	6/14197	MFBR	29.0	0.0	13.0
	6/17/97	MFBR - Sheep Creek	30.0	0.0	14.0
	6/21/97	MFBR - Half mile below Troutdale	32.0	0.0	16.0
	7/17/97	NFBR - In river near Graham	34.0	33.5	51.5
	8/1/97	NFBR - 3 mi upstream of Graham in river	34.0	36.5	54.5
	8/21/97	NFBR - 1.5 miles up Ballentyne Creek	34.0	38.5	56.5

Appendix G. Continued.

Frequency (150.XXX)	Date	Location	Mile ¹	Mile ²	Mile
	9/2/97	NFBR - 2 miles up Ballentyne Creek	34.0	39.0	57.0
	9/12/97	NFBR - Graham	34.0	33.5	51.5
	10/7/97	MFBR - Haga Creek	31.5	0.0	15.5
	10/9/97	MFBR - Sheep Creek Hot Springs	30.5	0.0	14.5
	10/16/97	MFBR - Birch Creek Campground	24.0	0.0	8.0
	10/21/97	Arrowrock Res/Irish Creek	14.0	0.0	-20
	10/24/97	Arrowrock Res/Irish Creek	14.0	0.0	-2.0
643					
	4/1/97	Arrowrock Reservoir - Cottonwood Ck.	16.0	0.0	0.0
	5/15/97	Arrowrock Reservoir - Cottonwood Ck.	16.0	0.0	0.0
	6/19/97	MFBR - Birch Creek Campground	25.0	0.0	9.0
	6/17/97	MFBR	26.0	0.0	10.0
	6/21/97	MFBR - Sheep Creek Hot Springs	30.5	0.0	14.5
	7/17/97	NFBR - Johnson Creek - near mouth	34.0	31.5	49.5
	8/1/97	NFBR - Johnson Creek - near mouth	34.0	31.5	49.5
	8/21/97	NFBR - 1.5 miles up Ballentyne Creek	34.0	38.5	56.5
	9/29/97	NFBR -1.5 miles up Ballentyne Creek	34.0	38.5	56.5
	9/12/97	NFBR - Graham	34.0	33.5	51.5
	9/19/97	MFBR - Sheep Creek	30.0	0.0	14.0
	9/23/97	MFBR	28.5	0.0	12.5
	9/25/97	MFBR - Twin Springs	27.0	0.0	11.0
	10/31/97	Arrowrock Res/Irish Creek	14.0	0.0	-2.0
	11/4/97	Arrowrock Res/Irish Creek	14.0	0.0	-2.0
	11/6/97	Arrowrock Res/Irish Creek	14.0	0.0	-2.0
	11/20/97	Arrowrock Res/Irish Creek	14.0	0.0	-2.0
	11/28/97	Arrowrock Reservoir - Nevins Ck.	16.5	0.0	0.5
663					
	4/1/97	Arrowrock Reservoir - Cottonwood Ck.	16.0	0.0	0.0
	5/15/97	Arrowrock Reservoir - Nevins Ck.	16.5	0.0	0.5
	8/21/97	NFBR - Johnson Creek	34.0	31.5	49.5
	9/29/97	NFBR - 1.5 miles up Ballentyne Creek	34.0	38.5	56.5
	9/12/97	NFBR - Four Mile Campground	34.0	21.0	39.0
	10/14/57	MFBR	20.5	0.0	4.5
	10/16/97	MFBR	20.5	0.0	4.5
	10/21/97	Arrowrock Res/Irish Creek	14.0	0.0	-2.0
	10/24/57	Arrowrock Res/Irish Creek	14.0	0.0	-2.0
	10/1/28/97	Arrowrock Reservoir	17.0	0.0	1.0
	10/31/97	Arrowrock Reservoir	17.5	0.0	1.5
	11/4/97	Arrowrock Res/Irish Creek	14.0	0.0	-2.0
	11/6/97	Arrowrock Res/Irish Creek	14.0	0.0	-2.0
	11/26/97	Arrowrock Reservoir	15.0	0.0	-1.0
	11/28/97	Arrowrock Reservoir - Nibbler Creek	14.5	0.0	-1.5
683					
	4/1/97	Arrowrock Reservoir - Cottonwood Ck.	16.0	0.0	0.0
	5/15/97	Arrowrock Reservoir - Cottonwood Ck.	16.0	0.0	0.0
	7/17/97	NFBR - In Johnson Cr 2 mi above mouth	34.0	33.5	51.5
	8/1/97	NFBR - 4 mi up Johnson Cr	34.0	35.5	53.5
	8/12/97	NFBR - 2 miles from top of Johnson Creek	34.0	49.5	67.5
	9/12/97	NFBR - Deer Park Campground	34.0	24.5	42.5
	9/12/97	NFBR - Barber Flat	34.0	14.5	32.5
703LP					
	5/18/97	Arrowrock Reservoir - Cottonwood Ck.	16.0	0.0	0.0
	5/15/97	Arrowrock Res/Irish Creek	14.0	0.0	-2.0
	6/9/97	MFBR - Birch Creek Campground	25.0	0.0	9.0
	6/14/97	MFBR - Birch Creek Campground	24.0	0.0	8.0
	6/17/97	MFBR - Birch Creek Campground	24.0	0.0	8.0
	6/21/97	MFBR - Birch Creek Campground	24.0	0.0	8.0

Appendix G. Continued.

Frequency (150.XXX)	Date	Location	Mile ¹	Mile ²	Mile ³
	6/24/97	MFBR - Browns Creek	28.0	0.0	12.0
	8/21/97	NFBR - At mouth of Ballentyne Creek	34.0	37.0	55.0
	9/2/97	NFBR - 1 mile up Ballentyne Creek from mouth	34.0	38.0	56.0
	9/12/97	NFBR - 0.5 mile up Ballentyne Creek	34.0	37.5	55.5
	10/7/97	MFBR	31.0	0.0	15.0
	10/9/97	MFBR	28.5	0.0	12.5
	10/14/97	MFBR - Twin Springs	27.5	0.0	11.5
	10/16/97	MFBR - Twin Springs	27.0	0.0	11.0
	10/21/97	MFBR	26.0	0.0	10.0
	10/24/97	MFBR	26.0	0.0	10.0
	10/28/97	MFBR - Alder Creek	26.5	0.0	10.5

¹ First number given for each bull trout indicates release location in Arrowrock Reservoir. Each number in same column thereafter indicates location in study area. The Highway 21 bridge crossing the Mores Creek Arm of Lucky Peak Reservoir was considered river mile zero.

² Numbers indicate miles traveled in tributary.

³ Numbers indicate total miles bull trout was located from their release location in Arrowrock Reservoir.