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Gething Creek Bull Trout Translocation Project, 1993 to 2005

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The Peace/Williston Fish & Wildlife Compensation Program is a cooperative venture of BC Hydro and the provincial fish and wildlife management agencies, supported by funding from BC Hydro. The Program was established to enhance and protect fish and wildlife resources affected by the construction of the W.A.C. Bennett and Peace Canyon dams on the Peace River, and the subsequent creation of the Williston and Dinosaur Reservoirs.

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ABSTRACT

Translocations of Gething Creek adult bull trout (*Salvelinus confluentus*) were undertaken as an enhancement project to compensate for impacts to fish and their habitat from the creation of Williston and Dinosaur reservoirs. The objectives were to increase the spawning success of adult bull trout, the rearing success of their fry, and the number of bull trout in Dinosaur Reservoir. The ideal result would be for a portion of annual production to migrate to Dinosaur Reservoir and a portion to remain as a stream-resident dwarf population, thus eliminating the need for future translocations. In 1993, 1994, 1997, and 1999, adult bull trout in spawning condition were translocated (transported) over impassable waterfalls in lower Gething Creek into both upper Gething Creek and Gaylard Creek, a tributary to Gething Creek in the upper watershed. Based on the increased amount and quality of spawning and rearing habitat in the upper watershed, we anticipated that these translocations had increased spawning and rearing success. This success was evident from the production of bull trout juveniles in the upper watershed. We applied a crude calculation to estimate production of 8,000 young-of-the-year bull trout for each of the four years that translocations occurred. By age 3, all bull trout juveniles had migrated out of the upper watershed, indicating that a stream-resident dwarf population had not established. The upper watershed streams appear to be too small (low discharge) to support bull trout beyond age 3 or 4. After reaching a size that the streams can no longer support, the fish presumably migrate downstream to Dinosaur Reservoir, increasing the recruitment to Dinosaur reservoir and thereby potentially meeting the stated objective of increasing the bull trout population in Dinosaur Reservoir. Some of the bull trout juveniles in Gething Creek unexpectedly migrated upstream to the headwater, Wright Lake, rather than downstream to Dinosaur Reservoir. The number of bull trout in Wright Lake is believed to be low, but this small population may result in future bull trout production.

INTRODUCTION

Background

Translocations of Gething Creek bull trout (*Salvelinus confluentus*) were undertaken as an enhancement project to compensate for impacts to fish and their habitat from the creation of Williston and Dinosaur reservoirs. A common theme in reports addressing the fish resources of Dinosaur Reservoir is the scarcity of spawning habitat (Hammond 1987; Pattenden and Ash 1993a, b). Thurber Consultants Ltd. (1975) conducted a pre-impoundment survey of the area that later became the Dinosaur Reservoir watershed, and they attributed the small resident bull trout population to a low degree of spawning success, possible low fry production, and angling pressure.

Gething Creek is the primary spawning area for bull trout in Dinosaur Reservoir (Hammond 1987). However, a six-metre-high waterfall restricts fish access and spawning to the first 550 m of Gething Creek. The spawning and rearing habitat in the accessible 550 m is low quality (personal observation), because the substrate is predominantly large, angular, “plate-like” sedimentary rock, and the limited spawning gravels have sediments in the interstitial spaces.

The habitat upstream of the waterfalls on Gething Creek is suitable for bull trout spawning and rearing (Langston and Zemlak 1998). The available upstream habitat is limited by the small size of upper Gething Creek and its tributaries, but it is abundant when compared with the lower 550 m of Gething Creek. For large adfluvial adult bull trout, the small creeks can only provide spawning opportunities; however, the creeks may be large enough to support a stream-resident dwarf population of bull trout, as described by McPhail and Baxter (1995).

In 1993, 1994, 1997, and 1999, pre-spawning adult bull trout were translocated (transported) from the base of the impassable waterfall in lower Gething Creek into the extensive upper watershed, which seemed to have ample spawning and juvenile rearing habitat for bull trout. The translocated bull trout were monitored to ensure that they spawned and survived. Juvenile bull trout presence in the creeks was also monitored to quantify the level of benefit derived from the project and determine if the translocation program should continue indefinitely.

In addition to the four translocations, a one-time stocking of 430 bull trout fry was conducted in 1985 by the Peace Canyon Hatchery. The fry were stocked into Dowling Creek, a tributary to upper Gething Creek (Langston and Murphy, in prep.). No follow-up records assessing the success of the 1985 stocking could be found.

Study Objectives

The primary objective of the translocation project was to increase bull trout numbers in Dinosaur Reservoir. To meet this objective, adult bull trout that were ready to spawn were moved into habitat in the upper Gething Creek watershed. The intent was to increase the spawning success of the translocated adult bull trout, increase the fry production, and ultimately increase bull trout numbers in Dinosaur Reservoir. The ideal result would be for a portion of annual production to emigrate to Dinosaur Reservoir and a portion to remain as a self-supporting, stream-resident dwarf bull trout population. The resident population would eliminate the need for future translocations.

This final report presents a documentation of all activities associated with the Gething Creek bull trout translocation project, including follow-up monitoring to determine if the translocations were successful and if a stream-resident dwarf population was established. Recommendations for future activities within Gething watershed are provided and considerations for future bull trout translocations in other systems are discussed.

Description of Study Area

Gething Creek (56° N, 122° 15' W), a tributary to Dinosaur Reservoir, is located 2 km downstream of Williston Reservoir and the W.A.C. Bennett Dam and 90 km west of Fort St. John in northeast British Columbia, Canada (Fig. 1). Approximately 21 km downstream of the W.A.C. Bennett Dam, a second hydroelectric dam, Peace Canyon Dam, impounds water nearly to the base of the W.A.C. Bennett Dam, creating Dinosaur Reservoir. After passing the Peace Canyon Dam, water flows eastward in the Peace River to the Mackenzie River drainage system and ultimately discharges into the Arctic Ocean.

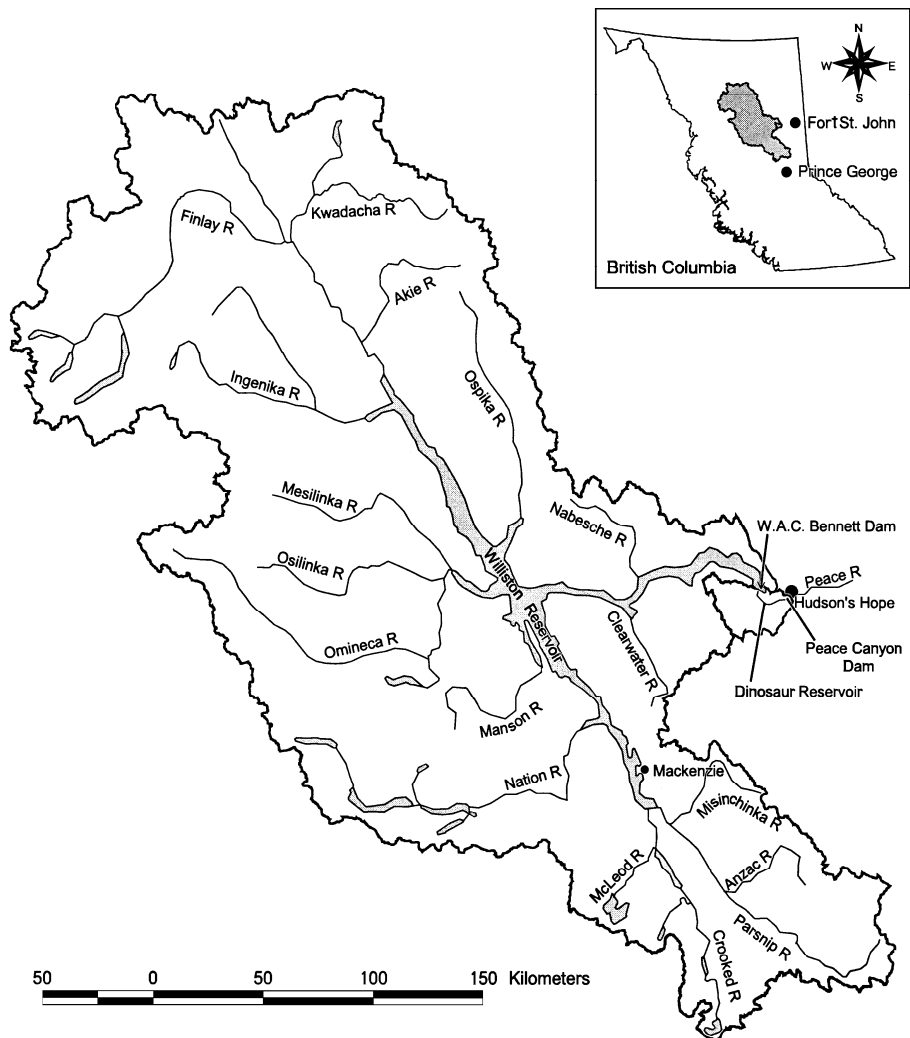


Figure 1. Williston and Dinosaur reservoir watersheds

Gething Creek (Fig. 2) is a 5th-order stream flowing north-eastward 27.1 km from its headwaters (Wright Lake, 23.2 ha) to Dinosaur Reservoir (Ministry of Environment, “*Lake and Stream Summary System*”). The lower 6 km of Gething Creek increases in size with the addition of two 4th-order streams, Dowling and Gaylard creeks.

A six-metre vertical waterfall located 550 m upstream from Dinosaur Reservoir prevents fish access from the reservoir to Upper Gething, Gaylard, and Dowling creeks. The confluence of Gaylard and Gething creeks occurs approximately 400 m upstream of the first Gething Creek waterfall and before additional barriers on Gething Creek. Two waterfalls occur on Gaylard Creek within 400 m of the confluence and are barriers to upstream fish passage. In the 800 m immediately upstream of the six-metre waterfall on Gething Creek are four additional impassable (upstream direction) barriers and chutes. Dowling Creek enters Gething Creek upstream of the five waterfalls on lower Gething Creek. The confluence of the two creeks is approximately 5 km upstream of the mouth of Gething Creek (Dinosaur Reservoir) and 50 m upstream of the Johnson Creek Forest Service road bridge that crosses Gething Creek (Fig. 2). A sixth waterfall on lower Gething Creek is located approximately 1 km upstream of the Dowling-Gething confluence. The sixth waterfall is three metres high and prevents upstream fish passage.

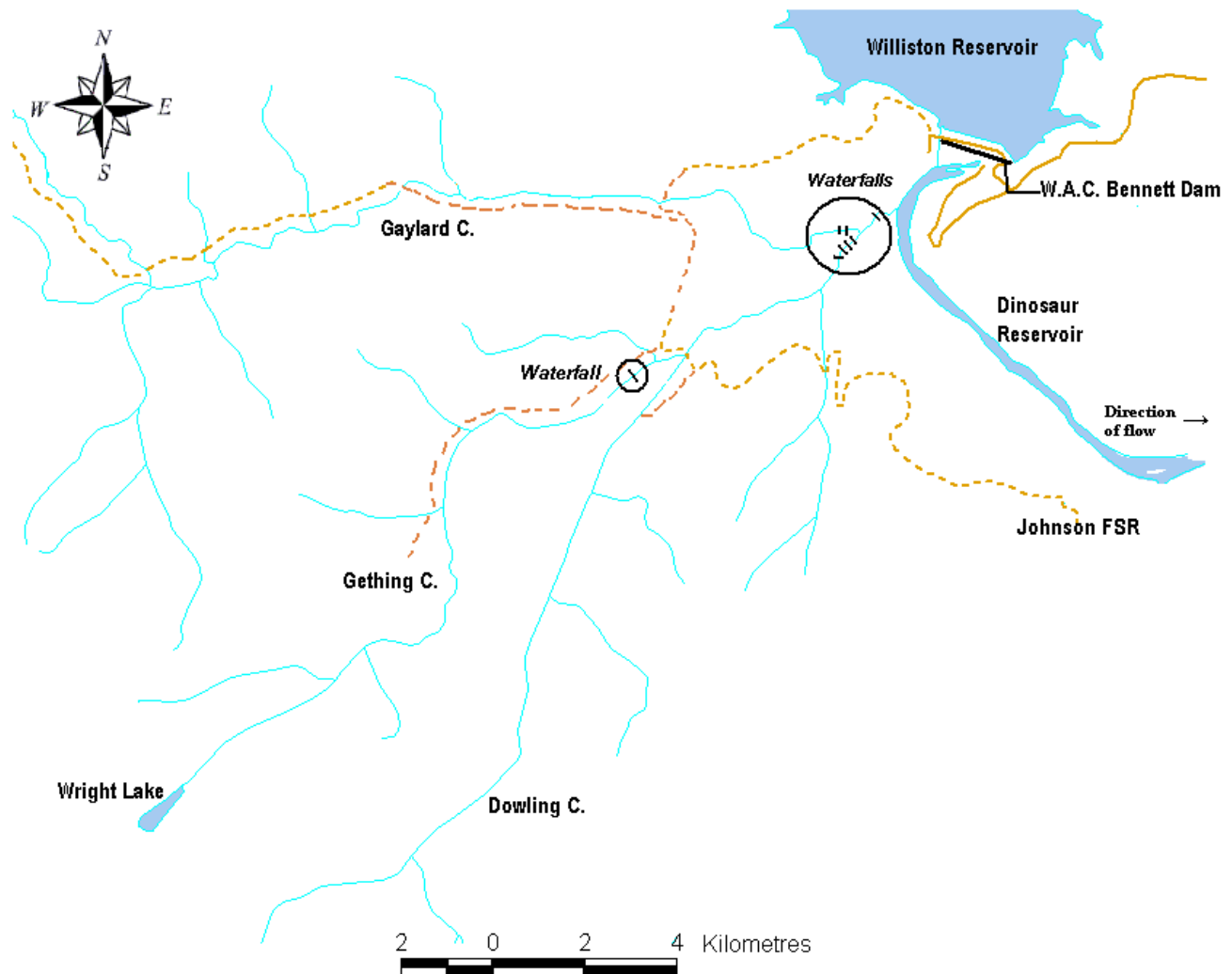


Figure 2. Gething Creek tributaries and waterfall locations.

Maximum daily discharge, Q_{maf} (mean annual flood), is estimated to be $38 \text{ m}^3/\text{s}$ near the mouth of Gething Creek (Province of BC, Water Management Branch, File 55.431022). Data collected at three Gething and Gaylard creek locations indicate winter discharge near the mouth of Gething Creek as low as $0.5 \text{ m}^3/\text{s}$ (data on file). Aquatic Resources Ltd. (1998) inferred discharge patterns from 1980–1995 hydrometric data collected from Moberly River (closest monitoring station). Discharge patterns for Gething Creek are likely to be similar and therefore should exhibit peak flows in mid-June with a gradual decay in flow rate until winter base flows are reached in November. Base winter flows continue until April and the onset of spring snowmelt.

Rainbow trout (*Oncorhynchus mykiss*) and longnose suckers (*Catostomus catostomus*) inhabit Gething Creek upstream of the waterfalls. Rainbow trout are not native to Gething Creek upstream of the waterfalls. The rainbow trout are: naturalized (offspring of hatchery-origin fish) from a one time 1983 experimental stocking, naturalized from a 1991-1999 stocking program of the head water Wright Lake, and hatchery origin rainbow trout that migrate from Wright Lake (Langston and Murphy, in prep). A sparse population of naturalized (from a one time 1983 experimental stocking) rainbow trout live in Gaylard Creek upstream of the impassable waterfalls 400 m from the confluence with Gething Creek.

Access to Study Area

The lower 4 km of Gething Creek are entrenched within a deeply incised canyon with numerous waterfalls; therefore, access to the mouth of Gething Creek is limited to boat via Dinosaur Reservoir or helicopter. Upstream of the canyon, Gething Creek can be accessed at six locations via the Johnson Creek FSR (Forest Service Road), which is a “main haul” two-lane gravel logging road, and a currently unnamed gravel road, which travels along the north side of Gething Creek. In the 1980’s, the gravel road extended to within 1 km of the headwaters at Wright Lake; however, the road has been deactivated for the last 10 km of its length and current access is limited to small all-terrain vehicles.

Gaylard Creek is accessible at numerous locations along its lower length from the lower bridge crossing on the Table FSR, at upstream locations from the Johnson Creek FSR and several small spur roads, and at a few upper reaches from the Itis FSR.

Dowling Creek is accessible by the Dowling Creek FSR, currently a 2-km-long, overgrown road passable only by 4-wheel-drive vehicles, which extends to the old bridge crossing site on Dowling Creek. Prior to the bridge removal at kilometre two, the Dowling Creek FSR continued approximately 16 km upstream along Dowling Creek, but this section is now completely impassable.

METHODS

Water Temperature

Water temperatures were recorded with Onset StowAway digital recording thermometers. Gaylard and Gething creek temperatures were recorded at the fish-fence trap locations (Fig. 3) from July 1994 to May 1995 and opportunistically with hand-held alcohol thermometers when electrofishing. Dowling Creek water temperatures were measured with a hand-held alcohol thermometer during electrofishing surveys. StowAway recording thermometers were used to collect

water temperature data in 1999 at the mouth of Gething Creek and in nearby Dinosaur Reservoir to determine if the time that adult bull trout entered the stream was influenced by water temperature.

Stream Discharge (flow rates)

Winter or base flows were determined for Dowling, Gaylard, and Gething creeks on March 30, 1994, with a revolving-propeller-style OTT current meter. Gaylard Creek flows were measured at the Table Creek FSR bridge crossing near the fish-fence trap. Gething Creek discharge was measured at three sites: Site 1 was the release site of bull trout (upstream of the fish-fence trap); Site 2 was 50 m upstream of the confluence with Dowling Creek; and Site 3 was at the Johnson Creek FSR bridge crossing of Gething Creek, approximately 100 m downstream of the confluence with Dowling Creek. A simple mathematical equation was used to estimate Dowling Creek discharge from the Site 2 and Site 3 measurements.

Maximum daily discharge, Q_{maf} (mean annual flood), near the mouth of Gething Creek was estimated by the Province of BC's Water Management Branch by performing a regional analysis of other streams in the area. "Floating chip" method was used on September 21 and October 5, 1994, to determine discharge at the Gaylard Creek fish-fence trap.

Capture and Translocation of Pre-Spawn Bull Trout

A crew of up to eight people, two equipped with dry suits and snorkel gear, captured adult pre-spawn bull trout at the base of the waterfall on Gething Creek, 550 m upstream from Dinosaur Reservoir (Fig. 2). The fish capture was done in late August to early September when the bull trout were most likely to be congregating at the waterfall but had not yet spawned. A long, fine-mesh beach seine net was used to capture the fish. In 1999, in addition to the capture of fish at the base of the waterfall, a temporary fish fence was erected at the mouth of Gething Creek to capture all adult bull trout migrating into Gething Creek. The fish fence allowed exact numbers and stream entry dates of spawners to be recorded, and it also provided an alternative method to capturing fish at the base of the impassable waterfall.

Based on the recommendations of Dr. Eric Talyor (University of British Columbia, Genetics Department), the goal was set of translocating at least 25 spawning pairs over the years of the study.

Captured pre-spawn bull trout were measured for length to the nearest millimetre and weight to the nearest ounce (equivalent to 28 g). The base (first 1 cm) of the leading edge pectoral fin ray was collected and submitted to North-South Consultants for age determination. A 5-cm coloured and numbered Floy Tag was inserted immediately below the posterior insertion of the dorsal fin to ensure anchoring of the plastic "T" between subcutaneous fin rays. A PIT tag was inserted either in the cheek flesh or subcutaneously between the pelvic fins. Sexual dimorphism is exhibited strongly in bull trout, enabling determination of sex by visual examination of captured fish. After examination, captured fish were kept calm in a dark holding bag in the stream for up to one hour while awaiting transport. Due to the narrow canyon walls, a helicopter could not land at the site; instead, a 205-litre water-filled barrel was lowered on a 30-m steel cable to the site. Fish were transferred from the bags to the barrel and were airlifted approximately 10 km to the release sites (Fig. 3) at either Gaylard Creek (1994) or Gething Creek (1993, 1997, and 1999).

The translocation project was originally intended to include both Gething and Gaylard creeks; however, efforts were directed solely to Gething Creek after 1994 due to the limited number of mature bull trout available each year and the concern that adult bull trout may not survive the downstream passage over the large (16 m) waterfall on Gaylard Creek.

Recapture and Transport of Post-Spawn Bull Trout

A fish-fence trap was installed upstream of the waterfalls and downstream of the release site to capture the adult bull trout after they had spawned (Fig. 3). Fish that had not completed spawning were released upstream of the fish fence, while fish that had completed spawning were transported by vehicle in a small holding tank to Dinosaur Reservoir. The fish were transported to the reservoir because of the concern that adult fish could not survive drops over the larger waterfalls, especially the approximately 16 m waterfall on Gaylard Creek.

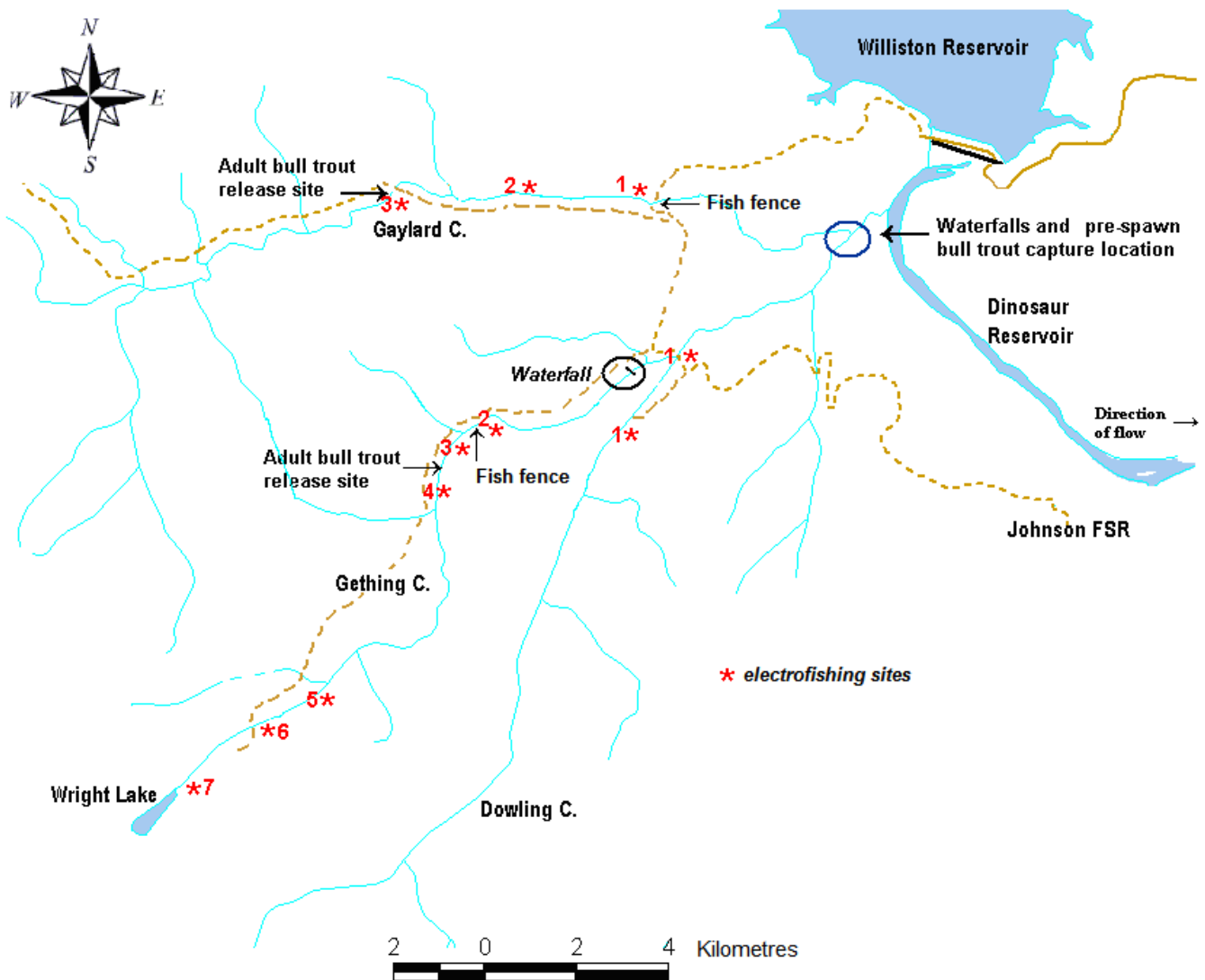


Figure 3. Adult bull trout capture and release sites, and electrofishing locations.

Capture of Bull Trout in Wright Lake

Small-lake reconnaissance survey techniques, as specified in the Ministry of Environment's *Fish collection methods and standards (version 4)* (1997), were used in 1989, 1998, and 2004 to capture fish in Wright Lake to evaluate the rainbow trout stocking program. Specifically, gill nets, trap nets, minnow traps, and angling were used to capture fish.

Capture of Juvenile Bull Trout

To determine if the translocated bull trout had created offspring, Smith-Root electrofishers were used to capture juvenile bull trout at seven locations along the length of Gething Creek (Fig. 3). Three electrofishing sites were also established in Gaylard Creek and one site in Dowling Creek (Fig. 3). PFWWCP and Ministry of Environment (MoE) crews used a single-pass, no-stop-nets methodology to cover large sections of stream during the juvenile capture. All captured fish including species other than bull trout were anaesthetised with a solution of creek water and Alka-Seltzer (inducing temporary hypoxia) and enumerated. Bull trout were measured for length to the nearest millimetre with a measuring board and, in most cases, weight to the nearest gram with a portable digital balance. Scale samples for age determination were collected. A search of the provincial Ministry of Environment's "fisheries data warehouse" was conducted to obtain any additional data that may have been collected in the area by other research groups.

RESULTS

Water Temperature

Water temperature data recorded at the fish-fence trap sites on Gething and Gaylard creeks ranged from slightly below zero to approximately 16 °C. The maximum temperature of 15.9 °C for Gething Creek was recorded on August 3, 1994. Water temperatures were warmest in July and August of 1994 with a mean of 10.5 °C for each month in Gaylard Creek and of 11.1 and 11.3 °C in Gething Creek (Table 1). Temperature decreases were most notable in October when the mean temperature dropped below 4.5 °C in both creeks, and by November the temperatures were at or near zero. From January through April 1995, Gething Creek's water temperature was either slightly below (-0.3 °C) or at zero degrees Celsius. Water temperature increased in May to a mean of 3.6 °C. Gaylard Creek likely experienced a similar progression of water temperatures.

Table 1. Mean daily water temperatures (°C) measured at the fish-fence trap sites in Gething and Gaylard creeks from July 9, 1994, to May 31, 1995.

Location	1994						1995				
	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Upper Gething Creek	11.1	11.3	8.4	3.4	0.1	0.0	-0.3	-0.3	-0.3	0.0	3.6
Upper Gaylard Creek	10.5	10.5	8.3	3.4	0.4	0.0	-0.2	-0.3	0.5	3.1	6.1

Water temperatures measured opportunistically in July and August, 1993 to 2006, did not exceed 15 °C.

Water temperature data collected at the mouth of Gething Creek near Dinosaur Reservoir from August 25 to September 20, 1999, averaged 9.9 °C and ranged from 6.2 to 13.8 °C. Water temperature

data collected from Dinosaur Reservoir just upstream of the confluence with Gething Creek averaged 12.3 °C and ranged from 7.1 to 14.6 °C.

Water Discharge

Winter or base flows ranged from 0.07 m³/s at the bull trout release site on Gething Creek to an estimated 0.39 m³/s at the mouth of Gething Creek (Table 2).

Table 2. Winter base flows for Gaylard, Dowling, and Gething creeks, March 30, 1994.

	Gaylard Creek	Dowling Creek (calculated)	Gething C at adult bull trout release site	Gething C upstream of confluence with Dowling C	Gething C downstream of confluence with Dowling C	Gething C at mouth (calculated)
Discharge (m ³ /s)	0.19	0.09	0.07	0.11	0.20	0.39

The MoE Water Management Branch performed a regional analysis of other streams in the area to estimate summertime flows for Gething Creek. Spring freshet or significant rain events can induce a maximum daily discharge, Q_{maf} , estimated at 38 m³/s near the mouth of Gething Creek, but this value is a mean daily flow; instantaneous flows could exceed 49.3 m³/s. Meaningful summertime discharge data were not collected for Gething Creek or its tributaries. The “floating chip” methodology indicated an approximate flow of 0.50 m³/s at the Gaylard Creek fish-fence trap on September 21 and October 5, 1994.

Capture and Translocation of Pre-Spawn Bull Trout

In total, 87 individual adult bull trout were captured at the base of the impassable waterfall on Gething Creek (Appendix A). Four of the 87 fish had been captured in two separate years, and one had been captured in three separate years). Sixty three bull trout were translocated upstream into suitable spawning habitat in Gaylard Creek (1994) and Gething Creek (1993, 1997, and 1999) (Table 3). Only 61 individual bull trout were translocated as 2 bull trout because two bull trout were translocated in both 1997 and 1999. Translocations were scheduled but unsuccessful in 1995, 1996, and 1998. In 1995, crews were unable to access the waterfall site due to high discharge rates from recent rains. In 1996, too few bull trout were captured: a first attempt on August 29 resulted in the capture of four small females and one male, all of which were released at the capture site, and a second attempt on September 5 yielded only the same four small females, one of which was “spent.” In 1998, the crew captured only four bull trout, insufficient to warrant the time and expense of a translocation.

Table 3. Translocated bull trout (63 total, 61 individual fish)

Year	Release location	Number released	Male / female ratio
1993	Upper Gething Creek	12	3 male / 9 female
1994	Gaylard Creek	16	9 male / 7 female
1997	Upper Gething Creek	14	5 male / 9 female
1999	Upper Gething Creek	21	12 male / 9 female
Total		63	29 male / 34 female

The captured bull trout ranged in age from 3 to 12 years, with a median age of 7 years (Appendix A). The mean length and weight were 633 mm and 2,800 g, respectively. Female fish (52) outnumbered males (38). The sex of two additional fish was not determinable by field staff.

The fish fence used in 1999 at the mouth of Gething Creek captured 28 of the 45 bull trout that entered Gething Creek that year to spawn (Newsholme 1999). The fish fence was installed on August 25 and the first bull trout was captured on August 27. The last was caught on September 14. An inspection of the pool at the base of the impassable waterfall on August 26 revealed 17 bull trout that had entered the creek prior to the fence installation.

Recapture and Transport of Post-Spawn Bull Trout

Of the 63 fish translocated into upper Gaylard and upper Gething creeks, 39 were recaptured in the fish-fence trap post-spawning and returned to Dinosaur Reservoir (Table 4). Two bull trout were found dead in the upper creeks, but no data were recorded to indicate if these fish had spawned. Twenty-two fish were neither recaptured in the fish-fence trap nor otherwise accounted for.

Table 4. Recaptured post-spawn bull trout.

Location	Year	Bull trout translocated above barriers	Bull trout recaptured and returned to Dinosaur Res.	Mortalities	Unaccounted for
Gething	1993	12	12		
Gaylard	1994	16	13		3
Gething	1997	14	3	1	10
Gething	1999	21	11	1	9
Total		63	39	2	22

Two of the fish that were unaccounted for in 1997 survived downstream passage over the waterfalls on Gething Creek and returned to Dinosaur Reservoir. These two fish were subsequently captured in 1999 at the base of the Gething Creek waterfall and translocated again into upper Gething Creek.

All 39 fish recaptured in the fish-fence trap were first examined to verify that they had spawned and were then transported back to Dinosaur Reservoir. Additional verification of spawning was done by ground surveys, which were conducted in accessible areas and in particular near the release site to locate redds and adult bull trout in spawning locations. Redds were observed near the release sites in all years, and they were mentioned in a daily journal kept by field crews; however, a precise record of locations and total numbers observed was not made.

Capture of Bull Trout in Wright Lake

No bull trout were captured in the 1989 reconnaissance survey of Wright Lake. Four bull trout were captured with gill nets in 1998. Two were mortalities and their otoliths were collected. Two others were measured and their scales were collected, and they were then released alive. One bull trout was captured in 2004 in a gill net set during the Wright Lake stocking assessment (Zemlak, 1999). One bull trout was captured in 2005 by electrofishing in the outlet (Gething Creek) approximately 150 m downstream of the lake. Table 5 shows the data collected from these six fish.

Table 5. Bull trout captured in Wright Lake

Year	Length (mm)	Weight (g)	Reported scale age	Reported fin ray age	Reported otolith age	Most likely age
1998	307	252	2			4
1998	330	347	2			4
1998	345	447			3	4
1998	375	575			4	4
2004	378	640		4		4
2005	270	238	3	3		3

Note: The 2005 bull trout was captured in the outlet (Gething Creek), 150 m downstream of the lake.

Reproductions of the scales collected from the two age-2 bull trout captured in 1998 are shown alongside an image of a scale collected from a known age-2 Gething Creek bull trout (Fig. 4). The red dots indicate approximate annuli locations marked by the scale reader, and the red “X” symbols indicate the suspected locations of four annuli (as interpreted by the author). The scale reader appears to have underestimated the age of the Wright Lake bull trout.

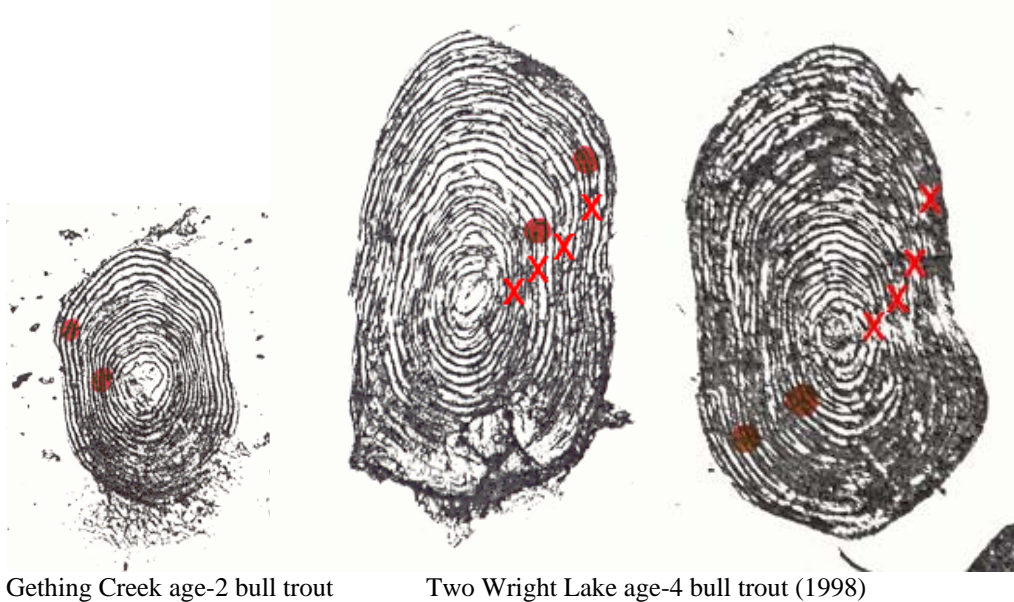


Figure 4. Scales from a known age-2 bull trout and from two Wright Lake bull trout

A different scale-reading company was employed to analyze the bull trout captured in 2005. Reproduction of the scale and fin ray collected from this bull trout both support the scale reader’s conclusion that the fish was age 3 (Fig. 5).

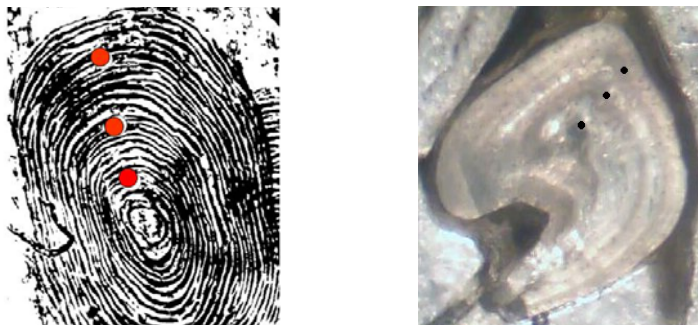


Figure 5. Scale and fin ray from the bull trout captured in 2005

Capture of Stream-Resident Juvenile Bull Trout

Bull trout juveniles, most likely offspring of the 1993, 1994, 1997, and 1999 translocated adult bull trout, were captured over a multi-year period by PFWWCP and MoE electrofishing crews. Initial translocation of adult bull trout are shaded in dark grey in Table 6. The bull trout juveniles presumed to have resulted from those translocations follow in the same row, but they are shaded light grey. Boxes with no entries indicate years that electrofishing was not undertaken. Bull trout juveniles were captured either near or downstream of the adult release sites (Fig. 3), with two exceptions, which were a lone age-0 bull trout captured in Dowling Creek and an age-3 bull trout captured in Gething Creek, 150 m downstream of Wright Lake. The 1999 Gething Creek electrofishing surveys did not capture offspring of the bull trout translocated in 1993, and the 2000–2002 surveys did not capture offspring of the bull trout translocated in 1993 or 1997. One age-0 bull trout was captured in Dowling Creek in 1999.

Electrofishing surveys were not conducted in 1996, 1998, 2003, or 2004. No bull trout juveniles were captured in the 2005 electrofishing surveys other than a single age-3 bull trout captured 150 m downstream of Wright Lake in Gething Creek. This fish is not believed to be a stream resident but a migrant from the lake. The ages presented in Table 6 are based on actual scale age determination (Appendix B) and interpolation of ages based on known introduction dates of spawning-condition bull trout (translocations).

The summary of electrofishing results (Appendix B) indicates where and when bull trout juveniles were captured. No bull trout juveniles were captured at the three upper Gething Creek electrofishing sites located upstream of the release site, with the exception of one 270-mm, age-3 fish captured at site seven, 150 m downstream of Wright Lake. The Gething Creek electrofishing results depict a slight trend toward larger bull trout juveniles at the lower sites of Gething Creek. No bull trout were captured during the 1999 Gaylard Creek electrofishing.

Table 6. Adult bull trout translocations and resultant juvenile numbers, ages, and fork length range

Creek	1985	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Dowling	430 fry							1 age-0 43 mm	0	0	0			0
Gething		Adults 3 male 9 female	27 age-0 22-41 mm	22 age-1 74-63 mm		1 age-3 No data		0	0	0	0			0*
						Adults 5 male 9 female		31 age-1 96-132 mm	0	0	0			0*
								Adults 12 male 9 female	46 age-0 50-71 mm	37 age-1 71-117 mm	15 age-2 141-202 mm			0*
Gaylard			Adults 9 male 7 female	22 age-0 61-92 mm		3 age-2 No data		0						0

* One age-3 bull trout was captured in 2005 but not included, because it was likely a migrant from Wright Lake as opposed to a stream-resident bull trout.

DISCUSSION

Water Temperature

The water temperatures recorded in the upper sections of both Gething and Gaylard creeks, where bull trout young were rearing in 1994–1995, indicate a potentially longer growing season than is typical of most streams in the area. The water temperature of the creeks rises rapidly in May, reaching double-digit levels by June. These temperatures extend into mid-September when cooling air temperature causes the water temperature to drop quickly by the end of September. Gething and Gaylard creeks may warm up faster than streams in most watersheds in the area for several reasons. Gething Creek's headwaters are fed by the surface water of Wright Lake, while Gaylard Creek's upper reaches are dominated by slow meanders with extensive beaver ponds, little crown closure, and little shade. In addition, the area has a history of timber extraction that potentially increases direct solar heating of the streams.

In 1999, adult bull trout entered Gething Creek earlier than anticipated. At least 17 bull trout (38% of enumerated escapement) had entered Gething Creek from Dinosaur Reservoir prior to installation of the fish fence on August 25. There are no data available to determine if Gething Creek's water temperature was a cue to initiate stream entry from Dinosaur Reservoir. Water temperatures in Dinosaur Reservoir ranged from 7.1–14.6 °C during the Aug. 25 – Sept. 20 fish-fence trap operations. However, water temperatures in the reservoir are not likely to be a cue for bull trout spawning, because they are highly variable and dependant on operations at the W.A.C. Bennett Dam. The ten intakes at the dam are at varying depths in Williston Reservoir, so the temperature of Dinosaur Reservoir is directly related to the volume of water passed through each intake. The temperature regime of Dinosaur Reservoir is not typical of a natural stream, as evidenced by the thermograph that indicated temperatures ranging from 7.1–14.6 °C in late August and early September. This variability in temperature was followed in the last two weeks of September by a change in operations at the dam (less volume of deep, cooler water used) that resulted in fairly constant temperatures of 12–14 °C.

Water temperature related to growth rates

The highest temperature recorded during the translocation study was slightly less than 16 °C at Gaylard Creek, well below the upper incipient lethal temperature of 20.9 °C reported by Selong et al. (2001). The unexpectedly large size of the bull trout juveniles caught in this study is likely explained in part by the relatively warm temperature of the streams, which potentially extends the growing season. Other probable factors in the large size of juveniles are the high density of stream invertebrate food resources (personal observation) and the low density of rainbow trout present.

Selong et al. (2001) determined that the temperature range at which bull trout growth could occur is between 5.2 and 20.7 °C, which indicates that the growing season for bull trout in Gething and Gaylard creeks may extend from May to October. In Selong et al.'s study, the optimal or peak rate of growth for bull trout (0.15 g/day), assuming complete satiation, occurred at 13.3 °C (range of 10.9–15.4 °C).

Bull trout (age 0) were collected in Gething Creek on July 6, 1994, with a weight range of 0.2–0.6 g (the water temperature was 11.3 °C). Applying Selong et al.'s (2001) growth curves and estimating 80 days growth at 0.15 g/day (maximum growth rate at 13.3 °C) and 0.1 g/day (growth rate

at 9.0 °C), a predictive estimate of weight by the end of September would be 8.2–12.6 g. Based on comparisons with juvenile fish captured in Gething Creek, this weight range is equivalent to a fork length range of 86–105 mm. Although none of the bull trout collected by electrofishing exhibited the predicted maximum growth, age-0 bull trout captured in Gaylard Creek on September 22, 1994, ranged between 61 and 92 mm (Table 6).

Age

The presence of juvenile bull trout in Gething and Gaylard creeks in the years following known introductions (Table 6) helps to provide validation for age results from scale reading. The ages of the bull trout juveniles captured in these creeks are known because bull trout had not previously existed in upper Gething and Gaylard creeks but were found in successive years following translocations of adults. These known-age data coupled with images of scales from fish of known ages were used to identify an error in the reported age (as determined from analysis of scales by a consultant) of two bull trout captured in Wright Lake. The fish were reported as age 2, but they were actually age 4. Although it is relatively easy to recognise four annuli when a scale is viewed alongside a known 2-year-old scale (Figure 4), it is difficult to identify four annuli when a scale is read in isolation. This difficulty indicates the problem of accurate age determination for bull trout when using scales. Another bull trout from Wright Lake, captured in 1998, was identified as age 3 from its otolith. Although a photo record of the otolith from this fish does not exist, we think that the fish must have been age 4 based on the history of bull trout translocations, as presented in Table 6.

The age data of the translocated adult bull trout are provided in tabular and graphic form in Appendix A. There are numerous obvious errors in age assignment. The errors are attributable to the unusual seasonal temperature regime occurring in Dinosaur Reservoir caused by the variable depth of water withdrawn from Williston Reservoir. The result of hypolimnetic water withdrawal is generally a colder and more seasonally homogenous water temperature. Some fish entrained from Williston Reservoir are either killed or stunned as they pass through the W.A.C. Bennett Dam turbines, presumably creating an abundant food resource for bull trout. The result is large bull trout that grow consistently throughout the year without the annual cycle of rapid summer growth followed by little winter growth. Therefore, the pattern of annuli established in structures that are used for age determination differs in the bull trout that grow year-round. The reported ages of the bull trout in Appendix A are underestimates and are not valid. They have only been reported here to demonstrate the unusual habitat and related growth patterns experienced immediately downstream of the W.A.C. Bennett Dam.

Gaylard Creek

1994 Translocation

The translocation of bull trout to Gaylard Creek resulted in the production of some juvenile fish; however, the 1999 and 2005 electrofishing surveys failed to capture any bull trout. The most likely explanation is that most bull trout juveniles emigrated downstream to Dinosaur Reservoir. The movement of bull trout juveniles would have started with age-0 fish being swept downstream by high flows (passive out-migration) to Dinosaur Reservoir. Since bull trout were not captured in 1999, it is likely most bull trout emigrated (active out-migration) by age 3 or 4 at the latest.

Gething Creek

1993 Translocation

The results of the 1993 translocation of bull trout to Gething Creek indicate a similar scenario to that observed in Gaylard Creek. Bull trout that resulted from the 1993 translocation were present only until 1997, indicating a maximum stream residency to age 4 or 5 before a presumed downstream migration to Dinosaur Reservoir. The cohort from the 1993 adult translocation was followed through to ages 2 and 3 (Table 6). No electrofishing was done in 1998, but 1999 electrofishing confirmed that these fish were no longer present in the areas surveyed of Gething Creek.

One age-3 bull trout (Fig. 5 and Table 5) was captured in Gething Creek, approximately 150 m downstream of Wright Lake. The fish was too large (270 mm at age 3) to be a stream-resident fish, so it had likely recently migrated downstream past the beaver dam at the outlet of Wright Lake into Gething Creek. The fish had to be an F2 (second generation) offspring from the 1993 translocation. None of the offspring from the 1997 and 1999 translocations would have been mature in 2001 when this bull trout was conceived.

1997 Translocation

The 1997 translocation resulted in a cohort that was found only to age 1 and was not located again (Table 6). It is possible that an event occurred, such as temperature that exceeded the upper lethal limit of 20.9 °C or low winter subterranean water flow, and caused the loss of all juvenile bull trout from that cohort. The fall 1999 field notes report that for a long section of Gething Creek (from 200 m downstream of the fish-fence recapture site potentially all the way to the confluence with Dowling Creek), the stream channel was dry. Obviously, any eggs in redds and any rearing juvenile bull trout located in this stretch would have died.

1999 Translocation

The cohort from the 1999 translocation was followed through to age 2 (Table 6). The 2005 electrofishing surveys confirmed the nearly complete absence of bull trout in Gething Creek and the lack of any fish from the 1999 translocation.

1999 Fish fence at mouth of Gething Creek

The fish-fence trap at the mouth of Gething Creek was intended to

- provide an indication of the stream entry date (spawning-run timing) of mature bull trout;
- provide an indication of the role of water temperature cues to spawning-run timing;
- enable enumeration and examination of all bull trout spawning in Gething Creek;
- provide a safer (for personnel) and less expensive method of fish capture and transport to the upper reaches of the creek.

The fish fence was installed on August 25, but bull trout had already entered the creek. On August 26, 17 bull trout (38% of the enumerated run) were observed at the base of the impassable waterfall. Additional bull trout (estimated at 12 or less) had likely entered the creek and were holding in some of the pools and deeper sections of the creek in the 550 m between the fence site and the waterfall pool. The estimate is based on the limited amount of holding habitat available between the pool and the mouth, as well as on previous years' surveys that indicated most bull trout migrate to the base of the falls and stage at that location prior to spawning. Therefore, although initially not scheduled, a fish capture at the waterfall pool (requiring 7 people) and helicopter translocation were

undertaken, because it was uncertain if enough mature bull trout would be captured in the fish fence at the mouth of the creek.

The conservative spawner number estimate for Gething Creek in 1999 is 57, but the true number could have been as low as the 45 actually enumerated. The spawning run in 1999 likely began as early as mid-August and extended to mid-September. Spawning was complete by the end of September, and the return to Dinosaur Reservoir occurred by early October.

The fish fence captured 28 of the 45 bull trout enumerated in Gething Creek in 1999. However, only six of these 28 bull trout were translocated to upper Gething Creek. The remaining bull trout were not moved to allow some of the run to spawn in lower Gething Creek below the waterfall. The decision not to move all the mature bull trout was a precautionary step in case an unforeseen incident resulted in the death of the translocated bull trout.

Dowling Creek

The absence of bull trout in Dowling Creek, except for one age-0 fish captured in 1999, indicates that the one-time stocking of 430 bull trout fry to this creek in 1985 did not result in a stream-resident population.

The single 43-mm, age-0 bull trout captured by electrofishing in 1999 suggests that some bull trout offspring from the 1993 translocation remained in the system, reached maturity, and created an F2 generation of bull trout. The timelines presented in Table 6 indicate the possibility that fry resulting from the 1993 translocation would be age 4 in the fall of 1998. MoE electrofishing crews captured a precocious age-3 male bull trout in Gething Creek in 1997. Age at first maturity for bull trout males is as early as age 3, but for females it is usually age 5 (Ford et al. 1995). The accelerated bull trout growth rates in Gething Creek could result in an earlier (i.e. age 4) age of sexual maturity.

Another possibility to explain the existence of the F2 bull trout centers on the 14 adult bull trout translocated in 1997. Ten were not recaptured in the fish fence and a pair of these fish could have remained in the system to spawn in the fall of 1998. Similarly, a female from 1997 could have remained and spawned in 1998 with one of the precocious males created by the 1993 translocation. However it is very unlikely that any of the translocated adult bull trout would have remained in Gething Creek for a year, they should have migrated to Dinosaur Reservoir.

Wright Lake

Rumours that bull trout were being caught by anglers in Wright Lake were confirmed when four bull trout (age 4) were captured by gillnet in 1998. The age of these fish, when compared to the timeline of Table 6, leaves no doubt that the fish resulted from the 1993 translocation of adults to Gething Creek. A fifth bull trout (age 4) was captured by gillnet in Wright Lake in 2004. This fish was either an F1 generation offspring of the adults translocated in 1999 or possibly an F2 generation offspring of the 1993 translocation that would have been age 5 when the gillnetted bull trout was conceived. An age-3 bull trout was captured 150 m downstream from Wright Lake in Gething Creek. The age-3 fish was too large to be a stream resident and was likely a fish that had reared in the lake and recently migrated into the creek at the lake's outlet.

The outlet of Wright Lake has one large beaver dam, approximately 1.5–2 m in height, that controls the lake level and acts as a barrier to most fish passage either into Gething Creek or from the

creek into Wright Lake. Although beaver dams are temporal in nature, this dam appears to be well maintained and likely persists over long periods of time. Nonetheless, the dam appears to be only a point of difficult passage for bull trout, since it is apparent that some bull trout juveniles migrated upstream into Wright Lake rather than downstream into Dinosaur Reservoir. The beaver dam may act as a barrier to the bull trout in Wright Lake during low flow periods and once they attain adult size. However, seasonal September and October rains and associated increased water levels may afford access past the dam during the spawning period used by bull trout.

The 2005 capture of the large age-3 bull trout in Gething Creek, 150 m downstream from the lake, is an example of bull trout migrating downstream past the beaver dam. Of interest are the notes from field staff in 1997 where they indicated that, surprisingly, five adult bull trout had ascended over a presumed barrier (large beaver dam) on Gething Creek just upstream of the release site. The unexpected colonization of Wright Lake by an unknown number of bull trout may yet result in a resident population of bull trout in the upper Gething Creek watershed and in long-term recruitment to Dinosaur Reservoir. Electrofishing in Gething Creek near the lake in 1999, 2001, and 2005 did not yield any young-of-the-year bull trout to indicate that spawning was occurring in the outlet, but evidently some recruitment has occurred.

Wright Lake may provide an interesting possibility to support a refuge population of bull trout in the future. If appropriate, future adult translocation projects could incorporate the additional step of the capture of the juvenile bull trout produced (off spring) and transport them into Wright Lake. A population may be established in Wright Lake with the potential for future spawning in the outlet and out migration of resultant juveniles to Dinosaur Reservoir.

Spawning Location Fidelity

One female bull trout was captured three times over the course of the study when she returned to spawn in Gething Creek in 1996, 1997, and 1999. Two other bull trout—one male and one female—that spawned in 1997 returned to spawn again in 1999. One bull trout that spawned in Gething Creek in 1997 had been tagged initially on September 11, 1995, in Dunlevy Creek, upstream of the W.A.C. Bennett Dam. While site fidelity does occur, the presence of the fish from Dunlevy Creek indicates that immigration and input of genetic material from Williston Reservoir and the upper Peace River watershed occurs.

Potential Bull Trout Egg Deposition

In *Inland Fishes of Washington*, a 6.8-kg female bull trout was reported to have 12,000 eggs (Wydoski and Whitney, 2003), the maximum number of eggs recorded. Ford et al. (1995) reported that bull trout fecundity ranges from 660–6,750 eggs and that a practical, standardized estimate is 920 eggs per kg of weight for a female with a fork length of 600 mm.

For the 11 female bull trout that were weighed during the translocation study, the mean fork length was 614 mm and the mean weight was 2.46 kg. A crude estimate of 920×2.46 results in an egg potential of 2,263 eggs per female. The approximately nine females translocated per year equates to a maximum potential of 20,000 eggs per year. Assuming that all females spawned successfully, and applying Shepard et al.'s (1984) value of 40 % survival of eggs if no fines (materials less than 6.35-mm diameter) are present, we propose a maximum fry recruitment estimate of 8,000 per year.

The figure of 8,000 represents a very crude estimate; however, applying conservative probabilities, it is likely that the maximum value is not much higher (a couple thousand at the most), while the minimum value could conceivably be as low as 2,000 fry.

Juvenile Bull Trout Production

The objective of the translocation project was to increase bull trout numbers in Dinosaur Reservoir. A physical enumeration (Gething Creek bull trout population estimate) was not undertaken, nor was any method of enumerating bull trout entering Dinosaur Reservoir from Gething Creek employed. An increase in the number of bull trout was presumed based on the belief that a greater egg-to-fry and fry-to-juvenile survival rate would result from egg deposition in the upper watershed.

Electrofishing surveys conducted upstream of the waterfalls in 1999, 2000, and 2001 revealed age-0 and age-1 bull trout densities as high as 0.09 and 0.05 fish/m², respectively. These were the highest densities observed and were in close proximity to redd sites; however, the densities were not uniform along the creek length, which prevented application of an expansion factor to estimate bull trout juvenile population. The important point is that translocated bull trout did spawn successfully.

Juvenile bull trout densities were highest (26 in a 5-m × 80-m site) at the 1999 adult bull trout release site (location of some confirmed redds) and were sparsely distributed downstream of the release site. The limited dispersion of juveniles from redd site locations is likely due to an abundant aquatic invertebrate food source and good-quality rearing habitat.

SUMMARY

Juvenile bull trout were produced in the upper Gething watershed as a result of the translocation of adult bull trout in 1993, 1994, 1997, and 1999. Juveniles reared in the upper watershed for up to three years. Bull trout juveniles were not captured in Gething, Dowling, and Gaylard creeks in 2005. No bull trout juveniles were captured in 2005 indicating that a stream-resident dwarf population was not established. The streams appear to be too small (low discharge) to support bull trout beyond age 3 or 4. After reaching a size that the streams can no longer support, the fish presumably migrate downstream to Dinosaur Reservoir, potentially meeting the stated objective of increasing the bull trout population in the reservoir.

The translocation of adult bull trout into upper Gething Creek has resulted in the occurrence of some bull trout residing in the headwater, Wright Lake. The number of bull trout residing in Wright Lake is unknown. While bull trout may persist for some time in Wright Lake, with so few founding fish the genetic integrity is low which will most likely lead to the eventual disappearance of the “introduced” bull trout in Wright Lake.

When the Gething Creek translocation project was initiated, it did not specify how the response would be measured. In retrospect, given the results of this follow-up study, there is no cost-effective way to document the number of bull trout produced above and below the waterfalls, nor can the number of bull trout produced before and after the translocation project be compared statistically. The only evidence of success with the project is the subsequent capture of bull trout fry by electrofishing in upper Gething Creek where none had existed before. To demonstrate that bull trout numbers had increased in Dinosaur Reservoir as a result of this project is impossible. With the results and

information currently available, it is only possible to infer that bull trout numbers in Dinosaur Reservoir increased.

The exact number of bull trout created through the translocation project is unknown, but as a compensation activity, it may be enough to simply know that bull trout are being produced. The temperature regime of the stream habitat and reduced competition for resources in the upper Gething watershed may offer advantages to rearing bull trout compared to the existing accessible areas of lower Gething Creek and Dinosaur Reservoir. Habitat quantity and quality is so low in Gething Creek between the waterfall and Dinosaur Reservoir that an inference of improved production is warranted.

If bull trout numbers in Dinosaur Reservoir and Gething Creek appear to be declining, a minimum two-year translocation project (to take into account the biannual spawning pattern of bull trout) using a fish capture trap at the mouth of Gething Creek should be undertaken. The project could be re-assessed after year two to determine if additional translocations are required. The trap would require operation for approximately three weeks, and fish could be transported by vehicle. A recapture fence may not be required as two bull trout in the study have shown that they can survive the downstream migration over the waterfalls in their journey back to Dinosaur Reservoir.

RECOMMENDATIONS

Before initiating future bull trout translocation projects, it is necessary to determine how the results will be measured. Specifically, a documented decision should indicate if it is adequate to presume that a beneficial response has occurred as a result of translocating adult bull trout (based on published research and known biological processes), or if it is necessary to undertake a rigorous, scientifically defensible estimate of increased numbers.

Experimental translocation projects within the Williston and Dinosaur reservoir watersheds with the intent of creating stream-resident dwarf fluvial populations should only be considered on streams with larger discharge than Gething Creek, because out-migration of the entire population by age 3 or 4 is possible.

There are two possible measures to provide insight into the long-term success of the project. First, the number of bull trout congregating at the waterfall barrier on Gething Creek may indicate success if adult spawner numbers spike upwards in the next few years as a result of site fidelity of trout reared in upper Gething Creek. For this reason, an annual early September underwater survey and count of bull trout at the base of the waterfall on Gething Creek is recommended. Second, the bull trout presence in Wright Lake can continue to be documented during the once per four year scheduled rainbow trout stocking assessment of Wright Lake for evidence of recruitment.

The bull trout population in Dinosaur Reservoir and Gething Creek is vulnerable to fishing pressure. All bull trout captured in Dinosaur Reservoir are required to be released, and Gething Creek is closed to fishing, but non-compliant fishing and harvest still occur. The bull trout may also be affected by possible competition from lake trout (*Salvelinus namaycush*) in Dinosaur Reservoir. For these reasons, the bull trout population size should be monitored using redd count or spawner number counts. Additional translocation projects could be undertaken if deemed a viable

conservation/enhancement option. Future translocation projects could be similar to those undertaken as part of this study, or they could include variations such as incorporating Wright Lake as a refuge.

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APPENDIX A
(Adult bull trout data)

Date	Release location	Length (mm)	Weight (g)	Sex	Age	Floy Tag	PIT Tag	Comments
09-Sep-93	upper Gething Creek	686		M	3	6677		
09-Sep-93	upper Gething Creek	721		F	5	6678		
09-Sep-93	upper Gething Creek	686		F	4	6679		
09-Sep-93	upper Gething Creek	619		F	5	6680		
09-Sep-93	upper Gething Creek	617		M	10	6676		
09-Sep-93	upper Gething Creek	628		F	4	6681		
09-Sep-93	upper Gething Creek	653		F	4	6682		
09-Sep-93	upper Gething Creek	657		F	4	6683		
09-Sep-93	upper Gething Creek	675		F	3	6684		
09-Sep-93	upper Gething Creek	528		F	5	6685		
09-Sep-93	upper Gething Creek	760		M	8	6686		
09-Sep-93	upper Gething Creek	610		F	3	6687		
15-Sep-93	not translocated			F		6688		released at capture site (waterfall)
29-Aug-94	Gaylard Creek	670		M		6626		not recovered and moved back to dinosaur
29-Aug-94	Gaylard Creek	710		M	7	6627		
29-Aug-94	Gaylard Creek	720		M		6628		
29-Aug-94	Gaylard Creek	660		F	5	6629		
29-Aug-94	Gaylard Creek	630		M		6630		
29-Aug-94	Gaylard Creek	710		M	7	6631		
29-Aug-94	Gaylard Creek	680		F	8	6632		
29-Aug-94	Gaylard Creek	490		F		6633		
29-Aug-94	Gaylard Creek	620		M	6	6634		
29-Aug-94	Gaylard Creek	740		F	8	6635		

Date	Release location	Length (mm)	Weight (g)	Sex	Age	Floy Tag	PIT Tag	Comments
29-Aug-94	Gaylard Creek	710		F	8	6636		
29-Aug-94	Gaylard Creek	850		M	6	6637		
29-Aug-94	Gaylard Creek	450		M		6638		not recovered and moved back to dinosaur
29-Aug-94	Gaylard Creek	670		M	8	6639		
29-Aug-94	Gaylard Creek	680		F	8	6640		
29-Aug-94	Gaylard Creek	700		F		6641		not recovered and moved back to dinosaur
11-Sep-97	upper Gething Creek	830		M	8	7506	20611B0F65	found dead upstream of Gething C fence Oct 6, 1997.
11-Sep-97	upper Gething Creek	860		M	9	7507	1F51093651	
11-Sep-97	upper Gething Creek	740		F	10	7508	1F53773463	
11-Sep-97	upper Gething Creek	850		M	10	7509	204F45014B	
11-Sep-97	upper Gething Creek	740		M	6	7510	1F554F3409	
11-Sep-97	upper Gething Creek	570		F	7	7511	2050510936	
11-Sep-97	upper Gething Creek	580		F	5	7512	204F482623	
11-Sep-97	upper Gething Creek	530		F	6	2908	1F534A7153	old floy tag, fish caught in Dunlevy fish fence in 1994
11-Sep-97	upper Gething Creek	600		F	8	7513	1F553C6070	
11-Sep-97	upper Gething Creek	660		F	8	7514	204F492127	
11-Sep-97	upper Gething Creek	530		M	7	7515	204F4F152D	
11-Sep-97	upper Gething Creek	580		F	6	7516	1F55380450	
11-Sep-97	upper Gething Creek	770		F	11	7517	1F553A0D45	
11-Sep-97	upper Gething Creek	580		F		6511	1F51023955	new Pit tag applied, old floy tag presumed from 1996.
10-Sep-98	not translocated	630		F		7511	2050510936	
10-Sep-98	not translocated	620		M	5	7709	401D5D3C3F	
10-Sep-98	not translocated	620		F	8	7710	401D6B5D76	
10-Sep-98	not translocated	660		F	6	7711	401D487640	
27-Aug-99	upper Gething Creek	660	3050	M	10	02325	407E4F2869	Mort Sept 19 - recovered pit & otoliths
28-Aug-99	upper Gething Creek	510	1750	F	5	02326	407E541C46	

Date	Release location	Length (mm)	Weight (g)	Sex	Age	Floy Tag	PIT Tag	Comments
28-Aug-99	upper Gething Creek	690	3350	M		02327	401D5D3C3F	Recapture, had lost floy tag# 7709, to tail race Sept 26.
29-Aug-99	upper Gething Creek	490	1200	M	5	02328	407E482050	Moved to Dinosaur Reservoir tail-race Sept 23
29-Aug-99	upper Gething Creek	735	4550	M	7	02329	407E5C0875	Moved to Dinosaur Reservoir tail-race Sept 26
29-Aug-99	upper Gething Creek	870	5900	M		07507	1F51093651	Recapture (tagged in 1997)
30-Aug-99	upper Gething Creek	470		M	7	02330	407E5D3674	
30-Aug-99	upper Gething Creek	710		F		07511	2050510936	Recapture (tagged in 1997)
30-Aug-99	upper Gething Creek	505		M	6	02331	407E427253	
30-Aug-99	upper Gething Creek	680		F	7	02332	407E593175	
30-Aug-99	upper Gething Creek	565		F	7	02333	407E456B37	
30-Aug-99	upper Gething Creek	515		M	6	02334	407E526778	
30-Aug-99	upper Gething Creek	685		M	10	02335	407E4E657B	
30-Aug-99	upper Gething Creek	490		F	6	02336	407E3D044B	
30-Aug-99	upper Gething Creek	685		F	8	02337	407E5C0B62	
30-Aug-99	upper Gething Creek	515		F	7	02338	407E4F1B03	
30-Aug-99	upper Gething Creek	745		F	11	02339	407E43765D	
30-Aug-99	upper Gething Creek	510		F	9	02340	407E47370B	
30-Aug-99	upper Gething Creek	595		M	7	02341	407E50140C	
30-Aug-99	not translocated	460		F ?	5	02342	407E526F3E	
30-Aug-99	upper Gething Creek	525		M	9	02343	407E38173A	
30-Aug-99	upper Gething Creek	495		M		02344	407E4E4275	
30-Aug-99	not translocated	460		?	5	02345	407E450979	Mort - found in trap wing Sept 5
31-Aug-99	not translocated	758		M	12	02346	407E4E7A4E	
4-Sep-99	not translocated	760	3900	M	10	02347	407E3F635B	
4-Sep-99	not translocated	610	2700	M	8	02348	407E49320E	Large hole below dorsal fin
4-Sep-99	not translocated	635	3650	M		02349	407E546C42	
4-Sep-99	not translocated	675	3300	F		06511	204F4F2C16	Recaptured (3 times: 9?, 97 & 99)

Date	Release location	Length (mm)	Weight (g)	Sex	Age	Floy Tag	PIT Tag	Comments
5-Sep-99	not translocated	748	4750	F	8	02350	407E3D3949	
5-Sep-99	not translocated	540	1600	F	9	02351	407E3C0F0E	
5-Sep-99	not translocated	460	1100	M	7	02352	407E470776	
5-Sep-99	not translocated	500	1750	F	5	02353	407E574379	S-shaped spine
6-Sep-99	not translocated	585	2200	F	6	02354	407E4D4206	
7-Sep-99	not translocated	570	1750	F	5	02355	407E304015	
9-Sep-99	not translocated	245		M	4			Untagged mort , found near trap, otoliths taken
10-Sep-99	not translocated	750		M	10	02356	407E3A1173	
10-Sep-99	not translocated	540		F	7	02357	407E460475	
10-Sep-99	not translocated	576		F	10	02358	407E375820	
10-Sep-99	not translocated	715		F	9	02359	407E4B4F12	
10-Sep-99	not translocated	630		F	8	02360	407E5A717F	
12-Sep-99	not translocated	685	2700	F	6	02361	407E323230	
12-Sep-99	not translocated	660	2700	F	7	02362	407E37197A	
13-Sep-99	not translocated	660	2800	F	7	02363	407E4D3F7D	
14-Sep-99	not translocated	628	1800	F	5	02364	407E3E2215	
14-Sep-99	not translocated	615	2150	M		02365	407E44200B	

Number of fish records = 92

Number of individual fish = 87

Number of fish translocated = 63

Mean length = 633 mm

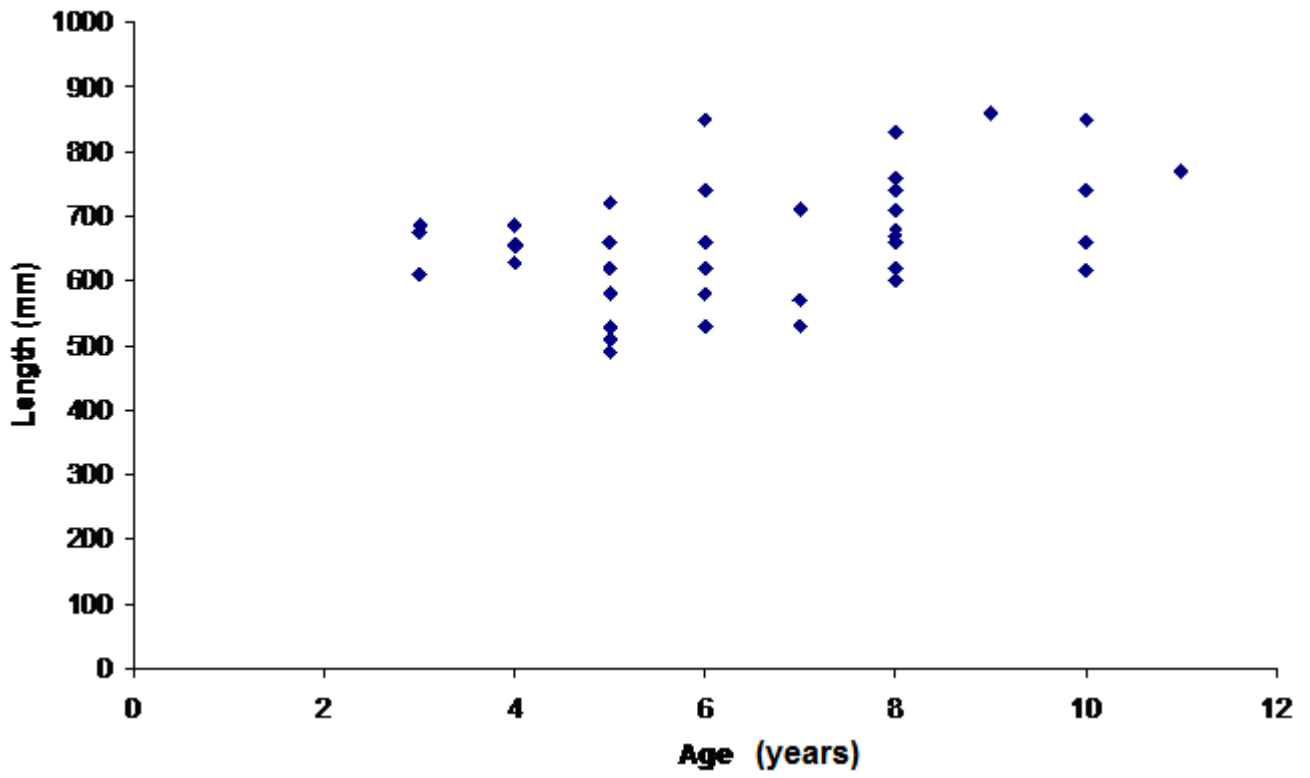
Mean weight = 2,793 g (rounded to 2,800 g)

Mean age = 7 years

Mode age = 7 year (most frequent age)

Sex Ratio = 36 male / 49 female (2 unknown)

Gething Creek translocated adult bull trout length at age



APPENDIX B
(Electrofishing summary and juvenile bull trout data)

Creek	Date	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7
Gething	June 1994			6 age-0 x=23 mm -				
	July 1994		12 age-0 x=35 mm 440 m ²					
	June 1995			14 age-1 x=89 mm -				
	Sept 1995		5 age-1 x=133 mm	3 age-1 x=124 mm -				
	July 1999	1 age-1 120 mm 1,600 m ²	14 age-1 x=114 mm 400 m ²	16 age-1 x=114 mm 350 m ²			0 bull trout - 180 m ²	
	Aug 2000		20 age-0 x=62 mm 222 m ²	26 age-0 x=57 mm 400 m ²				
	Oct 2000	0 bull trout - 1,050 m ²						
	July 2001	0 bull trout - 2,500 m ²	29 age-1 x=95 mm 4,200 m ²		8 age-1 x=103mm 4,200 m ²	0 bull trout - 5,000 m ²	0 bull trout - 2,450 m ²	0 bull trout - 1,200 m ²
	July 2002	4 age-2 x=184 mm 8,000 m ²		9 age-2 x=153 mm 1,360 m ²				
	Aug 2005	0 bull trout - 2,400 m ²	0 bull trout - 2,800 m ²	0 bull trout - 200 m ²		0 bull trout - 450 m ²	0 bull trout - 360 m ²	1 age-3 270 mm 600 m ²
Dowling	July 1999	1 age-0 43 mm 1,200 m ²						
	Aug 2000	0 bull trout - 935 m ²						
	July 2001	0 bull trout - 5,940 m ²						
	July 2002	0 bull trout - 7,175 m ²						
	Aug 2005	0 bull trout - 800 m ²						
Gaylard	Sept 1995	6-age 0 x=83 mm -	13-age 0 x=71 mm -	3 age-0 x=68 mm -				
	July 1999	0 bull trout - 2,100 m ²	0 bull trout - 875 m ²	0 bull trout - 750 m ²				
	Aug 2005	0 bull trout - 900 m ²	0 bull trout - 700 m ²					

Electrofishing sites

Gething Creek

- Site 1 10.05431.620375 Johnson Creek FSR bridge crossing
- Site 2 10.53747.620081 Recapture fish-fence location
- Site 3 10.05376.620046 Adult pre-spawn bull trout release site
- Site 4 10.05377.619983 Old cabin site approximately 500 m upstream of release site (site 3)
- Site 5 10.05349.619690 Hike-in location through cut block
- Site 6 10.05339.619640 Road crossing (ATV access only) of upper Gething Creek
- Site 7 10.05316.619526 400 m downstream of beaver dam at outlet of Wright Lake

Dowling Creek

- Site 1 10.05419.620236 Road end, approximately 1 km upstream of confluence with Gething C

Gaylard Creek

- Site1 10.54130.620727 Bridge crossing Table Creek FSR
- Site 2 10.53791.620740 Middle site between bridges
- Site 3 10.53707.620777 Bridge crossing Johnson Creek FSR at road km 51.5

