Bridge River Bull Trout (*Salvelinus confluentus)*

Investigation 2000

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ABSTRACT

In the Spring of 2000, WLAP (formerly, Ministry of Environment, Lands and Parks), through funding provided by the Bridge-Coastal Restoration Program (BCRP), formely Bridge-Coastal Compensation Program, contracted the British Columbia Conservation Foundation (BCCF) to undertake a preliminary investigation of bull trout within the Bridge River system. The objectives of the *Bridge River bull trout project* were, through the use of radio-telemetry, i) determine the timing and pattern of bull trout migration within the Bridge River, ii) identify those streams and reaches which provide key spawning and rearing habitats to adult and juvenile bull trout, and iii) determine the distribution range of bull trout within the Bridge River system,

In total we radio tagged seven bull trout in 2000. On average, we located each radio tagged bull trout 11 times including the initial tagging. Bull trout were tracked throughout the majority of the mainstem Bridge River between its confluence with the Fraser River upstream to its confluence with the Yalakom River. Overall, bull trout movements were concentrated within the lower sections of the Bridge River with the majority of these receptions located within the first six stream kilometers and recorded subsequent to the initial capture (April/May) time period. Movement and location data recorded for five of the seven tagged bull trout were consistent with spawning migration activities. After initial tagging these bull trout displayed consistent upstream migration and were located within the Yalakom River drainage during the typical bull trout spawning timing window (September to October).

The synthesis of telemetry and juvenile fish inventory data suggest that bull trout captured within the Bridge River represent a portion of a larger Fraser River fluvial population. Individuals in this population likely divide their time between rearing within the Bridge River mainstem, spawning and early rearing within the Yalakom River drainage and over-wintering in the Bridge and Fraser Rivers.

ACKNOWLEDGEMENTS

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Funding for the project was provided by BC Hydro through the Bridge-Coastal Restoration Program (formerly Bridge-Coastal Compensation Program).

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1.0 INTRODUCTION

To effectively manage fisheries and aquatic resources within the Southern Interior Region, the Ministry of Water, Land and Air Protection (WLAP) requires accurate data on fish populations inhabiting the regions watersheds. The need for comprehensive fisheries data is even more pertinent in those watersheds where fish species are or may be put at risk due to the effects of proposed or on-going land-use activities, such as those associated with forestry, mining, and hydro-electric generation. Within British Columbia and specifically the Southern Interior Region, additional emphasis has been placed on the collection of data related to the status of bull trout (*Salvelinus confluentus*). The heightened management concerns for bull trout stem from their provincial blue list (threatened) classification, their listing as an endangered species throughout their range in the United States and their vulnerability to habitat disturbances and exploitation by angling (McPhail and Baxter 1996, Meehan and Bjornn 1991).

Within the Lillooet Timber Supply Area (TSA) and specifically the Bridge River Watershed, there is an absence of data related to the status of bull trout. This deficiency of data related to bull trout within the Lillooet TSA has been recognized as a concern within the Lillooet Land and Resource Management Plan (LRMP) and the Ministry of Forests Resource Management Plan (RMP). Additionally, it is recognized that BC Hydro facilities within the Bridge/Seton systems have impacted fish and fish habitat within the watersheds in which they operate and in which contain bull trout (British Columbia et al 2000). A key example of a 'footprint' impact is the elimination of upstream fish passage at Terzhagi Dam. The Terzhagi dam effectively blocked all flow to the Bridge River most years, until a perennial flow release was initiated in August 2000.

In the Spring of 2000, WLAP (formerly, Ministry of Environment, Lands and Parks), through funding provided by the Bridge-Coastal Restoration Program (BCRP), formely Bridge-Coastal Compensation Program, contracted the British Columbia Conservation Foundation (BCCF) to undertake a preliminary investigation of bull trout within the Bridge River system.

2.0 OBJECTIVES

The objectives of the *Bridge River bull trout project* were, through the use of radio-telemetry, collect overview level information on bull trout migrating into the Bridge River. Specifically, the project sought to:

(i) Determine the timing and pattern of bull trout migration within the Bridge River,

(ii) Identify those streams and reaches which provide key spawning and rearing habitats to adult and juvenile bull trout,

(iii) Determine the distribution range of bull trout within the Bridge River system,

This investigation was originally intended to be the first year of a multi-year population assessment. Subsequent funding eligibility changes with the BCRP limited the scope and the duration of the project to the one-year (2000). The bull trout survey coincided with a telemetry study of steelhead trout (*Oncorhynchus mykiss*) (Hagen 2001).

3.0 STUDY AREA

The Bridge River is a 6th order tributary of the Fraser River, which drains approximately 4,735 km^2 east from the Pacific and Chilcotin Ranges of the Coast Mountains. The Bridge River joins the Fraser near the town of Lillooet, 332 km upstream of the mouth of the Fraser and 220 m above sea level (Figure 1). Physical descriptions of the watershed are available in Riley et al. (1998), and

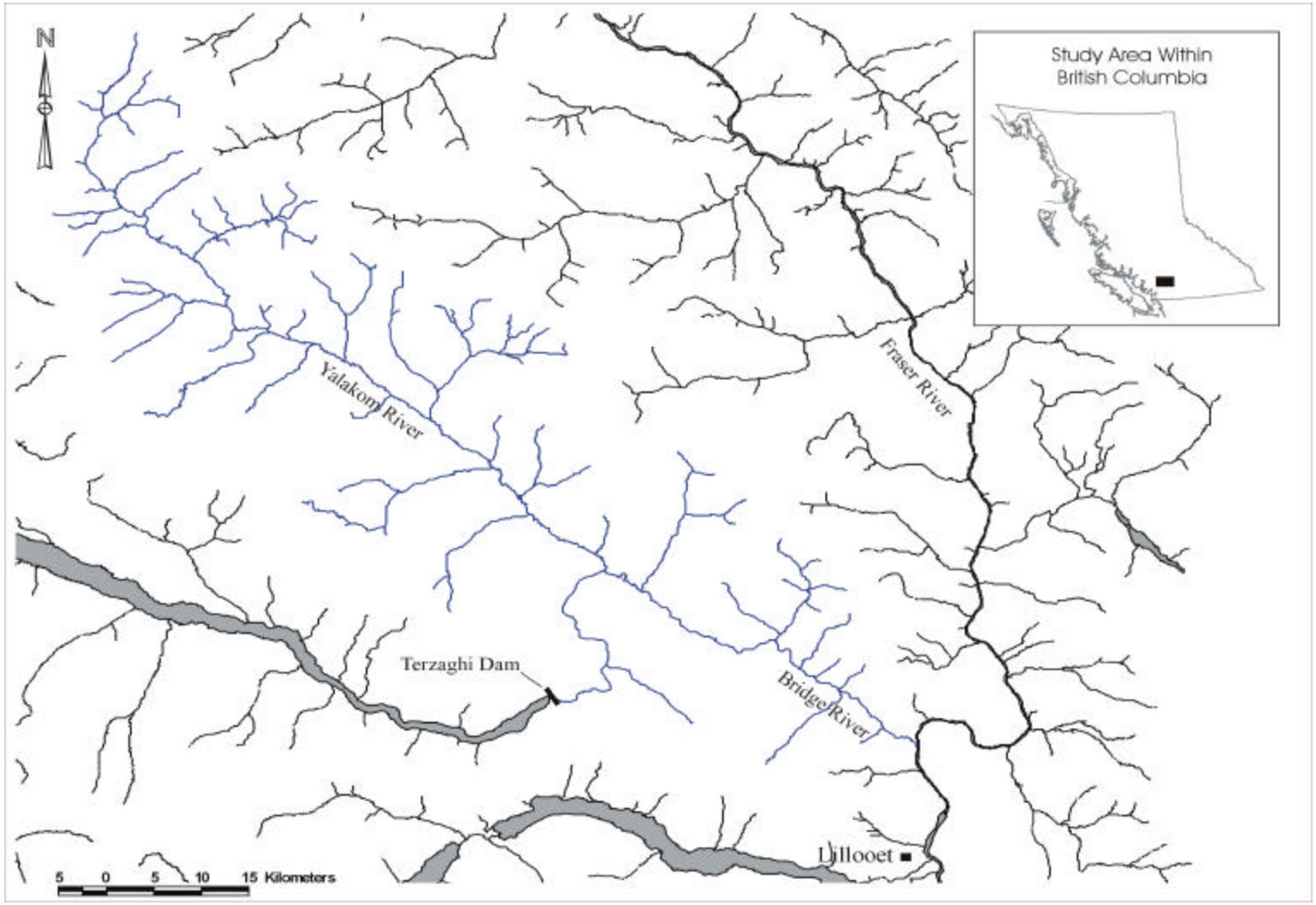

Figure 1. Bridge River Study Area

Webb et al. (2000). Until the summer of 2000, the river channel was dry for approximately 6 km below Terzhagi Dam, at which point surface flow is maintained by groundwater flow and the inputs of several small tributaries (Hagen 2001). The Bridge river is a very small stream (mean annual total discharge approximately 0.6 m^3/s - Riley et al. 1998) in the section extending approximately 9. 8 km downstream from the appearance of surface water to the Yalokom River confluence. The Yalakom River (mean annual discharge approximately 4.11 m^3/s - Riley et al. 1998) contributes the majority of the flow to the remaining 25 km of the Bridge River (Hagen 2001). The Bridge River hydrograph is typical of interior drainages with peak flows occuring from June to Mid-July (Griffith 1995)

The portion of the Bridge River located below Terzhagi Dam supports populations of five species of anadromous salmonid: steelhead, chinook salmon (*O. tsawytscha*), coho salmon (*O. kisutch*), sockeye salmon (*O. nerka*), and pink salmon (*O. gorbuscha*). Other fish species present in the river include resident rainbow trout (*O. mykiss*), bull trout (*Salvelinus confluentus*), mountain whitefish (*Prosopium williamsoni*), Pacific lamprey (*Lampetra tridentata*), and several species of suckers (*Catastomus spp.*) and sculpins (*Cottus spp.*) (Riley et al. 1998).

Bull trout within the Bridge River are impacted through both the construction and operation of the Terzaghi Dam on the Bridge River. Construction of the Terzaghi Dam blocked the upstream access to historic spawning and rearing tributaries for Bridge / Fraser River bull trout populations. Historically, the range of distribution for these fluvial stocks would have likely reached upstream to the current location of the La Joie Dam facility. This range would have made available the suitable rearing areas and suspected spawning locations within Tyaughton, Tommy, Nosebag and Gun Creeks.

4.0 METHODS

4.1 Capture and handling

Bull trout were captured by angling conducted between 19 April and 19 June, 2000, with sampling effort focused primarily within the first two kilometers of the Bridge River upstream of its confluence with the Fraser River and within the Bridge River mainstem downstream of the Yalakom River confluence. All angling locations were accessed by foot.

Captured bull trout were placed in collapsible fish tubes and anchored in the river until processing. All fish processing took place at the capture location. Captured bull trout were anaesthetized lightly and then tagged with an individually numbered Floy (t-anchor) tag (when possible), measured for both fork length (FL) and mass, sexed (when possible), and sampled for tissue and scales. The anaesthetic bath was a 121l plastic tub with a lid, containing 50l of water with 100 PPM clove bud oil. In locations accessed by foot, a 30l plastic tub with a lid, containing only 20l of water with 100PPM clove oil replaced the larger tub. When lightly anaesthetized, bull trout were measured (FL) and weighed, and tissue and scale samples were collected. Tissue and scale samples were stored in individual 1.5ml centrifuge tubes containing 95% ethyl alcohol. If not large enough for radio tagging, bull trout were held in current until fully recovered and released. Bull trout > 500mm were left in the anaesthetic bath and anaesthetized to a level suitable for surgery (McKinley et al. 1992).

4.2 Radio Tagging

All radio tags were manufactured by Lotek Engineering, Newmarket, Ontario. We used MCTF - 3A radio tags which are 16mm in diameter, 50mm in length,

have a 400mm whip antenna, and weigh 6.2g in water. The MCTF – 3A tags have an estimated operational life of >680 days.

Throughout this report, individual radio tagged bull trout are identified by the unique channel-code combination of their radio tag, proceeded by 'RT'. For example, a fish tagged with tag code 72 transmitting on channel 5 will be referred to as 'RT 5-72'. All of the tags transmitted on channel 5 (149.400MHz).

We had planned to select males over females for surgery, but low capture rates for larger fish overall excluded this possibility. We tagged all bull trout captured with FL > 470mm. By using this minimum size class, we kept the tag (in water) to fish (in air) weight ratio below the 1% suggested by some researchers to reduce complications from implanted tags (Marty and Summerfelt 1986, McLeod and Clayton 1993).

The surgical procedure followed the method described by McLeod and Clayton (1993). We placed the anaesthetized bull trout on its back in a wet neoprene lined surgical trough, and made a 2.5cm incision into the abdominal cavity on the mid-ventral line immediately anterior to the pelvic girdle. We then inserted a stainless steel needle (16guage, 5cm long) through the body wall from posterior to the pelvic girdle into the incision. The whip antenna of the radio tag was guided through the needle, the needle removed, and the tag inserted into the abdominal cavity. The incision was closed with three or four interrupted sutures. We then applied betadine to the closed incision and antenna exit wound. After the procedure, the tagged bull trout was removed from the surgical trough to the river and recovered by holding it in the current. When the fish was capable of maintaining equilibrium, it was placed in a collapsible fish tube and allowed to further recover (10 - 30 min.) before release.

4.3 Tracking

We used Lotek SRX-400 receivers to track radio tagged bull trout from vehicle, by foot, by aircraft, and from stationary data-logging stations. While tracking from the ground or from aircraft, we used a single two-element antenna. A Bell 305 (Jet Ranger) was used for the two aerial tracking sessions. All receptions were recorded as a channel-code combination, written description of location, and a UTM coordinate.

A stationary receiver was located at the Bridge River –Yalakom River confluence (Figure 2). The stationary site consisted of a solar / battery powered (1 deep-cycle 12V battery) receiver contained within an aluminum weatherproof housing, connected to three antennae (3 element antennas) - with multiple antennae used to help resolve direction of travel where appropriate. Data was downloaded to a portable computer when the batteries where changed or the battery status was checked. The stationary receiver commenced operation in March 2000 to coincide with the concurrent spring steelhead telemetry investigation (Hagen 2001).

4.4 Movement Data Analysis

We corrected raw reception UTM coordinates to the British Columbia Watershed Atlas using ARCVIEW. We created a kilometer scheme for the Bridge River watershed (Figure 2), and converted corrected reception points to kilometers for analysis. In addition, we reduced multiple receptions of an individual bull trout

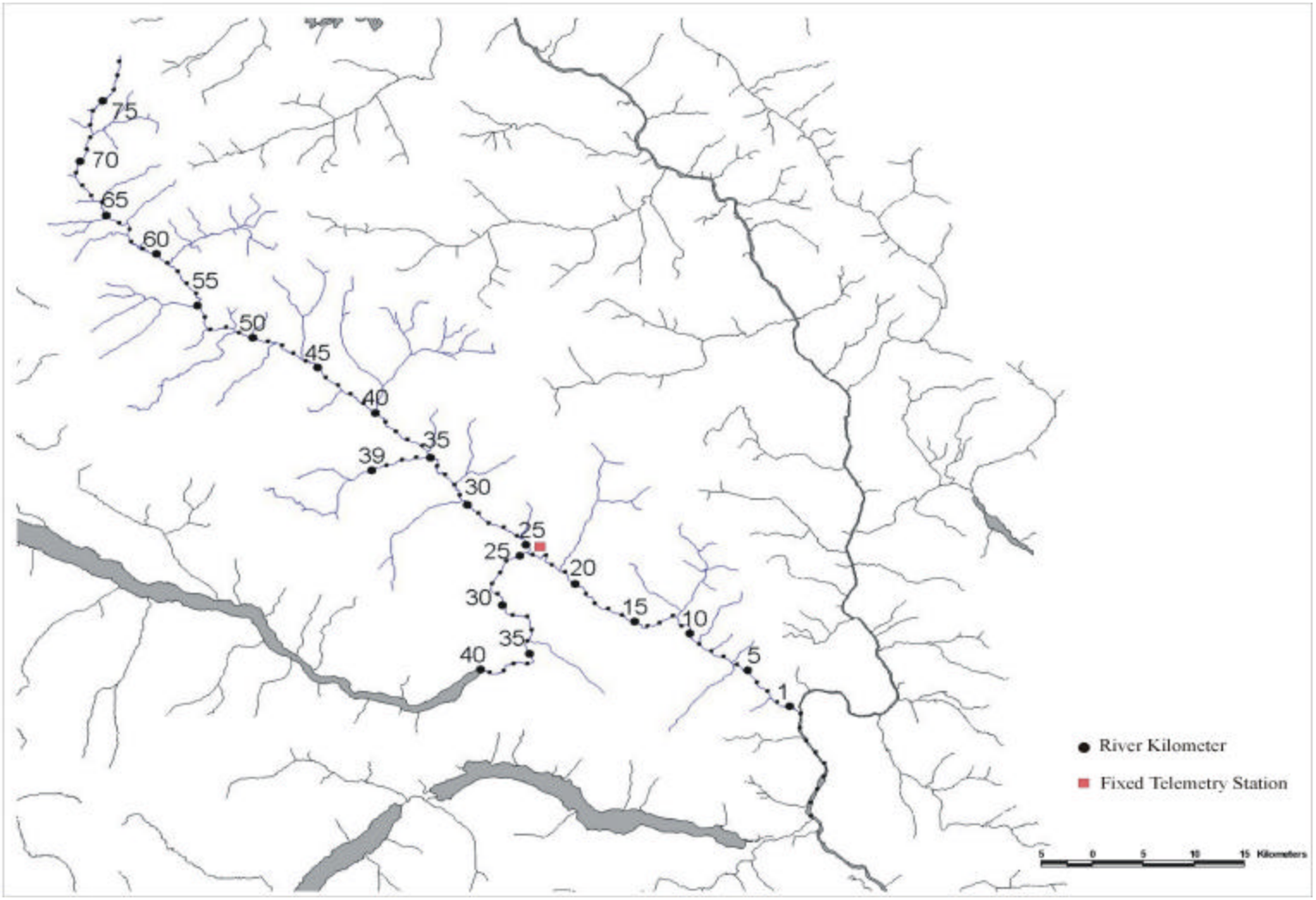

Figure 2. The location of stationary receiver sites and the kilometer scheme used for data analysis.

at a single stationary receiver site, on the same day, to a single data point for analysis.

5.0 RESULTS

5.1 Tagging

In total we radio tagged seven bull trout in 2000. Four of the seven radio tagged bull trout were captured in the lower portion of the Bridge River mainstem, while the remaining three were at or downstream of the Yalakom River confluence (Figure 3).

Data collected from bull trout surgically implanted with radio tags is summarized in Table 1. The bull trout we radio tagged averaged 539 mm ± 67 FL (min. 475 - max. 670, n = 7) and had an average mass of 1800g ± 693 (min. 1350 - max. 3000, n = 5).

Table 1. Summary of radio tagged bull trout, 2000.

Radio-Tag	Tag Date	External Tag	FL (mm)	Mass (g)
5-69	20-Apr-00	no tag	670	
5-72	19-Jun-00	5127A/5128A	580	3000
5-74	7-May-00	no tag	475	1350
5-86	19-Apr-00	no tag	540	
5-87	31-May-00	5124A/5123A	515	1800
5-90	7-May-00	no tag	500	1400
5-91	31-May-00	5121A/5122A	495	1450

5.2 Tracking

In total, we recorded date and location of individual bull trout (only coded receptions and physical (re)captures) 78 times subsequent to capture. Tracking flights were conducted on August 29 and September 21 and resulted in the

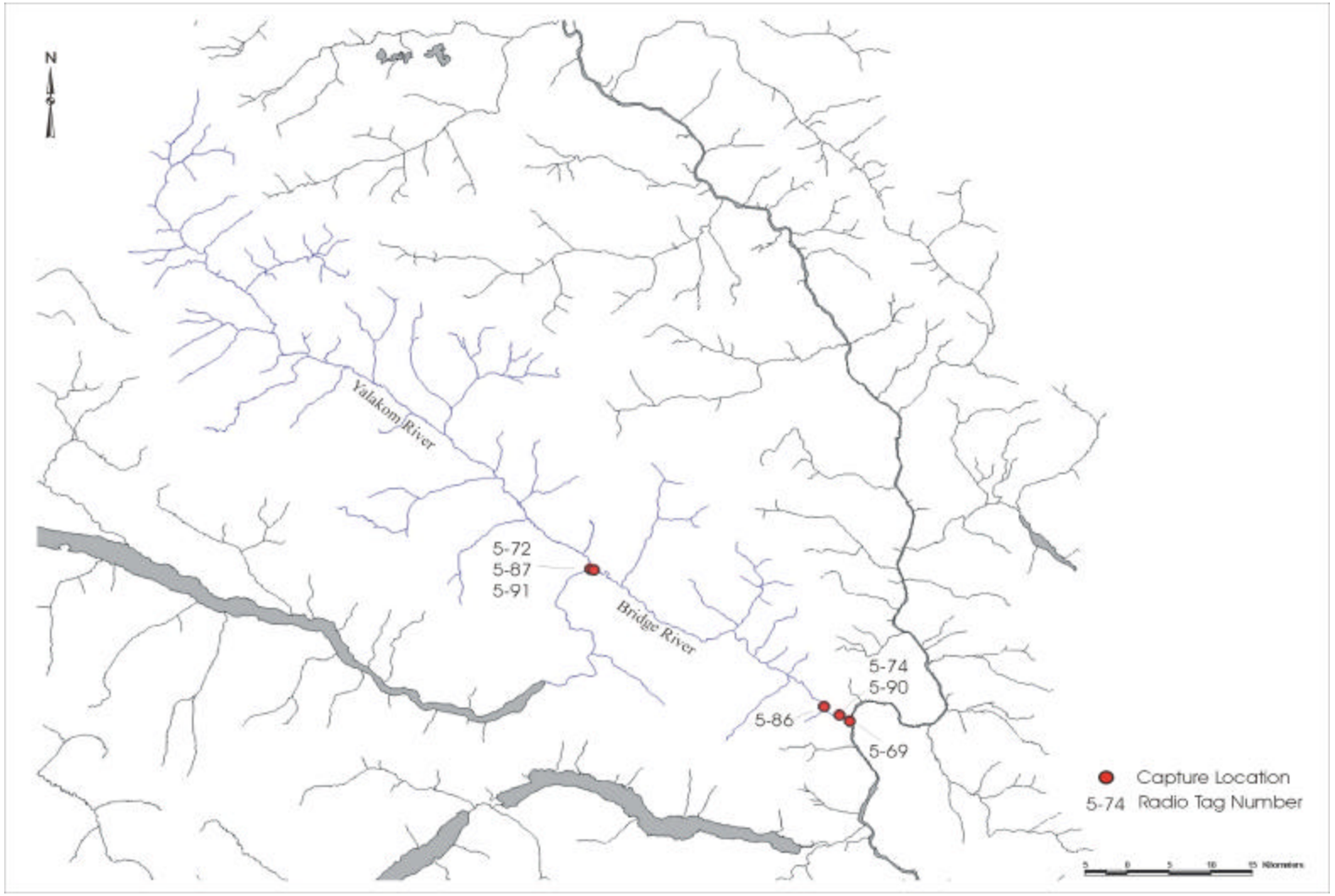

Figure 3. Capture locations of radio tagged bull trout.

location of four and six radio tagged bull trout, respectively. Additionally, bull trout were periodically located during spring steelhead flights and mobile tracking conducted between 16 May and 30 June 2000.

On average, we located each radio tagged bull trout 11 times (min. 5 - max. 21) including the initial tagging. Average total distance moved (upstream and downstream) by tracked bull trout was 42 km (min. 7 - max. 83). We tracked individual bull trout for, on average, 183 days (min. 84 - max. 274). A summary of number of receptions and total tracked movement by each radio tagged bull trout is presented in Table 2. The reception locations for individual bull trout are appended (Appendix 1 and 2).

Table 2. Summary of number of receptions, final reception date, total tracking time and distance by individual radio tagged bull trout in 2000/2001.

Radio-Tag	No. of Receptions	Final Reception Date	Total Time Tracked (d)	Total Distance Tracked (km)
5-69	21	24-Jan-01	274	71
5-72	6	27-Feb-01	271	80
5-74	9	9-Sep-00	125	48
5-86	17	21-Sep-00	159	83
5-87	8	24-Jan-01	84	58
5-90	12	27-Feb-01	262	22
5-91	5	21-Sep-00	109	7

5.3 Movement Data

Bull trout were tracked throughout the majority of the mainstem Bridge River between its confluence with the Fraser River upstream to its confluence with the Yalakom River (Figure 4). Overall, bull trout movements were concentrated within the 0 to 19 kilometer section of the Bridge River (Fraser River confluence

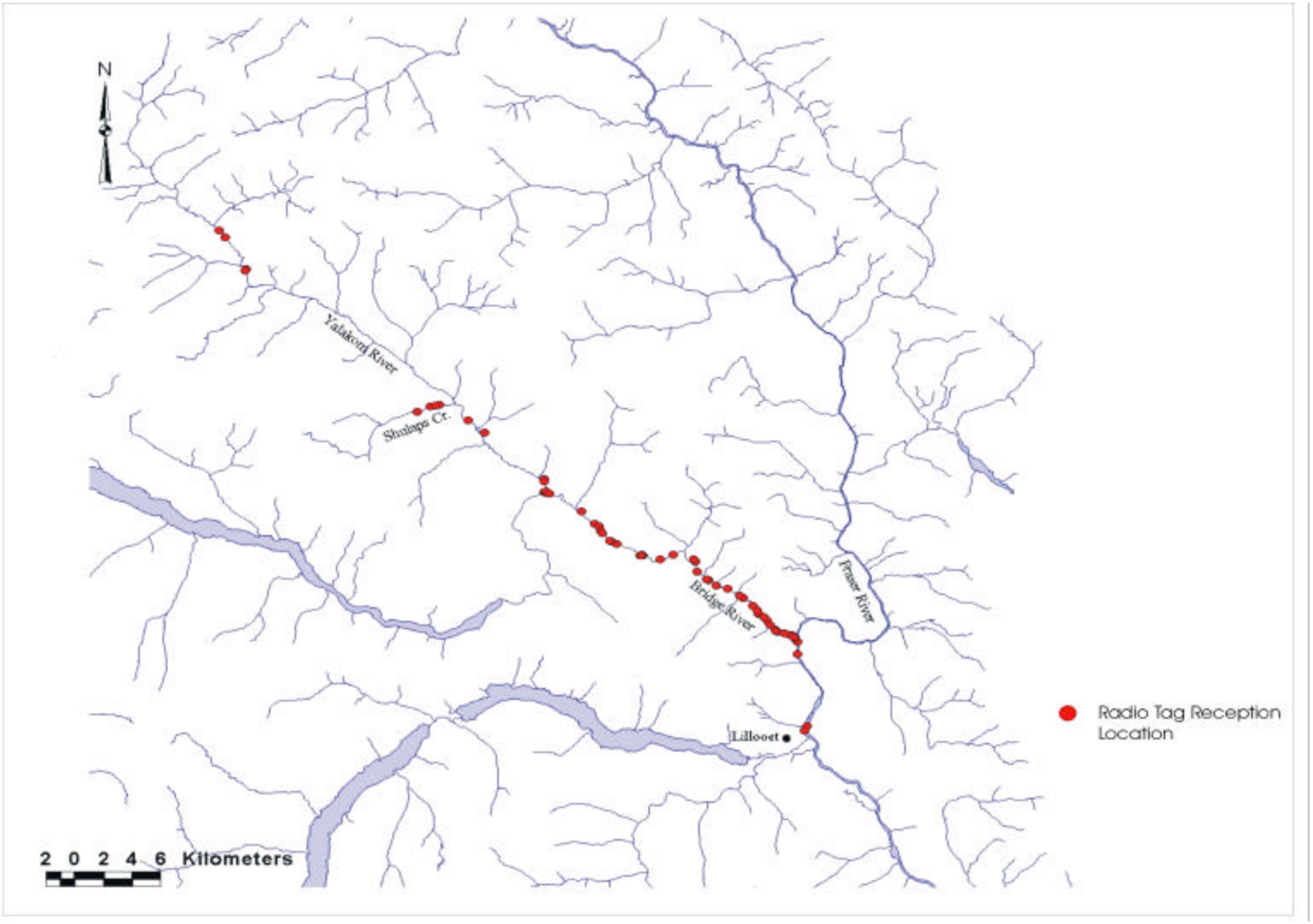

Figure 4. All locational data collected from radio tagged bull trout in 2000/2001 (n=85).

to Camoo Creek). With the majority of these receptions located within the first six stream kilometers and recorded subsequent to initial capture (April/May) time period.

Movement and location data recorded for five (RT 5-69, 5-72, 5-74, 5-86 and 5-87) of the seven tagged bull trout were consistent with spawning migration activities. After initial tagging these bull trout displayed consistent gradual upstream migration and all five were located within the Yalakom River drainage during the bull trout spawning window (September to October). On 30 June 2000, three of these fish were locate holding in close proximity to each other in the Yalakom River, downstream of the area reported to contain a partial obstruction (Griffith 1995). At least one fish entered the Yalakom River on 8 June and held in the lower Yalakom until after freshet. Of the five migrating bull trout three, (RT 5-69, 5-74 and 5-87) were located in Shulaps Creek (WSC), a 3rd order tributary located 11 kilometers up the Yalakom River, and two (RT 5-72, 5-86) were located in the mainstem of the Yalakom River approximately 35 kilometers upstream of the Bridge River confluence, near Yalakom Creek and upstream of the second obstruction reported by Griffith (1995). By November all spawning bull trout had moved out of the Yalakom downstream into either the Bridge or Fraser Rivers. At least one fish had left the Yalakom River by 21 September, where water temperature was recorded at 4^{o}C, suggesting that spawning activities may have occurred a few days earlier.

Location data for the remaining two bull trout (RT 5-90 and 5-91) suggests that they did not make spawning migrations in 2000. Movement of RT-90 was limited to the lower half of the Bridge River and portions of the Fraser River, while RT-91 was captured and subsequently relocated in and around the Bridge River/Yalakom River confluence (Appendix 2).

At the time of the study, the distribution of radio-tagged bull trout within the Bridge River itself was limited to the Bridge River mainstem below the Yalakom River confluence, possible due to low flow or water temperature restraints. Bull trout have a limited temperature tolerance (Parkinson and Haas 1996) and may avoid both higher temperatures and the shallow, exposed habitats typical in the Bridge River above the Yalakom. Flow releases initiated in August 2000 may alter bull trout distribution.

6.0 DISCUSSION

Telemetry data, while confirming two spawning areas in the Bridge River drainage, where not extensive enough to provide adequate data on the full range and migration pattern of Bridge River bull trout. The limited scope of the project and small sample of spawning aged fish also precludes any definite conclusions concerning the life history strategy of Bridge River bull trout. However, a reasonable prediction of life history can be made through use of the telemetry and inventory data collected within the watershed and from the known strategies of other fluvial bull trout populations within the province.

The synthesis of telemetry and juvenile fish inventory data suggest that bull trout captured within the Bridge River represent a portion of a larger Fraser River fluvial population. Individuals in this population likely divide their time between rearing within the Bridge River mainstem, spawning and early rearing within the Yalakom River drainage and over-wintering in the Bridge and Fraser Rivers. At some point in the their lifecycle entry into Seton River and / or other watersheds is suspected, but this was not confirmed by the limited tracking during the study. Entry into the Seton system poses a new risk of entrainment in the power canal. To ensure conservation of Bridge / Seton bull trout populations, anthropomorphic sources and rates of mortality (i.e. recreational and aboriginal harvest and entrainment mortality) should be assessed.

Within the Bridge River system spawning activities appear focused solely within the Yalakom River drainage with confirmed locations within the Yalakom River mainstem and Shulaps Creek. The captured of young-of-the-year bull trout during previous investigations suggests that spawning may also be located in Yalakom and Retaskit Creeks (Griffith 1995). The timing and duration of spawning activities (migration and stream residency) appears consistent with bull trout spawning migrations in other drainage's within British Columbia (O'Brien *et al* In prep, McPhail and Baxter 1996). On average within British Columbia, spawning occurs between early September and mid-October (McPhail and Baxter 1996). The start of the spawning migration tends to vary with individual populations, but is often associated with spring high water. Tracking data indicates that adult fish enter the Bridge River system from the Fraser River in early April, reside and slowly migrate up the Bridge River until late July when they enter the Yalakom River. As in other bull trout systems it is believed that Bridge River bull trout reach the spawning locations in the mainstem Yalakom or tributaries to the Yalakom River in late August and early September. It is unclear as to what percentage of fish, that enter the Bridge River in the spring make spawning migrations.

Young-of-the-year and juvenile rearing occurs in the natal and larger streams of the Yalakom drainage including the Yalakom River mainstem (Griffith 1995). Older (>3+) sub-adult bull trout likely move downstream into the larger systems (Yalakom, Bridge and possibly Fraser River mainstems) where they rear until sexual maturity. It is unclear at what age juvenile and sub-adult bull trout emigrate from the Yalakom to Bridge River system and Bridge River to Fraser River systems.

Cool water temperatures and higher flows within the Bridge River (below the Yalakom River confluence) may make the mainstem suitable for year round

residence. Two radio-tagged bull trout (5-90, 5-91) remained in the Bridge River below the Yalakom Confluence all summer and were detected on 21 September at km 10 and km 20, respectively. It appears that adult bull trout likely divide their time between habitats in the Bridge River, Fraser River and potentially other Fraser River tributaries (i.e. Seton River, Texas Creek). Movement data suggests that numerous adult bull trout move into the Bridge River in early spring targeting emerging salmon fry. A portion of those fish then utilize the mainstem for the majority of the year where they are reported to feed on salmon eggs in the late summer and fall. Over-wintering may take place in either the Bridge River, Fraser River or even Seton Lake. Of those fish entering the stream in the spring an unknown portion slowly migrate upstream to spawning reaches in the Yalakom drainage in the fall. Adult bull trout have been observed upstream of the Yalakom River confluence on occasion (Higgins pers comm..). The addition of an annual 3 cms Water Budget to the Bridge River from Terzhagi dam may attract more bull trout into the upper section of the river.

The life history and movement pattern of Bridge River bull trout is consistent with that of other fluvial and adfluvial bull trout populations where mature bull trout migrate into the headwaters of cold, often-glacial tributary streams in late summer and early fall. Spawning takes place in areas of suitable habitat between September and mid-October when water temperatures fall below 9°C (McPhail and Baxter 1996). After spawning adults emigrate to the larger river while eggs incubate in tributary gravel's between October and March. Fry emergence occurs in early spring with newly emerged bull trout utilizing stream margins, low velocity side-channels and instream cover (McPhail and Baxter 1996, Baxter 1997). Rearing of juvenile bull trout likely occurs in the same streams in which spawning occurs. Bull trout may stay in these spawning streams for up to three years before moving downstream into the Bridge River (McPhail and Murray

1979). Sexual maturity is reached between 4 and 7 years of age, but is often watershed dependent (McPhail and Murray 1979).

In addition to the first insight into the potential life history of Bridge River bull trout, telemetry results suggest that neither of the two obstructions identified by Griffith (1995) in the Yalakom River mainstem restrict the upstream movement to adult bull trout. Tagged bull trout may have delayed their migration in the lower Yalakom, below the first obstruction, but all were located upstream of both obstructions in the late summer and early fall, suggesting that the obstruction to fish passage may be flow dependent. This would also suggest that juvenile bull trout present within the upper Yalakom River are not a resident population as first suggested by Griffith (1995) but represent the rearing juveniles of the larger Bridge / Fraser River fluvial population. Prior to the construction of Mission dam the population had an even wider geographic range. An evaluation of enhancement / restoration opportunities was not part of this initial study, however within the Yalakom sub-basin few opportunities were apparent for adult life stages. The streamside riparian condition, instream habitat, road access management and tributary stability in the Yalakom River may require further investigation based on the long history of forestry activities within the watershed.

7.0 CONCLUSIONS AND RECOMMENDATIONS

- Bull Trout radio-tagged in spring 2000 utilized the Yalakom River and tributaries for spawning in late summer / fall after a slow migration up the Bridge River.

- This study confirmed that the population of bull trout previously documented (Griffith 1995) in the Yalakom River are part of a larger fluvial population that reside in the Bridge and Fraser Rivers.

While the 2000 Bridge River bull trout investigation expanded the information on the life-history and distribution range of bull trout within the Bridge River drainage downstream of the Terzaghi Dam, a number of data gaps still remain. For the proper management of bull trout within the Bridge and Fraser River systems a number of questions will need to be addressed. These questions include determining:.

- the relationship between populations of bull trout in the Bridge River and other Fraser River tributaries, including the Seton River.

- the current status, size and viability of the bull trout population within the Bridge and Fraser River systems.

- The identification of those stream reaches utilized for spawning and rearing throughout the Middle Fraser System (including key tributaries to larger systems).

- Status of the Yalakom watershed with respect to past resource/forestry activities (i.e. road building and road deactivation)

- The anthropogenic exploitation rate of Bridge/Fraser River bull trout (i.e. recreational anglers and first nations harvest rates).

- The effects of BC Hydro operations on bull trout migration and distribution including increased utilization of the Bridge River above the Yalakom River and potential entrainment in the Seton power canal..

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APPENDIX 1 Radio Tag Location Data

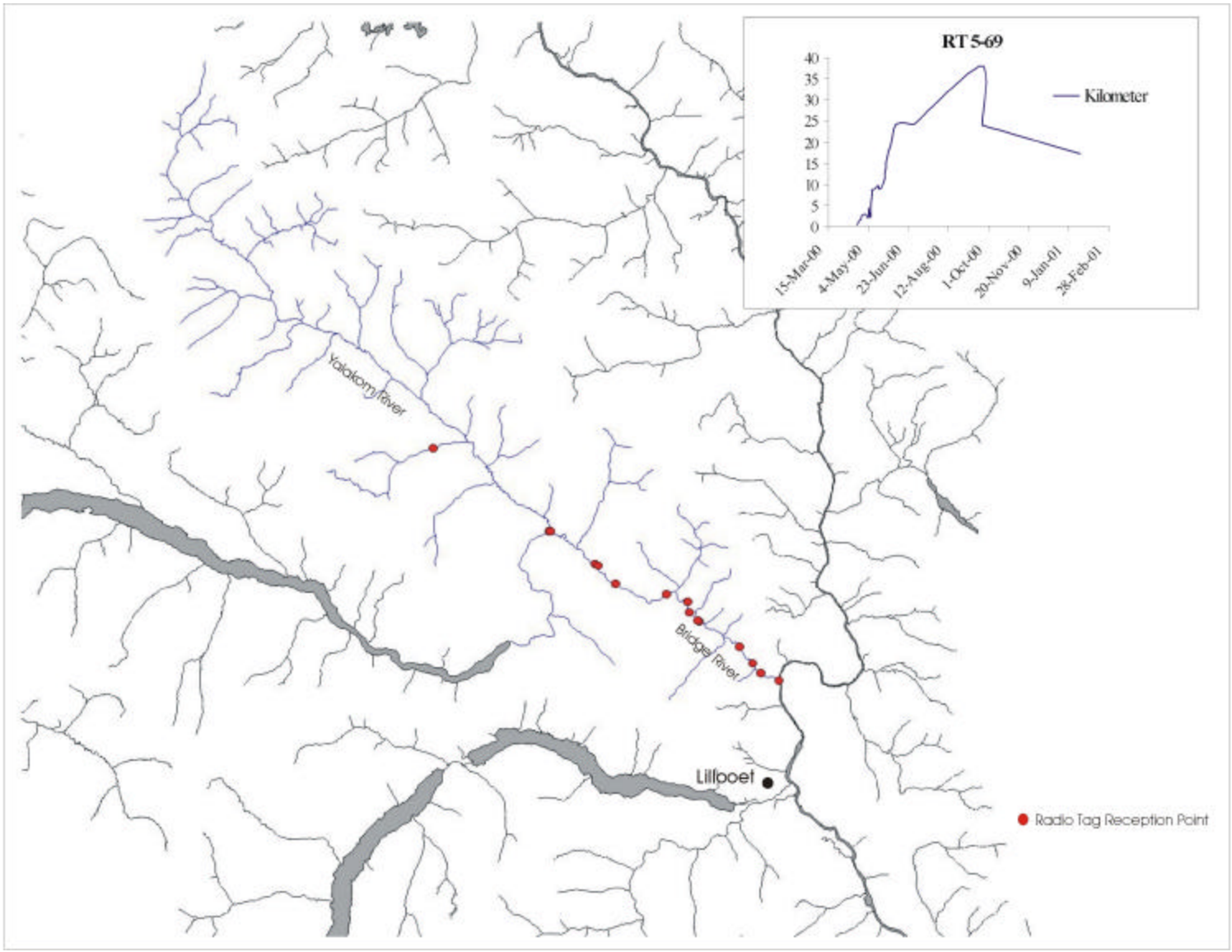
Locational Data for radio tagged bull trout: Bridge River 2000.

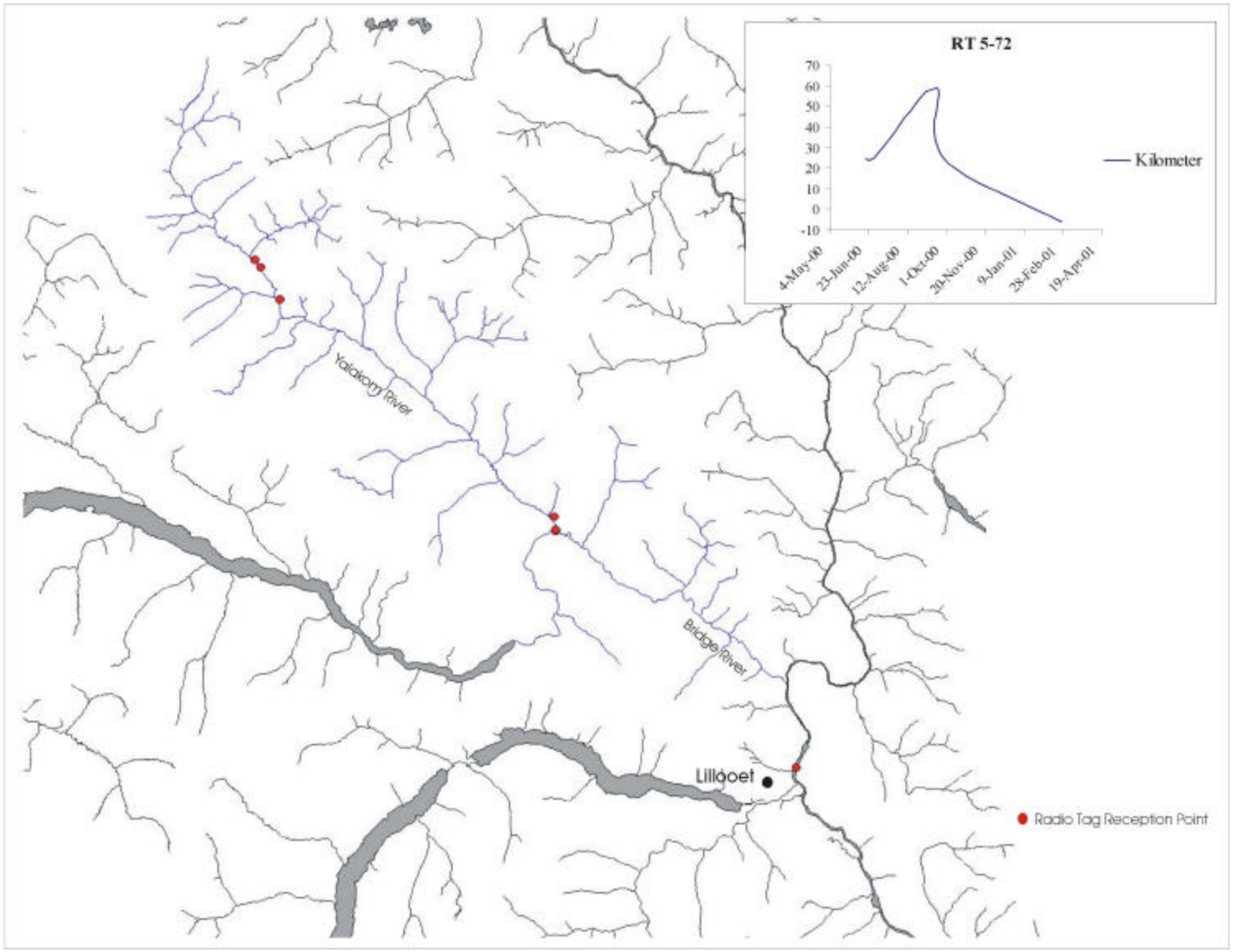
Date	Code	Channel	Zone	Easting	Northing	Type
20-Apr-00	69	5	10	575193	5622758	Capture
29-Apr-00	69	5	10	573282	5624211	Road
4-May-00	69	5	10	573840	5623440	Road
5-May-00	69	5	10	572312	5625472	Road
7-May-00	69	5	10	573840	5623440	Road
9-May-00	69	5	10	569291	5627568	Road
11-May-00	69	5	10	569291	5627568	Road
16-May-00	69	5	10	568574	5628306	Heli
18-May-00	69	5	10	569215	5627650	Road
23-May-00	69	5	10	568490	5629097	Road
25-May-00	69	5	10	566901	5629715	Heli
29-May-00	69	5	10	561806	5632136	Road
1-Jun-00	69	5	10	561538	5632314	Heli
1-Jun-00	69	5	10	561806	5632136	Road
8-Jun-00	69	5	10	558108	5634967	Road
29-Jun-00	69	5	10	558248	5634972	Road
30-Jun-00	69	5	10	558262	5634965	Fixed
21-Sep-00	69	5	10	549529	5641641	Heli
23-Sep-00	69	5	10	558262	5634965	Fixed
24-Sep-00	69	5	10	558262	5634965	Fixed
24-Sep-00	69	5	10	558262	5634965	Fixed
24-Jan-01	69	5	10	563036	5630695	Road
19-Jun-00	72	5	10	558242	5634898	Capture
30-Jun-00	72	5	10	558186	5635982	Road
29-Aug-00	72	5	10	538038	5653295	Heli
11-Sep-00	72	5	10	536261	5656418	Road
21-Sep-00	72	5	10	536688	5655851	Heli
28-Sep-00	72	5	10	558262	5634965	Fixed
27-Feb-01	72	5	10	575773	5616137	Road
7-May-00	74	5	10	574477	5623220	Capture
9-May-00	74	5	10	573996	5623354	Road
14-May-00	74	5	10	572695	5624810	Road
16-May-00	74	5	10	572603	5625083	Heli
16-May-00	74	5	10	572695	5624810	Heli
8-Jun-00	74	5	10	568373	5629282	Road
19-Jun-00	74	5	10	558262	5634965	Fixed
30-Jun-00	74	5	10	554453	5638593	Road
29-Aug-00	74	5	10	550447	5642025	Heli
8-Sep-00	74	5	10	558262	5634965	Fixed
9-Sep-00	74	5	10	558262	5634965	Fixed
19-Apr-00	86	5	10	573482	5623926	Capture
20-Apr-00	86	5	10	574943	5623082	Road
24-Apr-00	86	5	10	573784	5623535	Road
5-May-00	86	5	10	572662	5624861	Road
7-May-00	86	5	10	573051	5624508	Road

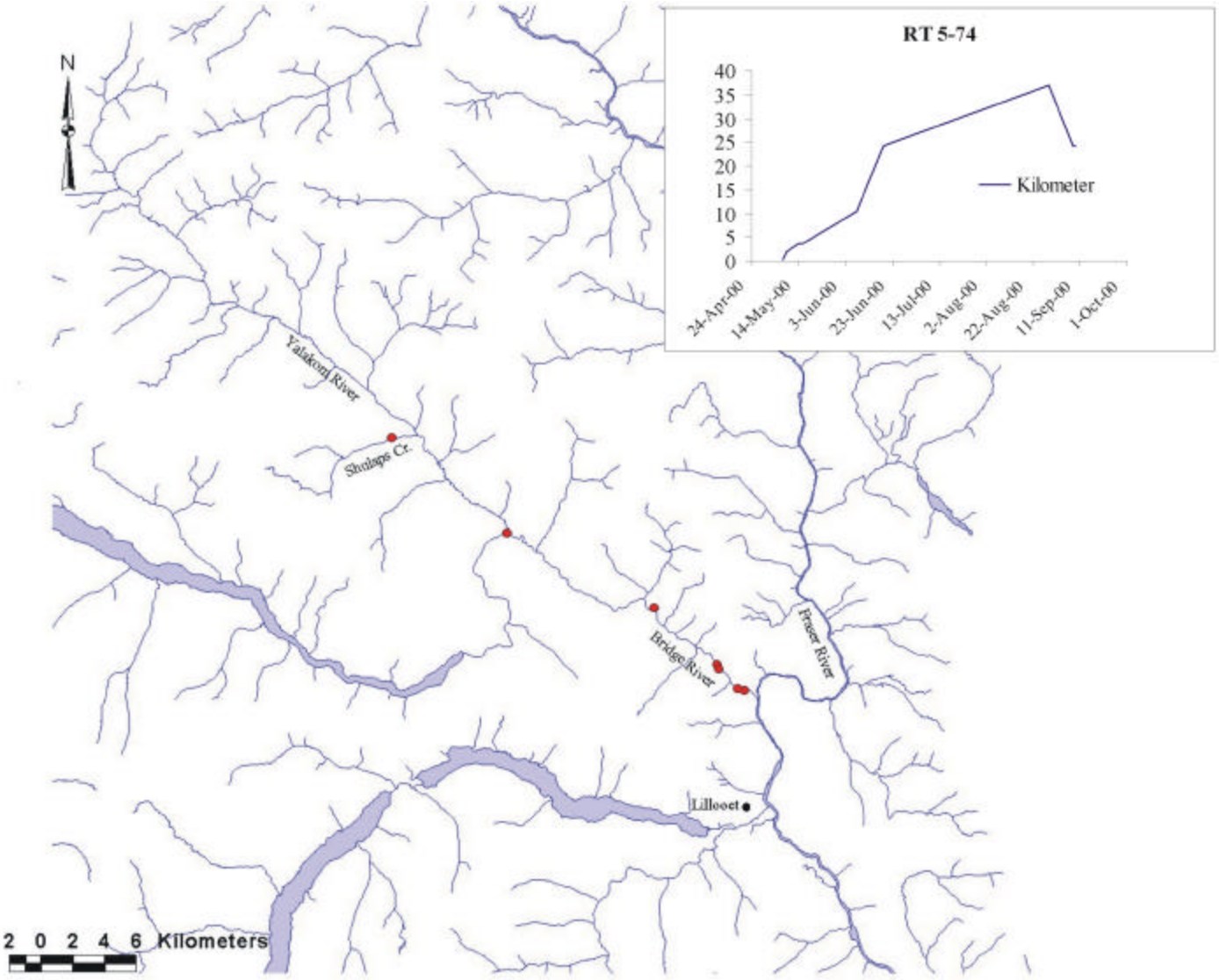
Locational Data continued

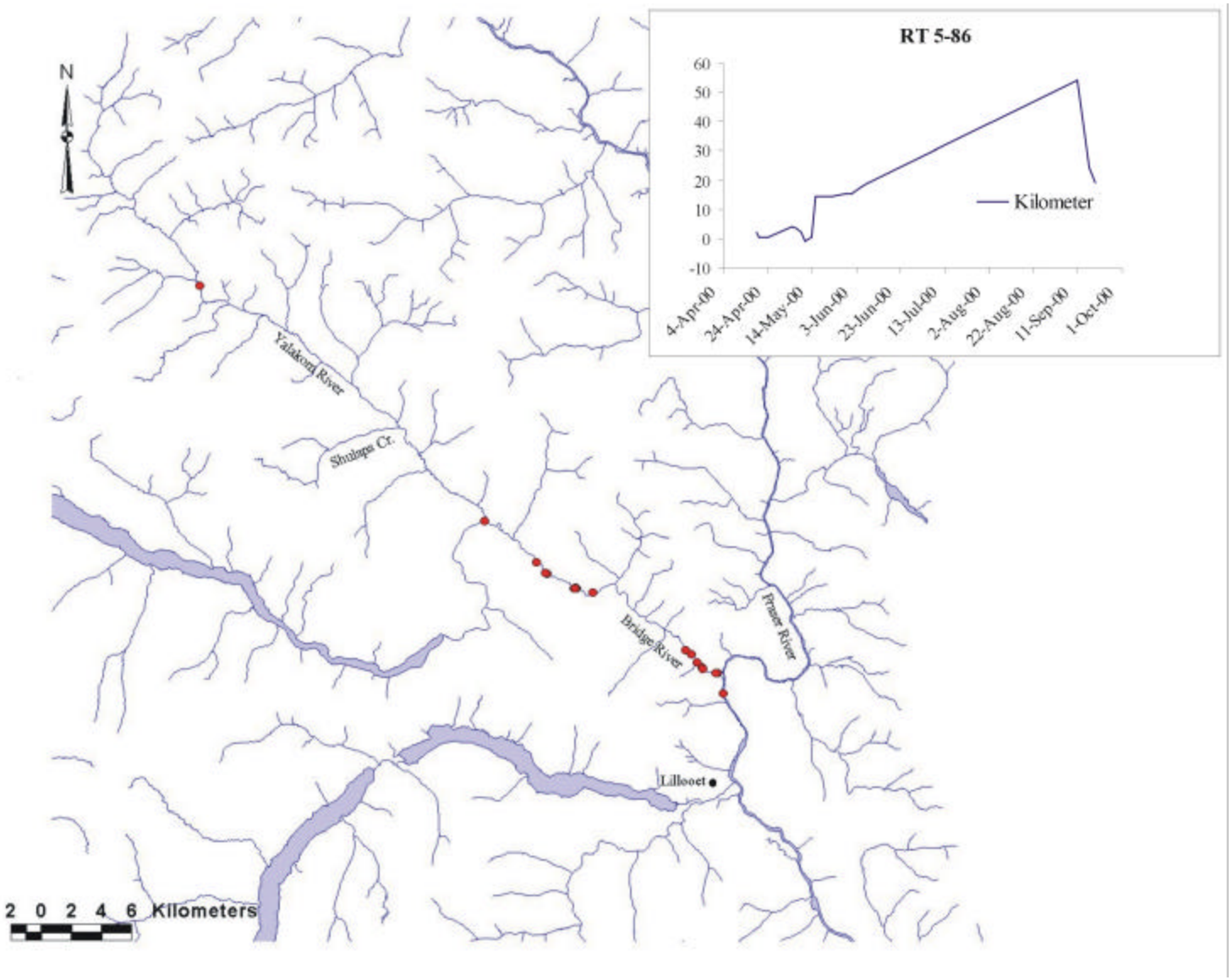
Date	Code	Channel	Zone	Easting	Northing	Type
9-May-00	86	5	10	573879	5623397	Road
11-May-00	86	5	10	575314	5621519	Road
14-May-00	86	5	10	574842	5623086	Road
16-May-00	86	5	10	566019	5629383	Heli
23-May-00	86	5	10	564822	5629737	Road
29-May-00	86	5	10	564724	5629809	Road
1-Jun-00	86	5	10	564654	5629744	Road
5-Jun-00	86	5	10	562659	5630882	Heli
5-Jun-00	86	5	10	562551	5630978	Road
8-Jun-00	86	5	10	561910	5631745	Road
11-Sep-00	86	5	10	537931	5653177	Road
16-Sep-00	86	5	10	558262	5634965	Fixed
21-Sep-00	86	5	10	564693	5629737	Heli
31-May-00	87	5	10	558242	5634898	Capture
5-Jun-00	87	5	10	558268	5634977	Heli
8-Jun-00	87	5	10	558243	5634995	Road
30-Jun-00	87	5	10	554155	5639772	Road
29-Aug-00	87	5	10	551123	5642122	Heli
11-Sep-00	87	5	10	550813	5642042	Road
21-Sep-00	87	5	10	553053	5640812	Heli
25-Sep-00	87	5	10	558262	5634965	Fixed
24-Jan-01	87	5	10	575720	5615893	Road
7-May-00	90	5	10	574477	5623220	Capture
9-May-00	90	5	10	575115	5622874	Road
11-May-00	90	5	10	575334	5622471	Road
14-May-00	90	5	10	575115	5622874	Road
16-May-00	90	5	10	575151	5622794	Heli
18-May-00	90	5	10	575115	5622874	Road
23-May-00	90	5	10	572610	5625066	Road
25-May-00	90	5	10	570601	5626878	Heli
25-May-00	90	5	10	569862	5627111	Heli
29-Aug-00	90	5	10	571670	5626093	Heli
21-Sep-00	90	5	10	571454	5626279	Heli
24-Jan-01	90	5	10	575497	5615529	Road
31-May-00	91	5	10	558462	5634823	Capture
5-Jun-00	91	5	10	560685	5633327	Heli
8-Jun-00	91	5	10	562039	5631605	Road
30-Jun-00	91	5	10	560686	5633368	Road
20-Sep-00	91	5	10	558262	5634965	Fixed
21-Sep-00	91	5	10	558144	5635814	Heli

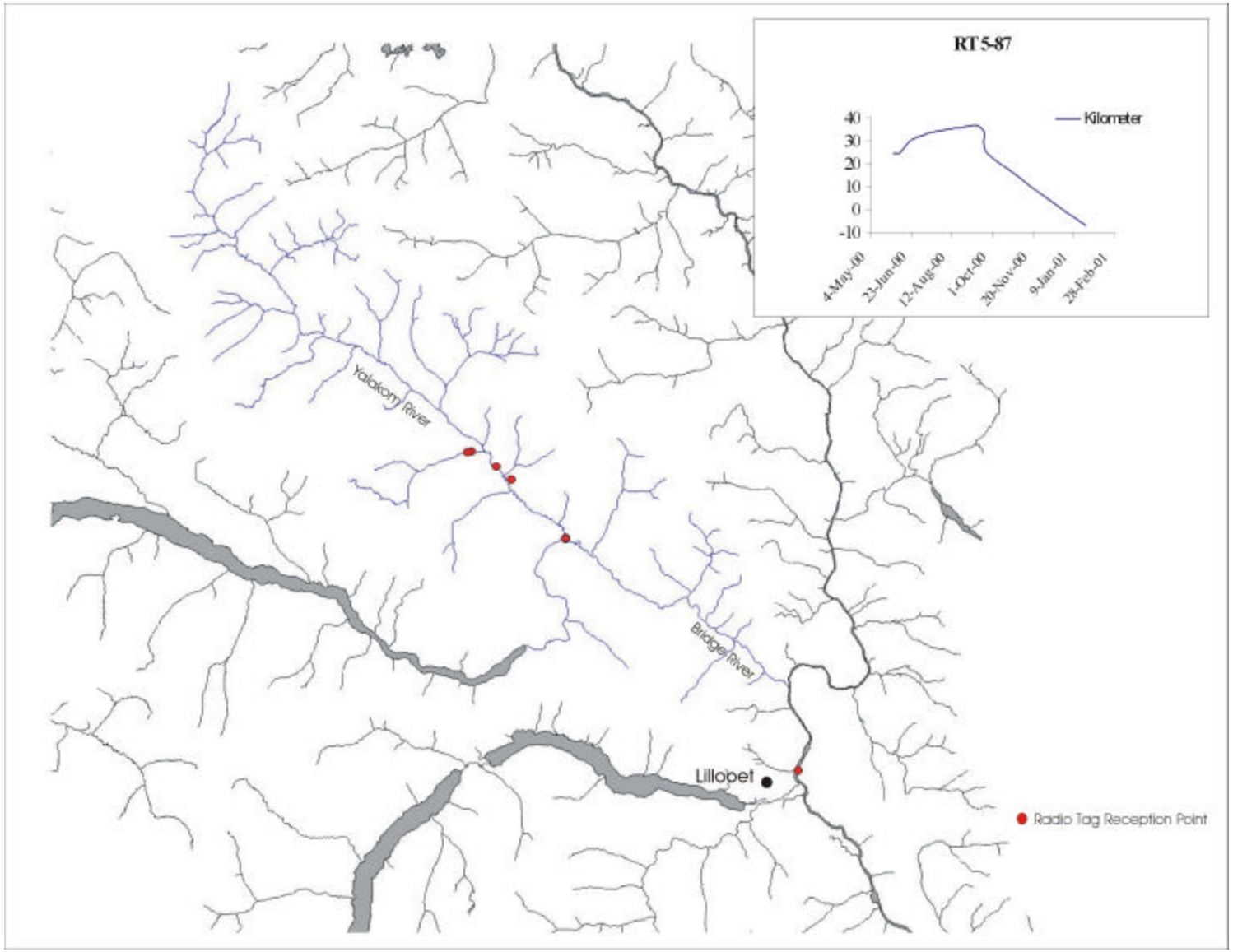
APPENDIX 2 Individual radio-tagged bull trout movement maps.

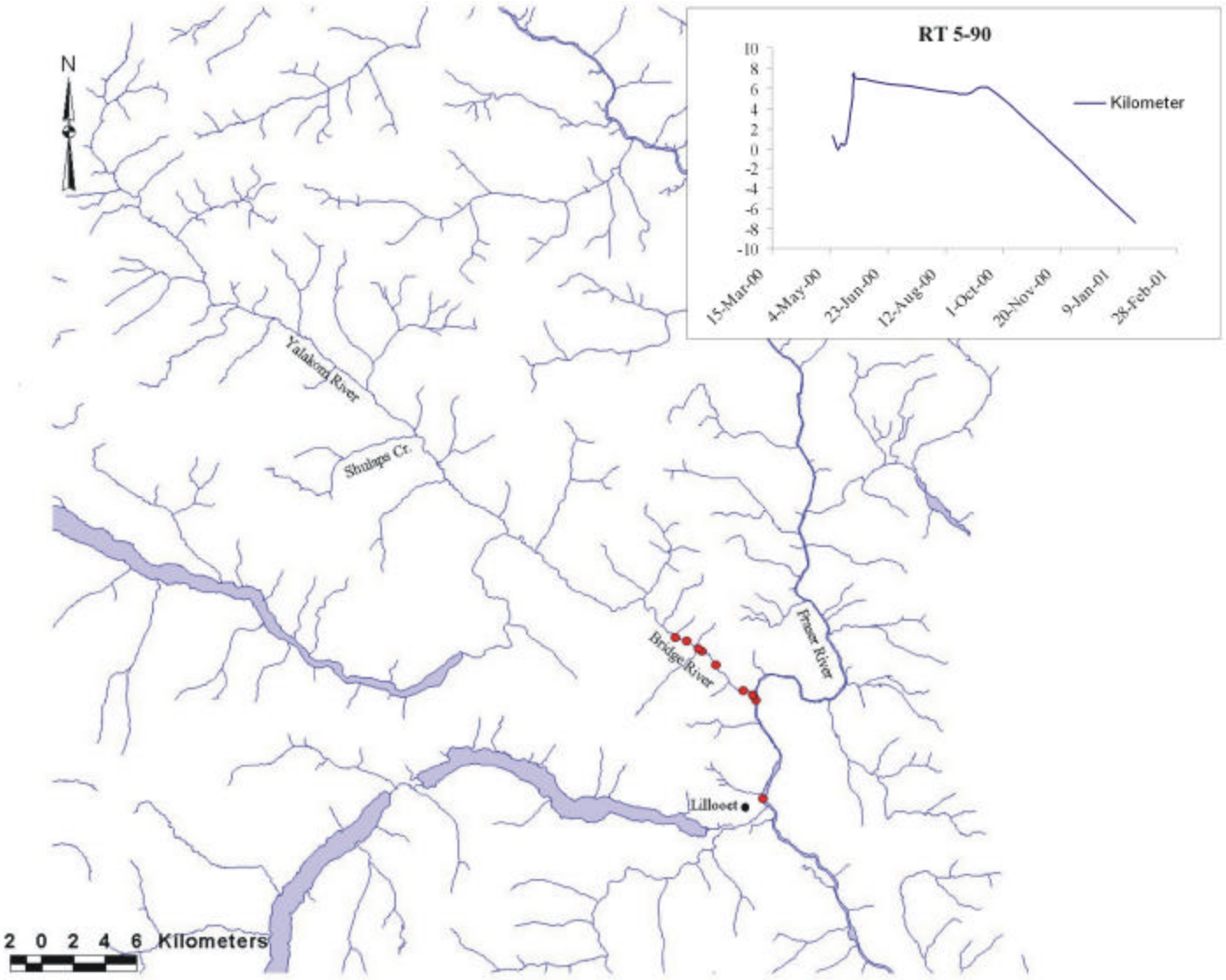

RT 5-69
Kilometer
40
35
30
25
20
15
10
5
0
15-Mar-00
4-May-00
23-Jun-00
12-Aug-00
1-Oct-00
20-Nov-00
9-Jan-01
28-Feb-01
Yalakom River
Bridge River
Lillooet
Radio Tag Reception Point

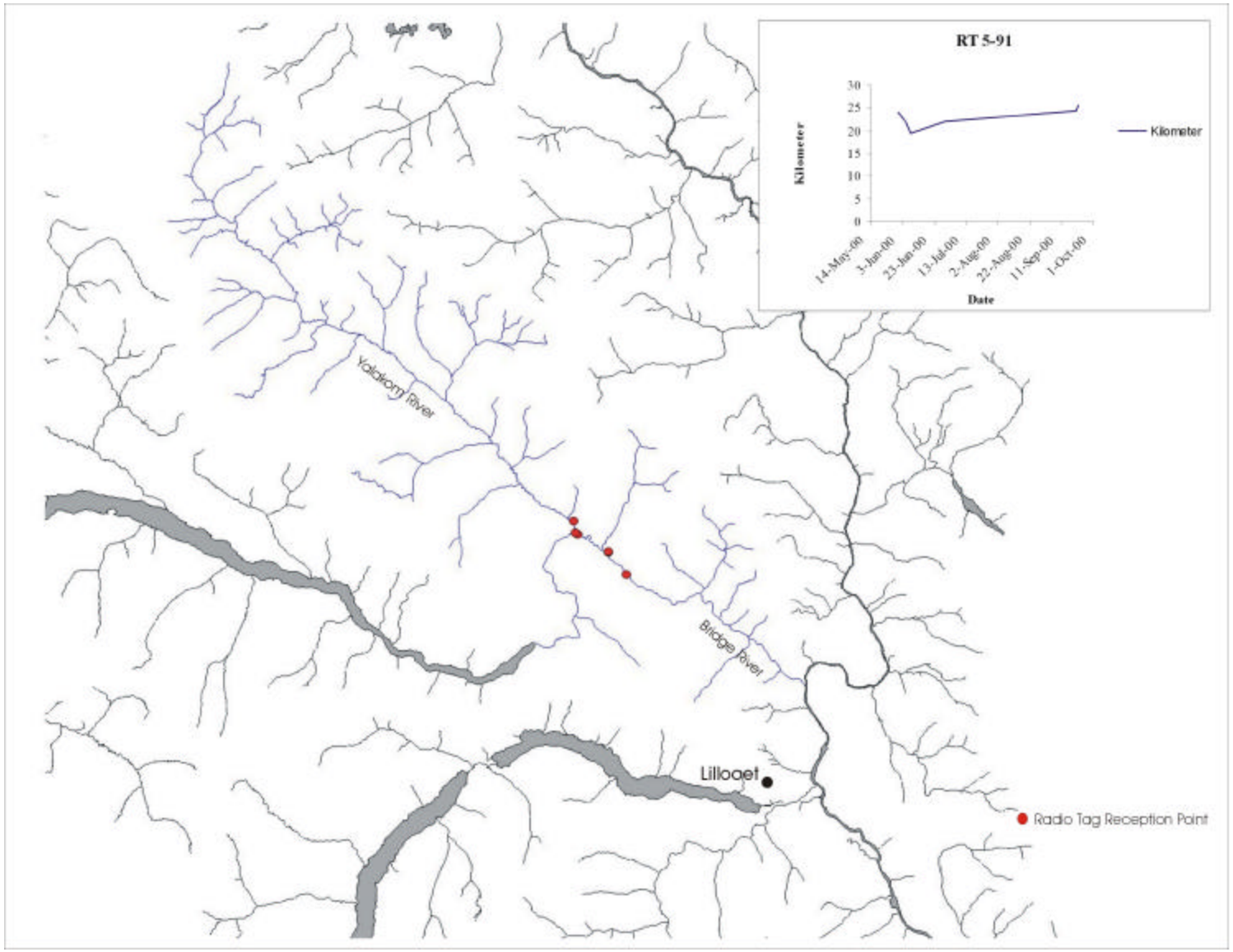

RT 5-72
70
60
50
40
30
20
10
0
-10
4-May-00
23-Jun-00
12-Aug-00
1-Oct-00
20-Nov-00
9-Jan-01
28-Feb-01
19-Apr-01
Kilometer
Yalakom River
Bridge River
Lillooet
Radio Tag Reception Point


RT 5-74
40
35
30
25
20
15
10
5
0
Kilometer
24-Apr-00
14-May-00
3-Jun-00
23-Jun-00
13-Jul-00
2-Aug-00
22-Aug-00
11-Sep-00
1-Oct-00
N
Yalakom River
Shulaps Ct.
Bridge River
Fraser River
Lillooet
2 0 2 4 6 Kilometers


RT 5-86
60
50
40
30
20
10
0
-10
Kilometer
4-Apr-00
24-Apr-00
14-May-00
3-Jun-00
23-Jun-00
13-Jul-00
2-Aug-00
22-Aug-00
11-Sep-00
1-Oct-00
N
Yalakom River
Shulaps Cr.
Bridge River
Fraser River
Lillooet
2 0 2 4 6 Kilometers


RT 5-87
Kilometer
40
30
20
10
0
-10
4-May-00
23-Jun-00
12-Aug-00
1-Oct-00
20-Nov-00
9-Jan-01
28-Feb-01
Yalakom River
Bridge River
Lillooet
Radio Tag Reception Point


RT 5-90
Kilometer
10
8
6
4
2
0
-2
-4
-6
-8
-10
15-Mar-00
4-May-00
23-Jun-00
12-Aug-00
1-Oct-00
20-Nov-00
9-Jan-01
28-Feb-01
N
Yalakom River
Shulaps Cr.
Bridge River
Fraser River
Lillooet
2 0 2 4 6 Kilometers


RT 5-91
Kilometer
30
25
20
15
10
5
0
14-May-00
3-Jun-00
23-Jun-00
13-Jul-00
2-Aug-00
22-Aug-00
11-Sep-00
1-Oct-00
Date
Kilometer
Yalakom River
Bridge River
Lillooet
Radio Tag Reception Point