POPULATION BIOLOGY of BULL TROUT (*Salvelinus confluentus*) in the SAINT MARY RIVER DRAINAGE

A Progress Report

Based on Field Investigations Conducted in 1997-2001

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(Interagency Agreement 98-AA-60-11170)

June 2001

ACKNOWLEDGEMENTS

Many individuals and organizations contributed valuable assistance to the project. Paul Hutchinson, Brian Spicer, Jarvis Gust, Robbin Wagner, Glenn Boltz and Sue McNeal of the U.S. Fish and Wildlife Service (Service), volunteers Lisa Musgrave, Curt Wilcox, Wayne Wilcox, Nick Peterson, Jesse Skates and Jeremy Skates, and Ira Newbreast and Sam Juneau of the Blackfeet Tribe assisted in field investigations. Special thanks are given to the owners and staff of the Saint Mary KOA Campground. Thanks are also given to Glacier National Park, especially Bill Michels and Judy Kuncl, and the U.S. Bureau of Reclamation (Bureau), especially Rick Blaskovich, Dick Long, Sue Camp, Jerry Moore, and Leroy Grant. This project was funded by the Bureau (Interagency Agreement 98-AA-60-11170) and is a cooperative effort among the Blackfeet Tribe, Glacier National Park, the Bureau, and the Service.

COVER IMAGES

At center is St. Mary Lake; top, left to right, upstream view of St. Mary diversion dam and canal headgates, downstream view of St. Mary diversion dam, downstream view of canal headgates, downstream view of Sherburne Dam and outlet structure; bottom, left to right, electrofishing upper Otatso Creek, adult bull trout captured in the Boulder Creek fish trap, implanting radio transmitter into adult bull trout.

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INTRODUCTION

The bull trout (*Salvelinus confluentus*) is a char (i.e. Genus *Salvelinus*) that inhabits predominantly freshwater environments in western North America. The species is closely related to the Dolly Varden (*S. malma*), which occurs only as an anadromous life-history form (Cavender 1978; Haas and McPhail 1991) and sometimes sympatrically with bull trout (Leary and Allendorf 1997). The phylogenetic relation between bull trout and Dolly Varden is so close that these fish had been considered a single species until 1980 (Robins et al. 1980).

The historic range of bull trout extends from northern California and Nevada to the Northwest Territories, Canada, and encompasses Puget Sound and the major coastal river systems in Washington, British Columbia, and southeast Alaska. To the east, bull trout primarily inhabit the tributaries and lakes of the Columbia River basin, including headwater regions in Montana and Canada, and the Klamath River basin in Oregon. Periodic connections between headwater streams apparently allowed bull trout west of the Continental Divide to enter some drainages east of the divide until soon after the last glacial period (i.e. the Pleistocene Epoch), about 10,000 years ago. Consequently, bull trout also inhabit the upper Saskatchewan River basin, Montana and Alberta, and the MacKenzie River system in Alberta, British Columbia, and the Northwest Territories (Cavender 1978; Bond 1992; Brewin and Brewin 1997; Leary and Allendorf 1997; Nelson and Paetz 1992).

Like the young of other inland salmonid species, young bull trout in both streams and lakes are opportunistic feeders that prey primarily on invertebrate organisms. In contrast, adult bull trout are notably piscivorous, i.e. they feed almost exclusively on other fishes (Fraley and Shepard 1989; Donald and Alger 1993). Bull trout usually mature at 4 to 7 years of age and spawn entirely in streams, primarily small tributaries. Spawning occurs between late summer and early fall, when seasonal water temperatures decline to between 9 C and 5 C (Fraley and Shepard 1989; Goetz 1989).

Bull trout that live wholly in fresh water have been categorized into three life-history forms: *Resident* fish spend their lives entirely in the natal tributaries; *fluvial* fish spawn in small tributaries but their resulting young migrate downstream to larger rivers where they grow and mature; and *adfluvial* fish spawn in streams but their young migrate downstream to mature in

lakes. After they spawn in tributaries, both fluvial and adfluvial bull trout migrate back to the rivers or lakes. It is not known whether those life-history forms represent genetically distinct types of bull trout or simply opportunistic behaviors (Rieman and McIntyre 1993; McCart 1997). All three forms may occur in a single drainage. Because lakes and large rivers are often more productive than headwater streams, the adfluvial and fluvial bull trout that use those habitats usually attain larger size and, accordingly, exhibit a higher degree of piscivory than resident fish. An anadromous bull trout life-history form may also occur in coastal streams (McPhail and Baxter 1996).

Today, bull trout are extirpated in California, remain in one river system in Nevada, and have declined noticeably in many other areas of their historic range in the contiguous United States (*Federal Register* 64: 58909). That decline is generally attributed to adverse, human-caused modifications of the aquatic environment; population fragmentation resulting from the blockage of bull trout migration routes by dams and other barriers; competition or hybridization with introduced, nonnative fish species such as brook trout (*S. fontinalis*); and excessive harvest by anglers. The decline of bull trout led the U.S. Fish and Wildlife Service (Service) to formally list the species throughout its historic range in the contiguous United States as threatened, under the Federal Endangered Species Act, in 1999 (*Federal Register* 64: 58909).

In reaching its decision to list the species as threatened, the Service concluded that bull trout in the contiguous United States presently occur in five distinct population segments (DPSs) (*Federal Register* 64: 58909). One of those DPSs lies east of the Continental Divide, in the St. Mary-Belly River drainage of the upper Saskatchewan River basin, in Montana and Alberta. In that drainage, bull trout co-evolved with lake trout (*S. namaycush*) and westslope cutthroat trout (*Oncorhynchus clarki lewisi*), another fish that has shown an appreciable decline in population across its historic range.

The Service further identified four bull trout subpopulations that comprised the St. Mary-Belly River DPS (*Federal Register* 64: 58909), each of which inhabits a distinct region of the St. Mary River drainage. The Service assumed that each of those bull trout subpopulations was reproductively isolated from the other subpopulations. Furthermore, a bull trout subpopulations was considered at risk of extirpation from natural events if it: (1) was unlikely to be reestablished

by individuals from another subpopulation (i.e. the subpopulation was functionally or geographically isolated from other subpopulations); (2) limited to a single spawning area; (3) characterized by low numbers of individuals or spawning adults; or (4) consisted primarily of a single life-history form. The Service also noted, however, that historic information on bull trout in the St. Mary-Belly River DPS was largely anecdotal and contemporary information was meager.

The primary objectives of the study described here were to: (1) characterize the contemporary bull trout population in the St. Mary drainage of Montana, in particular the locations of spawning areas, the numbers of spawning adults, and extent that bull trout move among the waters of the drainage; (2) identify the factors that may be unduly limiting the population; and (3) recommend management actions to eliminate or ameliorate the effects of those factors. These objectives are closely tied to the factors that the Service believed made a bull trout subpopulation at risk of extirpation from natural events. Also as part of this study, the status of westslope cutthroat trout in the drainage was determined.

STUDY AREA

Aquatic Habitats

The St. Mary River originates at Gunsight Lake, in Glacier National Park, and flows northeast about 10 km before entering St. Mary Lake (Figure 1). Upon leaving the 15-km-long lake, the river flows onto the Blackfeet Reservation and continues northeast for about 2 km before entering Lower St. Mary Lake (9 km long). From that lake, the river meanders northerly about 25 km to the international boundary, then continues north through shrub-grassland habitat about 55 km to St. Mary Reservoir, a large, man-made impoundment. The St. Mary River that flows from the reservoir joins the Oldman River about 8 km upstream from Lethbridge, Alberta.

Several major tributaries, all of which head in Glacier National Park and flow principally through forested habitats, enter the St. Mary River (or its lakes) along its course (Figure 1). Although each of those tributaries differs in physical characteristics that may be important to fish, all have in common the frequent occurrence somewhere along their length of natural year-round or seasonal barriers to the movements of fish.

Rose Creek originates at Otokomi Lake and flows southeast about 7 km to the north shore of St. Mary Lake. Rose Creek contains diverse habitat for fish, but a 2-m-high concrete dam located 1 km upstream from its mouth blocks the upstream movement of fish.

Red Eagle Creek, a large tributary, originates from glacial melt near the Continental Divide and flows northeast about 13 km, over a series of waterfalls, to Red Eagle Lake. From the lake, the creek continues northeast about 8 km to the south shore of St. Mary Lake. Red Eagle Creek contains a diversity of habitats for fish.

Wild Creek originates as snowmelt and flows east about 7 km, cascading over cobble-boulder substrates and abundant woody debris before entering the river between the St. Mary lakes. A complex of logjams, waterfalls, and cascades begins about 3 km upstream from the St. Mary River and probably blocks farther upstream movement of fish in this small stream.

Divide Creek originates at a cluster of small alpine lakes and flows northeast about 15 km before entering the St. Mary River between the St. Mary lakes. The creek contains diverse habitat for

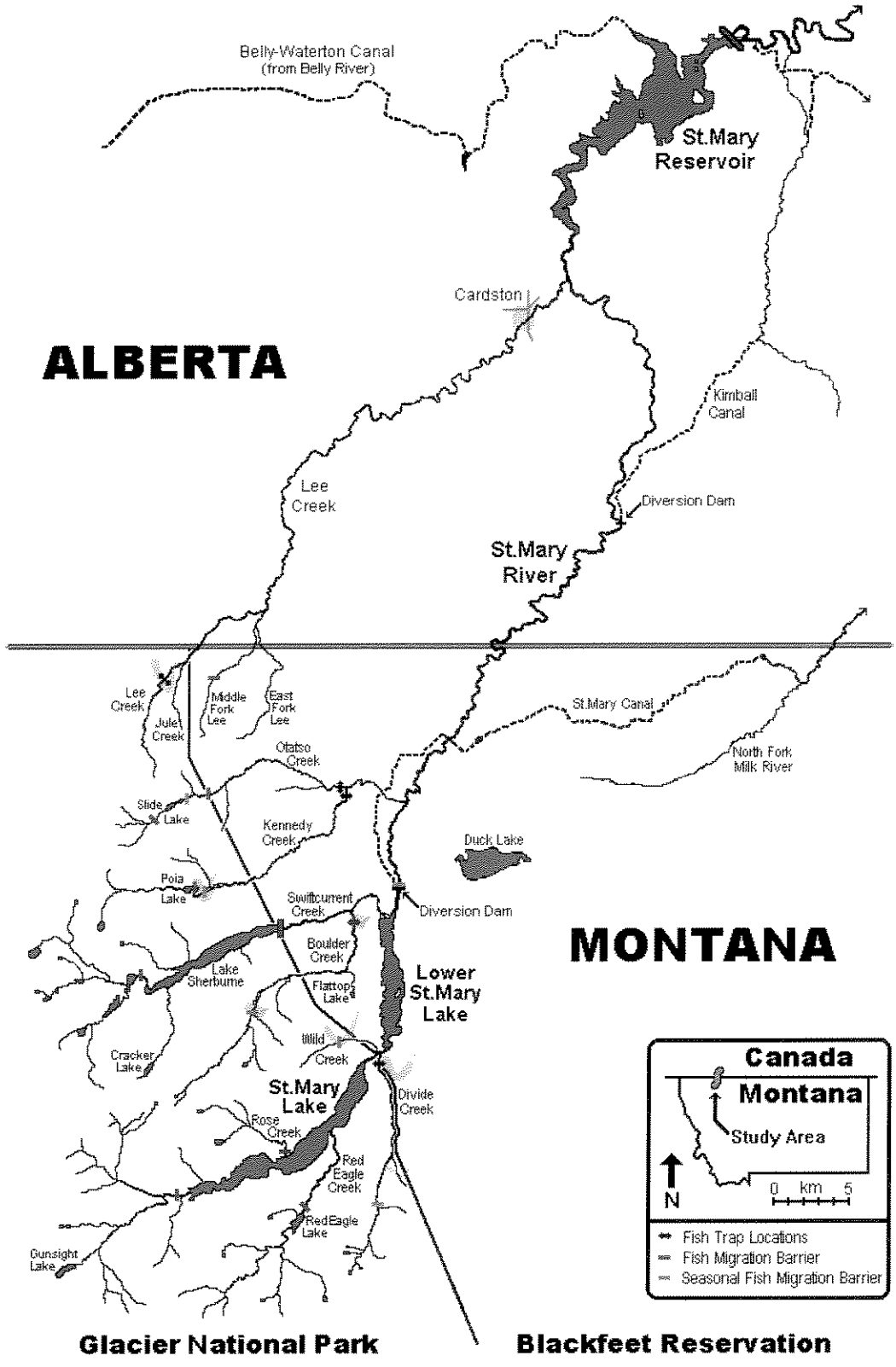

Figure 1. Study area, St. Mary River drainage, U.S. and Canada.

fish, including much woody debris and substrates dominated by cobble and boulders. About 11 km above the creek's confluence with the river, Divide Creek flows become entirely subsurface for a distance of about 200 m during the seasonal low-flow period. Downstream from that location, Divide Creek emerges as groundwater upwellings along a 1.5-km stretch of gravel-cobble alluvium.

Swiftcurrent Creek originates at a series of lakes near the Continental Divide and enters Lower St. Mary Lake near the lake outlet. About 1920, Swiftcurrent Creek was impounded by placement of a 33-m-high dam at the park boundary, thereby forming Lake Sherburne (Figure 1). That reservoir has a maximum surface area of 648 hectares and storage capacity of nearly 84 million cubic meters. Cracker Lake is drained by Canyon Creek, which flows north about 7 km, over a series of small waterfalls, before entering the upper end of Lake Sherburne.

Boulder Creek originates from snowmelt and flows northeast about 20 km before entering Swiftcurrent Creek, about 5 km above Lower St. Mary Lake. About 6 km upstream from the park boundary, Boulder Creek flows become entirely subsurface as they pass through gravel-cobble alluvium for about 400 m during low-flow periods in late summer. The creek then emerges as groundwater upwellings and flows through a 3-km, low-gradient stretch characterized by braided channels and abundant damming by beavers. Because Boulder Creek has exhibited notably large, seasonal flows, much of the channel in the creek's lower reaches is wide, braided, and has substrates consisting predominantly of boulders and other large materials.

Kennedy Creek originates at Kennedy Lake and flows northeast about 28 km before entering the St. Mary River about 8 km downstream from Lower St. Mary Lake. A 10-m-high waterfall occurs at the outlet of Poia Lake, about 5 km upstream from the park boundary on Kennedy Creek. Immediately downstream from Poia Lake, Kennedy Creek enters a high-gradient, boulder-strewn canyon. At the mouth of that canyon, about 0.7 km below the lake, the valley widens and the creek's gradient declines. In that stretch, Kennedy Creek disappears into the gravel-cobble alluvium during low-flow periods in late summer. About 300 m downstream, however, the creek emerges as groundwater upwellings and flows through a 1.5-km, low-gradient stretch characterized by braided channels and abundant beaver activity.

Otatso Creek originates at Otatso Lake and flows east about 18 km before entering Kennedy Creek, nearly 5 km above the St. Mary River. A large waterfall (50 m high) occurs in upper Otatso Creek, 15 km upstream from the confluence with Kennedy Creek. Two km downstream from the waterfall, Slide Lake is formed by a large landslide across Otatso Creek. Creek flows are entirely subsurface for nearly 100 m, i.e. while passing through the landslide, during all but seasonal high-flow periods. From that location, Otatso Creek continues downstream through a 2-km-long, high-gradient, boulder-strewn canyon before flowing over a second waterfall (3 m high) about 12 km above the confluence with Kennedy Creek and near the park boundary. Downstream from that waterfall, Otatso Creek enters a canyon that has exposed, highly erodible, shale walls that contribute substantially to the sediment load of the stream. Consequently, instream habitat in this lower reach is less diverse and most substrates are armored.

Lee Creek and its tributaries–Jule, Middle Fork Lee, and East Fork Lee creeks–drain the northern-most area of the St. Mary drainage in Montana. Lee Creek originates as snowmelt and flows north about 11 km before crossing the international boundary. It then meanders about 50 km through mostly shrub-grassland habitat of southern Alberta, before entering the St. Mary River near the town of Cardston.

The Belly River, not investigated in the present study, originates at Helen Lake near the Continental Divide in northeast Glacier National Park and drains the basin northwest of the St. Mary drainage. It flows north about 25 km to the international boundary, then continues about 175 km before entering the Oldman River in Alberta, about 35 km upstream from the confluence of the Oldman and St. Mary rivers.

Between 1914 and 1921, the U.S. Bureau of Reclamation (Bureau) built several water-control and delivery structures in the St. Mary River drainage, as part of the Milk River Irrigation Project. Among those structures is a diversion dam 1.2 km downstream from Lower St. Mary Lake. That dam, the St. Mary Diversion, diverts water into the St. Mary Canal, which conveys the water about 50 km–over the watershed divide and into Missouri River drainage–to the North Fork of the Milk River (Figure 1). In addition, Swiftcurrent Creek, which formerly flowed into the St. Mary River downstream from Lower St. Mary Lake, was diverted into the lake itself. That allowed water released from Lake Sherburne to be diverted into the St. Mary Canal.

Similar water-control and delivery structures have been built in Alberta (Figure 1). For example, a diversion dam about 20 km downstream from the international boundary diverts water from the St. Mary River into the Kimball Irrigation Canal. In addition, a canal system transfers water from the Waterton and Belly rivers east to the St. Mary River. Water is conveyed about 10 km to the Belly River from Waterton Reservoir, an impoundment on the Waterton River. One km downstream, a diversion dam on the Belly River diverts the water into another canal, which transfers the water about 40 km to St. Mary Reservoir.

Fish Species

The occurrence of natural, year-round barriers to the movements of fish, along with the stocking of nonnative fish species, have greatly influenced the historic and contemporary distributions of fishes in the St. Mary River drainage. Waters upstream from those year-round barriers that were historically barren of fish include the upper Red Eagle, Swiftcurrent, Kennedy and Otatso Creek watersheds, and the headwaters of the St. Mary River itself.

Among the fish species native to the drainage, bull trout, westslope cutthroat trout, and mountain whitefish (*Prosopium williamsoni*) are believed to have occurred naturally in all the streams and lakes of the St. Mary drainage to which they had access, while lake trout inhabited only the St. Mary and Lower St. Mary lakes. A degree of habitat partitioning between bull trout and lake trout may have resulted from competition between these highly piscivorous species (Fredenberg 1996; Donald and Alger 1993). Also indigenous to the drainage are northern pike (*Esox lucius*) and burbot (*Lota lota),* which inhabit the larger lakes, and white sucker (*Catostomus commersoni*), longnose sucker (*Catostomus catostomus*), lake chub (*Couesius plumbeus*), trout-perch (*Percopsis omiscomaycus*), longnose dace (*Rhinichthys cataractae*), pearl dace (*Semotilus margarita*), mottled sculpins (*Cottus bairdi*), and spoonhead sculpins (*Cottus ricei*), which inhabit many of the streams and lakes of the drainage to which the fish had natural access (Brown 1971).

Stocking of nonnative and native fishes in the St. Mary River drainage began in the late 1890s and continued in the park until the mid-twentieth century. Today, stocking of nonnative species

continues in some waters on tribal lands. Nonnative fishes that have established self-sustaining stocks within the St. Mary drainage include Yellowstone cutthroat trout (*O. clarki bouvieri*), rainbow trout (*O. mykiss*), and the intergrades (i.e. fish of various generations that have resulted from the interbreeding among F1 hybrids, their parent stocks, and subsequent backcross progeny) of those two fishes, as well as brook trout, kokanee (*O. nerka*), and lake whitefish (*Coregonus clupeaformis*). Brook, rainbow, Yellowstone cutthroat trout, and rainbow X Yellowstone intergrades inhabit Gunsight and Red Eagle lakes (Fredenberg 1996; Michels 1996); Yellowstone cutthroat trout occur in Flattop Lake, located at the head of a small nameless tributary to Boulder Creek (R. Wagner, Service, personal communication), and in Slide Lake, where they have apparently interbred with rainbow trout (Fredenberg 1996; Michels 1996); and rainbow trout, brook trout, and kokanee occur in Lake Sherburne, along with native mountain whitefish, burbot, northern pike, and suckers (Wagner and FitzGerald 1995; Fredenberg 1996). Upstream from Lake Sherburne, introduced rainbow and brook trout have established reproducing populations in the several lakes formerly barren of fish.

At least one self-sustaining stock of bull trout has also been established in formerly fishless waters in the St. Mary River drainage. Around the turn of the last century, bull trout are believed to have been introduced to Cracker Lake, where they persist today as an abundant population of slow-growing fish (Fredenberg 1996; Michels 1996).

Based on interviews with 29 senior citizens who had extensive angling experience in southwestern Alberta, Fitch (1997) concluded that the Oldman drainage retained an estimated 34% of its historic distribution of bull trout, largely due to minimal, adverse habitat changes in the headwaters, including Montana. He also concluded that bull trout in the St. Mary River in the 1920s and 1930s were abundant between the international border to Kimbal, Alberta, infrequently caught between Kimbal and the confluence with Lee Creek, and that the occurrence of bull trout farther downstream is entirely speculative.

Fitch (1997) considered it unlikely that a fluvial bull trout population persisted in the St. Mary River today. He believed that excessive harvest by anglers, related to improved human access to waters inhabited by bull trout in the 1970s, was an important factor in the decline of bull trout. In fact, no bull trout and few cutthroat trout were found during electrofishing surveys conducted

in the St. Mary River and its tributaries in 1993 and 1994 (Wagner and FitzGerald 1995). Fredenberg (1996) noted, however, that anglers still reported catching bull trout from the St. Mary River in Canada. Resident bull trout inhabit the Slide Lakes, and the stretch of Otatso Creek from the landslide downstream to the waterfall.

The westslope cutthroat trout may have never attained widespread abundance in the St. Mary River drainage (Marnell 1988; Marnell, NPS, *pers. comm.* 1999). Westslope cutthroat trout stocks that became established in the Glacier National Park part of the drainage probably maintained viable populations only in streams where they were secure from the highly predacious, native lake trout that subsequently and naturally colonized the St. Mary lakes. Today, westslope cutthroat trout survive only as isolated stocks in a few headwater streams along the park's east boundary (Marnell 1988).

METHODS

Electrofishing (1998-2000)

Electrofishing was used to characterize the fish communities and determine the status and distributions of bull trout and westslope cutthroat trout in Boulder, Kennedy, Otatso, Lee, Divide, and Wild creeks, and their tributaries. Sampling was conducted between mid-July and late August 1998-2000 (Table 1), when stream flows were generally low and waters were clear. Tributaries that appeared–upon inspection of their lower reaches–to be too small or to have gradients too high to support fish were not surveyed. Fish were captured using a Smith-Root battery-powered backpack electrofisher (Model 15-B) operated at 500-800 V and 25-30 Hz DC, depending upon the apparent efficacy of fish capture. Single electrofishing passes were made through each stream reach, and all cover types were sampled. No estimates of size of fish populations were made.

Captured fish were identified to species, counted, and marked with fin clips. Because the intergrades of rainbow and cutthroat trout can be difficult to distinguish from genetically pure parent stocks on the basis of external morphological characteristics evident in the field, data taken from all of these fishes were pooled except in those few cases where genetically pure westslope cutthroat trout were suspected. Total length (TL, mm) and weight (g) were measured and recorded for each captured trout. Scales from each bull trout, taken from an area slightly posterior to the dorsal fin and above the lateral line, were used in age and growth analyses. Bull trout longer than 200 mm TL were tagged. Passive integrated transponder (PIT) tags were injected into the dorsal musculature, directly below the dorsal fin. Samples of fin tissue were collected from most bull trout for subsequent biochemical-genetic analysis. In streams that had cutthroat trout suspected to be westslope cutthroat trout, five trout were sacrificed for subsequent biochemical-genetic analyses at the University of Montana Salmon and Trout Genetics Lab. A few samples of rainbow and brook trout were also collected for whirling disease analysis at the USFWS Fish Health Lab in Bozeman, MT.

Table 1. Dates and locations of fish trapping and electrofishing surveys in the St. Mary River drainage, Montana, 1997-2000.

	1997	1998	1999	2000
Boulder Creek				
Fish Trap	8/26 - 10/8	8/26 - 10/13	8/30 - 10/20	9/2 - 10/21
Electrofishing	---	7/28	8/23	7/17, 8/9, 8/23
Kennedy Creek				
Fish Trap	8/27 - 10/9	8/25 – 10/8	8/31 - 10/19	9/1 - 10/20
Electrofishing	---	7/15, 7/29, 8/12	7/26-27, 8/9, 8/25	7/12, 7/16, 7/26, 7/30, 8/8, 8/13, 8/25
Otatso Creek				
Fish Trap	8/27 - 10/9	8/25 – 10/8	8/31 - 10/19	9/1 - 10/20
Electrofishing				
Lower Otatso	---	---	8/6	7/28, 8/22
Upper Otatso	---	7/22-21	8/19-20	7/27, 8/11
Divide Creek				
Fish Trap	8/26 - 10/8	8/26 – 10/6	---	---
Electrofishing	---	7/8	8/5	---
Lee Creek				
Fish Trap	---	---	8/30 - 10/14	9/2 - 10/18
Electrofishing	---	8/18	7/24, 8/24	7/13, 7/15, 8/10, 8/24
Jule Creek				
Electrofishing	---	8/11	7/13	---
Middle Fork Lee Creek				
Electrofishing	---	8/11	7/13	---
East Fork Lee Creek				
Electrofishing	---	---	7/12	---
Roberts Creek				
Electrofishing	---	---	7/13	---
Wild Creek				
Electrofishing	---	7/27	7/23	---
Rose Creek				
Electrofishing	---	---	---	7/25

Fish Trapping (1997-2000)

Between about late August and mid-October, 1997-2000 (Table 1), fish traps were operated near the mouths of Boulder, Kennedy, Otatso, and Divide (1997 and 1998 only) creeks, and in Lee Creek near the international boundary (1999 and 2000 only), to collect information on bull trout departing these tributaries, ostensibly after spawning. Trapping on Lee Creek was substituted for that on Divide Creek because few bull trout were found in Divide Creek, whereas, in 1998, electrofishing revealed many large bull trout in Lee Creek. Throughout the trapping period, all traps were cleaned and checked at least daily according to the protocol described in Appendix A. Traps were removed after the downstream movements of bull trout appeared to have ended or weather and related conditions precluded further sampling. Fish captured in the traps were processed as described earlier for electrofishing, except that in 1997 fish were tagged with visual implant (VI) tags that were injected subcutaneously, just posterior to the left eye.

Traps, designed to capture adult bull trout and other downstream-moving fishes, consisted of boxes with weir wings that spanned the entire stream width (5-12 m). Boxes (1.0 m long, 1.0 m wide, and 1.0 m high) had frames made of steel tubing, 1.3-cm mesh galvanized hardware screen walls and bottoms, and hinged plywood lids secured with padlocks. Vexar® (i.e. rubber-coated hardware screen) funnels were fastened to the trap entrances. Weir wings, attached at the trap entrances and angled upstream to opposing streambanks, directed fish into traps and prevented fish movement around the traps. Wings consisted of 1.2-m lengths of 1.3-cm aluminum conduit, spaced at 2.5-cm intervals, and cabled together to form a "picket fence." Steel fence posts driven into the stream bottom supported the wings. The 2.5-cm interval between pickets was chosen to minimize the collection of debris while prohibiting the passage of large fish.

Water temperatures were recorded bi-hourly between late August and mid-October using Onset Optic StowAway® data-loggers installed at each trap site (Figure 1), and in Swiftcurrent Creek (West Shore Road Bridge; 1997-1998) and the St. Mary River (Bureau's Camp Nine Bridge; 1999-2000).

Radio Telemetry (1998-2001)

Radio telemetry was used to obtain information on bull trout home ranges and the relations between wintering and spawning habitats. Altogether, 29 adult bull trout (>1250 g) captured in the traps in 1998 (4 fish in Boulder, 6 in Kennedy, and 3 in Otatso creeks), 1999 (3 fish in Boulder, 3 in Kennedy, and 1 in Otatso creeks), and 2000 (4 fish in Boulder, 1 in Kennedy, 1 in Otatso, and 1 in Lee creeks) were surgically implanted with radio transmitters that had battery lives rated at 400 d. Transmitters had external whip antennas, emitted unique signals in the 30 MHz range, weighed about 25 g, and did not exceed 2% of recipient fish weight in air. Fish selected for surgical implantation of transmitters were anesthetized with MS-222 (tricaine methanesulfonate). Transmitters were then inserted internally through a 20-mm, longitudinal incision made anterior to the left pelvic fin, about 10 mm from the mid-ventral line. We used an angiocath (12GA), and a modified shielded-needle technique similar to that of Ross and Kleiner (1982), to make an outlet for the external antennae about 20 mm posterior and slightly caudal to the left pelvic fin base. Incisions were closed with four or five sutures (3-0 Ethilon®, non-absorbable, nylon monofilament, Ethicon Corp.). Each surgery lasted 6-10 minutes (mean, 7 min), during which time the fish's gills were continuously irrigated with water and anesthetic. Beginning about 1 minute before surgery completion, fresh water alone was used to begin the recovery process. Radiotagged bull trout were released downstream from the traps as soon as they had recovered from anesthesia.

Searches for radiotagged fish were conducted from the ground and from aircraft, as well as from stationary receiving stations. Because we were primarily interested in determining the relations between wintering and spawning areas used by the tagged bull trout, we focused our active searches for radiotagged fish on two periods, mid-winter and the spawning.

An ATS Model 2100 programmable receiver, equipped with a directional loop antenna, was used to track radiotagged fish. The receiver scanned sequentially for signals from each of the deployed transmitters. Ground-based searches were conducted from trucks or ATVs, but only about half of the St. Mary River corridor in Montana is accessible with those vehicles and much less in Canada. Aerial tracking was conducted from a fixed-wing aircraft (Cessna 185) that had a loop antenna attached to each wing strut and flew 90-120 km/hr, about 100 m above the water

surface. Although frequent high winds in the St. Mary River drainage often precluded aerial searches, when flights were possible the river corridor was usually flown in both downstream and upstream directions. Locations of the tagged fish, i.e. the locations of maximum signal strength, were recorded on topographic maps.

In addition, ATS Model DCC II data loggers, operated in concert with receivers and antennae of the aforementioned types, were established as stationary, continuously operated receiving stations at three locations along the river (Figure 1). Because our active searches for radiotagged fish were largely restricted to the winter and spawning periods, data recorded by the stationary stations provided information on the timing of fish movements along the river. The first station was installed in January 1999 at the Bureau Camp Nine Compound, about 17 km downstream from Lower St. Mary Lake. That station's antenna was fastened atop the shop building, about 30 m from and 20 m above the river. The second station was installed in January 2000 at the international boundary, on the Cooke Ranch, about 11 km downstream from the first station and 28 km downstream from Lower St. Mary Lake. That station's antenna was fastened atop a ranch shed, 10 m from and 10 m above the river. The third station was installed in June 2000 at the St. Mary diversion dam, near the outlet of Lower Saint Mary Lake. That station's antenna was fastened atop a post, directly above the canal headgates, 5 m above the river. At each location, the loop antenna was directed at nearby river pools that may provide resting habitat for migrating bull trout. The receiving stations operated constantly and scanned sequentially (5 s per frequency per cycle) for each of the deployed radio transmitters.

Because electronic interference (which occurred primarily during normal work-day hours and probably resulted largely from machinery and other motorized equipment) could not be completely tuned out and sometimes resulted in the logging of erroneous contacts by the stationary receivers, only records of tagged bull trout for which at least five consecutive contacts occurred outside the period of interference were considered reliable. Contacts that met that criterion were then compared to records for nearby frequencies at that location to assure that they did not also show the pattern of contacts. If similar patterns were evident among the nearby frequencies, the presumed contact with the tagged bull trout was considered unreliable and excluded from further analyses.

Saint Mary Canal Gillnetting and Seining in Sherburne Dam (1999)

Gillnetting was conducted in the St. Mary Canal during mid-October 1999 to assess fish loss to the canal system. Experimental gill nets were set after the irrigation season had ended and canal flows were substantially reduced. Nets were set in slow-moving water at various locations along the canal between the headgates and the Kennedy Creek crossing, including the pool directly below the headgates, bay-like backwaters, and several straight, deep-water reaches along the canal. Water depths at sampling locations ranged from about 0.5 to 1.5 m. In addition, the two outlet tunnels in Sherburne Dam were seined on 28 September, while the dam was closed and the water in the tunnels had been drawn down for dam repairs.

Redd Surveys (1997-2000)

The abundance of bull trout redds has been used to monitor trends in several bull trout populations (Rieman and Myers 1997). We began redd surveys in Boulder, Kennedy, Otatso and Divide creeks in 1997. Surveys were conducted as described by Spalding (1997), primarily during mid-October. The 2-4 person survey crew walked along each stream and searched for redds, proceeding upstream until a barrier to the upstream movement of fish was encountered. Validity of potential redds was decided by consensus among crew members. Brief descriptions of redds and spawning areas were recorded, and redd locations were marked on topographic maps. In 1997, surveys were made of all likely spawning habitats in each creek to establish index areas for subsequent annual surveys. In 1998-2000, however, only the spawning areas found in 1997 were surveyed for redds. Because no bull trout were found in Divide Creek, that stream was surveyed only in 1997.

RESULTS

Electrofishing Surveys

Electrofishing surveys conducted along Boulder Creek, from a location 2 km downstream of the Glacier National Park boundary to a point 8 km upstream of the boundary (Table 1), revealed bull trout (43-725 mm total length), cutthroat × rainbow intergrades (85-458 mm TL), brook trout (87-238 mm TL), and mountain whitefish (Figure 2 and Appendix B, Tables 10-12). Many large (>400 mm TL) adult bull trout were captured just downstream from the stretch of entirely subsurface flow (i.e. about 6 km upstream from the park boundary). One of the 12 (8%) adult bull trout caught in 1998, 8 of the 10 (80%) adult bull trout caught in 1999, and 13 of the 23 (57%) adult bull trout caught in 2000 had been captured and tagged in previous years. The region of subsurface flow is apparently only a seasonal barrier to fish movement because each species of fish found downstream in Boulder Creek was also captured upstream from the barrier. Two tributaries to upper Boulder Creek (entering from the east) were also electrofished on 23 August 2000. Small bull trout (<200 mm TL) and cutthroat trout were found in the lower reaches of those streams. The remainder of the tributaries appeared too small or too high-gradient to support fish, and were not electrofished.

The entire length of Kennedy Creek, i.e. from its mouth to the waterfall at the outlet of Poia Lake, was surveyed (Table 1). Bull trout (range, 44-725 mm TL), cutthroat × rainbow trout intergrades (100-450 mm TL), brook trout (92-284 mm TL), and mountain whitefish were captured from this lower stretch (Figure 2 and Appendix B, Tables 13-15). No fish were encountered upstream from the waterfall. Many large adult bull trout (>400 mm TL) were captured from a 4-km stretch of Kennedy Creek located near the park boundary, about 5 km downstream from the known bull trout spawning area. Seven of the 22 (32%) adult bull trout caught in 1998, 9 of the 22 (41%) adult bull trout captured in 1999, and 19 of the 39 (49%) adult bull trout caught in 2000 had been captured and tagged in previous years. About 3 km upstream from the Park boundary, a tributary enters Kennedy Creek from the north and appeared large enough to support fish; however, a large waterfall (20 m high) near the tributary's mouth prohibits fish passage upstream. All other tributaries to Kennedy Creek appeared too small or too high-gradient to support fish, and were not electrofished.

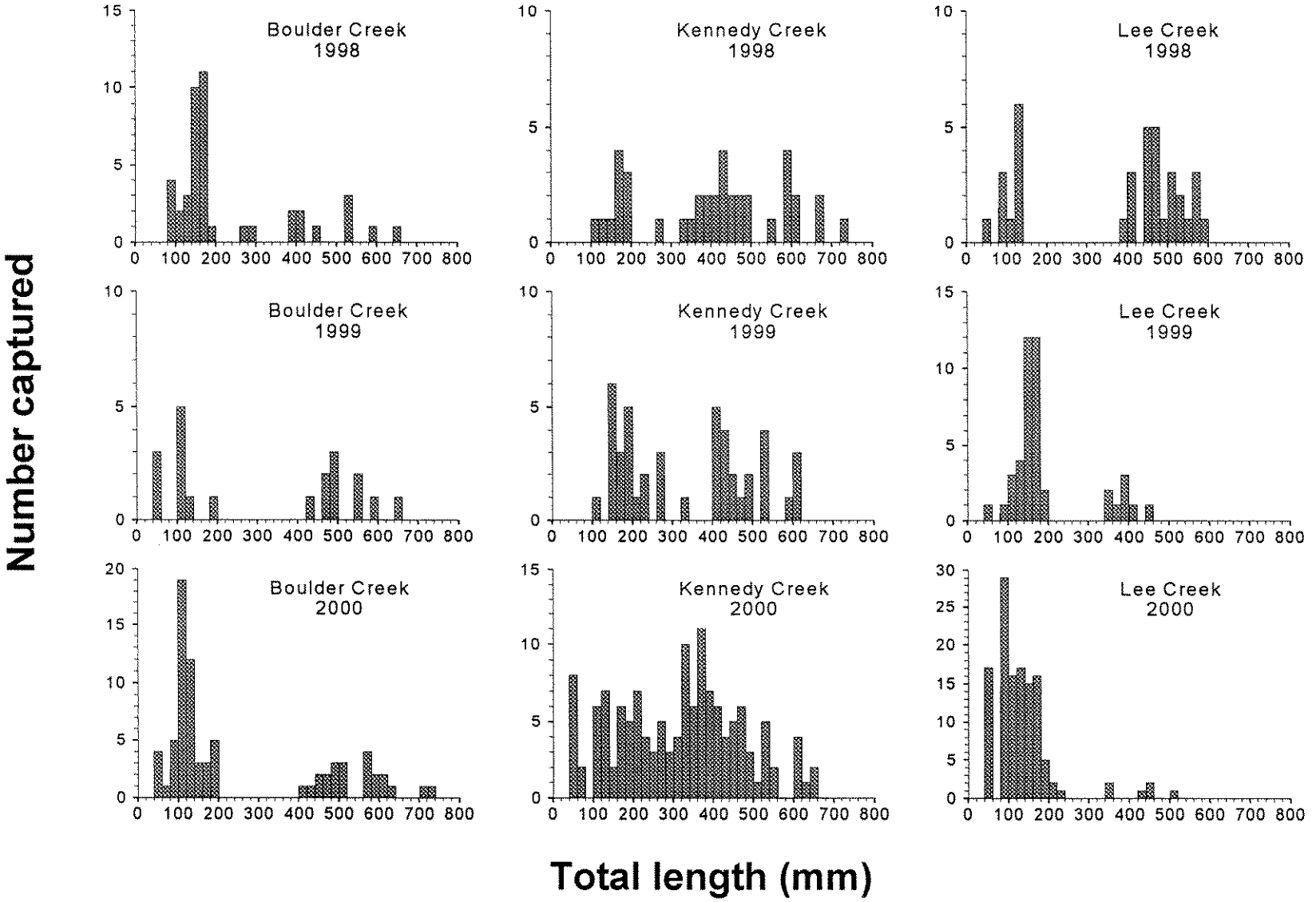

Figure 2. Length-frequency distributions for bull trout captured during electrofishing surveys in Boulder, Kennedy and Lee Creeks, St. Mary River drainage, Montana, 1998-2000.

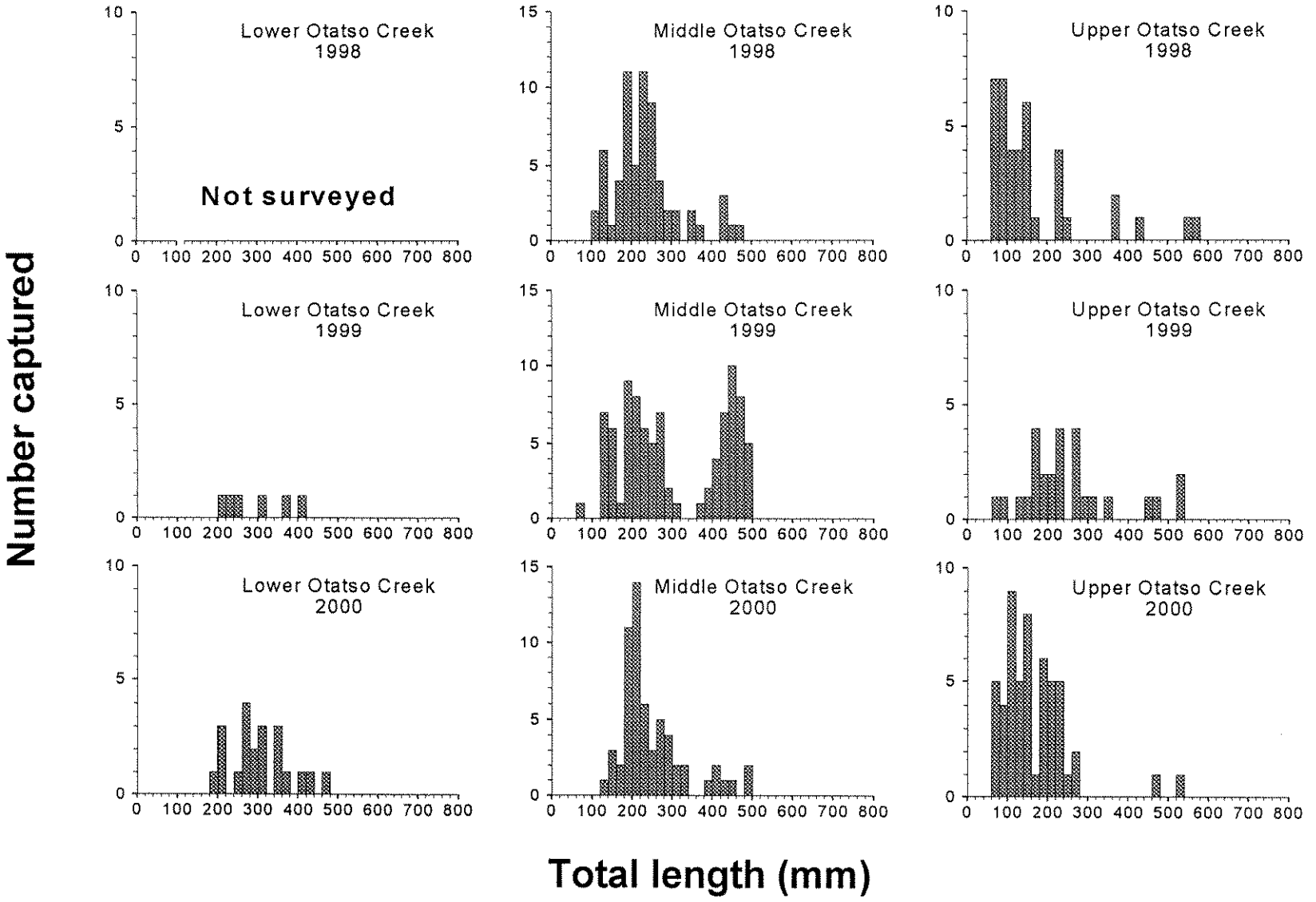

Figure 3. Length-frequency distributions for bull trout captured during electrofishing surveys in the Otatso Creek drainage, St. Mary River drainage, Montana, 1998-2000.

Lee Creek was surveyed at several locations upstream from the Chief Mountain Highway, in northeast Glacier National Park (Table 1). Bull trout (49-592 mm TL), cutthroat × rainbow intergrades (70-382 mm TL), and mountain whitefish were captured (Figure 2 and Appendix B, Tables 23-24). None of the 25 adult bull trout caught in 1998, none of the 8 adult bull trout captured in 1999, and 1 of the 6 (17%) adult bull trout caught in 2000 had been captured and tagged in previous years.

Otatso Creek was surveyed at several locations downstream from the waterfall near the park line (Table 1). In this lower stretch, bull trout (180-463 mm TL), cutthroat × rainbow intergrades (76-322 mm TL), and mountain whitefish were captured (Figure 3 and Appendix B, Tables 16 & 17). None of the 3 adult bull trout caught in 1999 and none of the 10 adult bull trout caught in 2000 had been captured and tagged in previous years. Two tributaries enter lower Otatso Creek from the south, one near the park boundary and the other near the confluence with Kennedy Creek. Although both streams appeared large enough to support fish, no fish were encountered during electrofishing surveys. About 3 km upstream from the waterfall, a large landslide across Otatso Creek is a barrier to fish movement during the period of seasonal low flows. In the stretch of Otatso Creek between the waterfall and the landslide, abundant, resident bull trout (69-493 mm TL) were found along with few cutthroat × rainbow trout intergrades (105-382 mm TL) and mountain whitefish (Figure 3 and Appendix B, Tables 18-20). In this middle stretch of Otatso Creek, none of the 10 adult bull trout caught in 1998, 2 of the 38 (5%) adult bull trout captured in 1999, and 3 of the 11 (27%) adult bull trout caught in 2000 had been captured and tagged in previous years. Slide Lakes, formed upstream from the landslide, support resident populations of bull trout and cutthroat × rainbow intergrades. Otatso Creek is fishless above a large waterfall (50 m high), about 1 km upstream from the lakes. Bull trout (62-572 mm TL) and cutthroat × rainbow intergrades (105-341 mm TL) were captured between the waterfall and the lakes, and in the 200-m stretch between the two lakes (Figure 3 and Appendix B, Tables 21 & 22). In the upper reaches of Otatso Creek, none of the 5 adult bull trout caught in 1998, none of the 6 adult bull trout captured in 1999, and neither of the 2 adult bull trout caught in 2000 had been captured and tagged in previous years.

Jule, Middle Fork Lee, and East Fork Lee creeks (the small tributaries of Lee Creek) and Roberts Creek (small tributary of the St. Mary River), were surveyed both upstream and downstream from their crossings with the Chief Mountain International Highway (Table 1). The lower 4 km of Jule Creek, entirely within Glacier Park, provides summer habitat for juvenile bull trout (89-148 mm TL) and cutthroat × rainbow intergrades (63-195 mm TL) (Appendix B, Table 26 and Figure 12). Middle Fork Lee Creek is highly impacted by human activities. Streamside grazing and logging result in heavy silt loads and turbidities in the creek, and an elevated highway culvert is a barrier (2-m waterfall) to the upstream movement of fish. Upstream from the culvert, no fish were captured from a 200-m reach, whereas two bull trout (175-235 mm TL) and several cutthroat × rainbow intergrades (115-234 mm TL) were captured from a 500-m reach downstream from the culvert (Appendix B, Table 27 and Figure 11). Although similarly impacted by grazing and logging, East Fork Lee Creek supports a population of small cutthroat trout (96-217 mm TL) of unknown genetic characteristics (Appendix B, Table 28). Five cutthroat trout (98-177 mm; unknown genetic characteristics) were captured from a pool below the highway culvert on Roberts Creek, a stream too small to shock effectively (Appendix B, Table 28).

Wild Creek was surveyed at several locations along a 2-km stretch near the park boundary (Table 1). The creek appears to be barren of fish in its upper reach, upstream from a series of temporary barriers (small logjam-waterfall-cascade complexes) about 1 km upstream from the park boundary. The middle reach of Wild Creek (immediately downstream from the barriers) supports a population of small (55-197 mm TL) cutthroat trout (Appendix B, Table 29 Figure 12). Although fish of no other species were captured from that middle reach, 1.5 km downstream, near the creek's confluence with the St. Mary River, small rainbow and brook trout were found. A sample (N=13) of cutthroat trout collected from the middle reach of Wild Creek in 1998 was subsequently determined to consist of genetically pure westslope cutthroat trout. Among all the cutthroat trout examined in the field, the fish in this sample, and those captured from two tributaries to Boulder Creek, had morphological characteristics most like those of westslope cutthroat trout. All other cutthroat trout were considered intergrades on the basis of phenotypic characteristics. Samples of cutthroat trout from the Boulder Creek tributaries are presently undergoing biochemical-genetic analysis.

The upper Divide Creek drainage was surveyed at several locations within Glacier National Park, from its head to the park boundary (Table 1). No bull trout and only two cutthroat trout (80 and 220 mm TL) were captured. Both cutthroat trout were captured just inside the park boundary. Lower Divide Creek was surveyed at several locations along a stretch from its mouth to the park boundary (Table 1). The few fish (Appendix B, Table 30) encountered were cutthroat × rainbow intergrades (69–186 mm TL) and mountain whitefish. Although no clear barriers to the upstream movement of fish were encountered in Divide Creek itself, high-gradient cascades probably prohibit fish passage into the few small tributaries of Divide Creek.

Rose Creek was surveyed at several locations along a stretch from its mouth to 2 km upstream (Table 1). The stream appears to be barren of fish in its upper reaches, upstream from a permanent barrier (2-m-high concrete dam, apparently abandoned) about 1 km upstream from its mouth. No fish were found upstream from the barrier, but cutthroat × rainbow intergrades (68–252 mm TL), brook trout (230 mm TL), and mountain whitefish were found downstream (Appendix B, Table 31).

Fish Trapping

Stream Temperatures

Stream temperatures during the trapping periods were warmest in 1998 and coolest in 1999 (Figure 4). Although seasonal temperature trends were similar between the five study streams, Kennedy Creek generally exhibited the warmest temperatures among years, followed by Otatso, Boulder, Divide, and Lee Creek, respectively. Mean-daily temperatures of Swiftcurrent Creek in 1997 and 1998 and the St. Mary River in 1999 and 2000 were appreciably higher than concurrent temperatures of the other streams during most of the trapping periods.

Captured Fish

Throughout most of the annual trapping periods, weather conditions were mild and stream flows were clear and generally stable, resulting in nearly ideal trapping conditions. Exceptions occurred late in 1999 and 2000, when high winds and frequent rains resulted in high flows and unusually high loads of aspen (*Populus tremuloides*) leaves in the streams. Leaves frequently clogged the weirs, causing daily "blowouts" at all locations and allowing unknown

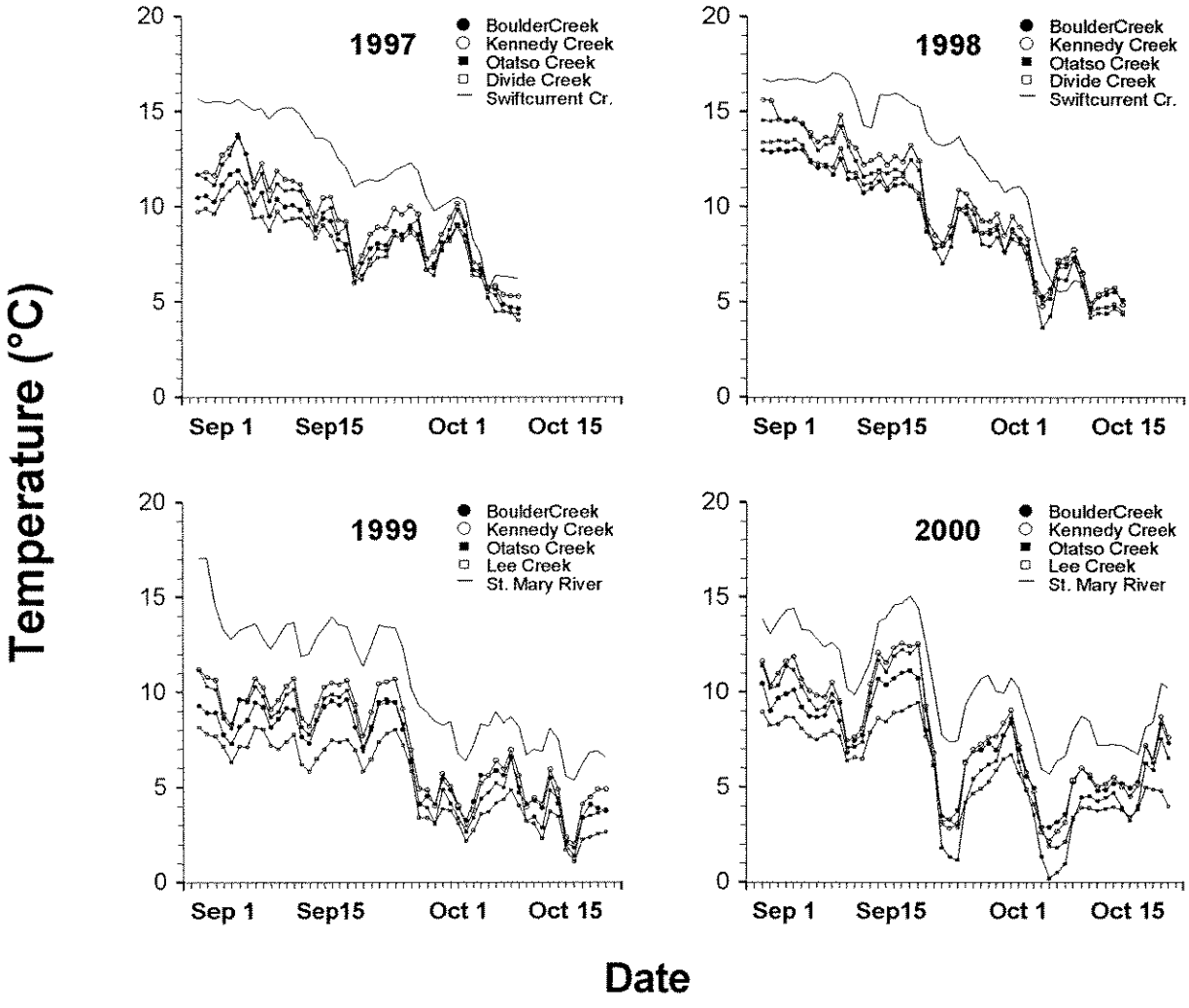

Figure 4. Mean-daily temperatures (°C) of Boulder, Kennedy and Otatso creeks, August-October, 1997-2000; Divide and Swiftcurrent creeks, August-October, 1997-98; and Lee Creek and the St. Mary River near Camp Nine, August-October, 1999, St. Mary drainage, Montana.

numbers of fish to pass around traps. Lesser problems included periodic overcrowding of fish in the traps and mink predation, which resulted in the loss of several whitefish, cutthroat trout, and eight bull trout. Mink traps set at the sites captured one mink in 1997, seven in 1998, none in 1999, and 2 in 2000.

Bull trout were captured in each of the traps annually between 1997 and 2000, except in the Divide Creek trap in 1998. Altogether, 691 salmonids were caught in 1997, 787 in 1998, 548 in

1999, and 440 in 2000 (Table 2 and Appendix C Tables 32-46). In addition to adult bull trout, appreciable numbers of small bull trout and small fish of other species were captured in traps. Native fish species caught were bull trout, cutthroat trout, mountain whitefish, white suckers, mountain suckers, longnose suckers, longnose dace, and sculpins. Nonnative fish included rainbow trout, cutthroat × rainbow intergrades, and brook trout.

Total annual captures of bull trout and other fish species in the Boulder, Kennedy, and Otatso Creek traps varied markedly among years (Table 2). Altogether, 166 bull trout (130-763 mm TL) were captured in the fish traps in 2000, compared to 194 (137-695 mm TL) in 1999, 167 (160-690 mm TL) in 1998, and 99 (156-720 mm TL) in 1997. Mountain whitefish dominated the catch in all years, followed by bull trout which accounted for 15% of the total catch in 1997, 21% in 1998, 35% in 1999 and 37% in 2000, and CTT × RBT intergrades (12% in 1997, 6% in 1998, 12% in 1999, and 18% in 2000). Brook trout were only captured in the Boulder (2 in 1998 and 1 in 1999) and Divide (1 in 1997) Creek traps. In all years, the Otatso Creek trap yielded the largest overall catch (mainly mountain whitefish); however, most large (>30 cm TL) bull trout were captured in the Kennedy trap in 1997 (48%) and in the Boulder trap in 1998 (53%), 1999 (32%) and 2000 (48%). The largest samples of juvenile (<30 cm TL) bull trout were captured in the Boulder trap in 1997 and 1998 and in the Lee Creek trap in 1999 and 2000. Total numbers and means and ranges in total lengths and weights for bull trout captured in traps are presented in Table 3. Although adult bull trout (> 30 cm TL) were captured shortly after the traps were installed in all years, most were captured after mid-September (Figure 5).

Total lengths of all bull trout (N=626) captured in the fish traps averaged 332 mm (range, 130-763 mm) during the four years of trapping. Adults averaged 495 mm (304-720 mm TL) in 1997, 470 mm (307-690 mm TL) in 1998, 479mm (321-695 mm TL) in 1999 and 470 mm (335-763 mm TL) in 2000. Length-frequency distributions for all bull trout captured in the Boulder, Kennedy, Otatso, Divide and Lee Creek traps are displayed in Figure 6.

Table 2. Total numbers of salmonid fishes captured in fish traps, St. Mary River drainage, Montana, 1997-2000.

Trap Site	Juvenile Bull Trout (<30 cm TL)				Adult Bull Trout (>30 cm TL)				Totals			
	1997	1998	1999	2000	1997	1998	1999	2000	1997	1998	1999	2000
Boulder	30	23	36	31	17	64	23	23	47	87	59	54
Kennedy	1	6	10	2	32	38	20	9	33	44	30	11
Otatso	1	17	6	1	16	19	11	12	17	36	17	13
Lee	--	--	69	84	--	--	19	4	--	--	88	88
Divide	0	0	--	--	2	0	--	--	2	0	--	--
Totals	32	46	121	118	67	121	73	48	99	167	194	166

Trap Site	Cutthroat × Rainbow				Brook Trout				Mountain Whitefish			
	1997	1998	1999	2000	1997	1998	1999	2000	1997	1998	1999	2000
Boulder	27	15	26	12	0	2	1	0	63	132	49	43
Kennedy	13	6	7	5	0	0	0	0	181	147	82	36
Otatso	16	19	15	9	0	0	0	0	220	278	152	120
Lee	--	--	19	56	--	--	0	0	--	--	3	3
Divide	27	3	--	--	1	0	--	--	44	18	--	--
Totals	83	43	67	82	1	2	1	0	508	575	286	202

Table 3. Total numbers and means and ranges in total lengths (TL) and weights for bull trout captured in the Boulder, Kennedy, Otatso, and Lee Creek fish traps, St. Mary River drainage, Montana, 1997-2000.

Trap Site, Variable	Juvenile Bull Trout (<30 cm)				Adult Bull Trout (>30 cm)			
	1997	1998	1999	2000	1997	1998	1999	2000
Boulder Creek								
Total Number	30	23	36	31	17	64	23	23
Mean TL (mm)	211	183	180	186	494	493	538	500
Range	178-255	163-235	158-216	162-222	416-586	311-690	389-695	346-763
Mean Weight (g)	81	47	47	53	1048	1121	1532	1255
Range	44-144	24-104	32-86	36-88	654-1650	306-2678	582-3220	310-3754
Kennedy Creek								
Total Number	1	6	10	2	32	38	20	9
Mean TL (mm)	156	230	189	249	513	442	478	485
Range	---	190-279	145-213	222-275	356-720	316-650	361-603	340-633
Mean Weight (g)	26	107	59	158	1172	808	968	1187
Range	---	52-200	26-86	116-200	406-2504	256-2236	430-1700	306-2230
Otatso Creek								
Total Number	1	17	6	1	16	19	11	12
Mean TL (mm)	196	203	207	217	463	448	441	417
Range	---	166-291	185-246	---	304-617	307-615	321-531	335-660
Mean Weight (g)	58	75	72	94	840	829	779	726
Range	---	34-246	46-120	---	234-1720	298-2108	288-1272	314-2312
Lee Creek								
Total Number			69	84			19	4
Mean TL (mm)			184	193			432	427
Range			137-289	130-272			358-580	335-606
Mean Weight (g)			53	64			720	636
Range			20-190	20-196			358-1710	276-1418

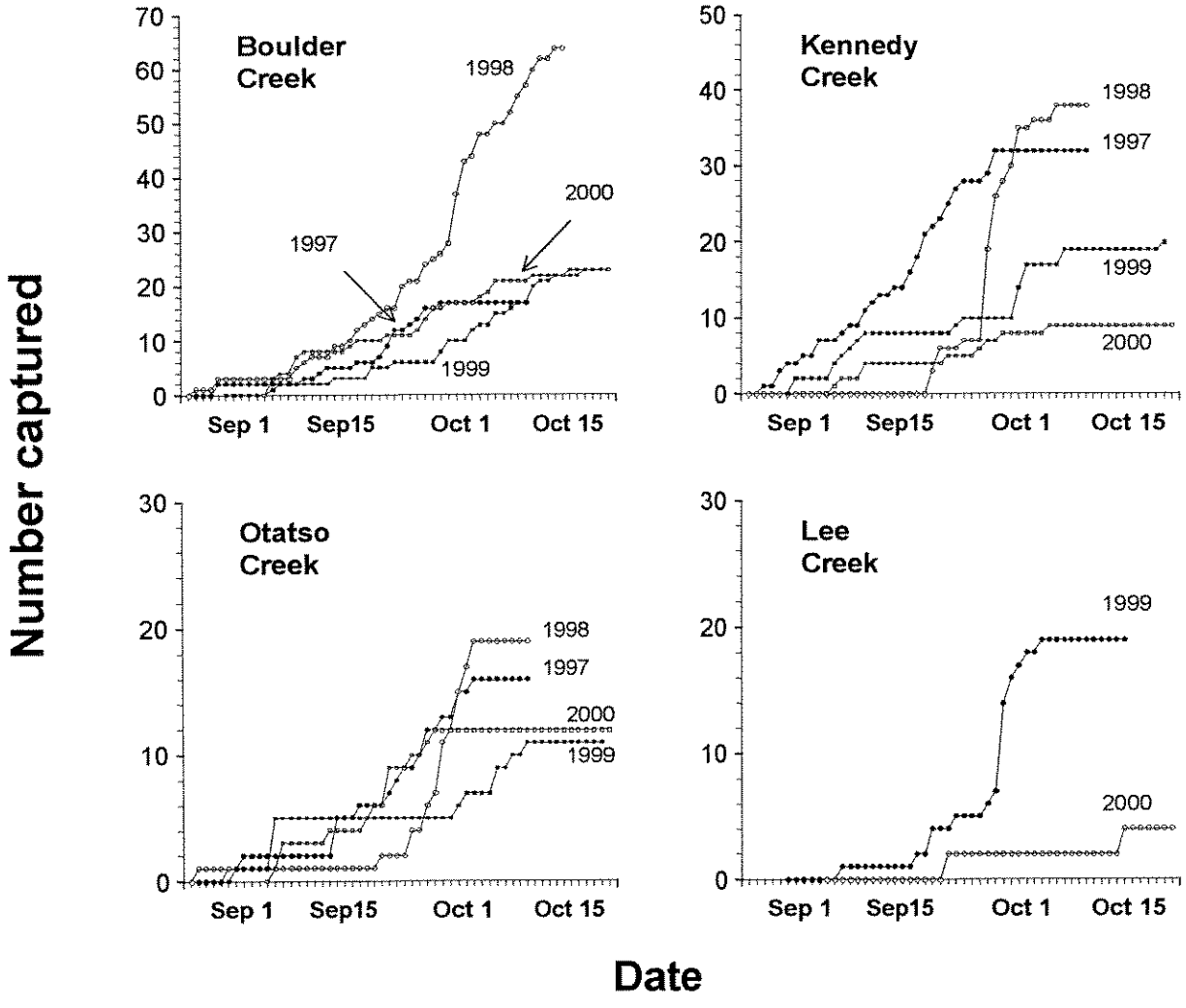

Figure 5. Cumulative catches of adult bull trout (> 30 cm TL) in the Boulder, Kennedy, Otatso, and Lee creek fish traps, St. Mary River drainage, Montana, August-October, 1997-2000.

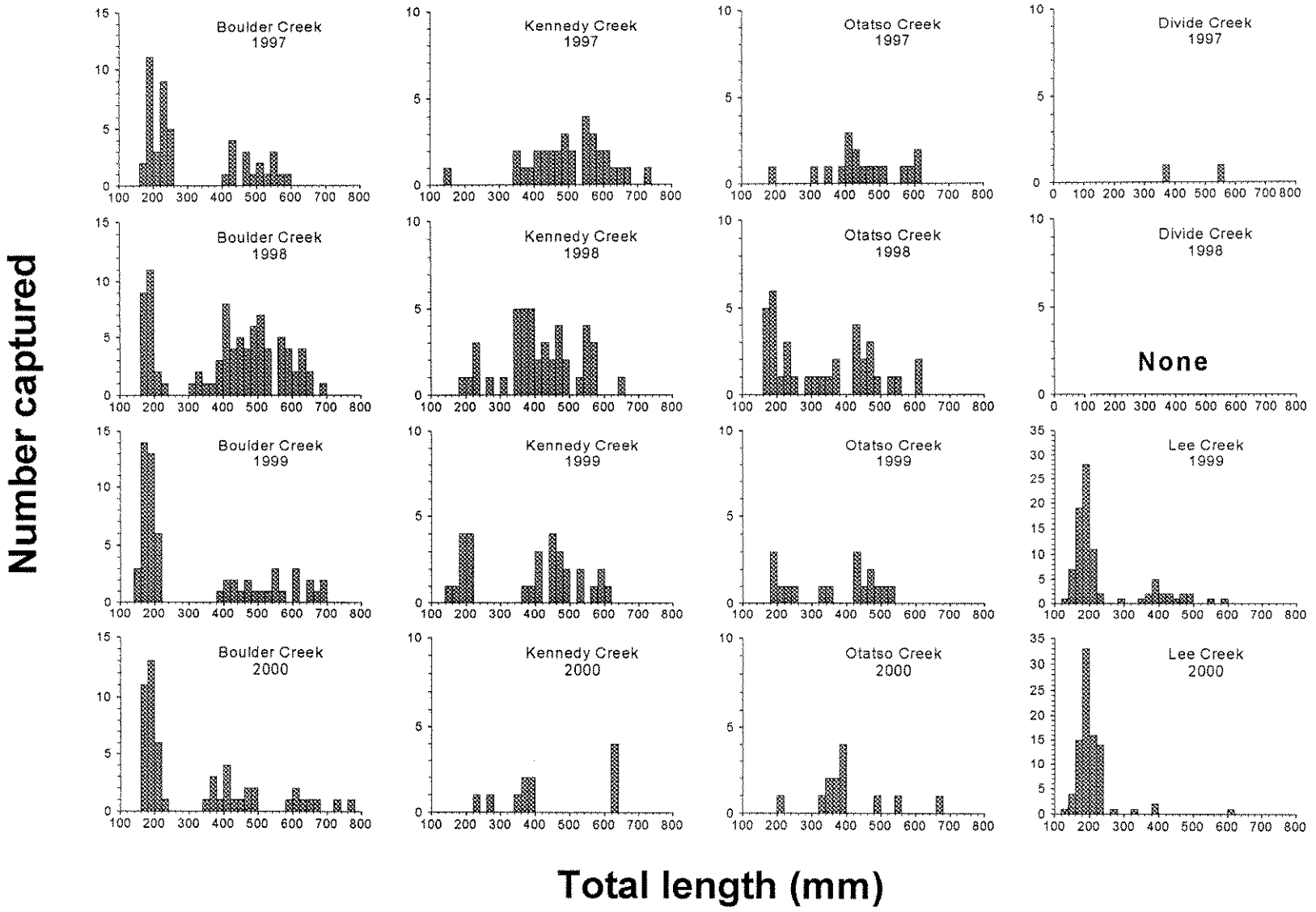

Figure 6. Length-frequency distributions for bull trout captured in the Boulder, Kennedy, Otatso, Divide and Lee Creek fish traps, St. Mary River drainage, Montana, 1997-2000.

Movements of Bull Trout

VI- and PIT-Tagged Fish

Altogether, 495 bull trout > 200 mm TL received either VI or PIT tags during the study (Table 4). Of that total, 206 (42%) fish were captured and tagged at the traps (1997-2000) and 289 (58%) during electrofishing surveys (1998-2000). Eighty-nine (18%) of the 495 tagged bull trout have been recaptured in traps or by electrofishing in subsequent years (Tables 5 and 6 and Appendix D Table 47). For the purposes of this discussion, a recapture event consists of a recapture that occurred at least one year after the previous capture; thus, multiple recaptures of individual fish within years are considered a single recapture event. Tags, retained in 85 (96%) of the 89 recaptured fish (only VI tags were lost), also allowed estimation of individual growth rates for the recaptured fish (Appendix D, Table 47).

Because the electrofishing surveys were conducted early in the season and upstream from the traps, tagged bull trout could be caught multiple times (e.g., by both electrofishing and traps) in a single season. Nonetheless, during1998-2000, few of the bull trout captured by electrofishing were subsequently recaptured in traps that year. In 1998, 5 of 12 (42%) and 8 of 29 (28%) bull trout tagged while electrofishing in Boulder and Kennedy creeks, respectively, were subsequently recaptured in traps. In 1999, 4 of 10 (40%), 5 of 26 (19%), 0 of 5 (0%), and 3 of 8 (38%) bull trout tagged while electrofishing in Boulder, Kennedy, Otatso, and Lee creeks, respectively, were subsequently recaptured in traps. In 2000, 5 of 23 (22%), 2 of 81 (2%), 0 of 13 (0%), and 0 of 6 (0%) bull trout tagged while electrofishing in Boulder, Kennedy, Otatso, and Lee creeks, respectively, were subsequently recaptured in traps. None of the 101 ostensibly resident bull trout tagged during electrofishing surveys in upper Otatso Creek was subsequently recaptured downstream in the Otatso Creek trap or elsewhere.

Most (86%) bull trout recapture events occurred in the stream from which the fish was originally captured. However, 16 instances occurred of a bull trout tagged in one stream being recaptured in another stream (Table 6); movements of tagged bull trout occurred among all streams except Lee and Upper Otatso creeks.

Table 4. Total numbers of bull trout (>200 mm TL) tagged in the St. Mary drainage, Montana, 1997-2000. Number of Otatso Creek fish that were tagged in the upper Otatso Creek-Slide Lake region during electrofishing surveys is given in parentheses.

Year, Method of Capture	Boulder Creek	Kennedy Creek	Otatso Creek	Lee Creek	Divide Creek	Combined Totals
1997 (VI Tags)						
Fish Traps	17	32	16	---	2	67
1998 (PIT Tags)						
Electrofishing	11	29	39 (39)	25	---	104
Fish Traps	51	25	14	---	0	90
Combined	62	54	53	---	0	194
1999 (PIT Tags)						
Electrofishing	2	17	46 (41)	8	---	73
Fish Traps	7	6	4	10	---	27
Combined	9	23	50	18	---	100
2000 (PIT Tags)						
Electrofishing	10	63	34 (21)	5	---	112
Fish Traps	11	4	5	2	---	22
Combined	21	67	39	7	---	134
Grand Total	109	176	158 (101)	50	2	495

Table 5. Summary of annual bull trout (BT) tagging and recapture events, St. Mary River drainage, Montana, 1997-2000. Numbers in parentheses are percentages of maximum possible value, based on the number of tags at large, for that category.

Year	Number of BT tagged that year	Maximum tags at large at end of field season	Number of recapture events for BT tagged 1-3 years earlier			
			1 year	2 years	3 years	Combined
1997	67	67	---	---	---	---
1998	194	261	23 (34.3)	---	---	23 (34.3)
1999	100	361	39 (20.1)	7 (10.4)	---	46 (17.6)
2000	134	495	9 (9.0)	32 (16.5)	5 (7.5)	46 (12.7)

Table 6. Summary of bull trout (BT) tagging and recapture events, 1997-2000 combined, by stream of initial capture, St. Mary River drainage, Montana. Numbers in parentheses are percentages for that tagging location.

Tagging location	Number of BT tagged 1997-1999	Number of BT Recaptured 1998-2000	Number of Recapture events 1998-2000	Location of recapture event				
				Boulder	Kennedy	Lower Otatso	Upper Otatso	Lee
Boulder Creek	88	31 (35)	40	39 (98)	1 (2)	0	0	0
Kennedy Creek	109	36 (33)	48	5 (10)	40 (83)	3 (6)	0	0
Lower Otatso Creek	39	13 (33)	16	1 (6)	6 (38)	9 (56)	0	0
Upper Otatso Creek	80	3 (4)	4	0	0	0	4 (100)	0
Lee Creek	43	6 (14)	7	0	0	0	0	7 (100)
Total	359	89 (25)	115	45 (39)	47 (41)	12 (11)	4 (3)	7 (6)

Radiotagged Fish

Twenty-seven adult bull trout (13 in 1998, 7 in 1999 and 7 in 2000) were implanted with radio transmitters (Table 7, Figure 7). Subsequent contact was made with 24 of the radiotagged fish. In addition, five radioed bull trout were among the bull trout recaptured by electrofishing or in the fish traps. The whereabouts of three bull trout (fish codes B9, O2 and L1; Table 7) remain unknown.

Table 7. Data for adult bull trout implanted with radio transmitters, St. Mary River drainage, 1998-2000.

Tagging Location	Fish Code	Year Implanted	Frequency (MHz)	PIT Tag Number	Length (mm)	Weight (g)
Boulder Creek	B1	1998	30.100	41456C4B4C	566	1532
	B2	1998	30.120 (a)	4144164449	623	1772
	B3	1998	30.140	41437A035F	585	1638
	B4	1998	30.160	4144024207	611	1871
	B5	1999	30.110	4143734A00	518	1248
	B6	1999	30.120 (b)	41477C441C	662	2152
	B7	1999	30.130		643	2448
	B8	2000	30.030	414375576A	650	2480
	B9	2000	30.070	4143762010	735	2900
	B10	2000	30.170	41440A6B36	763	3754
	B11	2000	30.211	41456E4777 (W40)	607	2062
Kennedy Creek	K1	1998	30.020	414377383C	532	1306
	K2	1998	30.040	4144107271	542	1396
	K3	1998	30.180	414B040901 (W42)	570	1510
	K4	1998	30.200	41440F5E6A	560	1604
	K5	1998	30.240	4148717245	577	1602
	K6	1998	30.270	4149113634	650	2236
	K7	1999	30.150	503077610C	525	1214
	K8	1999	30.261	414408662E	580	1666
	K9	1999	30.281	413B506C47	590	1700
	K10	2000	30.251	4148212B2A (W80)	633	2002
Otatso Creek	O1	1998	30.060	414374484B	606	2108
	O2	1998	30.080	414415293F	548	1302
	O3	1998	30.220	4143796924	525	1248
	O4	1999	30.191	41437F556E	531	1272
	O5	2000	30.231	503071457E (W66)	660	2312
Lee Creek	L1	2000	30.090	41437C3349	606	1418

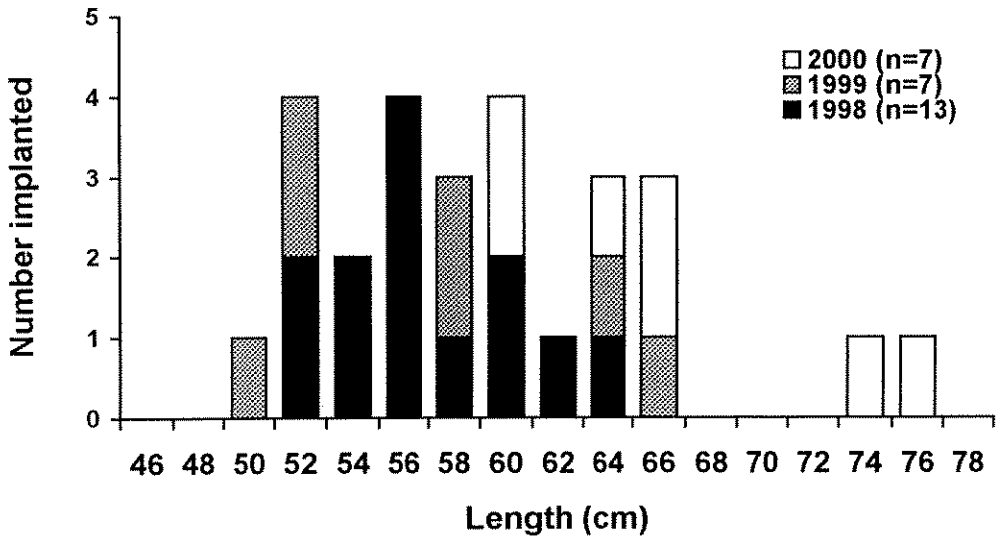

Figure 7. Length-frequency distribution for 27 adult bull trout implanted with radio transmitters, St. Mary River drainage, 1998-2000.

Distances traveled between tagging locations and probable wintering areas ranged from approximately 0.9 to 75.0 river km (Figures 8 and 9). Eight radiotagged bull trout (1 Boulder fish and 7 Kennedy fish) were found in the lower St. Mary River in Canada during winter. Nineteen radiotagged fish apparently wintered in Montana, 12 in the St. Mary River (4 Boulder, 5 Kennedy, 3 Otatso fish), three (all Boulder fish) in Lower St. Mary Lake, and three (all Boulder fish) in Swiftcurrent Creek downstream from Sherburne Dam. In contrast, only one radiotagged fish (O1) was found in a spawning tributary during winter. Fish with which radio contact was made in successive winters (e.g., B1, B6, K1, K2, K3, K5, K6, K7, O1 & O4) most often were found in the same river reaches between years (Figures 8 and 9).

The stationary receivers reliably recorded twelve different radiotagged bull trout between January 1999 and May 2001 (Table 8); several of those fish were recorded on multiple occasions. Bull trout were recorded in each month except August (Figure 10); the distribution of records by month was bimodal, with most contacts occurring in June and October.

Four radiotagged bull trout (B3, B5, B6 and B7), all tagged in Boulder Creek, passed over the St. Mary diversion dam enroute to winter habitats downstream in the St. Mary River (Figure 8 and Table 8). After being contacted in Lower St. Mary Lake in winter 1999-2000, bull trout B3 passed over the dam in September 2000, was recorded by the stationary receiver at the

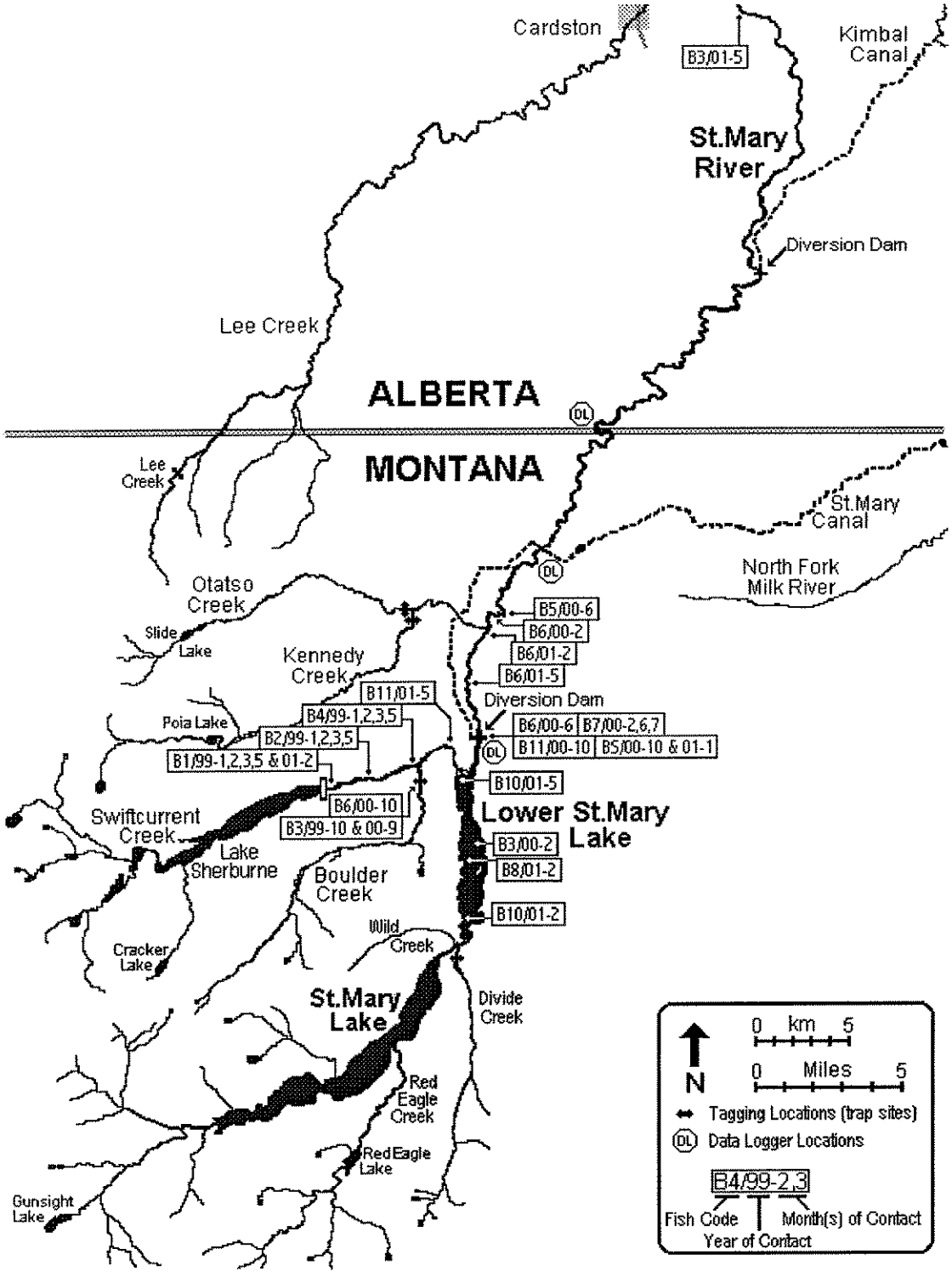

Figure 8. Locations of radiotagged bull trout that had been implanted with radio transmitters after their capture from Boulder Creek, St. Mary River drainage, U.S. and Canada, 1999-2001. See Table 7 for more information on these fish.

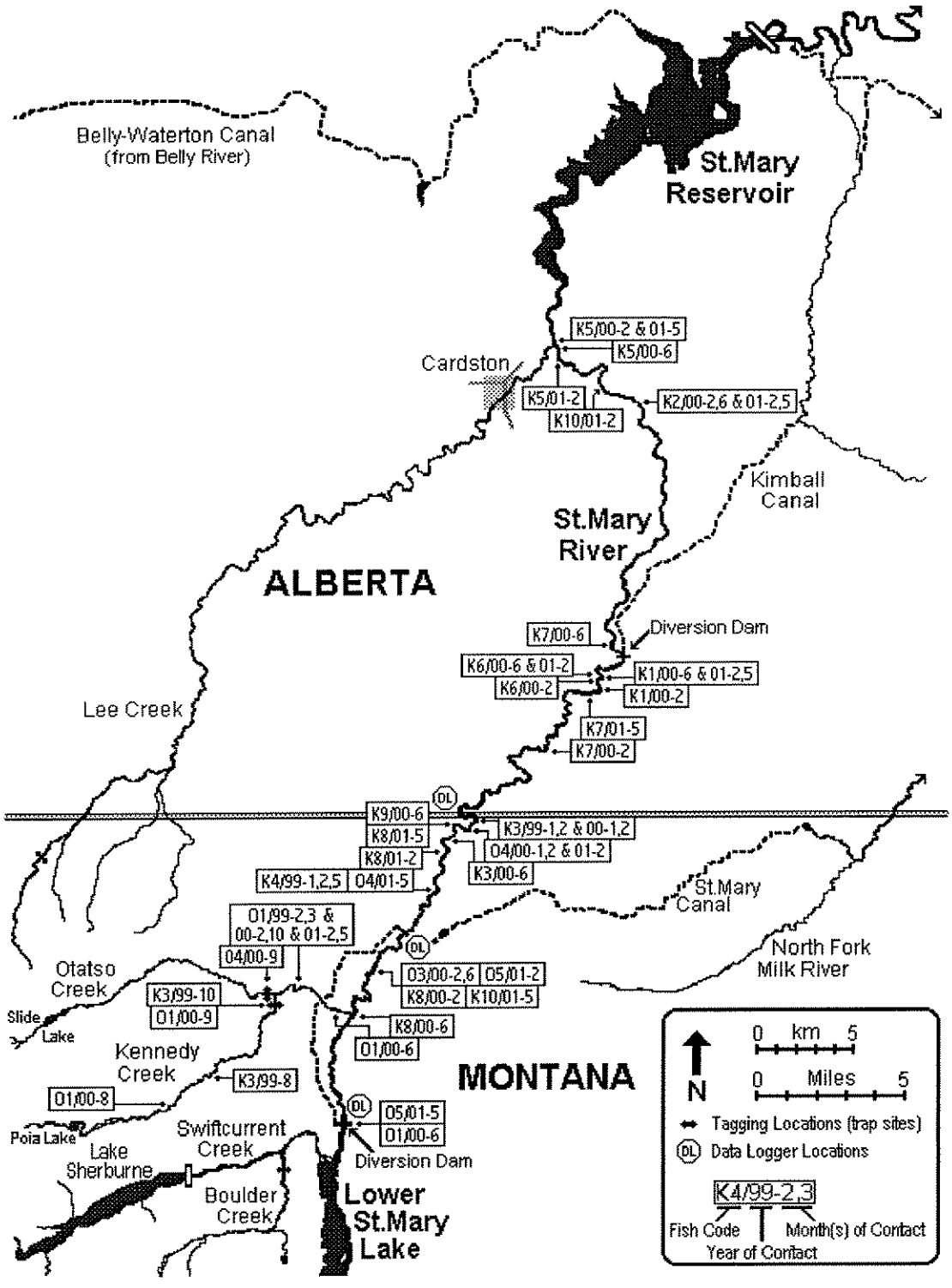

Figure 9. Locations of radiotagged bull trout that had been implanted with radio transmitters after their capture from Kennedy or Otatso creeks, St. Mary River drainage, U.S. and Canada, 1999-2001. See Table 7 for more information on these fish.

Table 8. Records of radiotagged bull trout (identified by fish code; see Table 7) reliably recorded by three receiving stations on the St. Mary River, 1999-2001.

Logger Location	Year		
	1999	2000	2001
Diversion Dam Deployed 20 June, 2000	not deployed	B7 – 6/20 - continuous (dead) B6 - 6/21-7/5 – continuous O1 - 6/25-7/5 – continuous B3 - 9/29 - 3:00-3:15pm B5 – 9/20-12/31 – continuous B11 - 10/19 - 6:30-11:45pm B11 - 10/20-11/5 – continuous B6 - 11/2 - 3:30-4:00am B11 - 11/18 - 2:45-9:30am	B5 - 1/1-4/26 - continuous O5 - 4/26-5/10 - continuous
Camp Nine Deployed 7 March, 1999	K3 - 6/9 - 4:00-6:00pm K3 - 10/18 - 3:15-4:15pm K9 - 10/21 - 7:30-8:00pm B6 - 10/22 - 2:30-3:30pm B5 - 10/25-26 - 6:00pm-10:00am B6 - 10/28 - 4:30-6:30pm B5 - 11/2 - 9:00-11:45pm	B5 - 2/3-2/24 – frequent B6 - 5/24 - 1:00-10:00pm O4 - 6/4-6 - 7:00pm-7:15am B6 - 6/7 - 7:30-10:15pm K8 - 7/3 - 1:30-3:00pm B5 - 9/21 - 12:30-4:30pm B5 - 9/23 - 3:30-6:15am O4 - 9/29-30 - 7:00pm-1:30am	no records
International Boundary Deployed 12 January, 2000	not deployed	B5 – 1/19-20 – 2:00am-9:00am K3 – 6/24-25 - 10:30-1:15am K7 - 7/18 - 7:30-8:30pm B3 - 10/1 - 3:00-3:45pm	no records

international border two days later, and eventually located 42 km downstream in Alberta in May 2001. Bull trout B5, which passed over the dam in October 1999 and was subsequently recorded on several dates by the stationary receivers at Camp Nine and the international border, was last located just below the diversion dam in January 2001. Bull trout B6 passed over the dam in October 1999 and ostensibly spent that winter downstream near the Kennedy Creek confluence. In July 2000, B6 passed over the diversion dam and was recaptured in the Boulder Creek trap in October 2000. B6 then passed over the dam in November 2000, and was subsequently found near the Kennedy Creek confluence that winter. Most recently, in May 2001, B6 was found in the St. Mary River 3 km downstream from the dam. Bull trout B7 passed over the dam in late

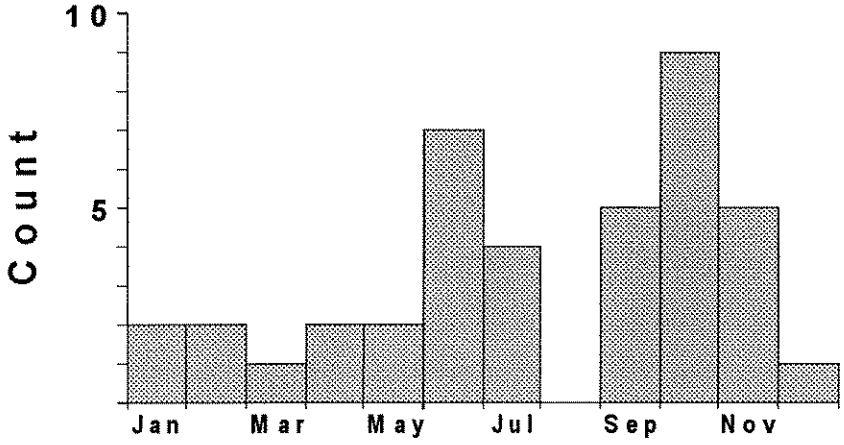

Figure 10. Distribution of radio contacts made by the stationary receivers by month, St. Mary River drainage, 1999-2001.

1999 and ostensibly spent the winter just downstream from the dam. Sometime in spring 2000, B7 apparently died in a pool just below the dam, where the functioning but motionless transmitter remained in May 2001. Another Boulder Creek fish (B11) was logged several times at the diversion dam in late 2000. It is not known, however, whether this fish passed over the dam because he was not found downstream. B11 was last located in lower Swiftcurrent Creek in May 2001.

In addition to the Boulder Creek fish, the receiver at the diversion dam recorded two Otatso Creek fish (O1 & O5). Bull trout O1, which was contacted each winters 1999-2001 in a pool about 1 km downstream from the Kennedy-Otatso Creek confluence, spent 10 d in a pool immediately downstream from the diversion dam in June-July 2000. O1 was subsequently recaptured during electrofishing in upper Kennedy Creek in August 2000, and again at the Kennedy Creek fish trap in September 2000. Bull trout O5, which spent the winter 2001 in the St. Mary River 4 km downstream from the Kennedy Creek confluence, arrived at the diversion dam in late April 2001 and was last located immediately below the dam in late May 2001.

At least four radiotagged bull trout are known to have died. One, a Kennedy Creek fish (K4), moved approximately 16 km downstream, where it was found in winter 1999 in the St. Mary River (Figure 9). That fish then traveled a few hundred meters upstream before it ostensibly died

in the spring 1999. Soon after being implanted with radios in Boulder Creek, bull trout B2 and B4 swam a short distance up Swiftcurrent Creek (Figure 8). Subsequently, in the fall 1998, flows from Sherburne Dam were turned off and those two fish may have become stranded in shallow pools, where they subsequently perished under the ice. The B2 radio, recovered in the spring 1999, was subsequently re-implanted in another Boulder Creek fish (B6) that fall. Another Boulder Creek fish (B1) also ascended Swiftcurrent Creek in fall 1998 before flows were reduced but entered an outlet tunnel of Sherburne dam, where it wintered in the deep water that location provided (Figure 8). Periodic radio contact was made with that fish until flows from the dam were increases substantially in May 1999 and the fish ostensibly moved downstream. Contact with B1 was not made again until it returned to the dam's outlet tunnel in fall 2000 where it remained until spring 2001. The fourth tagged bull trout that ostensibly died, another Boulder Creek fish (B7), moved 8 km downstream to a pool just downstream from the St. Mary diversion dam. The fish moved upstream to near the base of the diversion dam where it probably died in spring 2000 (Figure 8).

Age and Growth Analysis

Results of age and growth analysis based on scales taken from 74 bull trout in 1997 are presented in Appendix F, Tables 48 and 49. In addition, scales taken from bull trout captured in 1998 and 1999 were analyzed as part of a companion study completed in April 2001 (Gust 2001). Gust (2001) found that growth rates of bull trout did not differ among the four tributaries of the St. Mary River, and that bull trout growth in the St. Mary River drainage was similar to that of bull trout in the Columbia River drainage, Montana.

Gillnetting and Seining

A total of 9 experimental gillnet sets made at six different locations along the first 2 km of the St. Mary Canal yielded 295 fish, including 6 bull trout (Table 9). In addition, 38 fish were seined from the Sherburne Dam outlet tunnels on 28 September 1999, when water releases were temporarily halted for dam maintenance. Those fish including 1 bull trout (300 mm TL), 6 northern pike, 13 burbot, 12 whitefish, and 6 suckers.

Table 9. Total numbers and ranges in total length (mm) of all fish captured in experimental gill nets set overnight in the St. Mary Canal at six different locations (0-3 km downstream from headgates), St. Mary drainage Montana, 13-21 October. 1999. Whitefish includes mountain and lake whitefish; suckers includes white and longnose suckers.

Location, Variable	Bull Trout	CTT x RBT	Whitefish	Northern Pike	Burbot	Suckers
Pool 1						
Number Captured	3	2	26	2	0	53
Length range	325-360	295-303	211-386	440-500		307-515
Pool 1						
Number Captured	2	4	17	1	0	17
Length range	300-322	289-340	214-456	389		277-437
Headgate Pool						
Number Captured	1	0	17	0	1	1
Length range	332		211-309		230	413
Canal Stretch 1						
Number Captured	0	0	7	4	0	5
Length range			340-390	615-730		440-480
Pool 1						
Number Captured	0	1	47	0	0	34
Length range		322	210-380			300-516
Canal Stretch 1						
Number Captured	0	0	3	1	0	3
Length range			338-388	530		450-488
Pool 2						
Number Captured	0	0	4	1	0	4
Length range			211-300	220		298-380
Canal Stretch 2						
Number Captured	0	0	6	1	0	5
Length range			320-368	1090		452-490
Canal Stretch 3						
Number Captured	0	0	8	7	0	7
Length range			332-370	520-795		440-500
Total	6	7	135	17	1	129

Redd Surveys

In 1997, preliminary redd surveys identified bull trout spawning areas in Kennedy and Boulder creeks, both within Glacier National Park (Figure 11). Spawning in both streams occurred in areas of apparent groundwater upwelling, just downstream from the major regions of entirely subsurface flow during low-flow periods. Habitat characteristics of these spawning areas included widened valleys, braided, low-gradient channels with gravel substrates, and beaver activity. Redds, typically associated with undercut banks, root wads, debris jams, or other cover, were constructed in substrates ranging from fine gravel (>10 mm diameter) to small cobble (<150 mm diameter), generally near the stream margins. A few redds were found in areas of upwelling directly below beaver dams.

Although seemingly suitable spawning habitat occurred downstream from the spawning areas in Boulder and Kennedy creeks, no redds were identified in those areas. Only 12 redds were identified at the Boulder spawning area in 1997 (11 November), compared to 42 in 1998 (14 October), 20 in 1999 (3 November) and 30 in 2000 (17 October). In general, more redds were counted in surveys conducted in October than in November, perhaps because redds are more evident early in the post-spawning season. At the Kennedy Creek spawning area, 23, 37 and 23 bull trout redds were identified in 1997 (15 October), 1998 (13 October), and 2000 (18 October), respectively; no survey was conducted in 1999.

With the exception of two redds found just downstream from Slide Lakes in 1997, no spawning areas were found in Otatso Creek in 1997-2000. Unlike Otatso Creek, where spawning habitat appears scant, Divide Creek has many habitats seemingly suitable for spawning. However, no redds were identified in Divide Creek in 1997 (the only year redd surveys were conducted in this stream); only two bull trout (one male and one female) were captured in the Divide Creek trap that year.

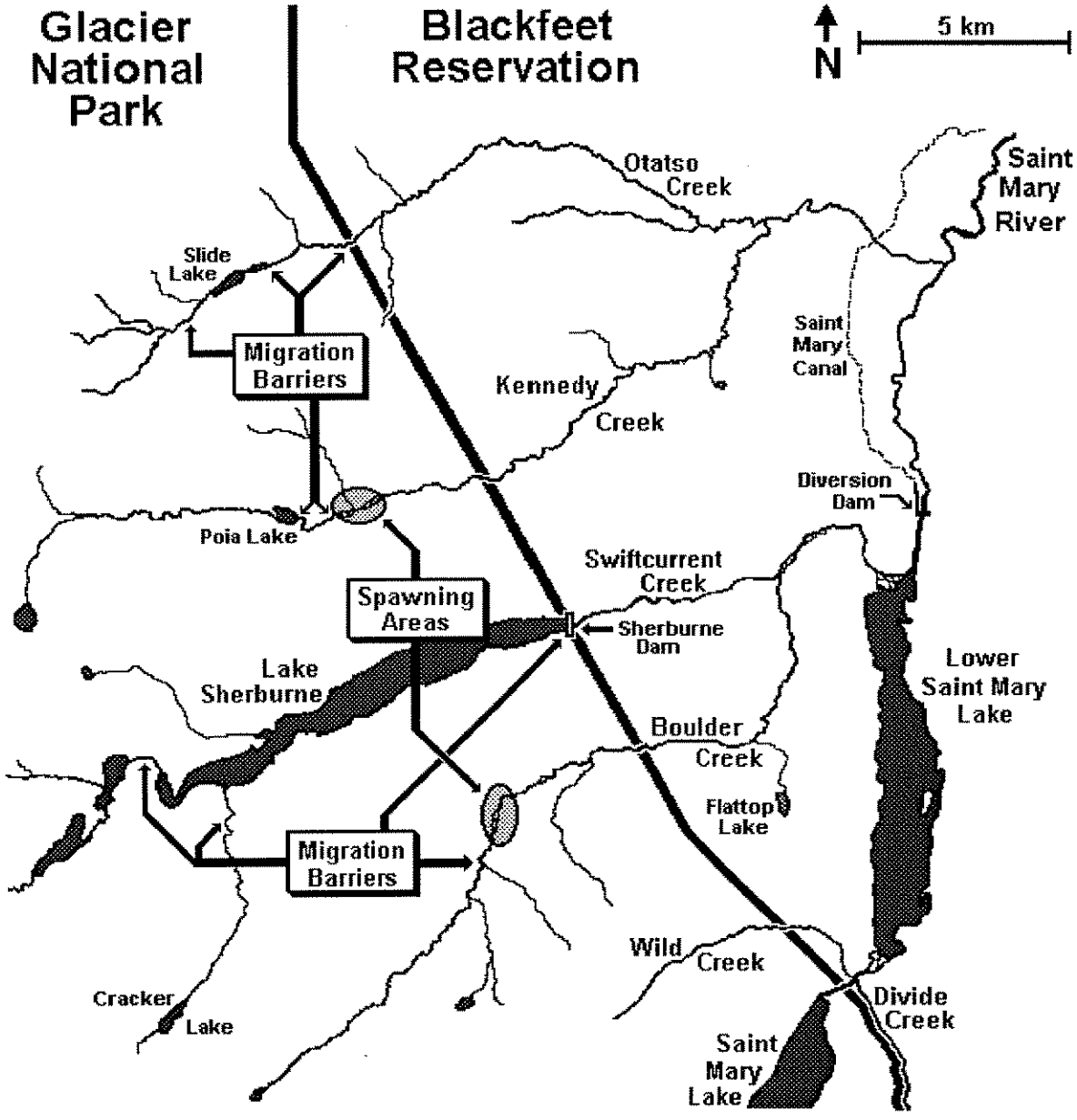

Figure 11. Approximate locations of spawning areas and migration barriers identified in Boulder, Kennedy, Otatso, and Swiftcurrent creeks, St. Mary River drainage, 1997-2000.

DISCUSSION

Distribution of Bull Trout

Electrofishing and trapping revealed bull trout in each of the principal tributaries of the St. Mary River that we examined, while radio telemetry indicated bull trout ranged throughout much of the mainstem St. Mary River, in Montana and Alberta. Juvenile bull trout were most abundant in Boulder, Kennedy, and Lee creeks, less abundant in lower Otatso Creek, and none was found in Divide Creek. Adult bull trout were found in lower Otatso and Divide creeks but were most abundant in Boulder, Kennedy, and Lee creeks. All age groups of bull trout were abundant in upper Otatso Creek, upstream from the waterfall near the park boundary. Although not sampled during our study, bull trout are also known to occur in Red Eagle Creek and Red Eagle Lake, and as an introduced stock in Cracker Lake (Fredenberg 1996; Michels 1996). Thus, bull trout are widely distributed in the St. Mary River drainage and occur in all of the waters that they inhabited historically, with the possible exception of the Sherburne Reservoir basin, which we did not study.

Spawning Areas for Migratory Bull Trout

Based on the occurrence of redds, we found bull trout spawning areas in Boulder and Kennedy creeks. Numbers of redds counted in both creeks varied among years, perhaps in response to differences among years in the numbers of bull trout spawning in those streams. During a 3-yr study in the Belly River drainage, annual numbers of redds were positively associated with the numbers of adult bull trout collected in traps downstream (Clayton 1998). Our data from traps and radio telemetry indicate the spawning areas in Boulder and Kennedy creeks were used by migratory (i.e. fluvial and adfluvial) bull trout, but those areas may also be used for spawning by resident bull trout.

Bull trout redds in Boulder and Kennedy creeks typically occurred in areas of apparent groundwater upwellings, just downstream from seasonal barriers to the movements of fish. General characteristics of those spawning areas included widened valleys, braided, low-gradient channels with gravel substrates, and beaver activity. Boag and Hvenegaard (1997) reported that adult, resident bull trout in a small Alberta foothill stream spawned in a short stream reach that

had abundant groundwater upwellings. Fraley and Shepard (1989) reported both groundwater influence and proximity to cover were important to explaining the occurrence of bull trout spawning areas in the Flathead River drainage.

Migratory bull trout probably also spawned in lower Otatso Creek (based in part on our capture of large, spent adults in the trap), although no redds were found in that stream, and in Lee Creek. Although redd surveys have not been conducted in Lee Creek, the large bull trout that we found there may winter in lower Lee Creek, the St. Mary River, or perhaps St. Mary Reservoir. Further evidence of bull trout spawning in Boulder, Kennedy, Otatso, and Lee creeks is provided by our collection of substantial numbers of immature bull trout from each of those streams.

Movements of Bull Trout

Spawning migrations of adults

The records of radiotagged bull trout detected by the stationary receivers suggest two annual periods of appreciable fish movement in the St. Mary River, the first about June and the other about October. Those periods probably corresponded with the movements of adult fluvial bull trout toward spawning areas in late spring, and the subsequent return movements of those fish toward winter habitats in fall. In the Blackfoot River, Montana, bull trout spawning migrations began on the descending limb of the hydrograph in June (Swanberg 1997). Conspicuously absent from our stationary receiver records were bull trout movements during August, which suggested that the fluvial fish had entered the tributaries by that time. Similarly, in the North Fork Belly River, in Alberta, the peak upstream migration of bull trout from the mainstem Belly River occurred before August 1996 (Clayton, 1998; Fox et al. 1996). In the Flathead River drainage, in Montana, adult bull trout entered spawning tributaries between July and September, particularly in August (Fraley and Shepard 1989).

Bull trout spawning is generally associated with seasonally declining water temperatures during September and October (Clayton 1998; Fox et al. 1996; Fraley and Shepard 1989; McPhail and Murray 1979) but as early as August in some areas (Goetz 1989; Riehle 1993). Stream temperatures that decline to 9.0°C to 5.0°C have been considered important to initiation of bull trout spawning (Fraley and Shepard 1989; McPhail and Murray 1979). Our data on creek

temperatures and the cumulative catches of ostensibly post-spawning, adult bull trout caught moving downstream in traps are consistent with that association. Our data also suggest that most adult bull trout that spawn in the tributaries of the St. Mary River probably do so after they have been in the tributaries at least a few weeks. Similarly, in the Flathead River drainage, adult migratory bull trout occupying tributaries for a month or more before spawning (Fraley and Shepard 1989).

In the North Fork Belly River, Alberta, the downstream migration of post-spawning bull trout began in early September, peaked around 20 September, and ended by early October 1995-1997 (Clayton 1998). Fraley and Shepard (1989) concluded that post-spawning bull trout generally departed tributaries soon after spawning in the Flathead River drainage. Although we caught most bull trout in traps soon after the waters had cooled and spawning presumably had occurred, many of the adult bull trout that we had captured and tagged upstream from the traps during the summer electrofishing surveys were not subsequently recaptured in traps that fall. That observation suggested that either (1) the spawning period for some migratory fish extended into late October, after the traps had been removed, (2) some post-spawning, migratory bull trout lingered in spawning streams before moving downstream, or (3) some of the adult fish that we tagged while electrofishing were actually resident fish that live entirely in the upstream areas.

Our tag-recapture data indicate that a notable proportion of bull trout apparently move among spawning streams that are tributaries of the St. Mary River in Montana. This suggests that reproductive isolation among these spawning stocks is incomplete. Estimates of size of the bull trout spawning runs are not presently available, although we are investigating ways to make such estimates using our recapture data. Those estimates will be provided in subsequent annual reports.

Winter Habitats of Adult Bull Trout

Radio telemetry revealed that adult bull trout used winter habitats scattered along much of the mainstem St. Mary River, Montana and Alberta, and in two of its tributaries, Swiftcurrent and Kennedy creeks. In addition, all but one (a Boulder Creek fish) of the radioed bull trout found in Alberta had been tagged in Kennedy Creek. A bull trout tagged in Otatso Creek subsequently occupied a pool in Kennedy Creek, about 1 km downstream from the trap, in three

consecutive winters. Bull trout winter habitats that we examined from the ground were generally deep pools. However, at least three bull trout, tagged in Boulder Creek, used Lower St. Mary Lake as winter habitat. In headwater streams of the Bitterroot River drainage, Montana, radiotagged resident bull trout wintered in pools and beaver ponds (Jakober et al. 1998). Similar wintering habitats were found in northern Idaho streams (Bonneau and Scarnecchia 1998; Saffel and Scarnecchia 1995) and in the upper Arrow Lakes drainage, British Columbia (McPhail and Murray 1979).

Movements of juveniles

Studies of bull trout in other waters indicated that most juvenile fish of migratory stocks remained in natal tributaries for one to three years before moving downstream to large rivers or lakes (Bjornn 1961; Fraley and Shepard 1989; McPhail and Murray 1979; Oliver 1979). Juvenile bull trout apparently moved downstream during June-August in the Flathead drainage (Fraley and Shepard 1989), and throughout the summer and fall in the Wigwam drainage, British Columbia (Oliver 1979). Because our traps were not designed to capture juvenile bull trout and were operated only between late August and mid-October, the period of juvenile movement from tributaries could not be determined.

Bull Trout Life-History Forms

Historically, bull trout may have moved freely among all of the creeks, rivers and lakes naturally inhabited by the species in the St. Mary River drainage. Moreover, each of the three life-history forms–resident, fluvial, and adfluvial–would have been present in that historic, widespread population. Fitch (1997), however, considered it unlikely that fluvial bull trout persisted in the St. Mary River today, and no bull trout were captured in limited sampling of the river just prior to our study (Wagner and Fitzgerald 1995). In contrast, results of our study indicate that all three bull trout life-history forms remain in the St. Mary River drainage.

Bull trout that have a fluvial life history, as revealed by our radio telemetry, use winter habitats in the mainstem St. Mary River, between Lower St. Mary Lake and at least Cardston, Alberta. Those fish apparently spawn in Boulder, Kennedy and Otatso creeks, and perhaps other tributaries. Our radio telemetry work also shows that adfluvial bull trout inhabit Lower St. Mary

Lake and probably spawn in Boulder Creek. In addition, because they must spawn in streams, the bull trout that inhabit St. Mary, Red Eagle, and Slide lakes are of the adfluvial form. Whether the large bull trout in upper Lee Creek, in Glacier National Park, represent resident, fluvial, or even adfluvial fish (that use St. Mary Reservoir as winter habitat) is unknown.

Bull trout that have the resident life-history form may occur in each of the tributaries that we have studied, but identifying those fish using our current data set is problematic. Because we radiotagged only adult bull trout caught in traps as those ostensibly post-spawning fish were departing the tributaries, our sample of radiotagged fish may consist entirely of fluvial and adfluvial (i.e. migratory) life-history forms. Furthermore, although resident fish live year-round in those tributaries, their individual growth rates may not differ from those of fluvial and adfluvial fish (McCart 1997). Gust (2001) found that growth rates estimated from scale annuli did not differ among bull trout captured from Boulder, Kennedy, upper and lower Otatso, and Lee creeks, even though the fish in upper Otatso Creek were confined there by barrier falls. Consequently, at present it does not appear that we can distinguish resident from migratory bull trout on the basis of their individual growth rates.

Knowledge of the seasonal movements of bull trout, as obtained from radio telemetry, can help us to classify those fish to life-history form. Nonetheless, such classifications are often subjective. For example, one of our tagged bull trout was found during three consecutive winters in lower Kennedy Creek. Although we might designate that fish as having a resident life history, the fish was also found at other times in the St. Mary River, which would be characteristic of a fluvial life history. Still other radiotagged bull trout passed through Lower St. Mary Lake, and perhaps spent considerable time therein, on their way to winter habitats in the lower St. Mary River. Should those fish, for purposes of classification, be distinguished from the fluvial bull trout that did not enter a lake? Despite the subjectivity in classifying individual bull trout to life-history form, the wide geographic distribution and diversity of habitats used by bull trout in the St. Mary River drainage greatly increase the stability and likelihood of persistence of the overall bull trout population of the drainage (Rieman and McIntyre 1993).

Milk River Project Effects on Bull Trout

In reaching its decision to list the bull trout as a threatened species, the Service concluded (Federal Register 64: 58909), among other things, that bull trout in the St. Mary River drainage are negatively affected by operation of the water-storage and delivery systems that are part of the Milk River Irrigation Project. Results of our study support several of the Service's conclusions important to reaching that decision, including that bull trout are entrained in the St. Mary irrigation canal. Because the canal headgates are barriers to the upstream movement of fish, those bull trout are unlikely to return to the river and are therefore lost from the reproducing population. In addition, our results from radio telemetry suggest that the acute reductions in discharge from Sherburne Dam, at the end of the annual irrigation season, produce low-flow conditions downstream in Swiftcurrent Creek that directly or indirectly result in the death of bull trout.

Although the Service also concluded (Federal Register 64: 58909) that the St. Mary diversion dam is a substantial barrier to the movement of bull trout, our results from both radio telemetry and conventional tag-recapture techniques show considerable upstream and downstream movements of bull trout through the diversion. Timing of those movements is not known precisely but probably occurred when the dam was open, usually between October and April. In general, our study has revealed more extensive movements of bull trout among regions of the St. Mary River drainage than had been earlier suspected (Federal Register 64: 58909).

2001 STUDY PLANS

1. **Radio telemetry:** We will increase the proportion of our study effort devoted to the radiotelemetry program, which has yielded especially useful results. In addition to tracking those bull trout that were tagged in 1998-2000, which number 27 fish, we will implant an additional 15 bull trout with transmitters. Unlike in past years, however, those bull trout will be collected during electrofishing surveys in tributaries, conducted primarily in August. Data described earlier in this report indicate that by August the migratory fish have entered those streams in preparation for spawning. Thus, the bull trout that we radio tag in 2001 could include resident as well as fluvial and adfluvial fish. We plan to conduct at least two aerial searches for radiotagged bull trout during each of the spawning and winter periods, in addition to continuing operation of our stationary receivers and conducting periodic ground-based searches.

2. **Fisheries Surveys:** We will conduct comprehensive electrofishing surveys in each of the major tributaries of the St. Mary River in August. In addition to capturing and telemetering the bull trout described in the preceding paragraph, we will examine captured bull trout for tags applied in previous years and apply PIT tags to all untagged bull trout > 200 mm TL. Like our radiotelemetry data and as described in this report, the tag-recapture data set has proven to be quite important to our understanding of the movements of bull trout in the St. Mary River drainage. In addition, the tag-recapture data set will allow us to estimate sizes of the bull trout spawning stocks.

3. **Sampling of the St. Mary Canal:** The Bureau plans to install an electric weir at the entrance to the St. Mary Canal, perhaps as early as 2002. The weir is intended to prevent the entrainment of fish into the canal. It is important that we assess the efficacy of future weir operations. Accordingly, we will conduct a quantitative survey of the fishes in the canal in fall 2001, to obtain baseline information on those fishes prior to weir operation. The electrofishing survey will be conducted after the canal headgates have been closed, at the end of the annual irrigation season. Any bull trout that we encounter will be placed in the St. Mary River.

4. **Comprehensive Data Analyses:** Our database for bull trout in the St. Mary River has grown substantially in recent years. It is important that we continue to move beyond simple summarizations and analyses of those data toward more comprehensive assessments that address the key issues raised by the Service when it listing bull trout in the St. Mary River drainage as a threatened species. Recovery of bull trout depends upon the outcomes of those comprehensive assessments, the management actions implemented as the result of those assessments, and, ultimately, the response of the bull trout population to those actions.

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APPENDICES

APPENDIX A

BULL TROUT TRAPPING OPERATION PROTOCOL

St. Mary River Drainage
Blackfeet Indian Reservation

Trap Locations:

1. **Divide Creek** (500 m above confluence with St. Mary River)
2. **Boulder Creek** (800 m above confluence with Swiftcurrent Creek)
3. **Kennedy Creek** (60 m above confluence with Otatso Creek)
4. **Otatso Creek** (10 m above confluence with Kennedy Creek)
5. **Lee Creek** (directly beneath the Chief Mountain Highway Bridge in Glacier Park)

* all traps are of a one-way design capturing downstream migrants only

Trapping Dates:

1. **Divide Creek**
   - **1997** - (8/26-10/8)
   - **1998** - (8/26-10/7)
2. **Boulder Creek**
   - **1997** - (8/26-10/8)
   - **1998** - (8/26-10/14)
   - **1999** - (9/1-10/20)
3. **Kennedy Creek**
   - **1997** - (8/27-10/9)
   - **1998** - (8/25-10/8)
   - **1999** - (8/31-10/19)
4. **Otatso Creek**
   - **1997** - (8/27-10/9)
   - **1998** - (8/25-10/8)
   - **1999** - (8/31-10/19)
5. **Lee Creek**
   - **1999** - (9/1-10/14)

Daily Trap Checking Procedures:

1. Slowly approach trap from downstream and observe if any fish are below the trap
   - if fish are observed below trap, attempt to identify and count them
   - modify weir to allow for upstream passage of these fish

2. Work fish in the following order, taking time between each step to allow for the fish to fully recover, minimize the time that fish are out of the water, and release all native fish downstream of traps in slack water.

   A. Bull Trout and Cutthroat Trout
   1. Weigh (g)
   2. Measure Total Length (mm)
   3. Take Scales for Age/Growth Analysis
   4. Mark fish with Fin Clip (save all bull trout adipose fins in labeled envelopes for genetic analysis)
   5. Mark all Bull Trout > 200 mm with Pit Tags inserted into muscle tissue directly ventral to the dorsal fin on left side of body (bull trout only)

   B. Burbot
   1. Weigh (g)
   2. Measure Total Length (mm)
   3. Mark with Left Pelvic Fin Clip (save fins in labeled tissue lysis buffer sample tubes for genetic analysis)

   C. Mountain Whitefish
   1. Count
   2. Mark with identifiable fin clip/punch (different fin for each stream)

   D. Rainbow and Brook Trout
   1. Weigh (g)
   2. Measure Total Length (mm)
   3. Sacrifice for Whirling Disease Testing and genetic analysis (place in zip-lock bags and freeze as soon as possible)

3. Clean and Repair traps if needed

4. Check data loggers (thermographs), be sure they are secure and completely submerged

Things to Remember:

- Be gentle with the fish
- Record all data on all-weather writing paper
- Label all samples
- Take lots of photos
- Pad-lock all trap boxes
- Be cautious of bears
- Take time to explain what we are doing when questioned by the public
- Take time to train volunteers and other personnel in various procedures

APPENDIX B

Table 10. Fish captured (raw data) during electrofishing surveys in Boulder Creek, St. Mary River drainage, Montana, 1998.

Boulder Creek - 7/28/98 - Electrofishing												
	Bull Trout					Cutthroat & Rainbow				Brook Trout		
Recap 1997	Length (mm)	Weight (g)	Condition (K)	Pit Tag Number	Scale Card Number	Length (mm)	Weight (g)	Condition (K)	Scale Card Number	Length (mm)	Weight (g)	Condition (K)
	158	30	0.76		19-3	177	58	1.05	18-1	167	42	0.90
	162	36	0.85		19-4	264	228	1.24	18-2	180	56	0.96
	158	32	0.81		19-5	430	728	0.92	18-3	238	128	0.95
	168	40	0.84		19-6	458	952	0.99	18-4	173	52	1.00
	157	32	0.83		19-7	425	716	0.93	18-5	190	60	0.87
	169	42	0.87		19-8	185	60	0.95	18-6	145	40	1.31
	168	42	0.89		19-9					115	12	0.79
	105	8	0.69		19-0					87	6	0.91
	138	24	0.91		20-1							
	178	46	0.82		20-2							
	158	34	0.86		20-3							
	170	46	0.94		20-4							
	273	190	0.93	41493D1E3D	19-1							
	280	206	0.94	41492D495B	19-2							
	390	514	0.87	413B340D6C	20-5							
	402	614	0.95	41485E3E5F	20-6							
	385	496	0.87	4144162029	20-7							
	648	2198	0.81	41477C441C	20-8							
	587	1946	0.96	414B0C3577	20-9							
	523	1146	0.80	414A106F51	20-0							
W54	532	1330	0.88	413B00197F	21-1							
	447	782	0.88	4148123534	21-2							
	533	1438	0.95	41477F7008	21-3							
	417	594	0.82	414A287D37	21-6							
	137	22	0.86		21-4							
	150	22	0.65		21-5							
	190	54	0.79		---							
	160	28	0.68		---							
	158	32	0.81		---							
	160	30	0.73		---							
	154	24	0.66		---							
	157	30	0.78		---							
	177	58	1.05		---							
	164	30	0.68		---							
	142	26	0.91		---							
	138	24	0.91		---							
	163	40	0.92		---							
	140	24	0.87		---							
	100	8	0.80		---							
	98	8	0.85		---							
	94	8	0.96		---							
	94	6	0.72		---							
	82	6	1.09		---							
n=	43					6				8		
Mean	231.7	287.1	0.85			323.2	457.0	1.01		161.9	49.5	0.96
Min	82	6	0.65			177	58	0.92		87	6	0.79
Max	648	2198	1.09			458	952	1.24		238	128	1.31

Table 11. Fish captured (raw data) during electrofishing surveys in Boulder Creek, St. Mary River drainage, Montana, 1999.

Boulder Creek - 8/23/99 - Electrofishing													
		Bull Trout					CTT & RBT			Brook Trout			
Recap		Length	Weight	Condition	Pit Tag	Scale Card	Length	Weight	Condition	Length	Weight	Condition	
1997	1998	(mm)	(g)	(K)	Number	Number	(mm)	(g)	(K)	(mm)	(g)	(K)	
	R	463	922	0.93	414855171D	B1-1	123	22	1.18	111	14	1.02	
		182	52	0.86		B1-2	106	12	1.01	134	24	1.00	
		115	14	0.92		B1-3	335	488	1.30	124	22	1.15	
		122	16	0.88		B1-4				123	18	0.97	
		116	12	0.77		B1-5							
		114	18	1.21		B1-6							
		113	12	0.83		B1-7							
		47	1	0.96									
		48	1	0.90									
		46	1	1.03									
		116	12	0.77									
		545	1628	1.01	5030761879	B1-8							
		547	1498	0.92	5030745D5E	B1-9							
	R	499	1088	0.88	4143771B28	B1-0							
	R	473	1028	0.97	413B3C3A4B	B2-1							
	R	492	1104	0.93	4144105165	B2-2							
	R	492	1080	0.91	4149336A1F	B2-3							
	R	640	2106	0.80	414375576A	B2-4							
	R	584	1716	0.86	414A733521	B2-5							
	R	422	638	0.85	414417474A	B2-6							
n=		20					3			4			
Mean		308.8	647.4	0.91			188.0	174.0	1.16	123.0	19.5	1.04	
Min		46	1	0.77			106	12	1.01	111	14	0.97	
Max		640	2106	1.21			335	488	1.30	134	24	1.15	

APPENDIX B (continued)

Table 12. Fish captured (raw data) during electrofishing surveys in Boulder Creek, St. Mary River drainage, Montana, 2000.

Boulder Creek - 7/17, 8/9 & 8/23 - 2000 - Electrofishing															
			Bull Trout					Cutthroat/Rainbow			Brook Trout				
Recap			Length	Weight	Condition	Pit Tag	Scale Card	Length	Weight	Condition	Length	Weight	Condition		
1997	1998	1999	(mm)	(g)	(K)	Number	Number	(mm)	(g)	(K)	(mm)	(g)	(K)		
	R		513	1330	0.99	414374412E	1B00-1	284	222	0.97	98	12	1.27		
	R		700	2806	0.82	41440D3E77	1B00-2	225	114	1.00	110	16	1.20		
		R	503	1300	1.02	50306D6364	1B00-3	142	24	0.84	111	16	1.17		
			442	722	0.84	50306F5F22		141	30	1.07	235	144	1.11		
			155	32	0.86			113	16	1.11	189	64	0.95		
	R		593	2320	1.11	414415472D	1B00-4	118	16	0.97	150	36	1.07		
			118	18	1.10			114	14	0.94	235	130	1.00		
		R	570	1852	1.00	5030745D5E	1B00-5	89	6	0.85	230	128	1.05		
	R		725	3882	1.02	41437E7925	1B00-6	96	8	0.90	190	74	1.08		
		R	503	1090	0.86	50306D1243	1B00-7	104	12	1.07					
			180	50	0.86			90	6	0.82					
			172	46	0.90			85	6	0.98					
			578	1680	0.87	5030141E46		325	392	1.14					
	R-K		608	2056	0.91	41437D0203	1B00-8	192	92	1.30					
			561	1636	0.93	5030737564		350	564	1.32					
			104	12	1.07			425	780	1.02					
			444	980	1.12	5030651D5F		365	570	1.17					
			464	992	0.99	50300E2B5E		272	190	0.94					
			613	1936	0.84	503067674E		190	64	0.93					
			480	1098	0.99	50306E3007		100	10	1.00					
	R-K		489	1016	0.87	414A5F221E	1B00-10	110	16	1.20					
	R		628	2226	0.90	4143764149	2B00-1	185	60	0.95					
	R		592	2088	1.01	41440B5B5F	2B00-2	191	58	0.83					
			422	680	0.90	503073593B		170	38	0.77					
			57	2	1.08			125	22	1.13					
			57	2	1.08			105	12	1.04					
			145	28	0.92			165	44	0.98					
			107	12	0.98			102	10	0.94					
			120	14	0.81			104	8	0.71					
			43	1	1.26			110	16	1.20					
			105	10	0.86			85	8	1.30					
			90	6	0.82			120	22	1.27					
			48	1	0.90			121	22	1.24					
			100	8	0.80			116	12	0.77					
			110	10	0.75			103	10	0.92					
	R-K		405	798	1.20	414413561B	2B00-4	123	18	0.97					
	R		472	1060	1.01	41485E3E5F	2B00-5	111	12	0.88					
			567	1858	1.02	503073293F		106	8	0.67					
			175	58	1.08										
			104	12	1.07										
			110	12	0.90										
			491	1082	0.91	5030735C02									
			130	20	0.91										
			118	12	0.73										

	190	62	0.90						
	120	18	1.04						
	113	14	0.97						
	150	32	0.95						
	165	42	0.93						
	103	10	0.92						
	111	14	1.02						
	119	16	0.95						
	115	16	1.05						
	120	14	0.81						
	132	22	0.96						
	113	16	1.11						
	104	12	1.07						
	192	60	0.85						
	103	10	0.92						
	103	12	1.10						
	122	20	1.10						
	111	14	1.02						
	113	16	1.11						
	190	60	0.87						
	110	14	1.05						
	98	10	1.06						
	114	14	0.94						
	122	18	0.99						
	192	52	0.73						
	104	12	1.07						
	110	14	1.05						
	100	10	1.00						
	105	12	1.04						
	135	24	0.98						
	62	2	0.84						
n=	75				38			9	
Mean	247.4	500.2	0.96		159.8	92.9	1.00	172.0	68.9	1.10
Min	43	1	0.73		85	6	0.67	98	12	0.95
Max	725	3882	1.26		425	780	1.32	235	144	1.27

APPENDIX B (continued)

Table 13. Fish captured (raw data) during electrofishing surveys in Kennedy Creek, St. Mary River drainage, Montana, 1998.

Kennedy Creek - 7/15, 7/29, & 8/12 -1998 - Electrofishing												
	Bull Trout					Cutthroat & Rainbow				Brook Trout		
Recap 1997	Length (mm)	Weight (g)	Condition (K)	Pit Tag Number	Scale Card Number	Length (mm)	Weight (g)	Condition (K)	Scale Card Number	Length (mm)	Weight (g)	Condition (K)
	178	50	0.89	CU0	1-1	276	242	1.15	1-2	153	36	1.01
	127	20	0.98		1-3	411	616	0.89	1-6			
	143	28	0.96		1-4	368	574	1.15	1-7			
	117	14	0.87		1-5	271	248	1.25	1-8			
	345	384	0.94	CU1	2-1	324	400	1.18	1-9			
	430	648	0.82	CU2	2-2	341	434	1.09	1-0			
	182	54	0.90	CU5	2-5	284	280	1.22	---			
	184	56	0.90	CU6	2-6	145	28	0.92	---			
	170	40	0.81		23-0	225	106	0.93	30-8			
	485	944	0.83	413B25640B	2-3	180	52	0.89	30-9			
	423	792	1.05	4148434A62	2-4	144	24	0.80	30-0			
W31	466	918	0.91	4143765014	22-1							
W42	596	1696	0.80	414B040901	22-2							
	484	998	0.88	413A7E0943	22-3							
	331	356	0.98	4147747D53	22-4							
	420	590	0.80	413B14615D	22-5							
	550	1404	0.84	413B506C4F	22-6							
	464	1038	1.04	4144110E3D	22-7							
	580	1580	0.81	413B577305	22-8							
W44	663	2226	0.76	414841377E	22-9							
	665	2580	0.88	4149113634	22-0							
	378	502	0.93	414B051537	23-1							
	380	520	0.95	413B3E2C7C	23-2							
W84	725	2406	0.63	414378167F	23-3							
	405	560	0.84	41495B1048	23-4							
	580	1800	0.92	4148252C2B	23-5							
W80	608	1766	0.79	4148212B2A	23-6							
W60	612	2226	0.97	41483B0941	23-7							
W28	592	1730	0.83	4148717245	23-8							
	444	764	0.87	414830624E	23-9							
	453	802	0.86	4145672926	---							
	381	428	0.77	414A5F221E	30-1							
	405	584	0.88	4143753C41	30-2							
	422	492	0.65	4147586858	30-3							
	360	360	0.77	4148437E05	30-4							
	265	162	0.87	41440D2C3D	30-5							
	165	38	0.85		30-6							
	186	54	0.84		30-7							
	170	40	0.81		23-0							
n=	39					11				1		
Mean	404.3	831.8	0.86			269.9	273.1	1.04		153.0	36.0	1.01
Min	117	14	0.63			144	24	0.80		153	36	1.01
Max	725	2580	1.05			411	616	1.25		153	36	1.01

APPENDIX B (continued)

Table 14. Fish captured (raw data) during electrofishing surveys in Kennedy Creek, St. Mary River drainage, Montana, 1999.

Kennedy Creek - 7/26, 7/27, 8/9 & 8/25 -1999 - Electrofishing													
		Bull Trout					CTT & RBT			Brook Trout			
Recap		Length	Weight	Condition	Pit Tag	Scale Card	Length	Weight	Condition	Length	Weight	Condition	
1997	1998	(mm)	(g)	(K)	Number	Number	(mm)	(g)	(K)	(mm)	(g)	(K)	
		198	68	0.88		K1-1	282	208	0.93	127	20	0.98	
		277	190	0.89	5030632618	K1-2	357	424	0.93	224	112	1.00	
		144	26	0.87		K1-3	327	358	1.02	214	108	1.10	
		145	28	0.92		K1-4	298	300	1.13	191	74	1.06	
		215	86	0.87		K1-5	242	176	1.24	186	70	1.09	
		180	44	0.75		K1-6	254	176	1.07	92	8	1.03	
		154	30	0.82		K1-7	259	188	1.08	201	84	1.03	
		322	336	1.01	50307A0D65	K1-8	310	310	1.04	162	42	0.99	
		435	730	0.89	5030763B6D	K1-9	323	356	1.06	177	60	1.08	
		527	1514	1.03	503077610C	K1-0	294	280	1.10	177	58	1.05	
		150	28	0.83		K2-1	245	142	0.97	275	192	0.92	
		146	30	0.96		K2-2	209	84	0.92	210	98	1.06	
		192	62	0.88		K2-3	258	160	0.93	155	40	1.07	
	R	590	1980	0.96	4148252C2B	K2-4	300	266	0.99	155	36	0.97	
W85		615	2252	0.97	5030670617	K2-5	301	296	1.09	217	102	1.00	
		441	782	0.91	503064704E	K2-6	261	178	1.00	203	90	1.08	
		441	812	0.95	5030156507	K2-7	265	200	1.07	177	54	0.97	
	R	487	1008	0.87	41481C5665	K3-1	341	408	1.03	182	60	1.00	
	R	495	1154	0.95	4145672926	K3-2	103	10	0.92	170	52	1.06	
		400	564	0.88	5030715B68	K3-3	333	340	0.92	122	16	0.88	
W80	R	618	2010	0.85	4148212B2A	K3-4	259	190	1.09	151	32	0.93	
	R	434	736	0.90	4148437E05	K3-5	248	170	1.11				
W42	R	600	2024	0.94	414B040901	K3-6	277	196	0.92				
		429	720	0.91	50306D6E1B	K3-7	192	78	1.10				
		437	746	0.89	5030765046	K3-8	355	420	0.94				
		409	604	0.88	5030654861	K3-9	115	18	1.18				
		169	36	0.75		K3-0	328	320	0.91				
		266	166	0.88	5030705A5F	K4-1	306	300	1.05				
		234	112	0.87		K4-2	340	382	0.97				
		411	582	0.84	5030775448	K4-3	283	244	1.08				
		415	696	0.97	5030797760	K4-4	153	36	1.01				
		401	584	0.91	5030796855	K4-5	187	78	1.19				
		272	178	0.88	5030672A48	K4-6	220	120	1.13				
		222	114	1.04		K4-7	191	66	0.95				
		171	44	0.88		K4-8	237	122	0.92				
		182	50	0.83		K4-9							
		151	28	0.81		K4-0							
W57		539	1410	0.90	503074381D	K5-1							
W30		522	1224	0.86	5030722454	K5-2							
		477	904	0.83	50306E4F48	K5-3							
		522	1294	0.91	5030690F4E	K5-4							
		196	66	0.88		K5-5							
		165	40	0.89		K5-6							
		116	14	0.90		K5-7							
n=		44					35			21			
Mean		338.9	593.3	0.89			264.4	217.1	1.03	179.4	67.0	1.02	
Min		116	14	0.75			103	10	0.91	92	8	0.88	
Max		618	2252	1.04			357	424	1.24	275	192	1.10	

APPENDIX B (continued)

Table 15. Fish captured (raw data) during electrofishing surveys in Kennedy Creek, St. Mary River drainage, Montana, 2000.

Kennedy Creek - 7/12, 7/16, 7/26, 7/30, 8/8, 8/13 & 8/25 - 2000 - Electrofishing															
			Bull Trout					Cutthroat/Rainbow			Brook Trout				
Recap			Length	Weight	Condition	Pit Tag	Scale Card	Length	Weight	Condition	Length	Weight	Condition		
1997	1998	1999	(mm)	(g)	(K)	Number	Number	(mm)	(g)	(K)	(mm)	(g)	(K)		
			415	648	0.91	50306B2C3D		100	8	0.80	215	96	0.97		
			355	452	1.01	5030763959		372	480	0.93	149	28	0.85		
			208	74	0.82	5030727D36		155	38	1.02	147	34	1.07		
			213	80	0.83			355	494	1.10	165	46	1.02		
			261	160	0.90			235	120	0.92	172	54	1.06		
			142	26	0.91			342	426	1.06	174	52	0.99		
			100	8	0.80			303	278	1.00	196	90	1.20		
			365	458	0.94	NOT READ		305	260	0.92	244	168	1.16		
			328	328	0.93	503069391D		219	104	0.99	171	54	1.08		
			264	160	0.87			148	30	0.93	205	92	1.07		
			185	64	1.01			296	238	0.92	260	172	0.98		
			160	34	0.83			297	256	0.98	205	96	1.11		
			125	18	0.92			190	66	0.96	284	240	1.05		
			113	10	0.69			211	90	0.96	202	94	1.14		
			173	52	1.00			290	220	0.90	205	92	1.07		
			113	12	0.83			258	174	1.01	122	18	0.99		
			120	14	0.81			170	50	1.02	192	64	0.90		
			180	54	0.93			221	100	0.93	184	62	1.00		
			105	10	0.86			195	72	0.97	114	12	0.81		
			173	40	0.77			149	32	0.97	139	26	0.97		
			182	52	0.86			158	34	0.86	235	120	0.92		
			110	10	0.75			180	64	1.10	235	112	0.86		
		R	474	1092	1.03	503064704E	1K00-1	335	320	0.85	233	114	0.90		
			349	386	0.91	5030751A3E		360	400	0.86	182	60	1.00		
			225	108	0.95			240	140	1.01	121	18	1.02		
			471	908	0.87	5030664260		200	82	1.03	135	22	0.89		
			320	318	0.97			175	54	1.01	120	16	0.93		
	R	R	533	1370	0.90	4148437E05	1K00-2	250	140	0.90	118	16	0.97		
			48	1	0.90			162	40	0.94	118	14	0.85		
			49	1	0.85			361	474	1.01	113	12	0.83		
			51	1	0.75			320	360	1.10	140	24	0.87		
			44	1	1.17			240	130	0.94	190	62	0.90		
			448	1016	1.13	501F3C1442		362	502	1.06	197	70	0.92		
			393	600	0.99	50306E141E		291	316	1.28	242	140	0.99		
			410	668	0.97	5030764A4A		362	502	1.06	100	10	1.00		
			385	494	0.87	5030705948		291	316	1.28	110	12	0.90		
W85		R	643	1780	0.67	5030670617	2K00-1	390	608	1.02					
	R	R	615	2086	0.90	4148252C2B	2K00-2	366	513	1.05					
	R		520	1380	0.98	4148102303	2K00-3	370	524	1.03					
			44	1	1.17			395	586	0.95					
			335	310	0.82	5030717119		450	928	1.02					
			340	338	0.86	50306A5366		270	200	1.02					
			327	288	0.82	502F3D7C3F		322	302	0.90					
			270	192	0.98	5030632953		328	320	0.91					
			310	262	0.88	50306F3855		114	12	0.81					
			263	190	1.04	503075180A		302	242	0.88					
			410	572	0.83	50300F2635		204	82	0.97					
			372	358	0.70	5030761A4D		148	30	0.93					
			368	346	0.69	5030681762		172	48	0.94					
			360	370	0.79	5030793D6B		285	200	0.86					
			361	380	0.81	5030676D3C		118	14	0.85					
			368	412	0.83	5030750957		105	10	0.86					
			300	270	1.00	501F370967		151	32	0.93					
			390	512	0.86	5030744F14		177	48	0.87					
			215	92	0.93			106	10	0.84					
	R-O	R	610	1958	0.86	414403781C	3K00-1	100	10	1.00					
			346	340	0.82	503072450D									
			316	280	0.89	50306E224D									
			330	332	0.92	503066521E									
			358	412	0.90	503079652A									
			324	300	0.88	5030790A1B									
			353	420	0.95	50306C0710									
			379	500	0.92	5030655D26	3K00-3								
	R	R	472	900	0.86	4144135F7E									
			378	488	0.90	503075135B									
			395	512	0.83	5030763A4E									
			465	910	0.91	503071587F									
W80	R	R	630	2250	0.90	4148212B2A	1K00-3								

			292	204	0.82	5030667E41									
			452	800	0.87	502F3C5832									
			243	136	0.95										
			370	522	1.03	5030632321									
			126	16	0.80										
			365	444	0.91	5030707A5C									
			325	310	0.90	5030760275									
			235	124	0.96										
	R		640	2182	0.83	414374484B	1K00-5								
			162	38	0.89										
			123	16	0.86										
			172	42	0.83										
			446	790	0.89	5030743675									
			405	610	0.92	50306A4702									
			323	310	0.92	5030111953									
			265	162	0.87										
	R-O	R	516	1566	1.14	414410745F	1K00-7								
			433	726	0.89	5030785F31									
	R	R	521	1276	0.90	4145672926	1K00-8								
			405	590	0.89	503074634B									
		R-O	489	1028	0.88	50306A4D70	1K00-9								
			190	58	0.85										
			200	74	0.93										
	R		558	1456	0.84	4144060D39	2K00-5								
			422	660	0.88	5030745A53									
			422	700	0.93	502F336B70									
			415	566	0.79	502F3A6478									
			213	78	0.81										
			172	50	0.98										
			130	18	0.82										
			132	18	0.78										
			240	172	1.24										
			613	2086	0.91	5030633048									
			338	350	0.91	50306D1912									
	R	R	529	1202	0.81	41495D2CO2									
			220	116	1.09										
			220	94	0.88										
			202	72	0.87										
			180	64	1.10										
			203	90	1.08										
		R-O	460	760	0.78	5030745021	2K00-6								
			442	750	0.87	5030775171									
			390	600	1.01	5030753576									
			605	1828	0.83	5030730059									
	R	R	529	1210	0.82	414916347F									
		R	481	1050	0.94	50306E1313	2K00-9								
	R		488	1126	0.97	41440A785F	2K00-10								
			285	210	0.91										
			331	384	1.06	5030770D2A									
			291	258	1.05	5030701C08									
W57		R	545	1414	0.87	503074381D	3K00-3								
			440	695	0.82	5030794856									
			365	420	0.86	5030680A63									
			373	438	0.84	5030761A4D									
			247	142	0.94										
			465	888	0.88	501F464778									
			385	522	0.91	50306F7F21									
			308	264	0.90	5030642B18									
			152	28	0.80										
			62	2	0.84										
			58	2	1.03										
			61	2	0.88										
			433	700	0.86	5030690231									
			115	12	0.79										
			125	16	0.82										
			381	488	0.88	502F2F3974									
			56	2	1.14										
			59	2	0.97										
n=			136					56			36				
Mean			313.2	466.9	0.90			249.5	216.6	0.97	175.9	67.0	0.98		
Min			44	1	0.67			100	8	0.80	100	10	0.81		
Max			643	2250	1.24			450	928	1.28	284	240	1.20		

APPENDIX B (continued)

Table 16. Fish captured (raw data) during electrofishing surveys in Lower Otatso Creek (downstream from the park line), St. Mary River drainage, Montana, 1999.

Lower Otatso Creek (Downstream from Park Line) - 8/6/99 - Electrofishing										
		Bull Trout					Cutthroat & Rainbow			
Recap		Length	Weight	Condition	Pit Tag	Scale Card	Length	Weight	Condition	
1997	1998	(mm)	(g)	(K)	Number	Number	(mm)	(g)	(K)	
		316	338	1.07	5030676F08	O1-1	193	80	1.11	
		419	622	0.85	5030794C4C	O1-2	202	82	0.99	
		218	92	0.89	503069136C	O1-3	209	86	0.94	
		235	124	0.96		O1-4	150	30	0.89	
		259	164	0.94	503074772F	O1-5	80	6	1.17	
		368	482	0.97	5030751456	O1-6	220	124	1.16	
							224	120	1.07	
							154	34	0.93	
							111	16	1.17	
							140	24	0.87	
							230	130	1.07	
							170	54	1.10	
							170	52	1.06	
							230	118	0.97	
							235	120	0.92	
	n=	6					15			
	Mean	302.5	303.7	0.95			181.2	71.7	1.03	
	Min	218	92	0.85			80	6	0.87	
	Max	419	622	1.07			235	130	1.17	

APPENDIX B (continued)

Table 17. Fish captured (raw data) during electrofishing surveys in Lower Otatso Creek (downstream from the park line), St. Mary River drainage, Montana, 2000.

Lower Otatso Creek (Downstream from Park Line) - 7/28 & 8/22 - 2000 - Electrofishing

			Bull Trout					Cutthroat/Rainbow		
Recap			Length	Weight	Condition	Pit Tag	Scale Card	Length	Weight	Condition
1997	1998	1999	(mm)	(g)	(K)	Number	Number	(mm)	(g)	(K)
			287	210	0.89	501F461D0D		138	24	0.91
			275	202	0.97	50301A363F		129	20	0.93
			422	664	0.88	503067711E		242	144	1.02
			207	76	0.86			270	202	1.03
			215	90	0.91			300	288	1.07
			296	244	0.94	5030715C65		252	152	0.95
			268	170	0.88	5030771605		210	90	0.97
			405	580	0.87	50306E7369		248	152	1.00
			463	794	0.80	503072216D		239	130	0.95
			253	178	1.10			243	144	1.00
			302	230	0.84			320	330	1.01
			358	390	0.85	50306E7650		251	150	0.95
			180	46	0.79			190	74	1.08
			340	292	0.74	5030756D37		132	24	1.04
			315	264	0.84	50306E5A0F		184	60	0.96
			367	460	0.93	5030713B12		151	36	1.05
			200	70	0.88			319	328	1.01
			275	190	0.91			286	248	1.06
			315	274	0.88	502F3C623D		287	256	1.08
			265	170	0.91			141	30	1.07
			346	346	0.84	50306E5E15		220	116	1.09
								240	126	0.91
								277	238	1.12
								230	148	1.22
								210	100	1.08
								220	114	1.07
								245	166	1.13
								175	56	1.04
								150	36	1.07
								201	86	1.06
								184	76	1.22
								243	154	1.07
								160	38	0.93
								295	340	1.32
								258	174	1.01
								322	352	1.05
								280	186	0.85
								256	164	0.98
								280	222	1.01
								145	40	1.31
								305	358	1.26
								285	268	1.16
								268	206	1.07
								264	202	1.10
								235	146	1.12
								263	202	1.11
								214	110	1.12
								210	102	1.10
								273	242	1.19
								220	130	1.22
								256	176	1.05
								198	84	1.08
								252	166	1.04
								270	210	1.07
								180	58	0.99
								284	240	1.05
								76	4	0.91
								260	222	1.26
								252	164	1.02
								131	22	0.98
								147	32	1.01
n=			21					47		
Mean			302.6	282.9	0.88			229.0	150.1	1.06
Min			180	46	0.74			76	4	0.85
Max			463	794	1.10			322	358	1.32

APPENDIX B (continued)

Table 18. Fish captured (raw data) during electrofishing surveys in middle Otatso Creek upstream from park line - downstream from Slide Lakes, St. Mary River drainage, Montana, 1998.

Middle Otatso Creek (downstream from Slide Lakes/Landslide) 7/22/98 - Electrofishing							
Bull Trout					Cutthroat& Rainbow		
Length (mm)	Weight (g)	Condition (K)	Pit Tag Number	Scale Card Number	Length (mm)	Weight (g)	Condition (K)
196	72	0.96		6-7	165	48	1.07
196	62	0.82		6-8	105	14	1.21
184	60	0.96		6-9	105	10	0.86
174	50	0.95		6-0	228	126	1.06
175	56	1.04		7-1			
146	28	0.90		7-2			
126	20	1.00		7-3			
125	22	1.13		7-5			
118	14	0.85		7-6			
110	12	0.90		7-7			
136	24	0.95		7-8			
125	18	0.92		7-4			
197	65	0.85		9-5			
203	76	0.91		9-6			
177	50	0.90		9-7			
188	66	0.99		9-8			
195	64	0.86		9-9			
196	72	0.96		9-0			
182	50	0.83		10-0			
130	18	0.82		10-2			
236	120	0.91		10-3			
183	58	0.95		12-3			
182	60	1.00		12-4			
190	66	0.96		12-5			
178	60	1.06		12-6			
137	18	0.70		12-7			
352	514	1.18	4149242B56	6-1			
270	180	0.91	41491D1A30	6-2			
265	156	0.84	414A2A2A5A	6-3			
241	136	0.97	414B125147	6-4			
205	82	0.95	413B097100	6-5			
210	88	0.95	413BA057A?	6-6			
472	1015	0.97	413B187C07	8-1			
435	720	0.87	414A44630C	8-2			
432	722	0.90	414A1E3336	8-3			
445	654	0.74	413B227975	8-4			
314	302	0.98	41480A4F79	8-5			
240	126	0.91	41482E6430	8-6			
242	138	0.97	4147620D50	8-7			
255	138	0.83	413B186B74	8-8			
246	152	1.02	414928472B	8-9			
300	240	0.89	41485E580B	8-0			
235	118	0.91	414A566975	9-1			
237	136	1.02	414806337A	9-2			
244	138	0.95	414A397955	9-3			
211	88	0.94	41481E0E43	9-4			

	432	856	1.06	41487E526E	10-4				
	352	386	0.89	413B1D6209	10-5				
	373	456	0.88	413B2F1A57	10-6				
	284	228	1.00	413B361533	10-7				
	287	220	0.93	4148552643	10-8				
	274	194	0.94	4147292069	10-9				
	224	236	2.10	41483B5217	10-0				
	245	140	0.95	413B501134	11-1				
	273	182	0.89	4148797F6D	11-2				
	238	138	1.02	41437F1868	11-3				
	237	126	0.95	413B320775	11-4				
	253	144	0.89	414829533F	11-5				
	234	130	1.01	414405561C	11-6				
	249	140	0.91	4149214834	11-7				
	237	120	0.90	414944131B	11-8				
	236	126	0.96	414A670231	11-9				
	224	106	0.94	4149063009	11-0				
	227	116	0.99	4144065D3E	12-1				
	200	78	0.98	414912271A	12-2				
n=	65						4		
Mean	235.6	173.0	0.95				150.8	49.5	1.05
Min	110	12	0.70				105	10	0.86
Max	472	1015	2.10				228	126	1.21

Table 19. Fish captured (raw data) during electrofishing surveys in middle Otatso Creek upstream from park line - downstream from Slide Lakes, St. Mary River drainage, Montana, 1999.

Middle Otatso Creek (downstream from Slide Lakes/Landslide) 8/19-8/20 1999 - Electrofishing								
	Bull Trout					Cutthroat & Rainbow		
1998 Recap	Length (mm)	Weight (g)	Condition (K)	Pit Tag Number	Scale Card Number	Length (mm)	Weight (g)	Condition (K)
R	310	294	0.99	414A397955	SL1-1	126	18	0.90
	237	136	1.02	5030695418	SL1-2	165	42	0.93
	264	196	1.07	503072227A	SL1-3	178	56	0.99
	245	144	0.98	502F266261	SL1-4	111	12	0.88
	195	60	0.81		SL1-5	202	82	0.99
	187	60	0.92		SL1-6	207	100	1.13
	192	66	0.93		SL1-7			
	190	68	0.99		SL1-8			
	135	20	0.81		SL1-9			
	143	24	0.82		SL1-0			
	265	188	1.01		SL2-1			
	220	94	0.88		SL2-2			
	255	148	0.89		SL2-3			
	207	88	0.99		SL2-4			
	219	84	0.80		SL2-5			
	197	60	0.78		SL2-6			
	138	22	0.84		SL2-7			
	125	20	1.02		SL2-8			
	129	22	1.02		SL2-9			
	234	116	0.91	5030746751	SL2-0			
	483	902	0.80	50306B7C3A	SL3-1			
	461	830	0.85	501F374D04	SL3-2			
	476	938	0.87	50306D4D0F	SL3-3			
	405	654	0.98	503067020D	SL3-4			
	493	998	0.83	5030793A66	SL3-5			
	457	804	0.84	50306A5071	SL3-6			
	292	250	1.00	5030635206	SL3-7			
	270	208	1.06	5030733333	SL3-8			
	279	184	0.85	5030146513	SL3-9			
	263	196	1.08	50306C5B4B	SL3-0			
	244	144	0.99		SL4-1			
	216	84	0.83		SL4-2			
	142	24	0.84		SL4-3			
	145	26	0.85		SL4-4			
	225	108	0.95		SL4-5			
	238	138	1.02		SL4-6			
	385	540	0.95		SL4-7			
	478	938	0.86		SL4-8			
	485	900	0.79		SL4-9			
	400	650	1.02		SL4-0			
	435	844	1.03	503065093B	SL5-1			
	413	668	0.95	5030717E52	SL5-2			
	491	998	0.84	5030744C03	SL5-3			
	448	778	0.87	5030663050	SL5-4			
	457	852	0.89	5030755116	SL5-5			
	69	3	0.91					
	273	180	0.88		SL5-6			

	197	60	0.78		SL5-7			
	240	138	1.00		SL5-8			
	205	78	0.91		SL5-9			
	210	92	0.99		SL5-0			
	203	74	0.88		SL6-1			
	193	60	0.83		SL6-2			
	197	60	0.78		SL6-3			
	148	28	0.86		SL6-4			
	127	18	0.88		SL6-5			
R	363	408	0.85	413B1D6209	SL6-6			
	490	990	0.84	503077556B	SL6-7			
	382	600	1.08	5030735818	SL6-8			
	448	780	0.87	5030756B19	SL6-9			
	425	836	1.09	4143705546	SL6-0			
	449	768	0.85					
	441	720	0.84	4144124E37	SL7-1			
	420	688	0.93	4143704D7E	SL7-2			
	461	918	0.94	41440E106F	SL7-3			
	413	666	0.95	414414504A	SL7-4			
	448	836	0.93	4144194542	SL7-5			
	451	764	0.83	41437E0270	SL7-6			
	438	720	0.86	41440F5F49	SL7-7			
	149	28	0.85		SL7-8			
	209	82	0.90		SL7-9			
	131	20	0.89		SL7-0			
	207	86	0.97		SL8-1			
	220	100	0.94		SL8-2			
	177	48	0.87		SL8-3			
	186	54	0.84		SL8-4			
	129	20	0.93		SL8-5			
	158	32	0.81		SL8-6			
	250	154	0.99		SL8-7			
	295	254	0.99	4144123178	SL8-8			
	267	182	0.96	41437E5926	SL8-9			
	468	808	0.79	4145786773	SL8-0			
	472	924	0.88	414409525D	SL9-1			
	432	778	0.97	41437F3603	SL9-2			
	451	836	0.91	414403205D	SL9-3			
	465	972	0.97	414408637B	SL9-4			
	443	774	0.89	41457B0243	SL9-5			
	432	842	1.04	414403734D	SL9-6			
	438	722	0.86	414379145F	SL9-7			
	463	808	0.81	4144176F0F	SL9-8			
n=	90					6		
Mean	301.6	379.4	0.91			164.8	51.7	0.97
Min	69	3	0.78			111	12	0.88
Max	493	998	1.09			207	100	1.13

APPENDIX B (continued)

Table 20. Fish captured (raw data) during electrofishing surveys in middle Otatso Creek upstream from park line - downstream from Slide Lakes, St. Mary River drainage, Montana, 2000.

Middle Otatso Creek (Downstream from Slide Lakes) - 7/27 & 8/11 - 2000 - Electrofishing

		Bull Trout					Cutthroat/Rainbow		
Recap		Length	Weight	Condition	Pit Tag	Scale Card	Length	Weight	Condition
1998	1999	(mm)	(g)	(K)	Number	Number	(mm)	(g)	(K)
		333	320	0.87	5030647577	O100-2	150	32	0.95
		289	242	1.00	5030184E1A		271	184	0.92
		210	84	0.91			260	172	0.98
		250	142	0.91			382	330	0.59
		270	192	0.98	502F265725		291	284	1.15
		137	24	0.93			281	222	1.00
		198	80	1.03			169	44	0.91
		204	80	0.94			380	676	1.23
		196	68	0.90			280	240	1.09
		187	62	0.95			290	300	1.23
	R	195	62	0.84			152	30	0.85
		175	44	0.82					
		444	840	0.96	5030686645				
		487	892	0.77	50306A565F				
		222	106	0.97					
		213	86	0.89					
		222	98	0.90					
		196	68	0.90					
		210	80	0.86					
		222	98	0.90					
		199	70	0.89					
		207	84	0.95					
		190	60	0.87					
		206	72	0.82					
		209	72	0.79					
		192	64	0.90					
		210	80	0.86					
		224	110	0.98					
		246	136	0.91					
		206	68	0.78					
		211	82	0.87					
R	R	390	598	1.01	413B1D6209	O100-1			
		277	192	0.90	50306C5F51				
		262	150	0.83	5030716921				
		210	78	0.84					
		206	82	0.94					
		200	70	0.88					
		140	22	0.80					
		409	610	0.89	503078341A				
		413	642	0.91	5030776E47				
		422	668	0.89	5030714922				
	R	492	926	0.78	5030744C03	O100-3			
		213	82	0.85					
		213	78	0.81					
		210	88	0.95					
		154	34	0.93					
		160	32	0.78					
		229	104	0.87					
		244	144	0.99					
		140	26	0.95					
		206	88	1.01					
		224	94	0.84					
		330	358	1.00	4147620D50				
		310	282	0.95	50306C6902				
		270	186	0.94	50306F0474				
		318	318	0.99	5030695844				
		280	232	1.06	5030661B02				
		261	170	0.96	502F3E0D6B				
		295	266	1.04	5030710F75				
		287	214	0.91	503073172A				
n=		60					11		
Mean		248.8	190.0	0.91			264.2	228.5	0.99
Min		137	22	0.77			150	30	0.59
Max		492	926	1.06			382	676	1.23

APPENDIX B (continued)

Table 21. Fish captured (raw data) during electrofishing surveys in Otatso Creek upstream from Slide Lakes, St. Mary River drainage, Montana, 1998-1999.

Upper Otatso Creek – Slide Lakes (Above Landslide)
Electrofishing - 1998 & 1999

	Bull Trout 7/21/98				CTT & RBT 7/21/98			Bull Trout 8/20/99				CTT & RBT 8/20/99		
	Length (mm)	Weight (g)	Condition (K)	Scale Card Number	Length (mm)	Weight (g)	Condition (K)	Length (mm)	Weight (g)	Condition (K)	Scale Card Number	Length (mm)	Weight (g)	Condition (K)
	572	1092	0.58	3-1	341	332	0.84	316	272	0.86	SL9-9	115	14	0.92
	540	938	0.60	3-2	245	140	0.95	295	236	0.92	SL9-0			
	161	36	0.86	3-3				277	180	0.85	SL10-1			
	157	32	0.83	3-4				279	190	0.87	SL10-2			
	140	26	0.95	3-5				235	108	0.83	SL10-3			
	145	30	0.98	3-6				274	182	0.88	SL10-4			
	146	26	0.84	3-7				345	328	0.80	SL10-5			
	125	18	0.92	3-8				179	50	0.87	SL10-6			
	126	22	1.10	3-9				265	152	0.82	SL10-7			
	135	20	0.81	3-0				232	106	0.85	SL10-8			
	96	8	0.90	4-1				177	46	0.83	SL10-9			
	110	12	0.90	4-2				201	72	0.89	SL10-0			
	101	8	0.78	4-3				223	106	0.96				
	120	16	0.93	4-4				168	40	0.84				
	100	6	0.60	4-5				207	80	0.90				
	101	10	0.97	4-6				236	132	1.00				
	90	8	1.10	4-7				99	8	0.82				
	97	8	0.88	4-8				474	850	0.80				
	84	4	0.67	4-9				530	1000	0.67				
	90	4	0.55	4-0				537	1080	0.70				
	68	2	0.64	---				459	804	0.83				
	82	4	0.73	---				173	46	0.89				
	72	4	1.07	---				156	32	0.84				
	70	2	0.58	---				180	52	0.89				
	62	2	0.84	---				183	54	0.88				
	75	4	0.95	---				76	4	0.91				
	76	4	0.91	---				124	18	0.94				
	75	4	0.95	---										
	423	716	0.95	5-1										
	367	466	0.94	5-2										
	367	438	0.89	5-3										
	247	132	0.88	5-4										
	238	114	0.85	5-5										
	225	106	0.93	5-6										
	235	128	0.99	5-7										
	226	100	0.87	5-8										
	155	32	0.86	5-9										
	152	34	0.97	5-0										
	87	4	0.61	---										
n=	39				2			27				1		
Mean	167.6	118.5	0.85		293.0	236.0	0.89	255.6	230.7	0.86		115.0	14.0	0.92
Min	62	2	0.55		245	140	0.84	76	4	0.67		115	14	0.92
Max	572	1092	1.10		341	332	0.95	537	1080	1.00		115	14	0.92

APPENDIX B (continued)

Table 22. Fish captured (raw data) during electrofishing surveys in Otatso Creek upstream from Slide Lakes, St. Mary River drainage, Montana, 2000.

Upper Otatso Creek (Upstream from Landslide) - 7/27/2000 - Electrofishing

		Bull Trout					Cutthroat/Rainbow		
Recap		Length	Weight	Condition	Pit Tag	Scale Card	Length	Weight	Condition
1998	1999	(mm)	(g)	(K)	Number	Number	(mm)	(g)	(K)
		535	960	0.63	5030744566		105	10	0.86
		275	202	0.97	5030722D31				
		470	822	0.79	501F436474				
		194	64	0.88					
		215	90	0.91					
		184	64	1.03					
		147	36	1.13					
		151	36	1.05					
		111	16	1.17					
		125	18	0.92					
		100	12	1.20					
		115	16	1.05					
		115	14	0.92					
		104	10	0.89					
		116	14	0.90					
		78	4	0.84					
		100	10	1.00					
		91	8	1.06					
		70	4	1.17					
		75	4	0.95					
		76	4	0.91					
		68	2	0.64					
		233	128	1.01					
		196	74	0.98					
		220	100	0.94					
		187	64	0.98					
		197	76	0.99					
		160	38	0.93					
		153	36	1.01					
		140	26	0.95					
		130	20	0.91					
		130	22	1.00					
		115	16	1.05					
		158	38	0.96					
		142	26	0.91					
		150	34	1.01					
		133	20	0.85					
		94	10	1.20					
		115	16	1.05					
		210	92	0.99					
		212	88	0.92					
		233	116	0.92					
		271	192	0.96					
		209	92	1.01					
		240	134	0.97					
		210	104	1.12					
		238	132	0.98					
		221	110	1.02					
		192	76	1.07					
		155	46	1.24					
		108	12	0.95					
		117	14	0.87					
		106	10	0.84					
n=		53					1		
Mean		167.7	82.5	0.97			105.0	10.0	0.86
Min		68	2	0.63			105	10	0.86
Max		535	960	1.24			105	10	0.86

APPENDIX B (continued)

Table 23. Fish captured (raw data) during electrofishing surveys in Lee Creek, St. Mary River drainage, Montana, 1998.

Lee Creek - 8/18/98 - Electrofishing									
	Bull Trout					Cutthroat & Rainbow			
	Length (mm)	Weight (g)	Condition (K)	Pit Tag Number	Scale Card Number	Length (mm)	Weight (g)	Condition (K)	Scale Card Number
	137	16	0.62		30-1	143	24	0.82	32-1
	118	12	0.73		30-2	231	116	0.94	32-2
	131	18	0.80		30-3	160	32	0.78	32-3
	121	12	0.68		30-4	160	34	0.83	32-4
	129	18	0.84		30-5	161	36	0.86	32-5
	126	16	0.80		30-6	211	88	0.94	32-6
	92	6	0.77		30-7	178	54	0.96	32-7
	93	6	0.75		35-2	190	56	0.82	32-8
	128	16	0.76		35-3	100	6	0.60	32-9
	97	8	0.88		35-4	96	8	0.90	32-0
	52	1	0.71		35-5	172	44	0.86	33-1
	520	974	0.69	4143722632	30-8	142	24	0.84	33-2
	475	802	0.75	4144134D34	30-9	121	18	1.02	33-3
	394	486	0.79	4144023B66	30-0	105	10	0.86	33-4
	403	510	0.78	4143712E07	31-1	148	24	0.74	33-5
	545	1286	0.79	413B442A78	31-2	70	2	0.58	33-6
	562	1206	0.68	414373796A	31-3	382	528	0.95	33-7
	514	1168	0.86	4144176167	31-4	202	78	0.95	33-8
	470	900	0.87	41440D4A69	31-5	219	108	1.03	33-9
	400	546	0.85	414400675A	31-6	132	20	0.87	33-0
	480	1004	0.91	41456D5B26	31-7	141	22	0.78	---
	410	592	0.86	41437E4B6C	31-8	157	32	0.83	---
	472	966	0.92	4144002E46	31-9				
	450	850	0.93	4144151E4F	31-0				
	453	778	0.84	414D2A5479	---				
	475	1034	0.96	414D17686C	---				
	500	1114	0.89	41440A0C41	34-2				
	442	840	0.97	41436E3342	34-3				
	445	960	1.09	414371582D	34-4				
	458	890	0.93	414D300D47	34-5				
	462	896	0.91	41440B154E	34-6				
	532	1312	0.87	4144167723	34-7				
	592	1704	0.82	4144025574	34-8				
	568	1664	0.91	41440F391D	34-9				
	563	1642	0.92	41437C3349	34-0				
	510	1228	0.93	4144177737	35-1				
n=	36					22			
Mean	370.0	707.8	0.83			164.6	62.0	0.85	
Min	52	1	0.62			70	2	0.58	
Max	592	1704	1.09			382	528	1.03	

APPENDIX B (continued)

Table 24. Fish captured (raw data) during electrofishing surveys in Lee Creek, St. Mary River drainage, Montana, 1999.

Lee Creek - 7/24 & 8/24 – 1999 - Electrofishing								
	Bull Trout					Cutthroat & Rainbow		
	Length (mm)	Weight (g)	Condition (K)	Pit Tag Number	Scale Card Number	Length (mm)	Weight (g)	Condition (K)
	387	492	0.85	5030686B3A	L1-1	190	72	1.05
	440	820	0.96	503072535D	L1-2	145	30	0.98
	155	36	0.97		L1-3	203	84	1.00
	163	32	0.74		L1-4	140	26	0.95
	170	38	0.77		L1-5	139	24	0.89
	139	24	0.89		L1-6	138	22	0.84
	160	38	0.93		L1-7	105	10	0.86
	168	38	0.80		L1-8	315	300	0.96
	164	36	0.82		L1-9	278	202	0.94
	128	16	0.76		L1-0	211	78	0.83
	175	44	0.82		L2-1	131	20	0.89
	129	16	0.75		L2-2	98	8	0.85
	141	22	0.78		L2-3	185	54	0.85
	180	50	0.86		L2-4	147	30	0.94
	413	654	0.93	501F35130C	L2-5	163	42	0.97
	358	350	0.76	50306D6150	L2-6	163	40	0.92
	370	454	0.90	502F277425	L2-7	94	8	0.96
	355	350	0.78	5030713354	L2-8	108	10	0.79
	185	54	0.85		L2-9	138	24	0.91
	147	26	0.82		L2-0	80	4	0.78
	167	36	0.77		L3-1	233	134	1.06
	121	16	0.90		L3-2	108	10	0.79
	164	36	0.82		L3-3	225	124	1.09
	154	32	0.88		L3-4	221	100	0.93
	168	36	0.76		L3-5	205	85	0.99
	165	34	0.76		L3-6			
	162	36	0.85		L3-7			
	158	34	0.86		L3-8			
	101	10	0.97		L4-1			
	151	28	0.81		L4-2			
	150	26	0.77		L4-3			
	142	20	0.70		L4-4			
	147	24	0.76		L4-5			
	100	8	0.80		L4-6			
	55	1	0.60					
	151	30	0.87		L4-7			
	108	12	0.95		L4-8			
	98	8	0.85		L4-9			
	384	456	0.81	5030721429	L4-0			
	160	36	0.88		L5-1			
	142	24	0.84		L5-2			
	143	24	0.82		L5-3			
	380	466	0.85	5030794D6F	L5-4			
n=	43					25		
Mean	190.7	116.8	0.83			166.5	61.6	0.92
Min	55	1	0.60			80	4	0.78
Max	440	820	0.97			315	300	1.09

Table 25. Fish captured (raw data) during electrofishing surveys in Lee Creek, St. Mary River drainage, Montana, 2000.

Lee Creek - 7/13, 7/15, 8/10 & 8/24 - 2000 - Electrofishing									
		Bull Trout					Cutthroat/Rainbow		
Recap		Length	Weight	Condition	Pit Tag	Scale Card	Length	Weight	Condition
1998	1999	(mm)	(g)	(K)	Number	Number	(mm)	(g)	(K)
		190	54	0.79			198	86	1.11
		157	38	0.98			215	114	1.15
		151	28	0.81			195	80	1.08
		129	18	0.84			124	22	1.15
		97	8	0.88			148	36	1.11
		80	4	0.78			160	42	1.03
		90	6	0.82			165	50	1.11
		90	6	0.82			111	14	1.02
		139	22	0.82			107	12	0.98
		141	24	0.86			114	12	0.81
		95	8	0.93			197	76	0.99
		173	46	0.89			188	68	1.02
		90	6	0.82			145	32	1.05
		85	6	0.98			180	60	1.03
		91	6	0.80			228	122	1.03
		88	6	0.88			229	144	1.20
		90	6	0.82			125	18	0.92
		92	8	1.03			249	156	1.01
		93	8	0.99			160	52	1.27
		100	8	0.80			200	104	1.30
		98	6	0.64			225	124	1.09
		145	46	1.51			198	78	1.00
		110	14	1.05			138	24	0.91
		100	12	1.20			170	50	1.02
		95	6	0.70			136	24	0.95
		143	26	0.89			136	26	1.03
		138	20	0.76			184	60	0.96
		130	18	0.82			205	100	1.16
		132	20	0.87			236	140	1.07
		94	8	0.96			200	68	0.85
	R	441	932	1.09	5030730D26		165	40	0.89
		430	750	0.94	502F3B2053		210	100	1.08
		130	20	0.91			160	42	1.03
		140	24	0.87			205	106	1.23
		153	36	1.01			183	68	1.11
		130	24	1.09			105	12	1.04
		135	24	0.98			210	78	0.84
		160	50	1.22			333	332	0.90
		135	22	0.89			156	34	0.90
		143	26	0.89			134	24	1.00
		90	6	0.82			125	18	0.92
		90	6	0.82			230	124	1.02
		88	6	0.88			210	78	0.84
		445	822	0.93	5030787A0B		153	34	0.95
		179	44	0.77			140	28	1.02
		220	94	0.88			215	102	1.03
		174	44	0.84			112	12	0.85
		179	72	1.26			206	92	1.05
		174	58	1.10			286	230	0.98
		133	20	0.85			261	186	1.05
		134	24	1.00			250	154	0.99
		177	56	1.01			263	188	1.03
		178	58	1.03			256	198	1.18
		176	52	0.95			230	144	1.18
		169	46	0.95			205	92	1.07
		172	52	1.02			196	80	1.06
		173	48	0.93			156	38	1.00

	504	1224	0.96	503079090C	152	36	1.03
	137	22	0.86		194	72	0.99
	358	448	0.98	502F3C777A	172	54	1.06
	145	30	0.98		137	28	1.09
	182	58	0.96		169	56	1.16
	179	50	0.87		214	108	1.10
	172	44	0.86		191	74	1.06
	160	32	0.78		145	32	1.05
	350	430	1.00	503068637C	207	104	1.17
	181	50	0.84		242	134	0.95
	153	30	0.84		190	64	0.93
	100	12	1.20		208	88	0.98
	105	10	0.86		176	48	0.88
	102	12	1.13		145	22	0.72
	103	12	1.10		206	80	0.92
	101	10	0.97		234	118	0.92
	90	8	1.10		189	56	0.83
	105	10	0.86		152	30	0.85
	200	68	0.85		220	122	1.15
	182	58	0.96		190	68	0.99
	152	30	0.85		100	12	1.20
	59	2	0.97		193	68	0.95
	93	8	0.99		152	32	0.91
	50	1	0.80		133	20	0.85
	109	12	0.93		175	48	0.90
	143	26	0.89		113	10	0.69
	58	2	1.03		195	72	0.97
	144	26	0.87		201	74	0.91
	100	8	0.80				
	133	22	0.94				
	108	12	0.95				
	51	1	0.75				
	96	8	0.90				
	190	56	0.82				
	130	22	1.00				
	150	28	0.83				
	92	8	1.03				
	100	10	1.00				
	85	8	1.30				
	95	8	0.93				
	95	8	0.93				
	91	6	0.80				
	92	6	0.77				
	52	1	0.71				
	51	1	0.75				
	53	1	0.67				
	54	1	0.64				
	54	2	1.27				
	49	1	0.85				
	50	1	0.80				
	52	1	0.71				
	96	8	0.90				
	142	24	0.84				
	178	50	0.89				
	135	22	0.89				
	57	2	1.08				
	136	20	0.80				
	97	8	0.88				
	207	78	0.88				
	135	22	0.89				
	106	10	0.84				
	55	2	1.20				
	54	2	1.27				
	57	2	1.08				
	95	8	0.93				
	92	6	0.77				
	51	1	0.75				
n=	124				85		
Mean	133.3	57.4	0.92		183.7	74.8	1.01
Min	49	1	0.64		100	10	0.69
Max	504	1224	1.51		333	332	1.30

APPENDIX B (continued)

Table 26. Fish captured (raw data) during electrofishing surveys in Jule Creek, St. Mary River drainage, Montana, 1998-1999.

Jule Creek - Electrofishing - 1998 & 1999												
	Bull Trout 8/11/98			CTT & RBT 8/11/98			Bull Trout 7/13/99			CTT & RBT 7/13/99		
	Length (mm)	Weight (g)	Condition (K)	Length (mm)	Weight (g)	Condition (K)	Length (mm)	Weight (g)	Condition (K)	Length (mm)	Weight (g)	Condition (K)
	148	26	0.80	140	26	0.95	95	8	0.93	64	2	0.76
	125	14	0.72	177	54	0.97	132	18	0.78	70	4	1.17
	104	8	0.71	195	70	0.94				68	2	0.64
	120	12	0.69	162	42	0.99				67	2	0.66
	100	8	0.80	156	34	0.90				63	2	0.80
	101	6	0.58	138	24	0.91				72	4	1.07
	99	8	0.82	152	34	0.97				64	4	1.53
	92	6	0.77	130	22	1.00				104	10	0.89
	89	6	0.85	135	24	0.98				141	22	0.78
	91	6	0.80	130	18	0.82				148	26	0.80
	95	6	0.70	118	14	0.85				81	4	0.75
				122	16	0.88						
				125	16	0.82						
				118	16	0.97						
				100	8	0.80						
				126	18	0.90						
				130	20	0.91						
				118	14	0.85						
				117	14	0.87						
				125	20	1.02						
				110	10	0.75						
				100	8	0.80						
				84	2	0.34						
				112	6	0.43						
				80	4	0.78						
				109	12	0.93						
				74	4	0.99						
				101	8	0.78						
				110	12	0.90						
				110	14	1.05						
				115	14	0.92						
				86	6	0.94						
				132	14	0.61						
				120	14	0.81						
				118	20	1.22						
				120	26	1.50						
				85	6	0.98						
n=	11			37			2			11		
Mean	105.8	9.6	0.75	121.1	18.5	0.89	113.5	13.0	0.86	85.6	7.5	0.90
Min	89	6	0.58	74	2	0.34	95	8	0.78	63	2	0.64
Max	148	26	0.85	195	70	1.50	132	18	0.93	148	26	1.53

APPENDIX B (continued)

Table 27. Fish captured (raw data) during electrofishing surveys in Middle Fork Lee Creek, St. Mary River drainage, Montana, 1998-1999.

Middle Fork Lee Creek - Electrofishing - 1998 & 1999											
	Bull Trout 8/11/98				CTT & RBT 8/11/98				CTT & RBT 7/13/99		
	Length (mm)	Weight (g)	Condition (K)	Scale Card Number	Length (mm)	Weight (g)	Condition (K)	Scale Card Number	Length (mm)	Weight (g)	Condition (K)
	235	100	0.77	28-1	234	108	0.84	28-3	155	34	0.91
	175	46	0.86	28-2	205	80	0.93	28-4	191	66	0.95
					150	38	1.13	28-5	178	54	0.96
					160	40	0.98	28-6	180	68	1.17
					180	60	1.03	28-7	172	52	1.02
					115	14	0.92	28-8	175	60	1.12
					185	58	0.92	28-9	176	60	1.10
					155	40	1.07	28-0			
					160	32	0.78	29-1			
					150	32	0.95	29-2			
					174	54	1.03	29-3			
					135	26	1.06	29-4			
					162	40	0.94	29-5			
					145	26	0.85	29-6			
n=	2				14				7		
Mean	205.0	73.0	0.81		165.0	46.3	0.96		175.3	56.3	1.03
Min	175	46	0.77		115	14	0.78		155	34	0.91
Max	235	100	0.86		234	108	1.13		191	68	1.17

APPENDIX B (continued)

Table 28. Cutthroat Trout captured (raw data) during electrofishing surveys in East Fork Lee Creek and Roberts Creek, St. Mary River drainage, Montana, 1999.

East Fork Lee Creek - Cutthroat
7/12/99 - Electrofishing

	Length (mm)	Weight (g)	Condition (K)
	148	32	0.99
	217	114	1.12
	124	20	1.05
	103	10	0.92
	135	24	0.98
	157	38	0.98
	198	84	1.08
	191	68	0.98
	174	50	0.95
	140	30	1.09
	128	22	1.05
	180	64	1.10
	192	88	1.24
	150	36	1.07
	123	20	1.07
	148	34	1.05
	161	52	1.25
	137	26	1.01
	132	22	0.96
	113	14	0.97
	135	24	0.98
	128	24	1.14
	98	8	0.85
	96	10	1.13
	119	18	1.07
	108	14	1.11
	105	12	1.04
n=27			
Mean	142.2	35.5	1.04
Min	96	8	0.85
Max	217	114	1.25

Roberts Creek - Cutthroat Trout
7/13/99 - Electrofishing

	Length (mm)	Weight (g)	Condition (K)
	98	8	0.85
	177	52	0.94
	165	42	0.93
	135	18	0.73
	110	10	0.75
n=5			
Mean	137.0	26.0	0.84
Min	98	8	0.73
Max	177	52	0.94

APPENDIX B (continued)

Table 29. Westslope cutthroat trout captured (raw data) during electrofishing surveys in Wild Creek, St. Mary River drainage, Montana, 1998-1999.

Wild Creek - Electrofishing - 1998 & 1999							
	Westslope CTT - 7/27/98				Westslope CTT - 7/23/99		
	Length (mm)	Weight (g)	Condition (K)	Scale Card Number	Length (mm)	Weight (g)	Condition (K)
	147	34	1.07	15-1			
	104	10	0.89	15-2	65	3	1.09
	157	40	1.03	15-3	63	2	0.80
	147	36	1.13	15-4	113	14	0.97
	138	32	1.22	15-5	148	34	1.05
	186	74	1.15	15-6	115	18	1.18
	125	22	1.13	15-7	122	16	0.88
	148	34	1.05	15-9	114	12	0.81
	113	14	0.97	15-0	118	12	0.73
	144	34	1.14	15-8	114	12	0.81
	140	28	1.02	16-1	62	2	0.84
	127	20	0.98	16-2	61	2	0.88
	125	20	1.02	16-3	62	2	0.84
	55	1	0.60	16-4	63	4	1.60
	134	24	1.00	16-5	64	4	1.53
	143	32	1.09	16-6	144	32	1.07
	130	22	1.00	16-7	130	22	1.00
	143	32	1.09	16-8	113	14	0.97
	197	90	1.18	16-9	155	42	1.13
	133	22	0.94	16-0	110	14	1.05
	130	22	1.00	17-1	133	28	1.19
	147	34	1.07	17-2	175	60	1.12
	124	18	0.94	17-3	154	40	1.10
	66	2	0.70	17-4	130	26	1.18
	148	32	0.99	17-5	103	14	1.28
	124	18	0.94	17-6	125	24	1.23
	116	16	1.03	17-7			
	110	12	0.90	17-8			
	113	14	0.97	17-9			
	75	2	0.47	17-0			
	110	10	0.75	---			
	108	10	0.79	---			
	109	14	1.08	---			
	64	3	1.14	---			
	66	2	0.70	---			
n=	34				25		
Mean	124.2	23.7	0.98		110.2	18.1	1.05
Min	55	1	0.47		61	2	0.73
Max	197	90	1.22		175	60	1.60

APPENDIX B (continued)

Table 30. Cutthroat trout × rainbow trout captured (raw data) during electrofishing surveys in Divide Creek, St. Mary River drainage, Montana, 1998-1999.

Divide Creek - Electrofishing - 1998 & 1999 Cutthroat and Rainbow Trout						
	07/08/1998			08/05/1999		
	Length (mm)	Weight (g)	Condition (K)	Length (mm)	Weight (g)	Condition (K)
	80	4	0.78	186	62	0.96
	220	84	0.79	162	40	0.94
				128	18	0.86
				134	20	0.83
				131	16	0.71
				110	12	0.90
				113	14	0.97
				110	12	0.90
				75	4	0.95
				82	4	0.73
				84	6	1.01
				77	6	1.31
				79	4	0.81
				69	4	1.22
				75	4	0.95
n=	2			15		
Mean	150.0	44.0	0.79	107.7	15.1	0.94
Min	80	4	0.78	69	4	0.71
Max	220	84	0.79	186	62	1.31

APPENDIX B (continued)

Table 31. Cutthroat × rainbow and brook trout captured (raw data) during electrofishing surveys in Rose Creek, St. Mary River drainage, Montana, 2000.

Rose Creek (Rising Sun) - 7/25/2000 - Electrofishing												
	Bull Trout					Cutthroat/Rainbow			Brook Trout			
	Length (mm)	Weight (g)	Condition (K)	Pit Tag Number	Scale Card Number	Length (mm)	Weight (g)	Condition (K)	Length (mm)	Weight (g)	Condition (K)	
						242	152	1.07	230	150	1.23	
						180	64	1.10				
						213	86	0.89				
						184	72	1.16				
						252	164	1.02				
						163	44	1.02				
						74	2	0.49				
						68	2	0.64				
n=	0					8			1			
Mean						172.0	73.3	0.92	230.0	150.0	1.23	
Min						68	2	0.49	230	150	1.23	
Max						252	164	1.16	230	150	1.23	

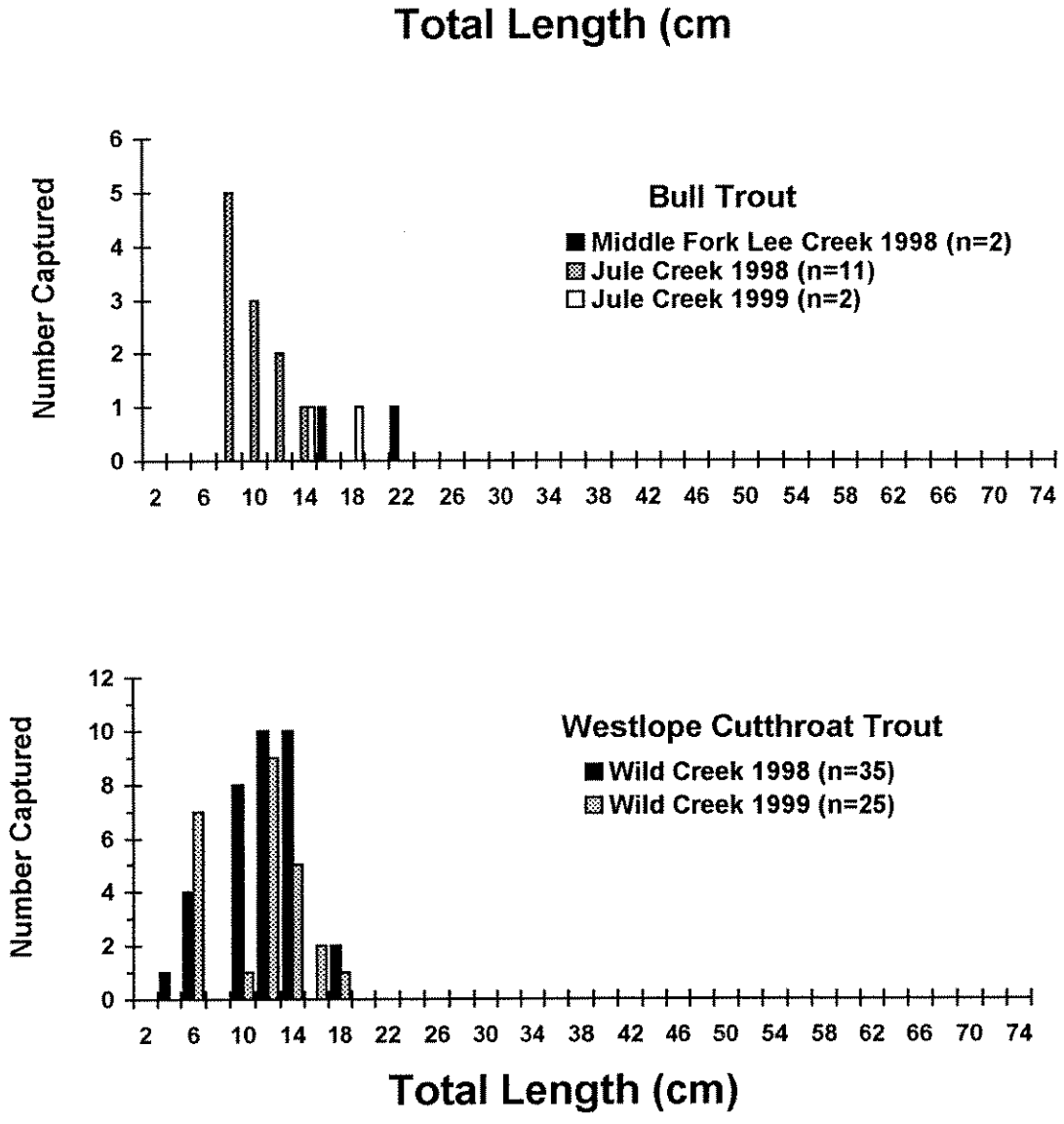

Figure 12. Length-frequency distributions for all bull trout captured during electrofishing surveys in Middle Fork Lee and Jule creeks and all westslope cutthroat trout captured during electrofishing surveys in Wild Creek, St. Mary River drainage, Montana, 1998-1999.

APPENDIX C

Table 32. Fish captures (raw data), Boulder Creek fish trap, St. Mary River drainage, Montana, 1997.

BOULDER CREEK FISH TRAP – 1997

A-BLT (17)				J-BLT (30)				CTT & RBT (27)		
TAG #	LENGTH (mm)	WEIGHT (g)	K	TAG #	LENGTH (mm)	WEIGHT (g)	K	LENGTH (mm)	WEIGHT (g)	K
W02	425	774	1.008	W00	245	128	0.870	185	68	1.074
W03	416	780	1.083	W01	220	88	0.826	223	132	1.190
W27	433	816	1.005	W04	211	80	0.852	195	88	1.187
W29	478	962	0.881	W05	227	98	0.838	206	92	1.052
W32	515	1144	0.838	W06	224	92	0.819	465	934	0.929
W40	438	744	0.885	W09	255	144	0.868	196	74	0.983
W43	472	896	0.852	W17	179	50	0.872	210	100	1.080
W46	545	1308	0.808	W19	195	66	0.890	209	90	0.986
W47	524	1158	0.805	W20	206	72	0.824	245	152	1.034
W53	431	654	0.817	W21	221	86	0.797	225	120	1.053
W54	501	1022	0.813	W24	223	86	0.776	201	80	0.985
W55	555	1414	0.827	-	182	48	0.796	185	62	0.979
W62	465	784	0.780	W26	202	66	0.801	237	132	0.992
W65	554	1402	0.825	W52	248	132	0.865	211	100	1.065
W70	565	1410	0.782	W61	237	114	0.856	202	84	1.019
W71	586	1650	0.820	W69	243	114	0.794	233	128	1.012
W76	493	900	0.751	W75	226	102	0.884	205	74	0.859
				-	185	56	0.884	203	86	1.028
				-	192	58	0.819	172	42	0.825
				-	186	52	0.808	193	72	1.002
				W78	244	124	0.854	245	148	1.006
				W79	230	104	0.855	230	120	0.986
				-	194	60	0.822	190	64	0.933
				-	184	54	0.867	170	50	1.018
				W81	229	98	0.816	206	92	1.052
				-	194	56	0.767	194	72	0.986
				-	191	62	0.890	321	312	0.943
				-	182	48	0.796			
				-	188	48	0.722			
				-	178	44	0.780			
AVE	493.9	1,048.1	0.858		210.7	81.0	0.830	220.6	132.1	1.010
MIN	416	654	0.751		178	44	0.722	170	42	0.825
MAX	586	1,650	1.083		255	144	0.890	465	934	1.190

Table 33. Fish captures (raw data), Boulder Creek fish trap, St. Mary River drainage, Montana, 1998.

BOULDER CREEK FISH TRAP - 1998

A-BLT (64)						J-BLT (23)					CTT & RBT (15)		
PIT TAG #	RECAP 1997	LENGTH (mm)	WEIGHT (g)	K	SCALE CARD	PIT TAG #	LENGTH (mm)	WEIGHT (g)	K	SCALE CARD	LENGTH (mm)	WEIGHT (g)	K
414417474A		311	322	1.070	42-1	4143794161	171	44	0.880	42-2	184	48	0.771
41437E320D		343	306	0.758	42-3	4143732C54	183	48	0.783	42-5	215	94	0.946
41440B6C2F		520	1256	0.893	42-4	---	181	46	0.776	42-6	270	96	0.488
41440F2963		404	594	0.901	42-7	---	163	32	0.739	46-1	243	146	1.017
tag not read		408	596	0.878	42-8	---	169	36	0.746	46-2	197	66	0.863
41437E2A35		409	604	0.883	42-9	---	181	44	0.742	46-9	225	111	0.974
414855171D		393	546	0.900	42-0	---	174	42	0.797	46-0	230	120	0.986
41487D4263		400	600	0.938	46-3	---	185	48	0.758	47-2	245	134	0.911
413B0D4052		447	756	0.846	46-4	---	189	54	0.800	49-4	190	72	1.050
4149065073		332	344	0.940	46-6	---	179	40	0.697	49-5	126	10	0.500
41456E4777	W40	500	1148	0.918	46-5	---	174	38	0.721	49-6	221	64	0.593
41456C4B4C		566	1532	0.845	46-7	---	169	34	0.704	51-9	221	92	0.852
4143786F1E		335	335	0.891	46-8	---	205	74	0.859	51-0	220	90	0.845
414903163C		519	1272	0.910	47-1	---	183	48	0.783	57-5	172	42	0.825
414A733521		516	1330	0.968	47-3	---	185	52	0.821	57-6	224	105	0.934
41437F5F1C		409	534	0.780	47-4	---	180	46	0.789	---			
4144023037	W62	497	1067	0.869	47-5	---	182	30	0.498	---			
4144146F7C		397	488	0.780	47-6	---	173	24	0.464	57-9			
4148123D72		417	596	0.822	47-7	---	182	34	0.564	57-0			
41437A035F		585	1638	0.818	47-8	4144187977	235	104	0.801	60-5			
4143774838		492	1023	0.859	47-9	---	183	44	0.718	---			
41437D127D		459	808	0.836	49-1	---	171	38	0.760	---			
413B3C3A4B		422	706	0.939	49-2	---	214	74	0.755	---			
4144140928		468	880	0.859	49-3								
414A287D37		416	534	0.742	---								
---		385	450	0.789	49-7								
41437B0B0D		513	1008	0.747	49-8								
4144164449		623	1772	0.733	49-9								
4143736548	(lost)	512	1084	0.808	49-0								
41440B365A		504	902	0.705	51-1								
41437D1C15		511	1122	0.841	51-2								
41440B5B5F		478	884	0.809	51-3								
4144105165		434	766	0.937	51-4								
4143727B4A		470	900	0.867	51-5								
414403172D		441	666	0.777	51-6								
4143734A00		496	884	0.724	51-7								
4144024207	W71	611	1871	0.820	51-8								
41437B2445		565	1448	0.803	57-2								
4143764149		576	1604	0.839	57-3								
4143712B3E		491	926	0.782	57-4								
4148123534		436	818	0.987	---								
413B00197F	W54	523	1212	0.847	---								
41440A6B36		648	2365	0.869	57-7								
41477C441C		632	1668	0.661	---								
4144083C5B	(lost)	536	1364	0.886	60-1								
41437F256A	(lost)	462	874	0.886	60-2								
41436F4920		487	1350	1.169	60-3								
4144052321		368	424	0.851	60-4								
414415472D		493	1262	1.053	60-6								
41440D3E77		603	1756	0.801	60-7								
41437E7925		582	1688	0.856	60-9								
41456F2137		561	1598	0.905	60-0								
414B0C3577		575	1768	0.930	61-1								
414413616B		621	2168	0.905	61-2								
4143762010		690	2654	0.808	61-3								

41440D1228		656	2678	0.949	---								
4143753B4C		442	672	0.778	---								
414418137F		419	582	0.791	---								
41440E5016		430	672	0.845	---								
41436C580E		589	1658	0.811	---								
414374412E		448	792	0.881	---								
---		639	2166	0.830	---								
---		529	1362	0.920	---								
414375576A		590	2102	1.023	---								
AVE		492.7	1,121.2	0.860			183.1	46.7	0.737		212.2	86.0	0.837
MIN		311	306	0.661			163	24	0.464		126	10	0.488
MAX		690	2,678	1.169			235	104	0.880		270	146	1.050

Table 34. Fish captures (raw data), Boulder Creek fish trap, St. Mary River drainage, Montana, 1999.

BOULDER CREEK FISH TRAP - 1999

A-BLT (23)								J-BLT (36)				CTT & RBT (26)		
PIT TAG #	RECAP 1997	RECAP 1998	RECAP 1999E	LENGTH (mm)	WEIGHT (g)	K	SCALE CARD	LENGTH (mm)	WEIGHT (g)	K	SCALE CARD	LENGTH (mm)	WEIGHT (g)	K
4149065073		R		410	802	1.164	BT1-1	175	48	0.896	---	200	78	0.975
50306D1243				422	814	1.083	BT2-1	207	74	0.834	BT2-2	176	42	0.770
5030654D58				389	608	1.033	BT2-5	159	32	0.796	BT2-3	234	118	0.921
414417474A		R	E	410	582	0.844	BT2-8	175	44	0.821	BT2-4	224	106	0.943
50306D6364				471	944	0.903	BT2-9	187	46	0.703	BT2-6	139	26	0.968
41437A3322		R		466	826	0.816	BT2-0	162	32	0.753	BT2-7	150	34	1.007
41456E4777	W40	R		554	1692	0.995	BT1-6	158	32	0.811	---	215	98	0.986
414375576A		R	E	613	2048	0.889	BT1-7	181	44	0.742	BT1-4	163	38	0.877
41436F4920		R		534	1622	1.065	BT1-8	169	38	0.787	BT1-5	147	26	0.819
5030733862				432	840	1.042	BT1-9	169	42	0.870	---	205	88	1.021
5030775814				543	1522	0.951	BT1-0	173	44	0.850	---	210	90	0.972
41440A6B36		R		695	3220	0.959	BT3-1	203	62	0.741	BT3-3	247	138	0.916
414415472D		R		545	1446	0.893	BT3-2	204	68	0.801	BT4-1	232	108	0.865
4143734A00		R		518	1248	0.898	BT3-4	210	70	0.756	BT4-2	255	166	1.001
41477C441C		R		662	2152	0.742	BT3-5	216	86	0.853	BT4-3	215	94	0.946
4143762010				690	2872	0.874	BT3-6	207	74	0.834	BT4-4	195	60	0.809
----------	???			643	2448	0.921	BT3-7	181	46	0.776	BT4-5	208	88	0.978
4144105165		R	E	489	978	0.836	BT3-8	182	44	0.730	BT4-6	296	264	1.018
41456F2137		R		610	2022	0.891	BT3-9	191	58	0.832	BT4-7	229	128	1.066
5030797A1F				650	2120	0.772	BT3-0	184	48	0.771	BT4-8	225	100	0.878
414A733521		R	E	560	1728	0.984	BT5-1	183	40	0.653	BT4-9	206	82	0.938
41437A035F		R		613	1860	0.807	---	173	42	0.811	BT4-0	195	70	0.944
MORT				454	836	0.893	BT6-2	162	36	0.847	---	227	126	1.077
								181	42	0.708	---	203	66	0.789
								168	34	0.717	---	185	50	0.790
								183	46	0.751	---	172	38	0.747
								170	42	0.855	---			
								165	36	0.801	BT5-2			
								186	52	0.808	BT5-3			
								177	46	0.830	BT5-4			
								167	40	0.859	BT5-5			
								184	54	0.867	BT5-6			
								185	50	0.790	BT5-7			
								176	40	0.734	BT5-8			
								165	36	0.801	BT5-9			
Recaps (n=)	2	14	4					160	34	0.830	BT5-0			
AVE				538.0	1532	0.924		180	47	0.795		206	89	0.924
MIN				389	582	0.742		158	32	0.653		139	26	0.747
MAX				695	3220	1.164		216	86	0.896		296	264	1.077

APPENDIX C (continued)

Table 35. Fish captures (raw data), Boulder Creek fish trap, St. Mary River drainage, Montana, 2000.

BOULDER CREEK FISH TRAP - 2000

A-BLT (23)									J-BLT (31)			CTTxRBT (12)		
PIT TAG #	RECAP 1997	1998	1999	2000E	LENGTH (mm)	WEIGHT (g)	K	SCALE CARD	LENGTH (mm)	WEIGHT (g)	K	LENGTH (mm)	WEIGHT (g)	K
502F391E7D					415	632	0.884		165	38	0.846	235	118	0.909
503063392D					441	734	0.856		202	68	0.825	200	72	0.900
503072361E					432	846	1.049		175	40	0.746	217	96	0.939
503078715A					412	588	0.841		185	46	0.727	185	68	1.074
501F416530					384	404	0.713		174	44	0.835	295	80	0.312
5030693D07					410	628	0.911		173	42	0.811	205	82	0.952
5030793971					346	310	0.748		207	68	0.767	196	80	1.062
5030724200					372	430	0.835		194	66	0.904	200	84	1.050
50306B7903					372	390	0.758		186	60	0.932	210	82	0.885
5030751929					372	420	0.816		205	68	0.789	189	68	1.007
41437D0203		R-kt		E	580	1570	0.805		191	50	0.718	200	90	1.125
41437A035F		R	R		620	2038	0.855		162	36	0.847	136	24	0.954
50306E3007				E	495	1100	0.907		187	64	0.979			
503067674E				E	600	2042	0.945	1BT00-1	210	82	0.885			
41440A6B36		R	R		763	3754	0.845	1BT00-2	162	40	0.941			
50306B7371					410	622	0.902		179	42	0.732			
414413561B		R-kt		E	489	890	0.761	1BT00-3	193	46	0.640			
5030651D5F				E	460	954	0.980		194	46	0.630			
4149065073		R	R		475	872	0.814		193	44	0.612			
41456E4777	W40	R	R		607	2062	0.922	1BT00-5	200	62	0.775			
414375576A		R	R		650	2480	0.903		180	46	0.789			
4143762010		R	R		735	2900	0.730	1BT00-6	168	36	0.759			
41477C441C		R	R		668	2200	0.738		200	66	0.825			
									222	88	0.804			
									185	48	0.758			
									178	38	0.674			
									165	40	0.890			
									178	46	0.816			
									190	58	0.846			
									183	54	0.881			
									182	56	0.929			
Recaps (n=)	1	9	7	5										
AVE					500.3	1,255.0	0.849		186.1	52.5	0.804	205.7	78.7	0.931
MIN					346	310	0.713		162	36	0.612	136	24	0.312
MAX					763	3,754	1.049		222	88	0.979	295	118	1.125

Table 36. Fish captures (raw data), Kennedy Creek fish trap, St. Mary River drainage, Montana, 1997.

KENNEDY CREEK FISH TRAP - 1997										
A-BLT (32)				J-BLT (1)				CTT & RBT (13)		
TAG #	LENGTH (mm)	WEIGHT (g)	K	TAG #	LENGTH (mm)	WEIGHT (g)	K	LENGTH (mm)	WEIGHT (g)	K
W08	442	812	0.940	-	156	26	0.685	109	10	0.772
W12	360	472	1.012					262	164	0.912
W13	480	1050	0.949					113	12	0.832
W14	506	1394	1.076					340	350	0.890
W18	358	408	0.889					207	78	0.879
W22	409	616	0.900					266	166	0.882
W23	356	406	0.900					248	150	0.983
W25	396	594	0.957					321	374	1.131
W28	550	1476	0.887					333	342	0.926
W30	428	622	0.793					250	174	1.114
W31	400	570	0.891					174	44	0.835
W36	665	1828	0.622					197	66	0.863
W37	495	814	0.671					210	80	0.864
W39	565	1312	0.727							
W41	542	1306	0.820							
W42	565	1418	0.786							
W44	636	2020	0.785							
W45	492	1000	0.840							
W49	422	582	0.774							
W50	555	1360	0.796							
W51	550	1380	0.829							
W57	474	928	0.871							
W60	582	1620	0.822							
W63	516	1002	0.729							
W64	571	1434	0.770							
W67	445	682	0.774							
W68	643	1798	0.676							
W74	470	760	0.732							
W80	580	1518	0.778							
W84	720	2504	0.671							
W85	611	1940	0.851							
W86	615	1886	0.811							
AVE	512.5	1,172.3	0.823		156.0	26.0	0.685	233.1	154.6	0.914
MIN	356	406	0.622		156	26	0.685	109	10	0.772
MAX	720	2,504	1.076		156	26	0.685	340	374	1.131

APPENDIX C (continued)

Table 37. Fish captures (raw data), Kennedy Creek fish trap, St. Mary River drainage, Montana, 1998.

KENNEDY CREEK FISH TRAP - 1998

A-BLT (38)						J-BLT (6)					CTT & RBT (6)		
PIT TAG #	RECAP 1997	LENGTH (mm)	WEIGHT (g)	K	SCALE CARD	PIT TAG #	LENGTH (mm)	WEIGHT (g)	K	SCALE CARD	LENGTH (mm)	WEIGHT (g)	K
414411121F		357	356	0.782	44-2	4144090D11	279	200	0.921	---	166	44	0.962
4148102303		394	532	0.870	44-3	413B231547	190	52	0.758	44-1	255	140	0.844
41436E3261		461	846	0.864	44-4	---	233	104	0.822	52-0	210	90	0.972
414A5F221E		375	416	0.789	30-1	---	237	116	0.871	53-1	280	198	0.902
414A71691D		382	440	0.789	44-5	---	211	78	0.830	53-5	257	154	0.907
41481C5665		424	618	0.811	44-6	4144012503	227	92	0.787	53-8	219	100	0.952
4144100D3E		355	378	0.845	44-7								
41437D0203		471	886	0.848	44-8								
414419436C		481	864	0.776	44-9								
41440D7648		436	698	0.842	44-0								
414413561B		395	550	0.892	52-1								
414916347F		384	458	0.809	52-2								
41440A785F		373	450	0.867	52-3								
414411767F		350	384	0.896	52-4								
4144153729		374	422	0.807	52-5								
41495D2C02		351	382	0.883	52-6								
4144060D39		354	386	0.870	52-7								
4144170507		370	408	0.805	52-8								
---		316	256	0.811	52-9								
41437A3322		401	560	0.868	53-2								
41436D793A		415	574	0.803	53-3								
4144070F19		383	502	0.894	53-4								
4149113634		650	2236	0.814	---								
4144107271	W13	542	1396	0.877	---								
4148717245	W28	577	1602	0.834	---								
41440F5E6A	(lost)	560	1604	0.913	53-6								
413A7E0943		482	882	0.788	---								
414B040901	W42	570	1510	0.815	---								
4144110E3D		477	798	0.735	---								
4144160604		462	770	0.781	53-7								
4143771B28		451	840	0.916	53-9								
4143765014	W31	455	780	0.828	---								
4144135F7E		435	822	0.999	53-0								
41437A3201	W14	534	1320	0.867	58-1								
414377383C	W51	552	1306	0.776	58-2								
4144184762		367	420	0.850	58-3								
413B506C4F		541	1358	0.858	---								
414408662E		553	1698	1.004	54-2								
AVE		442.4	808.1	0.844			229.5	107.0	0.832		231.2	121.0	0.915
MIN		316	256	0.735			190	52	0.758		166	44	0.844
MAX		650	2,236	1.004			279	200	0.921		280	198	0.972

Table 38. Fish captures (raw data), Kennedy Creek fish trap, St. Mary River drainage, Montana, 1999.

KENNEDY CREEK FISH TRAP -1999

				A-BLT (20)				J-BLT (10)				CTT & RBT (7)		
PIT TAG	RECAP			LENGTH	WEIGHT	K	SCALE	LENGTH	WEIGHT	K	SCALE	LENGTH	WEIGHT	K
#	1997	1998	1999E	(mm)	(g)		CARD	(mm)	(g)		CARD	(mm)	(g)	
414916347F		R		466	860	0.850	KT1-1	189	60	0.889	---	322	324	0.970
414403781C		R		565	1588	0.880	KT1-2	170	38	0.773	KT2-9	241	140	1.000
502F3E5409				475	900	0.840	OT/KT-5	145	26	0.853	KT2-0	213	90	0.931
----------				395	544	0.883	---	206	76	0.869	KT3-1	110	14	1.052
503072173E				406	540	0.807	KT2-1	191	56	0.804	KT3-2	210	82	0.885
4148437E05		R	E	446	748	0.843	KT1-3	210	72	0.777	KT3-3	262	178	0.990
5030791134				456	824	0.869	KT1-4	180	46	0.789	KT3-4	210	100	1.080
5030796855				400	574	0.897	KT1-5	213	86	0.890	KT3-6			
4145672926		R	E	482	934	0.834	KT1-6	181	48	0.809	KT3-7			
414410745F		R		485	966	0.847	KT1-7	209	80	0.876	KT3-8			
4144135F7E		R		455	842	0.894	KT2-2							
503077610C			E	525	1214	0.839	KT2-3							
503074381D	W57		E	529	1172	0.792	KT2-4							
414408662E		R		580	1666	0.854	KT2-5							
50306E1313				478	828	0.758	KT2-6							
50306A4D70				455	814	0.864	---							
41436C092A		R		361	430	0.914	KT2-7							
413B506C4F		R		590	1700	0.828	KT2-8							
414B040901	W42	R	E	603	1618	0.738	---							
41495D2C02		R		410	594	0.862	KT3-5							
Recaps (n=)	2	11	5											
AVE				478	968	0.845		189	59	0.833		224	133	0.990
MIN				361	430	0.738		145	26	0.773		110	14	0.885
MAX				603	1700	0.914		213	86	0.890		322	324	1.080

APPENDIX C (continued)

Table 39. Fish captures (raw data), Kennedy Creek fish trap, St. Mary River drainage, Montana, 2000.

KENNEDY CREEK FISH TRAP -2000

	A-BLT (9)								J-BLT (2)			CTTxRBT (5)		
PIT TAG	RECAP				LENGTH	WEIGHT	K	SCALE	LENGTH	WEIGHT	K	LENGTH	WEIGHT	K
#	1997	1998	1999	2000E	(mm)	(g)		CARD	(mm)	(g)		(mm)	(g)	
5030757F7D					385	404	0.708		222	116	1.060	184	52	0.835
502F297D76					340	306	0.779		275	200	0.962	258	166	0.967
41456F2137		R-bt	R-bt		628	2230	0.900	1KT00-1				192	62	0.876
5030676D3C				E	377	400	0.747	1KT00-2				255	136	0.820
5030680A63					360	376	0.806					242	128	0.903
mink mort					385	546	0.957							
5030691461					623	2220	0.918							
414374484B		R		E	633	2200	0.867							
4148212B2A	W80	R	R		633	2002	0.789							
Recaps (n=)	1	3	2	2										
AVE					484.9	1,187.1	0.830		248.5	158.0	1.011	226.2	108.8	0.891
MIN					340	306	0.708		222	116	0.962	184	52	0.820
MAX					633	2,230	0.957		275	200	1.060	258	166	0.967

Table 40. Fish captures (raw data), Otatso Creek fish trap, St. Mary River drainage, Montana, 1997.

OTATSO CREEK FISH TRAP - 1997										
A-BLT (16)				J-BLT (1)				CTT & RBT (16)		
TAG #	LENGTH (mm)	WEIGHT (g)	K	TAG #	LENGTH (mm)	WEIGHT (g)	K	LENGTH (mm)	WEIGHT (g)	K
W07	354	462	1.041	W16	196	58	0.770	247	146	0.969
W11	422	670	0.892					227	120	1.026
W33	581	1264	0.644					194	66	0.904
W34	415	636	0.890					182	56	0.929
W35	304	234	0.833					142	24	0.838
W38	601	1572	0.724					240	134	0.969
W48	508	1016	0.775					285	234	1.011
W56	467	734	0.721					263	196	1.077
W59	482	976	0.872					125	12	0.614
W66	617	1720	0.732					107	8	0.653
W72	418	536	0.734					178	48	0.851
W73	440	776	0.911					256	186	1.109
W77	395	406	0.659					124	14	0.734
W82	428	594	0.758					175	50	0.933
W83	561	1324	0.750					293	260	1.034
-	419	522	0.710					178	48	0.851
AVE	463.3	840.1	0.790		196.0	58.0	0.770	201.0	100.1	0.906
MIN	304	234	0.644		196	58	0.770	107	8	0.614
MAX	617	1,720	1.041		196	58	0.770	293	260	1.109

APPENDIX C (continued)

Table 41. Fish captures (raw data), Otatso Creek fish trap, St. Mary River drainage, Montana, 1998.

OTATSO CREEK FISH TRAP - 1998

A-BLT (19)						J-BLT (17)					CTT & RBT (29)		
PIT TAG #	RECAP 1997	LENGTH (mm)	WEIGHT (g)	K	SCALE CARD	PIT TAG #	LENGTH (mm)	WEIGHT (g)	K	SCALE CARD	LENGTH (mm)	WEIGHT (g)	K
41457D585D		307	312	1.078	41-1	41436C092A	291	246	0.998	41-2	224	108	0.961
413B3C6D41		447	904	1.012	41-7	41440F2D79	234	108	0.843	41-3	197	66	0.863
4149336A14		424	638	0.837	41-8	---	254	142	0.867	41-4	157	30	0.775
41437D404E	W82	464	816	0.817	48-3	---	172	36	0.707	41-5	201	76	0.936
41440D7C3A	W38	615	1562	0.672	41-0	---	166	34	0.743	41-6	187	58	0.887
41436C6A47		378	420	0.778	50-1	---	197	60	0.785	50-3	149	24	0.726
4144021951		450	762	0.836	50-5	---	191	54	0.775	50-4	121	16	0.903
4143796924	W48	524	1148	0.798	55-1	41440E1829	238	102	0.757	50-2	217	96	0.939
41440E1C33	W49	461	784	0.800	50-0	---	200	60	0.750	50-6	210	86	0.929
4144187D6B		358	420	0.915	50-9	---	188	50	0.752	50-7	203	76	0.909
4144004759		375	510	0.967	50-8	---	177	42	0.757	55-3	182	56	0.929
414403781C		480	962	0.870	55-2	---	193	54	0.751	55-4	353	148	0.336
414374484B		606	2108	0.947	55-5	---	238	104	0.771	---	185	58	0.916
414415293F		548	1302	0.791	55-6	---	175	44	0.821	55-0	266	172	0.914
41440E3D13	W87	438	668	0.795	55-7	---	172	36	0.707	---	220	104	0.977
41437F556E		462	918	0.931	55-8	---	190	52	0.758	59-3	224	100	0.890
414410745F		425	694	0.904	55-9	---	180	50	0.857	---	212	90	0.945
41436E5516		420	526	0.710	59-1						238	128	
41437A092D		335	298	0.793	59-2						187	52	
											166	34	
											166	44	
											215	94	
											228	108	
											227	112	
											139	22	
											146	24	
											127	16	
											225	112	
											272	206	
AVE		448.3	829.1	0.855			203.3	74.9	0.788		201.5	79.9	0.867
MIN		307	298	0.672			166	34	0.707		121	16	0.336
MAX		615	2,108	1.078			291	246	0.998		353	206	0.977

Table 42. Fish captures (raw data), Otatso Creek fish trap, St. Mary River drainage, Montana, 1999.

OTATSO CREEK FISH TRAP - 1999

				A-BLT (11)				J-BLT (6)				CTT & RBT (15)		
PIT TAG #	RECAP 1997	RECAP 1998	RECAP 1999E	LENGTH (mm)	WEIGHT (g)	K	SCALE CARD	LENGTH (mm)	WEIGHT (g)	K	SCALE CARD	LENGTH (mm)	WEIGHT (g)	K
503O6A4D70				465	870	0.865	OT1-1	186	48	0.746	---	143	26	0.889
41436C6A47		R		435	772	0.938	OT/KT-1	185	46	0.727	OT1-4	243	148	1.031
5030662517				456	820	0.865	OT/KT-2	196	58	0.770	OT1-5	240	154	1.114
---				321	288	0.871	OT/KT-3	207	78	0.879	---	227	112	0.958
---				340	308	0.784	OT/KT-4	246	120	0.806	OT1-6	225	112	0.983
41440E1C33		R		487	874	0.757	OT1-2	221	84	0.778	OT1-9	186	66	1.026
4148434A62		R		469	1096	1.062	OT1-3					149	28	0.846
5030750C6E				424	586	0.769	OT1-7					154	30	0.821
5030745021				420	658	0.888	OT1-8					227	116	0.992
41437F556E		R		531	1272	0.850	OT1-0					140	20	0.729
41437D404E	W82	R		504	1020	0.797	OT2-1					132	18	0.783
												136	18	0.716
												195	80	1.079
												142	26	0.908
Recaps (n=)	1	5	0									240	150	1.085
AVE				441	779	0.859		207	72	0.784		185	74	0.931
MIN				321	288	0.757		185	46	0.727		132	18	0.716
MAX				531	1272	1.062		246	120	0.879		243	154	1.114

APPENDIX C (continued)

Table 43. Fish captures (raw data), Otatso Creek fish trap, St. Mary River drainage, Montana, 2000.

OTATSO CREEK FISH TRAP - 2000

A-BLT (12)									J-BLT (1)			CTTxRBT (9)		
PIT TAG #	RECAP 1997	1998	1999	2000E	LENGTH (mm)	WEIGHT (g)	K	SCALE CARD	LENGTH (mm)	WEIGHT (g)	K	LENGTH (mm)	WEIGHT (g)	K
50306C001D					389	390	0.663		217	94	0.920	240	130	0.940
4148434A62		R-ke	R		492	1422	1.194	1OT00-1				290	232	0.951
503079652A					364	320	0.664	1OT00-2				246	122	0.820
502F350E58					385	476	0.834					257	164	0.966
5030797C31					390	490	0.826					226	100	0.866
503071457E	W66				660	2312	0.804					210	96	1.037
mink mort					350	340	0.793					84	6	1.012
mink mort					360	396	0.849					175	58	1.082
mink mort					335	314	0.835					155	36	0.967
503076411B					387	436	0.752							
no tags					350	400	0.933							
41437F556E		R	R		542	1412	0.887							
Recaps (n=)	1	2	2	0										
AVE					417.0	725.7	0.836		217.0	94.0	0.920	209.2	104.9	0.960
MIN					335	314	0.663		217	94	0.920	84	6	0.820
MAX					660	2,312	1.194		217	94	0.920	290	232	1.082

Table 44. Fish captures (raw data), Divide Creek fish trap, St. Mary River drainage, Montana, 1997.

DIVIDE CREEK FISH TRAP - 1997										
A-BLT (2)				J-BLT (0)				CTT & RBT (27)		
TAG #	LENGTH (mm)	WEIGHT (g)	K	TAG #	LENGTH (mm)	WEIGHT (g)	K	LENGTH (mm)	WEIGHT (g)	K
W10	546	1728	1.062					158	36	0.913
W58	362	396	0.835					147	30	0.944
								179	58	1.011
								199	78	0.990
								129	19	0.885
								205	70	0.813
								196	90	1.195
								200	80	1.000
								189	64	0.948
								187	60	0.918
								191	68	0.976
								191	70	1.005
								127	18	0.879
								102	8	0.754
								186	60	0.932
								147	30	0.944
								164	46	1.043
								184	56	0.899
								184	58	0.931
								201	74	0.911
								180	54	0.926
								115	14	0.921
								185	66	1.042
								158	36	0.913
								165	48	1.069
								184	60	0.963
								207	96	1.082
AVE	454.0	1,062.0	0.948					171.3	52.0	0.951
MIN	362	396	0.835					102	8	0.754
MAX	546	1,728	1.062					205	90	1.195

APPENDIX C (continued)

Table 45. Fish captures (raw data), Lee Creek fish trap, St. Mary River drainage, Montana, 1999.

LEE CREEK FISH TRAP - 1999

A-BLT (19)							J-BLT (69)					CTT & RBT (19)		
PIT TAG #	RECAP 1998	RECAP 1999E	LENGTH (mm)	WEIGHT (g)	K	SCALE CARD	PIT TAG #	LENGTH (mm)	WEIGHT (g)	K	SCALE CARD	LENGTH (mm)	WEIGHT (g)	K
5030721429		E	375	440	0.834	---		192	60	0.848	LT1-1	245	164	1.115
41436E3342	R		489	916	0.783	---		187	60	0.918	LT1-2	202	82	0.995
5030730D26			409	604	0.883	LT2-1		193	62	0.862	LT1-3	240	154	1.114
414D300D47	R		487	966	0.836	LT2-2		182	52	0.863	LT1-4	182	64	1.062
502F3D7F28			424	624	0.819	LT2-4		174	40	0.759	LT1-5	182	66	1.095
502F3E4477			470	786	0.757	LT3-5		193	56	0.779	LT1-6	233	126	0.996
5030646509			384	516	0.911	LT3-6		189	56	0.829	LT1-7	242	140	0.988
41437C3349	R		580	1710	0.876	LT4-1		200	64	0.800	LT1-8	254	178	1.086
5030646509			391	496	0.830	---		192	58	0.819	LT1-9	254	178	1.086
4143712E07	R		449	746	0.824	LT4-2		170	38	0.773	LT1-0	213	94	0.973
502F277425		E	358	358	0.780	---		202	66	0.801	LT2-3	185	64	1.011
5030640F01			381	500	0.904	LT4-3		206	76	0.869	LT2-5	220	100	0.939
5030687A67			374	480	0.918	LT4-4		226	96	0.832	LT2-6	175	54	1.008
			435	686	0.833	LT4-0		212	78	0.819	LT2-7	264	200	1.087
50306C3559			405	592	0.891	LT5-1		165	34	0.757	LT2-8	205	90	1.045
5030752326			389	492	0.836	LT5-2		184	52	0.835	LT2-9	215	104	1.046
4144167723	R		549	1554	0.939	LT6-1		175	46	0.858	LT2-0	216	96	0.953
503079014A			387	434	0.749	---		210	74	0.799	LT3-1	221	106	0.982
503072535D		E	465	788	0.784	LT7-1		204	66	0.777	LT3-2	161	44	1.054
								219	80	0.762	LT3-3			
								174	44	0.835	LT3-4			
								195	60	0.809	LT3-7			
								168	38	0.801	LT3-8			
								193	64	0.890	LT3-9			
								193	58	0.807	LT3-0			
								191	56	0.804	---			
								170	38	0.773	LT4-5			
								183	44	0.718	LT4-6			
								213	78	0.807	LT4-7			
								204	70	0.825	LT4-8			
								195	62	0.836	LT4-9			
							501F377232	289	190	0.787	LT5-3			
								221	86	0.797	LT5-4			
								175	40	0.746	LT5-5			
								160	32	0.781	---			
								185	48	0.758	---			
								143	20	0.684	LT5-6			
								185	46	0.727	LT5-7			
								149	26	0.786	LT5-8			
								160	30	0.732	LT5-9			
								193	56	0.779	LT5-0			
								185	50	0.790	---			
								154	30	0.821	---			
								179	44	0.767	---			
								175	43	0.802	---			
								170	32	0.651	---			
								181	34	0.573	---			
								144	20	0.670	---			
								165	30	0.668	---			
								209	74	0.811	LT6-2			
								174	42	0.797	---			
								170	38	0.773	---			
								195	64	0.863	---			
								184	50	0.803	---			
								197	60	0.785	LT6-3			
								198	60	0.773	LT6-4			
								200	62	0.775	LT6-5			
								195	68	0.917	LT6-6			

									176	40	0.734	LT6-7					
									172	40	0.786	---					
									143	24	0.821	---					
									144	24	0.804	---					
									185	54	0.853	LT6-8					
									180	56	0.960	LT6-9					
									182	52	0.863	LT6-0					
									173	44	0.850	---					
									137	22	0.856	---					
									146	26	0.835	---					
Recaps (n=)	5	3							197	60	0.785	---					
AVE			432	720	0.841				184	53	0.798			216	111	1.029	
MIN			358	358	0.749				137	20	0.573			161	44	0.939	
MAX			580	1710	0.939				289	190	0.960			264	200	1.114	

APPENDIX C (continued)

Table 46. Fish captures (raw data), Lee Creek fish trap, St. Mary River drainage, Montana, 2000.

LEE CREEK FISH TRAP - 2000

A-BLT (4)								J-BLT (84)			CTTxRBT (56)		
PIT TAG #	RECAP 1998	RECAP 1999	RECAP 2000E	LENGTH (mm)	WEIGHT (g)	K	SCALE CARD	LENGTH (mm)	WEIGHT (g)	K	LENGTH (mm)	WEIGHT (g)	K
50306F6A60				380	392	0.714		211	78	0.830	211	90	0.958
501F34277F				335	276	0.734		185	48	0.758	136	22	0.875
41437C3349	R	R		606	1418	0.637	1LT00-1	272	196	0.974	260	200	1.138
				386	458	0.796		211	70	0.745	234	98	0.765
								140	26	0.948	168	38	0.801
								220	86	0.808	250	122	0.781
								216	86	0.853	215	96	0.966
								221	82	0.760	219	100	0.952
								190	50	0.729	225	102	0.895
								198	60	0.773	230	130	1.068
								204	78	0.919	235	140	1.079
								185	50	0.790	241	133	0.950
								164	32	0.725	220	96	0.902
								230	90	0.740	232	132	1.057
								213	84	0.869	215	104	1.046
								170	42	0.855	207	84	0.947
								190	52	0.758	215	100	1.006
								162	42	0.988	210	86	0.929
								207	74	0.834	177	50	0.902
								198	64	0.824	280	204	0.929
								190	56	0.816	245	154	1.047
								190	56	0.816	210	86	0.929
								180	50	0.857	255	152	0.917
								180	52	0.892	213	86	0.890
								152	28	0.797	251	144	0.911
								188	52	0.783	277	200	0.941
								192	54	0.763	250	144	0.922
								222	118	1.079	221	106	0.982
								195	54	0.728	216	100	0.992
								170	38	0.773	150	34	1.007
								185	52	0.821	125	18	0.922
								180	50	0.857	125	16	0.819
								182	49	0.813	178	40	0.709
								192	50	0.706	260	148	0.842
								178	42	0.745	190	68	0.991
								185	42	0.663	240	140	1.013
								140	64	2.332	220	98	0.920
								191	50	0.718	172	46	0.904
								168	38	0.801	214	82	0.837
								185	38	0.600	295	210	0.818
								211	72	0.766	225	108	0.948
								200	62	0.775	200	78	0.975
								201	62	0.763	240	138	0.998
								165	46	1.024	262	188	1.045
								193	84	1.168	315	390	1.248
								195	84	1.133	172	46	0.904
								180	76	1.303	193	70	0.974
								225	88	0.773	243	148	1.031
								235	104	0.801	220	108	1.014
								220	86	0.808	232	140	1.121
								224	92	0.819	258	152	0.885
								215	72	0.724	272	202	1.004
								200	86	1.075	242	150	1.058

								220	86	0.808		215	90	0.906
								195	60	0.809		146	32	1.028
								205	90	1.045		222	130	1.188
								188	50	0.752				
								214	80	0.816				
								180	74	1.269				
								165	44	0.979				
								190	70	1.021				
								168	46	0.970				
								223	76	0.685				
								194	54	0.740				
								195	60	0.809				
								174	40	0.759				
								224	88	0.783				
								198	56	0.721				
								130	26	1.183				
								140	20	0.729				
								185	56	0.884				
								230	96	0.789				
								223	90	0.812				
								173	50	0.966				
								205	88	1.021				
								206	90	1.030				
								226	86	0.745				
								165	34	0.757				
								178	42	0.745				
								192	56	0.791				
								160	44	1.074				
								185	60	0.948				
								217	68	0.665				
								167	48	1.031				
Recaps (n=)	1	1												
AVE				426.8	636.0	0.721		193.0	63.9	0.868		220.4	113.7	0.957
MIN				335	276	0.637		130	20	0.600		125	16	0.709
MAX				606	1,418	0.796		272	196	2.332		315	390	1.248

APPENDIX D

Table 47. Total lengths of 89 bull trout recaptured during trapping (T) or electrofishing (E). Recaptures with missing or unreadable tags (***) included but not used in growth increment calculations.

Recaptured Bull Trout - Electrofishing and Trapping, 1997 - 2000																				
	Tag Number		Capture Method					Total Length (mm)				Growth Increment			Same-Year Recap		
	V.I. Tag	Pit Tag	1997	1998	1999	2000		1997	1998	1999	2000	1997-98	1998-99	1999-00	1998	1999	2000
Boulder	W62	4144023037	T	T				465	497			32					
n=31	W71	4144024207	T	T				586	611			25					
	W54	413B00197F	T	E-T				501	523			22			E-532		
	W40	41456E4777	T	T	T	T		438	500	554	607	62	54	53			
		4149065073		T	T	T			332	410	475		78	65			
		41440A6B36		T	T	T			648	695	763		47	68			
		41456F2137		T	T	Kt	X		561	610	628		49	18			
		41437A035F		T	T	T			585	613	620		28	7			
		4143762010		T	T	T			690	690	735		0	45			
		41477C441C		E-T	T	T			632	662	668		30	6	E-648		
		414375576A		T	E	T			590	640	650		50	10			
		4144154720		T	T				493	545			52				
		4143734A00		T	T				496	518			22				
		41436F4920		T	T				487	534			47				
		4144105165		T	E-T				434	489			55			E-492	
		414417474A		T	E-T				311	410			99			E-422	
		414A733521		T	E-T				516	560			44			E-584	
		413B3C3A4B		T	E				422	473			51				
		414374412E		T		E			448		513			65('98)			
		41440D3E77		T		E			603		700			97('98)			
		414415472D		T		E			493		593			100('98)			
		41437E7925		T		E			582		725			143('98)			
		4143764149		T		E			576		628			52('98)			
		41440B5B5F		T		E			478		592			114('98)			
		41485E3E5F		E		E			402		472			70('98)			
		50306D6364			T	E				471	503			32			
		5030745D5E			E	E				547	570			23			
		50306D1243			T	E				422	503			81			
	***	4144083C5B	T	T					536								
	***	4143736548	T	T					512								
	***	41437F256A	T	T					462								
Kennedy	W13	4144107271	T	T				480	542			62					
n=36	W14	41437A3201	T	T				506	534			28					
	W51	414377383C	T	T				550	552			2					
	W49	41440E1C33	T	Ot			X	422	461			39					
	W31	4143765014	T	E-T				400	455			55			E-466		
	W28	4148717245	T	E-T				550	577			27			E-592		
	W60	41483B0941	T	E				582	612			30					
	W44	414841377E	T	E				636	663			27					
	W84	414378167F	T	E				720	725			5					
	W80	414821282A	T	E	E	E-T		580	608	618	630	28	10	12			T-633
	W42	414B040901	T	E-T	E-T			565	570	603		5	33		E-596	E-600	
	W57	503074381D	T		E-T	E		474		529	545		55('97)	16		E-539	
	W85	5030670617	T		E	E		611		615	643		4('97)	28			
	W30	5030722454	T		E			428		522			94('97)				
		4144135F7E		T	T	E			435	455	472		20	17			
		41495D2C02		T	T	E			351	410	529		59	119			
		414916347F		T	T	E			384	466	529		82	63			
		4148252C2B		E	E	E			580	590	615		10	25			
		4145672926		E	E-T	E			453	495	521		42	26		T-482	
		4148437E05		E	E-T	E			360	434	533		74	99		T-446	
		4148434A62		E	Ot	Ot	X		423	469	492		46	23			
		41481C5665		T	E				424	487			63				
		414408662E		T	T				553	580			27				
		41437A3322		T	Bt		X		401	466			65				
		4143771B28		T	Be		X		451	499			48				
		413B506C4F		E	T				550	590			40				
		414374484B		T		E-T			606		633			27('98)			E-640
		4148102303		T		E			394		520			126('98)			
		4144060D39		T		E			354		640			286('98)			
		41440A785F		T		E			373		488			115('98)			
		41437D0203		T		Bt	X		471		580			109('98)			
		414413561B		T		Bt	X		395		489			94('98)			
		414A5F221E		T		Be	X		375		489			114('98)			
		503064704E			E	E				441	474			33			
		50306E1313			T	E				478	481			3			
	***	41440F5E6A	T	T					560								
Continued																	

Otatso (Lower) n=13	W87	41440E3D13	T	T				419	438			19					
	W48	4143796924	T	T				508	524			16					
	W38	41440D7C3A	T	T				601	615			14					
	W82	41437D404E	T	T	T			428	464	504		36	40				
	W66	503071457E	T			T		617			660			43('97)			
		41437F556E		T	T	T			462	531	542		69	11			
		414403781C		T	Kt	Ke	X		480	565	610		85	45			
		41436C6A47		T	T				378	435			57				
		41436C092A		T	Kt		X		291	361			70				
		414410745F		T	Kt		X		425	485	516		60	31			
		4149336A1F		T	Be		X		424	492			68				
		50306A4D70			T	Ke	X			465	489			24			
		5030745021			T	Ke	X			420	460			40			
Otatso (Middle) n=3		414A397955		E	E				244	310			66				
		413B1D6209		E	E	E			274	363	390		89	27			
		5030744C03			E	E				491	492			1			
Lee n=6		41437C3349		E	T	T			563	580	606		17	26			
		414D300D47		E	T				458	487			29				
		41436E3342		E	T				442	489			47				
		4143712E07		E	T				403	449			46				
		4144167723		E	T				532	549			17				
		5030730D26			T	E				409	441			32			

APPENDIX E

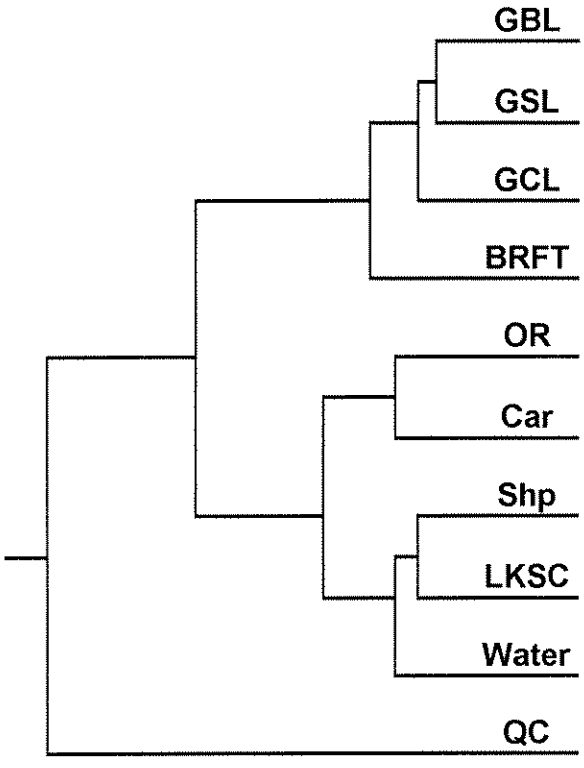

Figure 13. Phenogram representing genetic distances among Glacier National Park (GSL=Slide Lake; GCL=Cracker Lake; GBL=Red Eagle Creek) and Alberta (BRFT=Belly River; OR=Oldman River; Car=Carbondale River; Shp=Sheep River, LKSC=Smith-Dorian Creek and Water=Waterton River). Brook trout from Quirk Creek (QK), Alberta were included as an outgroup. Distance values were calculated using the Cavalli-Sforza algorithm and the distance tree was drawn with KITSCH from PHYLIP ver. 3.5 (from Thomas et al. 1997).

APPENDIX F

Table 48. Numbers and mean total length (MTL) in millimeters at capture of age classes of bull trout captured in Boulder, Kennedy and Otatso creeks, St. Mary River drainage, Montana, 1997. Divide Creek (n=1; age-IV; MTL=362) included in combined. Numbers based on 74 scale samples and only represent 75% of all bull trout (99) captured in 1997. Impressions of scales were made on sheets of cellulose acetate and examined using a Bioscope (model 60-A) projector at 10 X magnification. Data were entered into a computer program written in Turbo-Basic (version 1.1) by USFWS personnel. Based on the direct proportion method, back-calculated lengths at annuli were estimated by the scale method (Bagnal and Tesh 1978) and mean age was estimated by expanding results with an age-length key (Westrheim and Ricker 1978).

Age Class	Combined (all streams)		Boulder Creek	
	Number (%)	MTL	Number (%)	MTL
I	0 (0%)	---	0 (0%)	---
II	15 (20%)	187 (156-196)	13 (37%)	189 (179-195)
III	13 (18%)	238 (206-304)	12 (34%)	232 (206-255)
IV	10 (14%)	380 (354-419)	0 (0%)	---
V	16 (22%)	439 (415-492)	5 (14%)	438 (425-465)
VI	9 (12%)	482 (438-508)	2 (6%)	470 (438-501)
VII	6 (8%)	550 (515-565)	2 (6%)	540 (515-565)
VIII	4 (5%)	600 (565-636)	1 (3%)	586 (586-586)
IX	1 (1%)	665 (665-665)	0 (0%)	---
Totals	74 (100%)	351 (156-665)	35 (100%)	287 (179-586)

Age Class	Kennedy Creek		Otatso Creek	
	Number (%)	MTL (Range)	Number (%)	MTL (Range)
I	0 (0%)	---	0 (0%)	---
II	1 (4%)	156 (156-156)	1 (7%)	196 (196-196)
III	0 (0%)	---	1 (7%)	304 (304-304)
IV	6 (25%)	379 (356-404)	3 (22%)	389 (354-419)
V	6 (25%)	452 (422-492)	5 (35%)	425 (415-440)
VI	4 (16%)	486 (470-506)	3 (22%)	486 (467-508)
VII	3 (13%)	552 (550-555)	1 (7%)	561 (561-561)
VIII	3 (13%)	605 (565-636)	0 (0%)	---
IX	1 (4%)	665 (665-665)	0 (0%)	---
Totals	24 (100%)	468 (156-665)	14 (100%)	415 (196-561)

APPENDIX F (continued)

Table 49. Mean back-calculated total lengths (MBCTL) at annuli and mean growth increment (MGI) between annuli in millimeters of 74 bull trout captured in Divide, Boulder, Kennedy and Otatso creeks, St. Mary River drainage, Montana, 1997. Impressions of scales were made on sheets of cellulose acetate and examined using a Bioscope (model 60-A) projector at 10 X magnification. Data were entered into a computer program written in Turbo-Basic (version 1.1) by USFWS personnel. Based on the direct proportion method, back-calculated lengths at annuli were estimated by the scale method (Bagnal and Tesh 1978) and mean age was estimated by expanding results with an age-length key (Westrheim and Ricker 1978).

Drainage	Age Class								
	I	II	III	IV	V	VI	VII	VIII	IX
Divide Creek (n=1)									
MBCTL	64	117	187	298					
MGI	64	53	70	111					
Boulder Creek (n=35)									
MBCTL	74	135	208	307	388	450	510	558	
MGI	74	61	75	86	81	61	68	50	
Kennedy Creek (n=24)									
MBCTL	77	144	233	328	412	474	532	578	630
MGI	77	67	88	95	86	62	48	44	42
Otatso Creek (n=14)									
MBCTL	76	147	225	319	398	471	539		
MGI	76	70	79	94	86	54	44		
Combined (n=74)									
MBCTL	76	140	221	320	402	467	526	574	630
MGI	76	65	81	93	85	60	53	45	42