Aspects of the Biology of Bull Trout (*Salvelinus confluentus*) in the Salmo River Watershed as Identified Through Radio Telemetry

Report Prepared For:
Columbia-Kootenay Fisheries Renewal Partnership and Columbia Basin Trust
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EXECUTIVE SUMMARY

A total of ten bull trout (eight females and two males) were implanted with radio tags in the Salmo River watershed (nine in the mainstem Salmo River and one in Clearwater Creek). The average size of tagged fish was 57.0 cm fork length and 1972 g weight. Catch per unit effort averaged 0.44 bull trout per angler day, and post-surgery mortality was 0% as all bull trout underwent extensive upstream migrations to spawning areas. Bull trout began migrations to their spawning areas between July 15 and August 10 during a period of reduced decline in Salmo River discharge. Bull trout were tracked to a total of five spawning locations (the upper Salmo River, Clearwater Creek, Sheep Creek, the South Salmo River, and Stagleap Creek (tributary to the South Salmo River)), with one fish spawning in the United States of America (South Salmo River). During tracking four of the ten tagged fish entered the South Salmo watershed, with two fish utilizing the South Salmo River in the United States of America. Bull trout entered spawning tributaries as early as the first week of August, with spawning peaking in the first or second week of September. There was significantly more use of tributary habitat than mainstem habitat by radio tagged bull trout for spawning. Post-spawning migrations to overwintering habitat had generally occurred by the end of November, and it appeared that post-spawning mortality was 0% as all fish had moved significant distances downstream to overwintering areas. Overwintering habitat was limited to an 11 km section of the mainstem Salmo River between 13 km and 24 km, with some fish overwintering in the same pool in which they were originally tagged. Overwintering habitat was mainly in the form of deep pool in association with large woody debris or boulder. No tagged bull trout migrated into Seven Mile Reservoir, suggesting that the population is a fluvial population.

ACKNOWLEDGEMENTS

Funding for the project was provided by the Columbia-Kootenay Fisheries Renewal Partnership to the Salmo Watershed Streamkeepers Society. However, as funding for this project was limited, its successful completion was made possible only as a result of the co-operation of a large number of organizations and individuals within the following organizations.

Columbia-Kootenay Fisheries Renewal Partnership and Columbia Basin Trust

Funding for this project ($12,400) was provided by the Columbia-Kootenay Fisheries Renewal Partnership and Columbia Basin Trust. Bill Green provided comments on the project, while Jaime Christales provided administrative assistance.

BC Hydro

BC Hydro supplied the ten radio tags that were utilized for the study and provided equipment, personnel, and monies for tracking flights. Specifically Ric Olmsted and Gary Birch were instrumental in providing funds and expertise for the project, with Ric providing assistance with fish capture. Dean den Biesen and Chris Madland assisted in the field, and Dean's knowledge of the river identified likely sampling areas.

BC Ministry of Environment, Lands and Parks

The Ministry of Environment, Lands and Parks provided tracking equipment and personnel to aid in the completion of the project. Specifically John Bell assisted with fish capture and tracking. Colin Spence provided equipment for the fixed station. Albert Chirico ensured collection permits were put in place to allow fish capture. Jay Hammond and Bob Lindsay provided insight into project requirements and management issues.

Salmo Watershed Streamkeepers Society (SWSS)

Community volunteers that are members of SWSS assisted with various components of the project. The "captain" Peter Neil dedicated a significant amount of volunteer time (one hundred plus hours) and equipment (drift boat, vehicle, sampling equipment) to ensure capture of the ten fish for tagging. He also assisted with surgery, tracking, and discussion about the project. Art Field assisted with tracking. Alice Nellestijn assisted with project management and sampling logistics. Alice Kuzma assisted with project management. Doug Ellis provided assistance during tracking.

Members of the HRDC/Youth Services Canada Salmo Watershed Assessment Project Squad that was administered by SWSS, assisted with many aspects of the project. Specifically Mike van Wijk and Darcy Torrans assisted with fish capture, surgery, and fish tracking. Their enthusiasm was essential to tracking fish on the ground, and their persistence located four of the tracked fish in locations where they were not expected.

QNB Creative Inc.

Alice Nellestijn produced maps and data sheets that were utilized for the study and ensured that collected data was safely stored and entered into the tracking database. She also produced a poster display that was shown at Fisheries Renewal meetings and open houses within the community. Alice also provided reporting logistics, and worked her wonders in getting the report together.

Baxter Environmental

Jeremy Baxter volunteered time to fish capture and surgery, as well as providing volunteer assistance with tracking. Baxter Environmental provided volunteer time for project logistics and administration, as well as providing volunteer equipment to ensure the completion of the project. Robyn Roome provided volunteer time for project administration. Thomas Baxter provided inspiration for getting this project completed.

Seattle City Power and Light

Seattle City Power and Light provided an additional ten radio tags for use in the study if they were required. The company also provided encouragement for the study and the option for possible funding in 2000/2001.

Columbia Basin Fish and Wildlife Compensation Program

Equipment was provided by the Columbia Basin Fish and Wildlife Compensation Program.

Geosense Consulting Ltd.

Graham Smith provided mapping logistics.

Canadian Helicopters

Duncan Wassick ensured aerial tracking could be undertaken.

Water Survey of Canada

Gordon Corcoran provided discharge data for the study period.

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1.0 INTRODUCTION

The Salmo River watershed has a long history of importance of stream fisheries in the West Kootenay region. Prior to construction of hydroelectric dams the watershed was a major producer of chinook salmon (*Oncorhynchus tshawytscha*) and steelhead (*O. mykiss*) that were targeted by First Nation's for harvest (Fulton 1968; Scholz et al. 1985), as well as recreational anglers. These populations of salmon were extirpated when their migration routes were cut off by the large dams constructed on the mainstem Columbia River, and fisheries for these species also died as a result. In more recent times, recreational fisheries for non-anadromous species such as rainbow trout (*O. mykiss*) and bull trout (*Salvelinus confluentus*) have dominated angler activity in the watershed. These are generally small scale fisheries that are experienced predominantly by local residents. These sport fisheries for bull trout and rainbow trout are also thought to have severely declined (Sigma Engineering Ltd. 1996; Baxter et al. 1998), and in the past the river has been closed to angling in an attempt to rebuild salmonid stocks, and stop population declines (B. Lindsay, Fisheries Biologist, Ministry of Environment, Lands and Parks (MELP), Nelson, B.C.; personal communication).

Within the watershed, bull trout attain the largest size of sportfish that are targeted in recreational fisheries, and as such have likely been harvested to a high degree in the recent past. Despite this, very little is known about the biological characteristics of the bull trout population, and recent study suggests that the population of adult bull trout in the watershed is likely less than 200 individuals (Baxter et. al 1998; Baxter 1999). Given the concern about the small population size, and the fact that the river was open to retention of bull trout over 30 cm, MELP regulated the river to a mandatory release of bull trout in the 1999/2000 angling season (B. Lindsay, Fisheries Biologist, MELP, Nelson, B.C.; personal communication).

As the bull trout is a key species in the fisheries ecosystem of the Salmo River watershed, and that very little is known about its biology, the Salmo Watershed Streamkeepers Society (SWSS) and Baxter Environmental applied for funding from the Columbia-

Kootenay Fisheries Renewal Partnership (CKFRP) and Columbia Basin Trust. The project was designed with the main goal to further the biological understanding about the species within the watershed in the hopes that this information would enable fisheries personnel to make informed management decisions. A secondary goal was to involve members of the local community and of SWSS with the project in order to promote stewardship of the fisheries resources in the Salmo watershed through a partnered study of the fisheries ecosystem of the area. Other partners involved with this project included BC Hydro, MELP, the Columbia Basin Fish and Wildlife Compensation Program, QNB Creative Inc., and Seattle City Power and Light.

For this project, radio telemetry was used as a methodology to identify the spawning locations of, and determine the overwintering and spawning habitat preferences of, the Salmo River bull trout population. The main objectives of this study were to:

1. identify spawning areas (mainstem and tributary) within the watershed;
2. expand knowledge about the biology (migration timing, spawning timing) and habitat use (summering, spawning, and overwintering);
3. determine whether the Salmo River bull trout population utilizes Seven Mile Reservoir for overwintering;
4. collect data that could be used in future conservation and enhancement opportunities; and
5. promote community stewardship for the fisheries resources of the watershed.

2.0 METHODS

2.1 Study Site

The Salmo River rises from the Selkirk Mountains 12 km southeast of Nelson, B.C. (Figure 1). The river progresses in a southerly direction for approximately 60 km from its origin to the confluence with the Pend d'Oreille River (Seven Mile Reservoir). Geographic information is summarized in Table 1. The system is a 5th order stream, and has a total drainage basin area of roughly 123,000 ha.

Elevation in the basin ranges from 564 meters at its confluence to 2,343 meters at the height of land. Within this elevation range, the system comprises two biogeoclimatic zones (Braumandl and Curran 1992). At lower elevations, the valley lies within the Interior Cedar-Hemlock (ICH) zone, while areas in the higher elevations are found within the Englemann Spruce-Subalpine Fire (ESSF) zone. The Salmo River has a total of eight 2nd and 3rd order tributaries (including Apex Creek, Clearwater Creek, Hall Creek, Barrett Creek, Ymir Creek, Porcupine Creek, Erie Creek, and Hidden Creek) and two 4th order tributaries (Sheep Creek and the South Salmo River) (Figure 1). The Water Survey of Canada maintains a gauging station on the Salmo River near the town of Salmo (Anonymous 1977). Mean annual discharge in the Salmo River (1949-1976) was 32.5 $m^3 \cdot sec^{-1}$, with mean monthly minimum and maximum values of 7.5 and 128.5 $m^3 \cdot sec^{-1}$, respectively. Runoff reaches a peak in May, with the highest flows between April and July each year.

2.2 Fish Capture and Tagging

Bull trout in the Salmo River watershed were captured using angling. Capture primarily occurred in the mainstem Salmo River in 1999 from early-July to the end of July, and continued again on August 31 with one fish being captured in a tributary. The mainstem

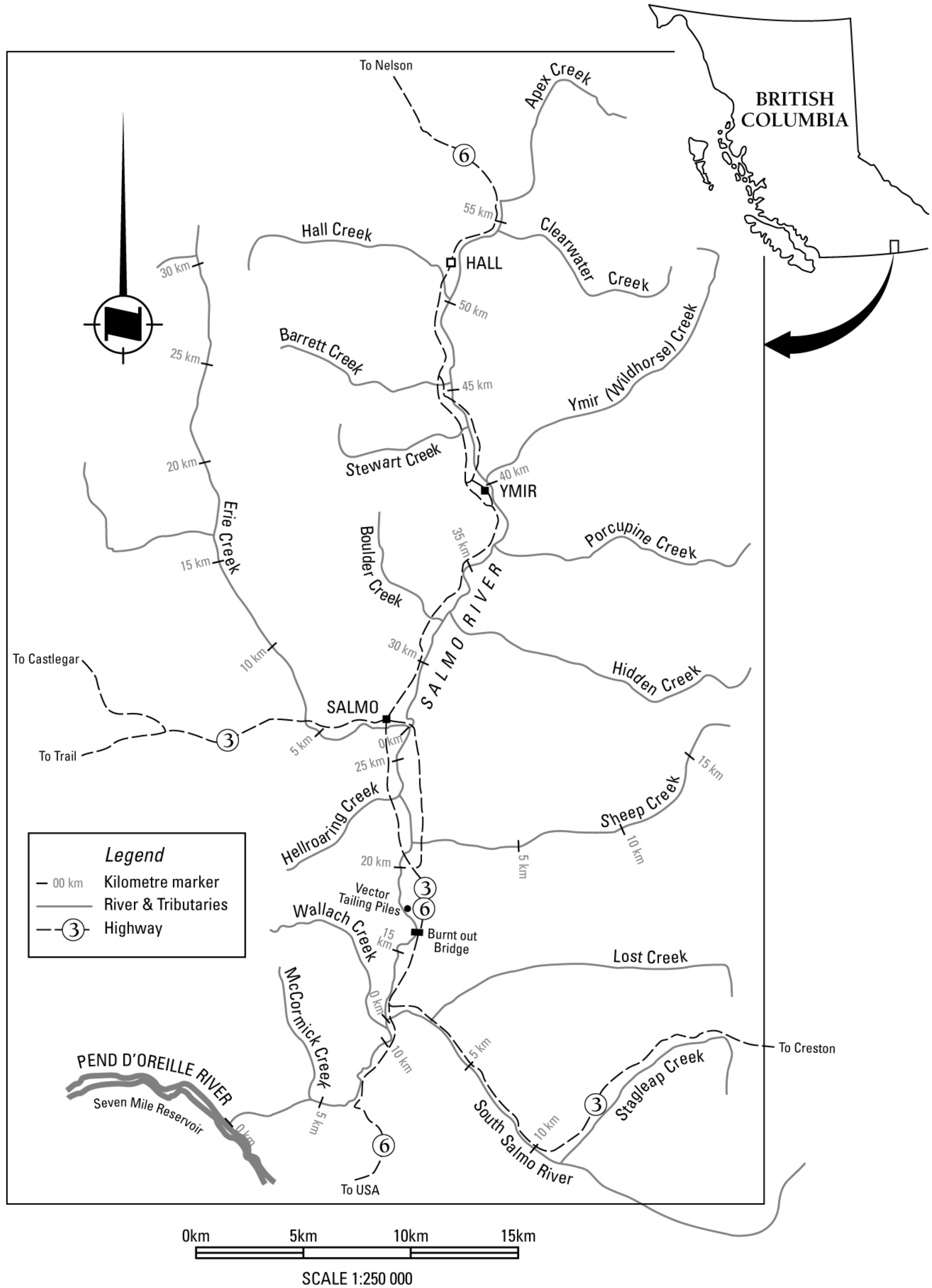

Figure 1. **The Salmo River watershed study area.**

Salmo River was sampled from the town of Ymir to the South Salmo River confluence (roughly 60% of the available mainstem river habitat), with the majority of access for sampling occurring through the use of drift boats. Two boats of two people (four persons total) drifted on each sampling day, and capture effort was focussed primarily on the mainstem Salmo River above the South Salmo River confluence, and not in Seven Mile Reservoir, for a number of reasons.

Table 1. Summary of geographic information for the Salmo River study area.

<table>
<tr><th>Gazetted Name</th><th colspan="2">Stream Length (km)</th><th>Area (ha)</th></tr>
<tr><td>Salmo River</td><td colspan="2">60</td><td>123,000</td></tr>
<tr><td colspan="4">Geographic Information</td></tr>
<tr><td colspan="2">Approximate distance and direction to the nearest town, city or landmark</td><td colspan="2">12 km southeast of Nelson, B.C.</td></tr>
<tr><td colspan="2">MELP Region</td><td colspan="2">4</td></tr>
<tr><td colspan="2">MELP Management Unit</td><td colspan="2">4-8</td></tr>
<tr><td colspan="2">DFO District</td><td colspan="2">Interior South East (#30)</td></tr>
<tr><td colspan="2">Ministry of Forests Region</td><td colspan="2">Nelson</td></tr>
<tr><td colspan="2">Ministry of Forests District</td><td colspan="2">Kootenay Lake</td></tr>
<tr><td colspan="2">NTS Base Map Reference</td><td colspan="2">82 F/3 and 82 F/6</td></tr>
</table>

The primary reason was that it was felt that the timing of sampling effort would coincide with the upstream spawning migration of bull trout, and it would be a effective use of time and effort to sample above the South Salmo River confluence. The secondary reason was that fisheries work on Seven Mile Reservoir in 1994 and 1995 had failed to sample a large number of bull trout (R.L.&L. 1995) suggesting that the population was possibly a fluvial (mainstem overwintering) population and not an adfluvial (reservoir overwintering) population. The report also suggested that sampling efficiency would by higher in the Salmo River than in the reservoir. Effort was also limited to the areas above the South Salmo River confluence due to access restrictions and the limited mainstem fish habitat (large pools) available below this point.

Fish that were captured during sampling, and suitable for radio tagging, were held in flow through fish tubes prior to processing and implantation of the radio tag. Fish targeted for tagging were a minimum 500 mm in fork length, and 0.91 kg in weight, so that the weight of the transmitter did not exceed 2% of the fish weight. Sterile conditions were maintained at the site with the biologist scrubbing up with Betadine liquid soap, and donning sterile gloves. All operating instruments and radio tags were sterilized in a container of ethanol.

Once fish were ready for processing they were immersed in a 20 L anaesthetic bath with a concentration of clove oil at 100 PPM (2 mL of clove oil emulsified in ethanol per 20 L water). The fish were taken to stage IV of anaesthesia (equilibrium lost, operculum movement slow and irregular, no response to external stimuli), which was achieved after a period of approximately three minutes in the bath. The fish was then removed from the bath, laid on its back in a V-shaped operating trough lined with foam, and the gills were irrigated with water using a sitz bath bag and tubing that was placed into the fishes mouth (Figure 2). The incision into the abdominal cavity (left hand body side wall about 3 to 5 cm anterior of the pelvic fins; see Figure 3) was then made with a scalpel fitted with a curved (No. 12) blade.

After the incision was complete, a 16 gauge stainless steel needle was inserted through the abdominal wall posterior to the incision and back out the incision. The antennae of the radio tag was then threaded through the needle, and the needle was then pulled out, leaving the antennae coming out the side wall of the fish (Figure 4). The radio tag was then inserted into the abdominal cavity, and the incision was closed with three interrupted sutures of 2/0 monofilament on a cutting needle (Figure 5). We then applied Betadine to the closed incision and exit point of the antennae. After the surgical procedure a numbered Floy tag was inserted into the dorsal fin pterigiphores, and fork length and mass measurements were taken. The fish was also sexed where possible. The entire procedure took approximately 4-5 minutes, after which the fish was allowed a 15-20 minute recovery period in a flow through fish tube. The location (UTM co-ordinate) of capture was then recorded and the fish was released.

Figure 2. Bull trout being prepared for surgery.

Figure 3. Incision made through bull trout body wall prior to inserting radio tag into abdominal cavity.

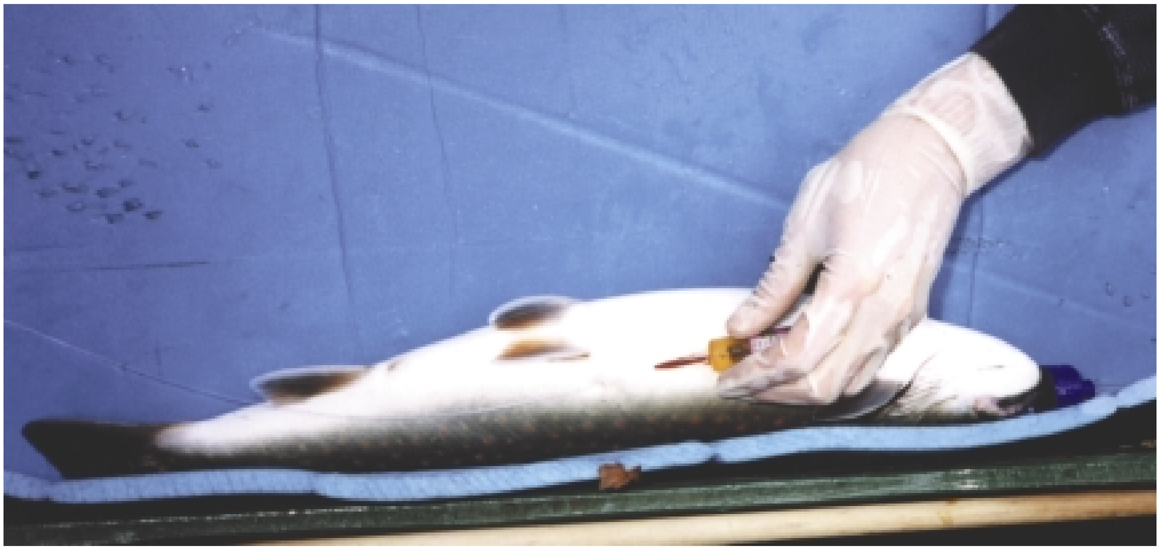

Figure 4. **Antennae coming out bull trout body wall prior to inserting radio tag into abdominal cavity.**

Figure 5. **Sutured incision on bull trout body wall with radio tag antennae coming out the side of fish (the bull trout is recovering from surgery).**

Radio tags used for this study were manufactured by Lotek Engineering in Newmarket Ontario. The tags used were model MCFT-3A (16 mm diameter, 50 mm length, 6.2 g weight in water, operation life >680 days), and were digitally coded tags transmitting on frequency 149.520 Mhz (channel 11).

2.3 Discharge

Discharge data for the Salmo River is collected annually, and was obtained from the Water Survey of Canada from a recording station located at the Black Bluffs (downstream of the South Salmo River confluence). This was done to determine if bull trout spawning movements were correlated with a certain discharge level or trend through July and August of 1999.

2.4 Tracking

Tracking was carried out by ground checks (boat and vehicle), and through the use of aerial monitoring in a helicopter (A-STAR). We used Lotek SRX-400 receivers in conjunction with a single two or three element Yagi antennae for all ground and aerial tracking, and during tracking the location of each fish was noted as a description (river location) and UTM co-ordinate.

A fixed data-logging tracking station was also established at the mouth of the Salmo River in the fall of 1999 to determine if any bull trout migrated into Seven Mile Reservoir. The fixed station consisted of a battery powered receiver (Lotek SRX-400 with data logging software) within a weatherproof housing and connected to an upstream and downstream antennae (four element Yagi antennae) to resolve movement direction. The battery was replaced every two weeks, at which time the recorded data was downloaded to a portable computer.

3.0 RESULTS

3.1 Fish Capture and Tagging

A total of ten bull trout were implanted with radio tags of which nine fish were captured in the mainstem Salmo River between km 15 and km 30 (from the mouth), and one fish was sampled in a spawning tributary. The date, capture location, sex, length, weight, radio tag code, and Floy tag number for each fish is found in Table 2. Although we targeted tagging an equal number of male and female bull trout, the capture of fish for the study required a significant amount of effort. As such, each fish that was sampled, and of suitable size for radio tagging was selected for the study. Of the tagged fish, eight fish were identified as females and two fish were classified as males. The average length of fish sampled was 57.0 cm, while the average weight was 1972 g. Length- and weight-frequency histograms are found in Figures 6 and 7.

Table 2. Summary data of bull trout captured in the Salmo River watershed and implanted with radio tags in 1999.

Date	Capture Location (km)	Sex	Length (cm)	Weight (g)	Code	Floy Tag #
07/15/99	Salmo River (18.45)	F	58.0	2177	51	P-24025
07/07/99	Salmo River (17.25)	F	59.5	1860	54	P-24004
07/15/99	Salmo River (23.05)	M	60.0	2358	56	P-24007
07/11/99	Salmo River (25.25)	F	60.5	2359	58	P-24005
07/17/99	Salmo River (21.05)	F	56.0	1860	60	P-24022
07/07/99	Salmo River (25.25)	F	53.0	1320	61	P-24003
08/31/99	Clearwater Creek (3.80)	F	54.0	1750	65	W-C00148
07/11/99	Salmo River (17.85)	F	52.0	1134	67	P-24006
07/11/99	Salmo River (18.45)	F	50.0	1814	68	P-24024
07/09/99	Salmo River (23.05)	M	67.0	3084	70	P-24002

Most fish were angled in large pools or glides within the study section, and were often found in association with cover in the form of deep pools or overhead cover (bank vegetation and instream woody debris), or at the mouth of a tributary flowing into the Salmo River. The catch per unit effort of fishing was extremely low (Table 3), and averaged 0.44 fish per angler day. A total of 39 angler days were expended using various

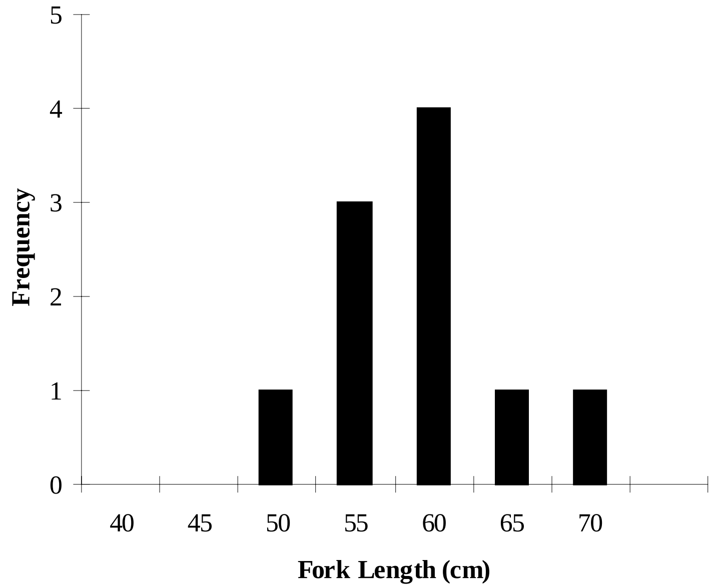

Figure 6. **Length-frequency histogram of bull trout implanted with radio tags in the Salmo River watershed in 1999.**

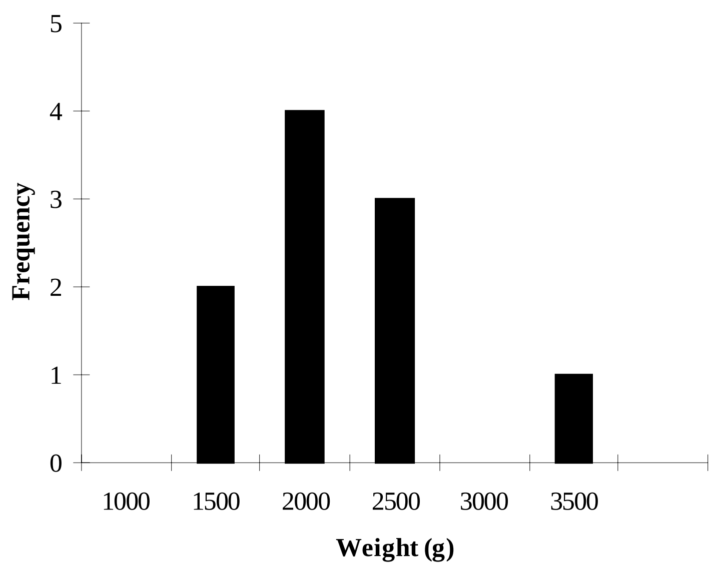

Figure 7. **Weight-frequency histogram of bull trout implanted with radio tags in the Salmo River watershed in 1999.**

methods, during which 17 bull trout were angled. Summary data of other bull trout that were sampled during the study is found in Table 4, and other fish species captured during sampling were limited to rainbow trout between 30 and 50 cm (n=~15). One of the radio tagged bull trout (Code 70) was angled in the spring of 2000 by a recreational angler, and released. Post-surgery mortality of fish was 0% as all fish made upstream migrations to spawning areas.

Table 3. Catch per unit effort during bull trout fishing in the Salmo River watershed in 1999.

Angler	Method	Average Catch per Unit Effort (No. Fish Landed per Angler Day)
1	Fly	2.00
1	Lures	0.00
2	Fly	0.00
2	Lures	0.25
3	Fly	0.00
3	Lures	0.00
4	Lures	3.00
5	Fly	0.33
5	Lures	0.11
6	Lures	0.13
7	Fly	0.00
8	Lures	4.00
9	Lures	1.00

Table 4. Summary data of bull trout that were angled, but not utilized for surgery, during bull trout fishing in the Salmo River watershed in 1999.

Date	River	River km	Sex	Length (cm)	Weight (g)	Floy Tag
7-Jul-99	Salmo	25.25	Male	53.0	1230	P-24001
7-Jul-99	Salmo	22.90	?	40.0		W-C00150
7-Jul-99	Salmo	23.05	Female	40.0		W-C00149
11-Jul-99	Salmo	23.05	?	46.0		W-C00145
15-Jul-99	Salmo	17.25	Female	50.0		P-24023
17-Jul-99	Salmo	17.25	?	36.0		W-C00146

After the tagging portion of the program was completed, SWSS initiated a bull trout awareness campaign that informed the public through a newspaper article and poster campaign in the watershed (see Appendix I). This campaign identified what the goals of the study were, and what the management regulations in the Salmo River watershed were with regard to the bull trout fishery. The poster also asked anglers that captured a radio tagged bull trout to release the fish and report the catch.

3.2 Discharge

Discharge in the Salmo River in July and August of 1999 followed typical hydrograph patterns observed in British Columbia, with a decrease in runoff occurring through this period (Figure 8). The greatest decreases in discharge occurred in the second week of July

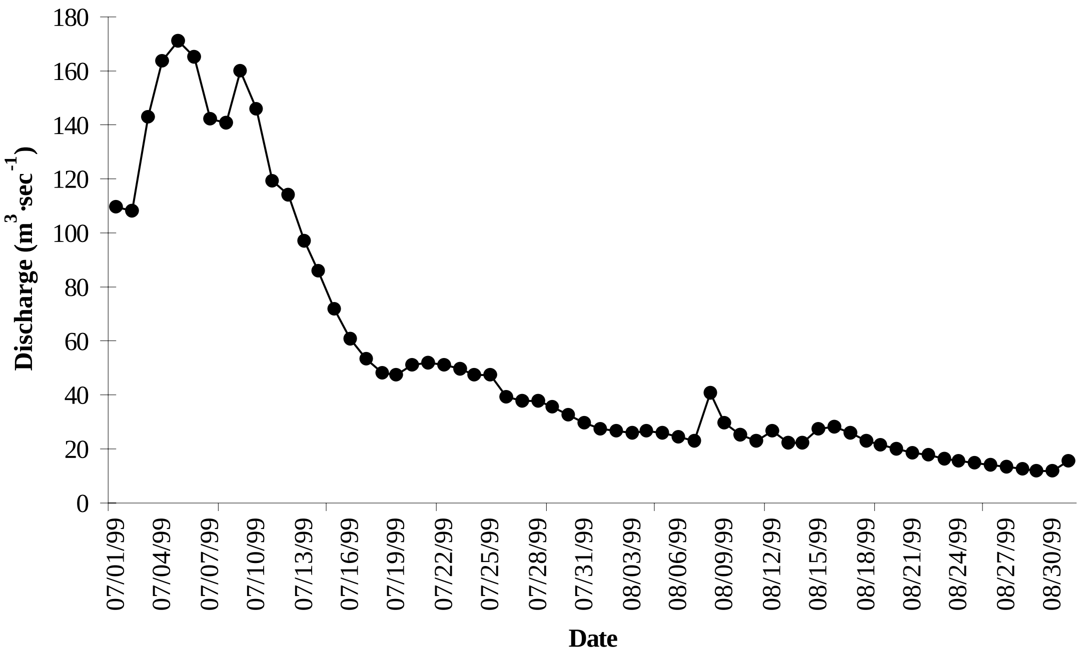

Figure 8. River discharge of the Salmo River during July and August 1999.

3.3 Tracking

For this study we utilized both ground (road and boat) and aerial (helicopter) tracking. Fish were tracked on a maximum of a weekly basis from July to the end of September (spawning period), and on a maximum of a monthly basis from October to the end of April (overwintering period). Ground tracking did not locate all of the fish on all occasions. However, aerial tracking did locate the fish on all occasions that this survey method was used. In total 15 ground tracking surveys and 5 aerial tracking surveys were conducted during this study. Locations of individual radio tagged bull trout found during tracking events are summarized in Appendix II.

The fixed data-logging tracking station was established at the mouth of the Salmo River from the end of August to the end of December 1999. No tracking events were recorded through the station during this period, suggesting that the population of bull trout does not utilize Seven Mile Reservoir. Aerial tracking also found no radio tagged bull trout below the South Salmo River confluence (start of the canyon section).

3.3.1 Upstream Migration, Spawning Locations, and Spawning Timing

3.3.1.1 General Patterns

Although the bull trout that were radio tagged within the mainstem river were all sampled within a relatively small area (8 km distance; less than 13% of available mainstem habitat), extensive migrations occurred and bull trout spawning locations were found throughout the watershed. All bull trout that were tagged made migration movements greater than 10 km, presumably to spawning locations, with two general migration patterns emerging for the nine bull trout that were tagged in the mainstem. The first pattern was an upstream movement within the Salmo River to a spawning area or tributary, while the second pattern was a downstream migration within the Salmo River to a major tributary. During this study bull trout underwent typical migration patterns that suggested spawning in five locations, and the migration pattern of all fish (movement to an area, a holding pattern, and then movement away from that holding area) suggested successful spawning.

Four of the nine tagged bull trout made upstream migrations of 5 to 30 km in the Salmo River, typically in the first week of August. The locations that these fish spawned in include the mainstem Salmo River above Hall Creek, Clearwater Creek, and Sheep Creek. Five of the nine tagged bull trout made downstream migrations of 5 to 10 km in the Salmo River to spawning tributaries, also in the first week of August. The locations that these fish spawned in include the South Salmo River (both in Canada and the U.S.A.), and Stagleap Creek (tributary to the South Salmo River). The one fish that was tagged in a spawning area within a tributary (Clearwater Creek), likely would have made an upstream migration within the Salmo River.

The spawning period (timing while fish were in their spawning areas) for bull trout in the watershed ranges between the beginning of August and end of September, with spawning likely peaking around the middle of September. Fish remained in their spawning areas generally until the first or second week of October.

3.3.1.2 Individual Patterns

A summary of the locations of individual fish is found in Appendix II, and includes UTM co-ordinates and km locations of fish by date.

3.3.1.2.1 Code 51

Code 51, a 58 cm female tagged in the Salmo River at km 18.45 on July 15 1999, held in the tagging location for two weeks after which it made a gradual upstream migration into Sheep Creek in the third week of August (see Figures 9 and 10). The fish then likely spawned in Sheep Creek at the confluence of Aspen Creek (6.15 km up Sheep Creek), after which it remained in the spawning area until the first week of October, when it started its post spawning migration (see Figures 9 and 10).

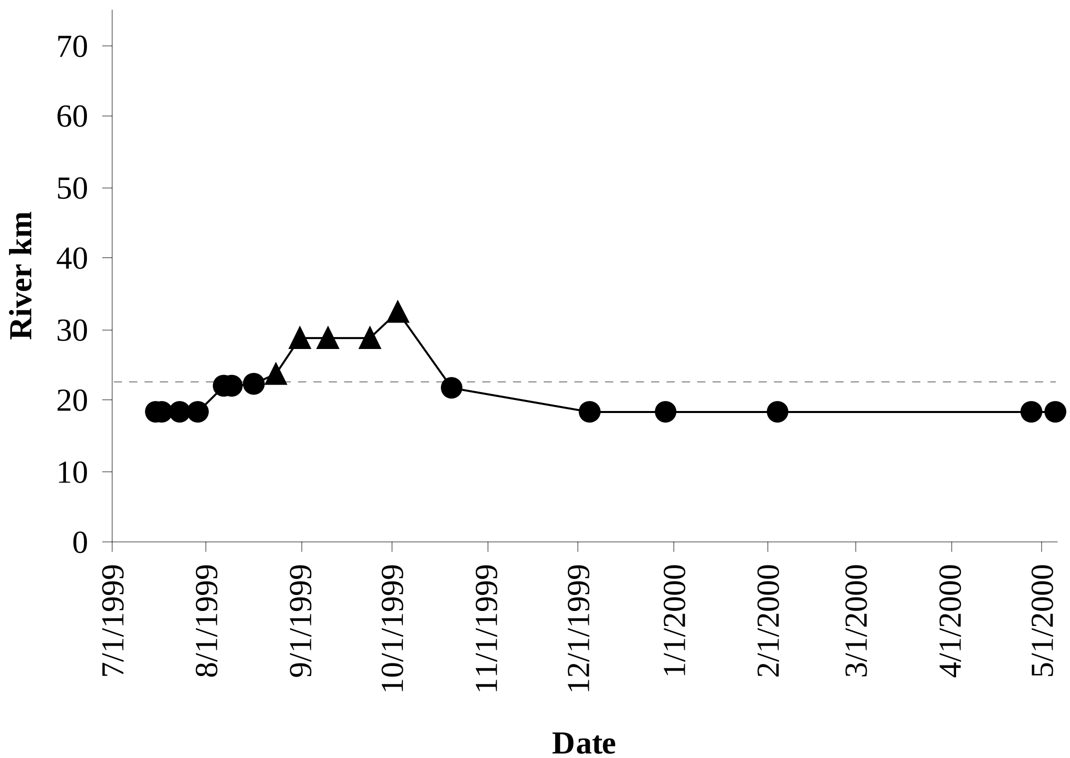

Figure 9. **Migratory pattern of a 58 cm female bull trout (Code 51) in the Salmo River watershed from July 1999 to May 2000. Triangle points above the dotted gridline represent movement within the Sheep Creek watershed (spawning location), and circle points represent locations within the Salmo River mainstem.**

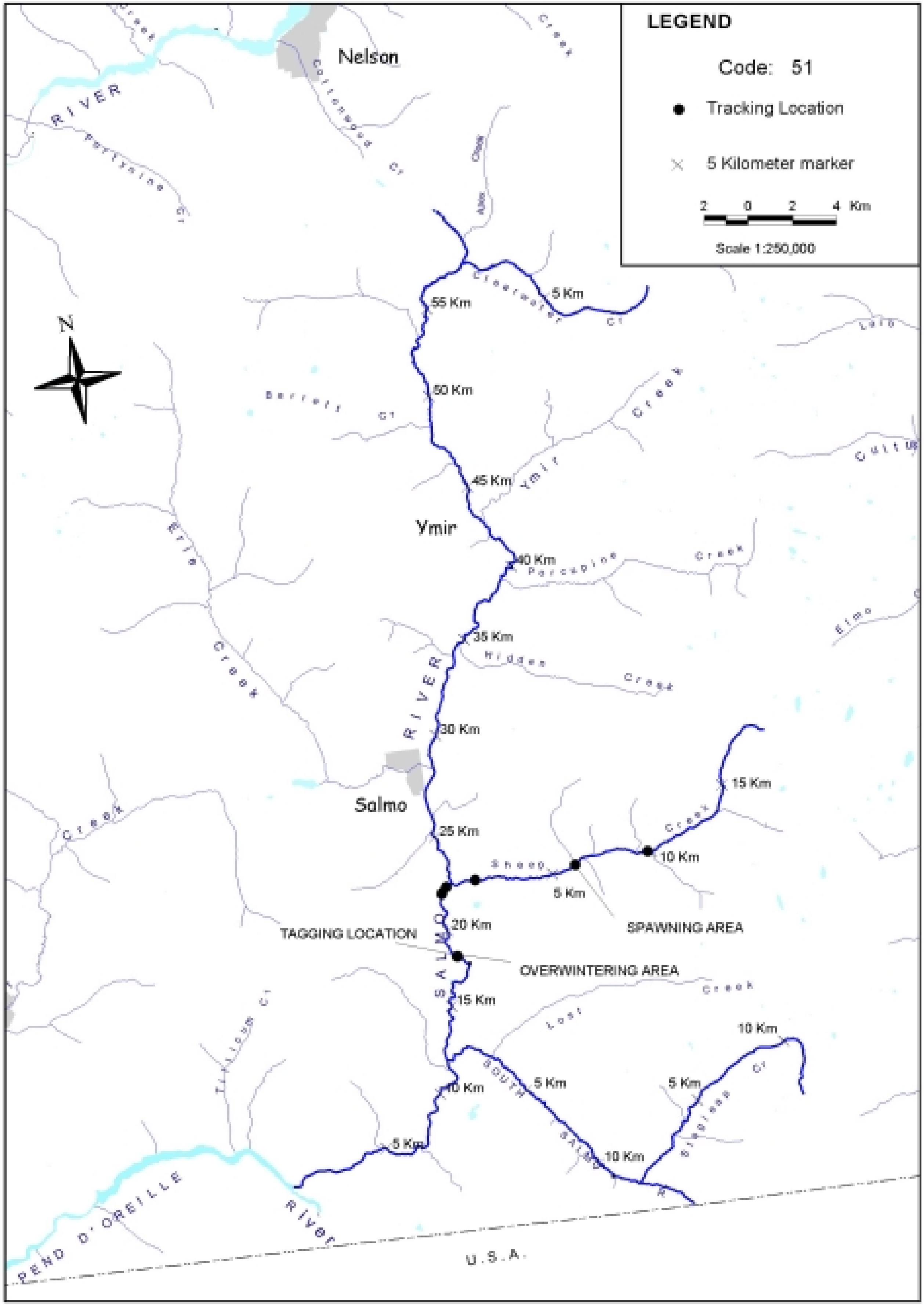

Figure 10. **Tracking locations of a 58 cm female bull trout (Code 51) within the Salmo River watershed from July 1999 to May 2000.**

3.3.1.2.2 Code 54

Code 54, a 60 cm female tagged in the Salmo River at km 18.25 on July 7 1999, held in the tagging location for three weeks after which it made a rapid downstream migration to the South Salmo River (see Figures 11 and 12). The fish then moved up the South Salmo River to spawn below the ATCO Forestry Bridge (11.05 km up the South Salmo River), after which time it remained in the spawning area until the first week of October. It then made a rapid post-spawning migration into the Salmo River where it moved upstream a considerable distance to overwinter (see Figures 11 and 12).

3.3.1.2.3 Code 56

Code 56, a 60 cm male tagged in the Salmo River at km 23.05 on July 15 1999, held in the tagging location for one week after which it made a rapid downstream migration to the South Salmo River (see Figures 13 and 14). The fish then moved up the South Salmo River into the United States of America to spawn (16.75 km up the South Salmo River), after which time it remained in the spawning area until the end of October. It then made a post-spawning migration into the Salmo River where it moved upstream to suitable overwintering habitat (see Figures 13 and 14).

3.3.1.2.4 Code 58

Code 58, a 61 cm female tagged in the Salmo River at km 25.25 on July 11 1999, held in the tagging location until the first week of August. It then made a rapid downstream migration to the South Salmo River (see Figures 15 and 16). The fish then moved up the South Salmo River, into Stagleap Creek (a tributary to the South Salmo River), and back down Stagleap Creek into the South Salmo River where it spawned at the confluence of Stagleap Creek (12.20 km up the South Salmo River) in the first week of September. The fish then moved upstream into the United States of America (16.55 km up the South Salmo River), after which it made a rapid post spawning migration into the Salmo River in the first two weeks of October (see Figures 15 and 16).

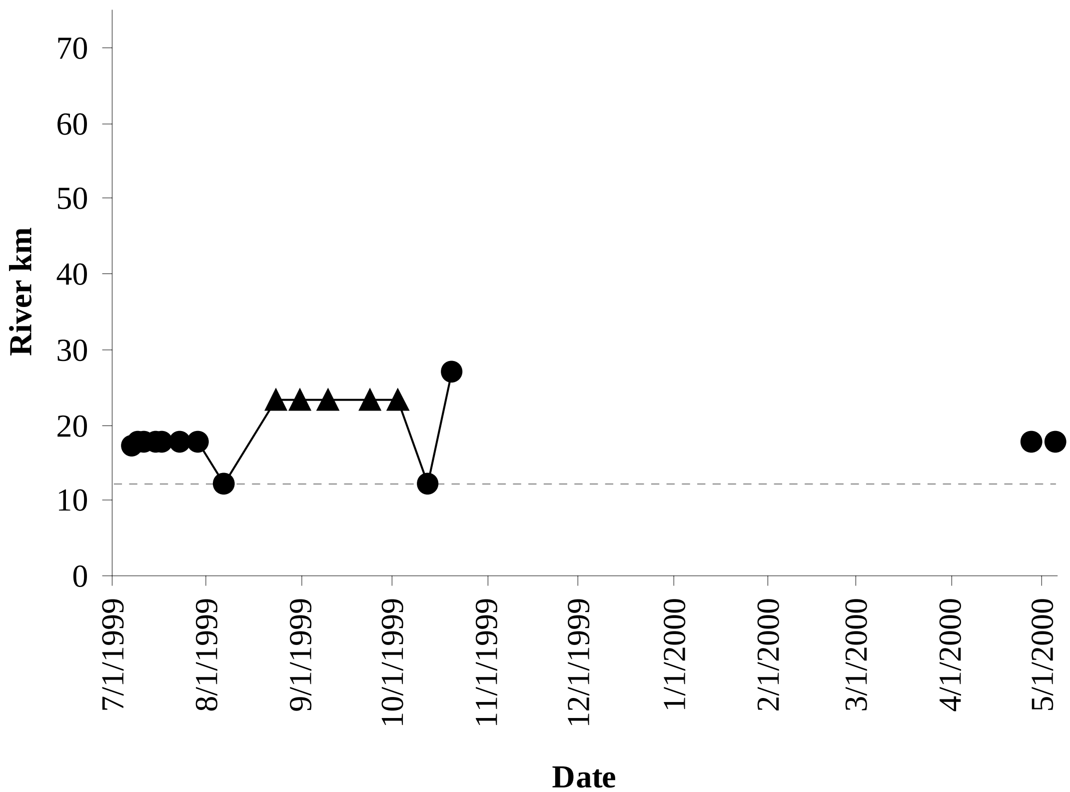

Figure 11. Migratory pattern of a 60 cm female bull trout (Code 54) in the Salmo River watershed from July 1999 to May 2000. Triangle points above the dotted gridline represent movement within the South Salmo River watershed (spawning location), and circle points represent locations within the Salmo River mainstem.

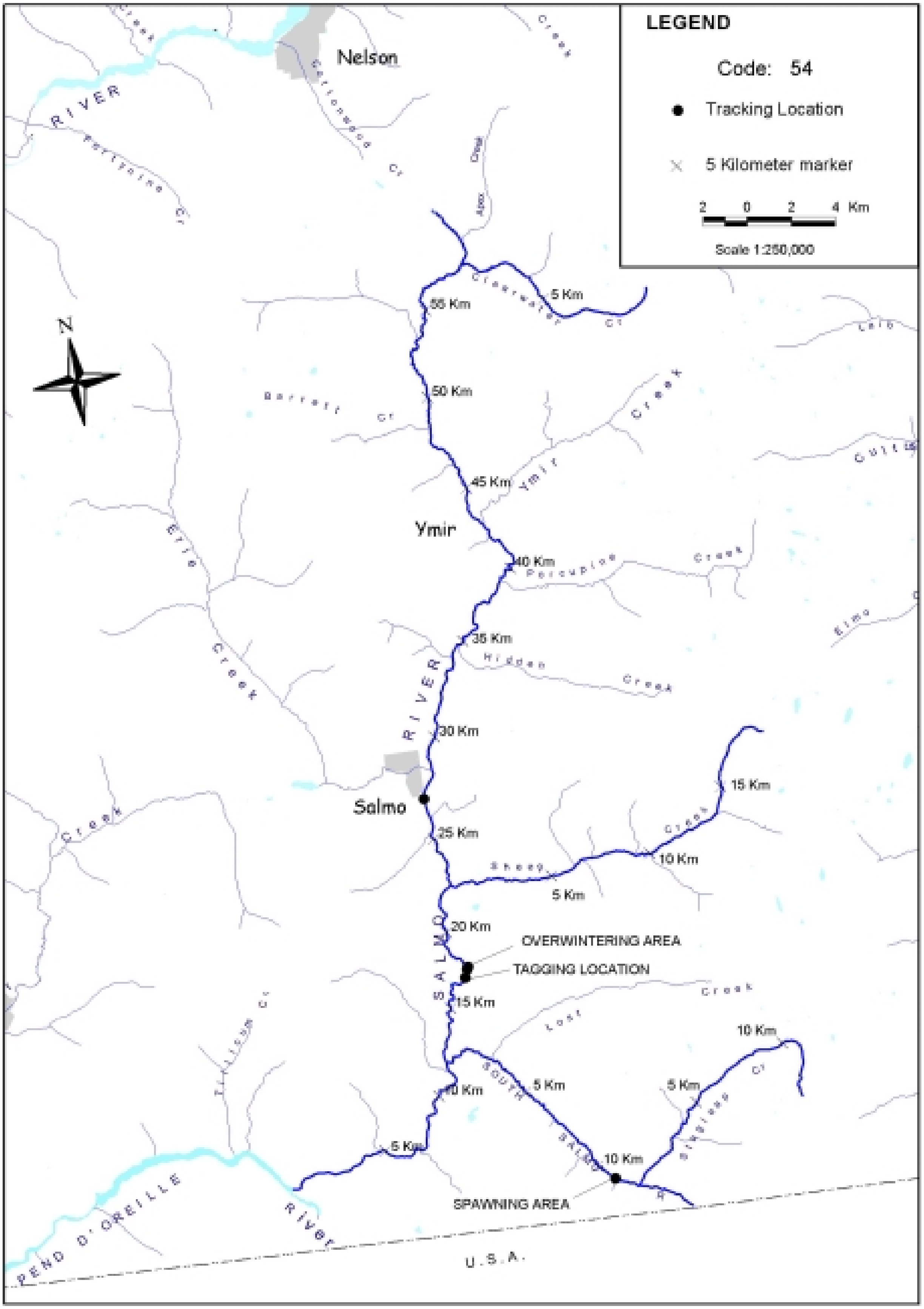

Figure 12. **Tracking locations of a 60 cm female bull trout (Code 54) within the Salmo River watershed from July 1999 to May 2000.**

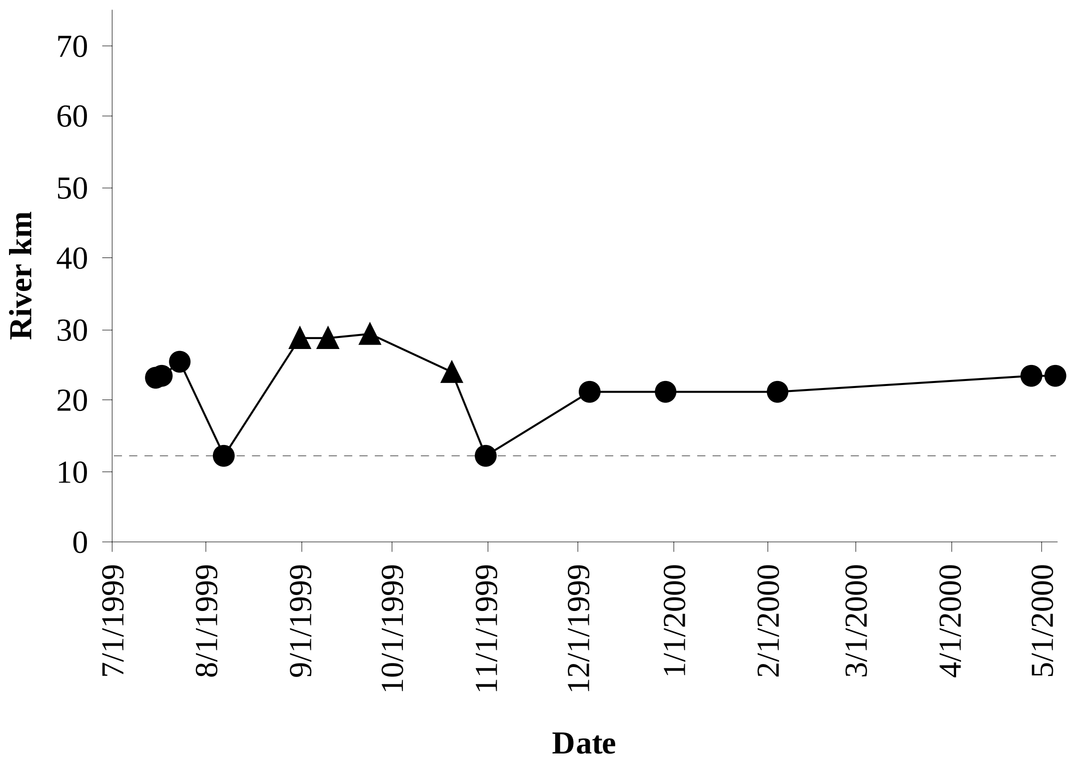

Figure 13. Migratory pattern of a 60 cm male bull trout (Code 56) in the Salmo River watershed from July 1999 to May 2000. Triangle points above the dotted gridline represent movement within the South Salmo River watershed (spawning location), and circle points represent locations within the Salmo River mainstem.

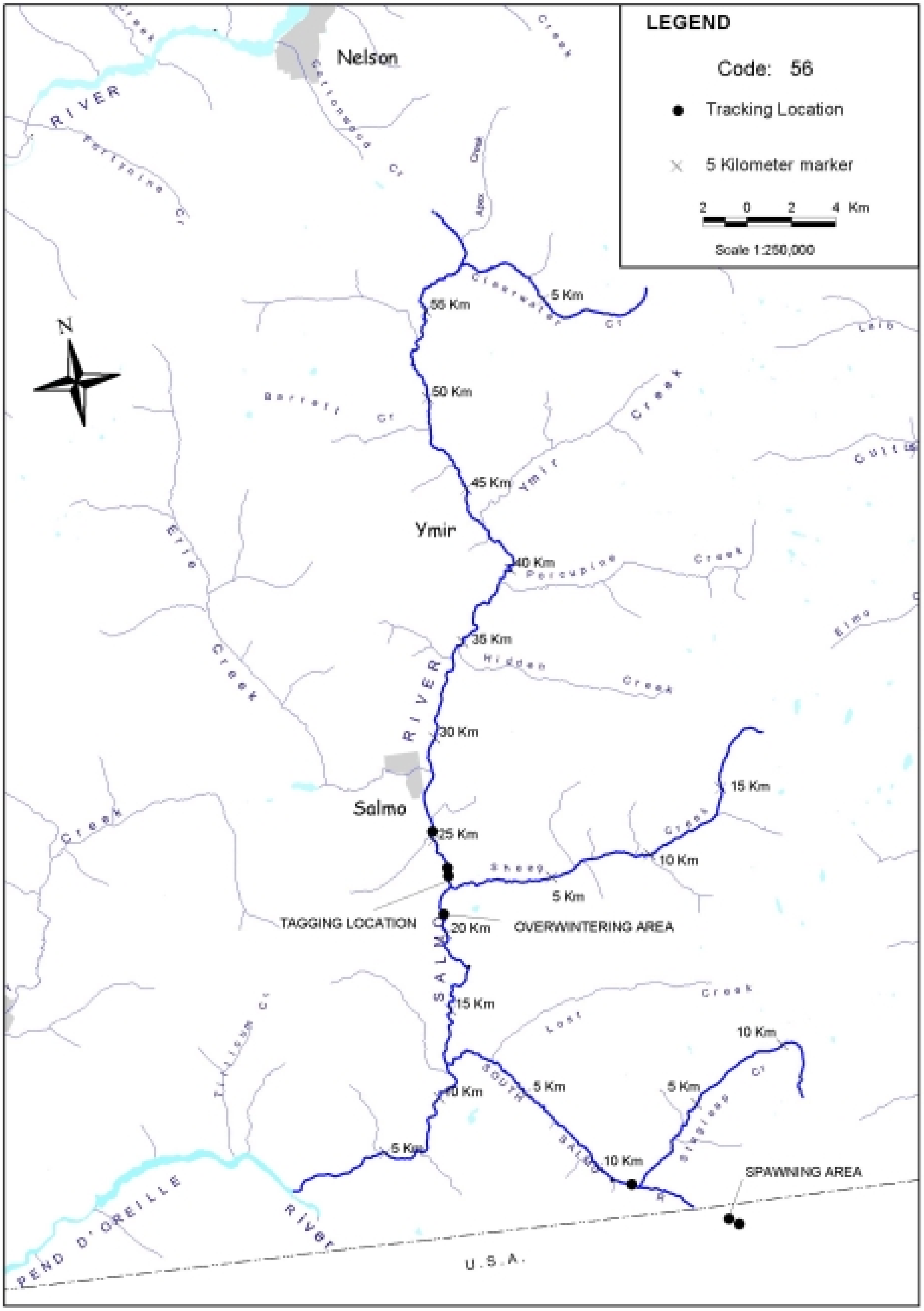

Figure 14. **Tracking locations of a 60 cm male bull trout (Code 56) within the Salmo River watershed from July 1999 to May 2000.**

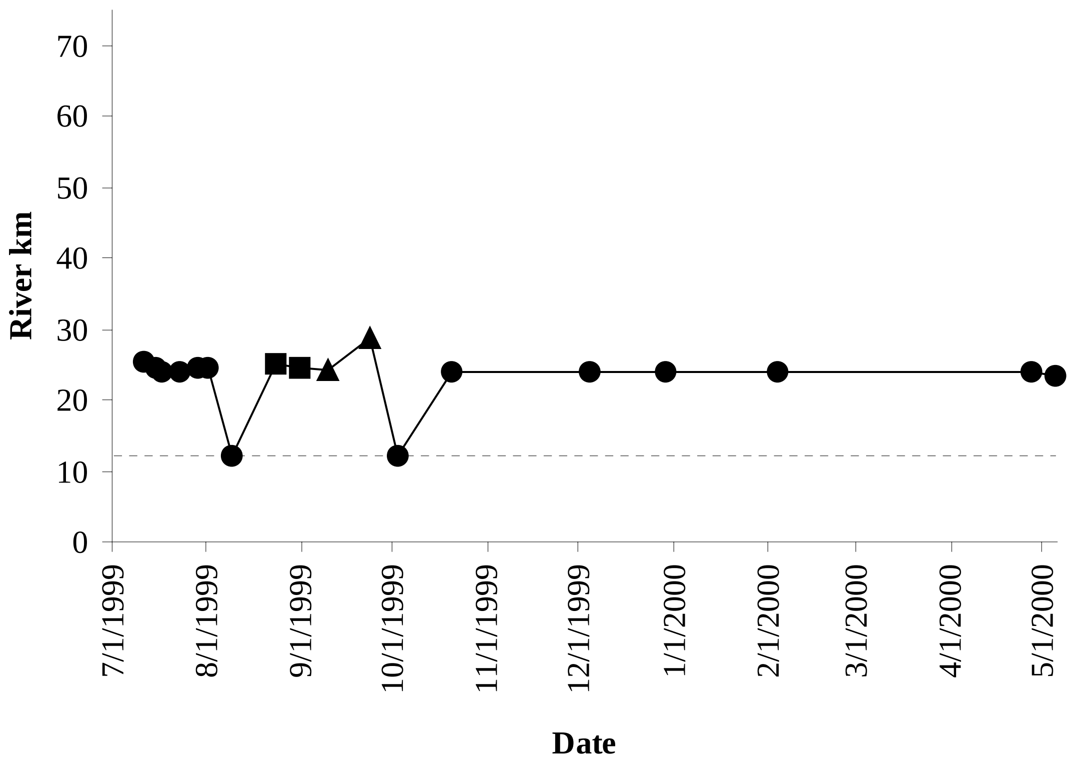

Figure 15. **Migratory pattern of a 61 cm female bull trout (Code 58) in the Salmo River watershed from July 1999 to May 2000. Square points (Stagleap Creek) and triangle points (South Salmo River) above the dotted gridline represent movement within the South Salmo River watershed (spawning location), and circle points represent locations within the Salmo River mainstem.**

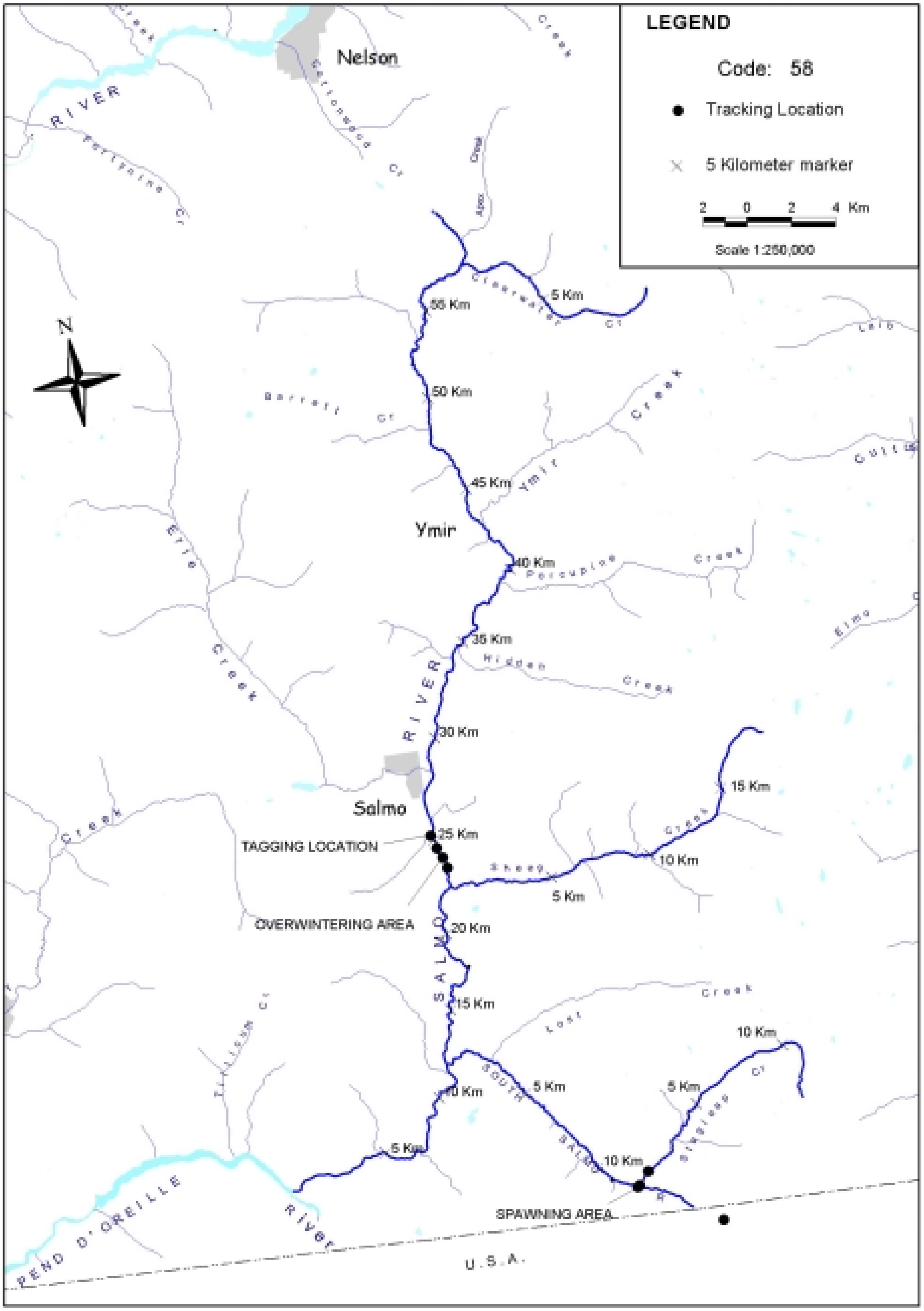

Figure 16. **Tracking locations of a 61 cm female bull trout (Code 58) within the Salmo River watershed from July 1999 to May 2000.**

3.3.1.2.5 Code 60

Code 60, a 56 cm female tagged in the Salmo River at km 21.05 on July 17 1999, held in the tagging location for three weeks after which time it made a gradual upstream migration in the Salmo River (see Figures 17 and 18). The fish moved up the Salmo River mainstem to spawn 300 m downstream of the Hall Creek confluence (53.80 km up the Salmo River) in the first week of September. The fish then made a gradual downstream migration through the first week of October to its overwintering areas (see Figures 17 and 18).

3.3.1.2.6 Code 61

Code 61, a 53 cm female tagged in the Salmo River at km 25.25 on July 7 1999, made a gradual downstream migration from the tagging location over three weeks to the Sheep Creek confluence (see Figures 19 and 20). The fish then moved up Sheep Creek in the first three weeks of August to its spawning site (7.55 km up Sheep Creek), where it spawned in the first week of September. It then made a post-spawning migration upstream in Sheep Creek until the end of September, after which it moved downstream into the Salmo River to suitable overwintering habitat (see Figures 19 and 20).

3.3.1.2.7 Code 65

Code 65, a 54 cm female was tagged in Clearwater Creek at km 3.80 on August 31 1999, its likely spawning location, where it spawned in the first two weeks of September. It held in this area until the first week of October (see Figures 21 and 22). The fish then moved downstream rapidly into the Salmo River in the first two weeks of October to its overwintering area (see Figures 21 and 22).

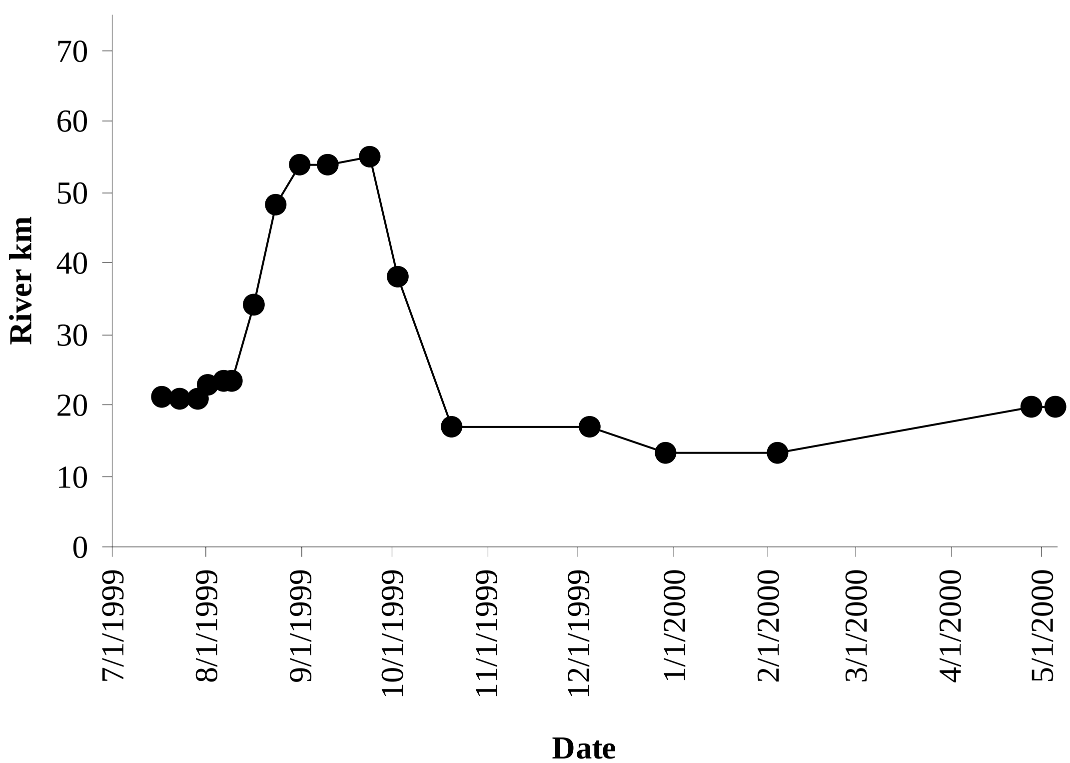

Figure 17. Migratory pattern of a 56 cm female bull trout (Code 60) in the Salmo River watershed from July 1999 to May 2000. Circle points represent locations within the Salmo River mainstem (spawning area).

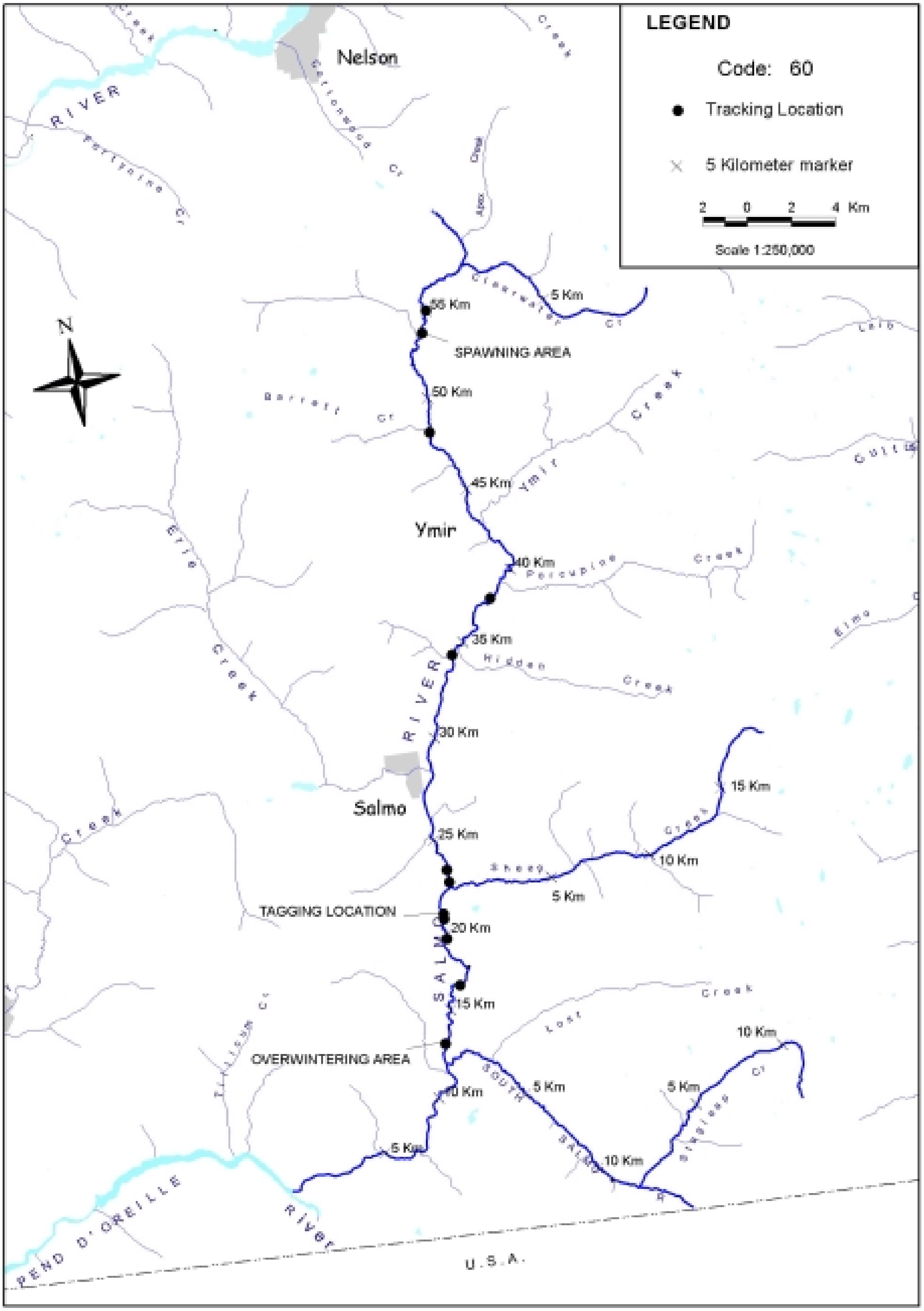

Figure 18. **Tracking locations of a 56 cm female bull trout (Code 60) within the Salmo River watershed from July 1999 to May 2000.**

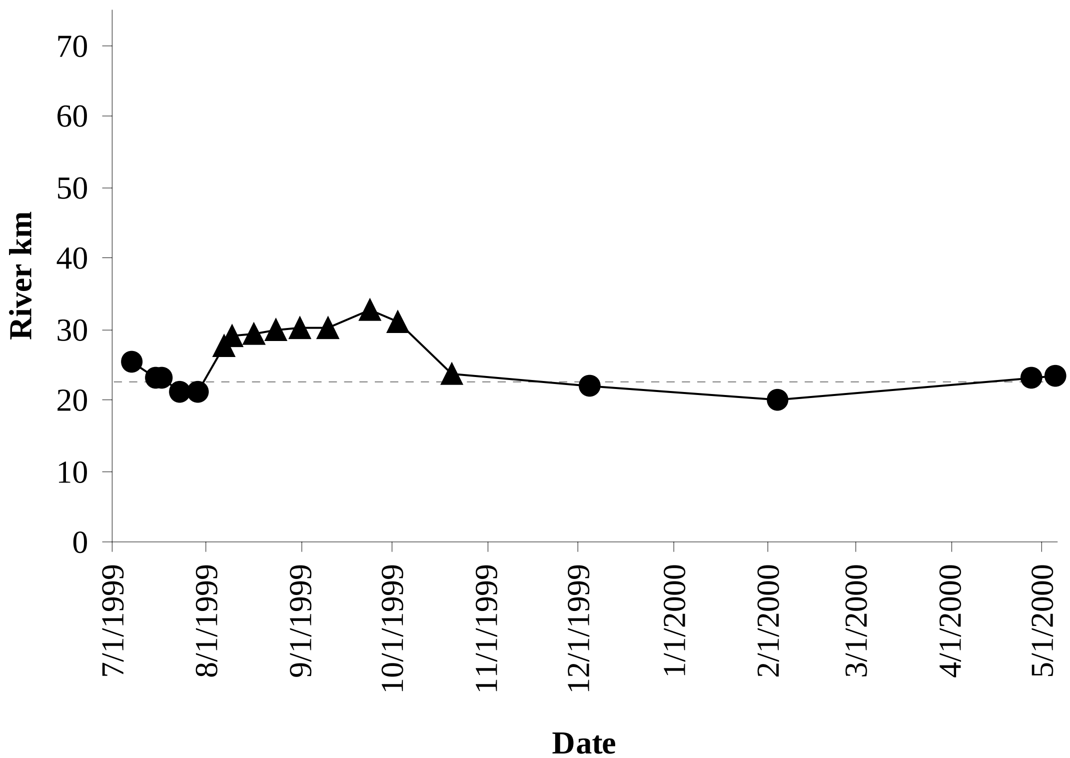

Figure 19. Migratory pattern of a 53 cm female bull trout (Code 61) in the Salmo River watershed from July 1999 to May 2000. Triangle points above the dotted gridline represent movement within the Sheep Creek watershed (spawning location), and circle points represent locations within the Salmo River mainstem.

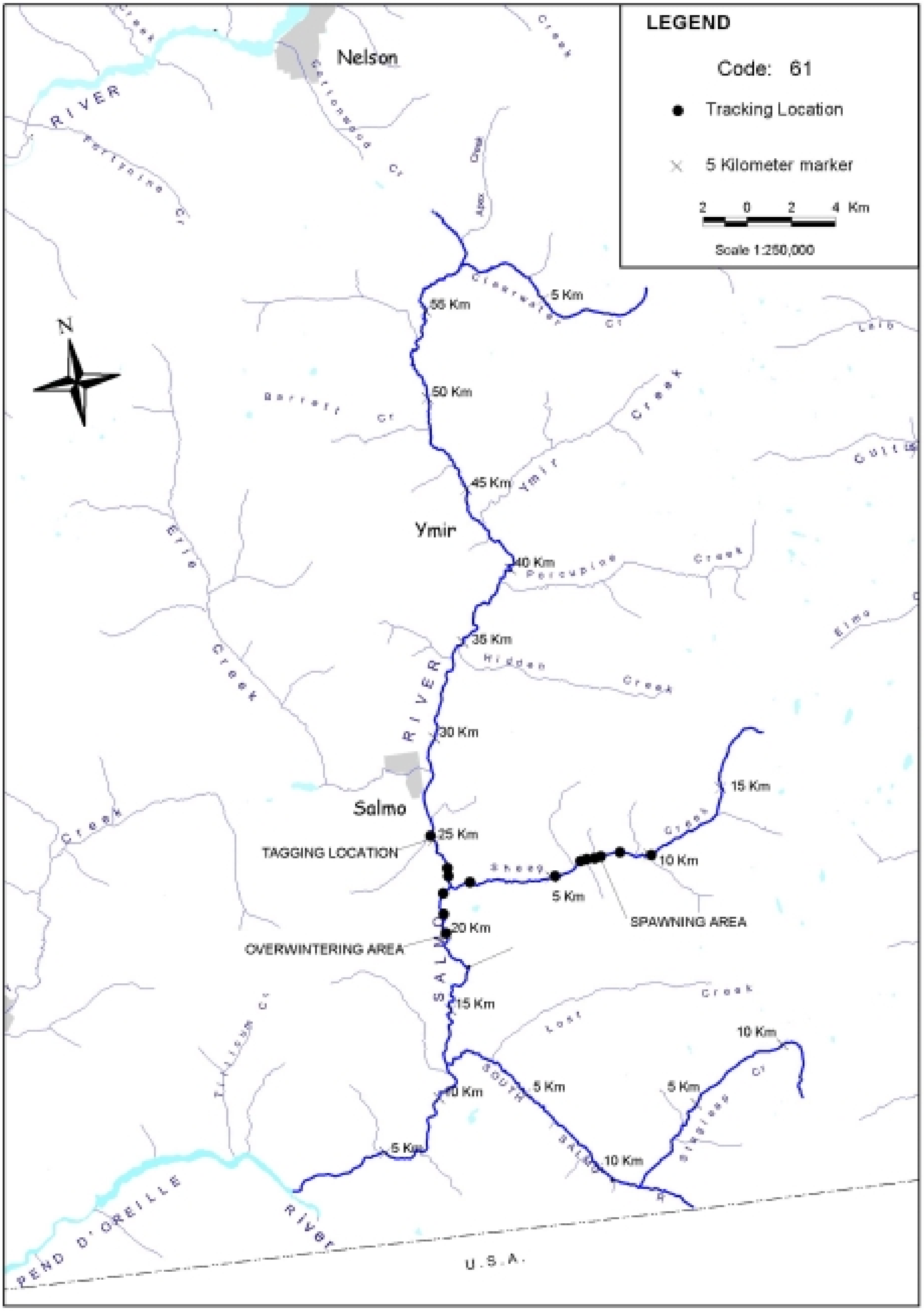

Figure 20. **Tracking locations of a 53 cm female bull trout (Code 61) within the Salmo River watershed from July 1999 to May 2000.**

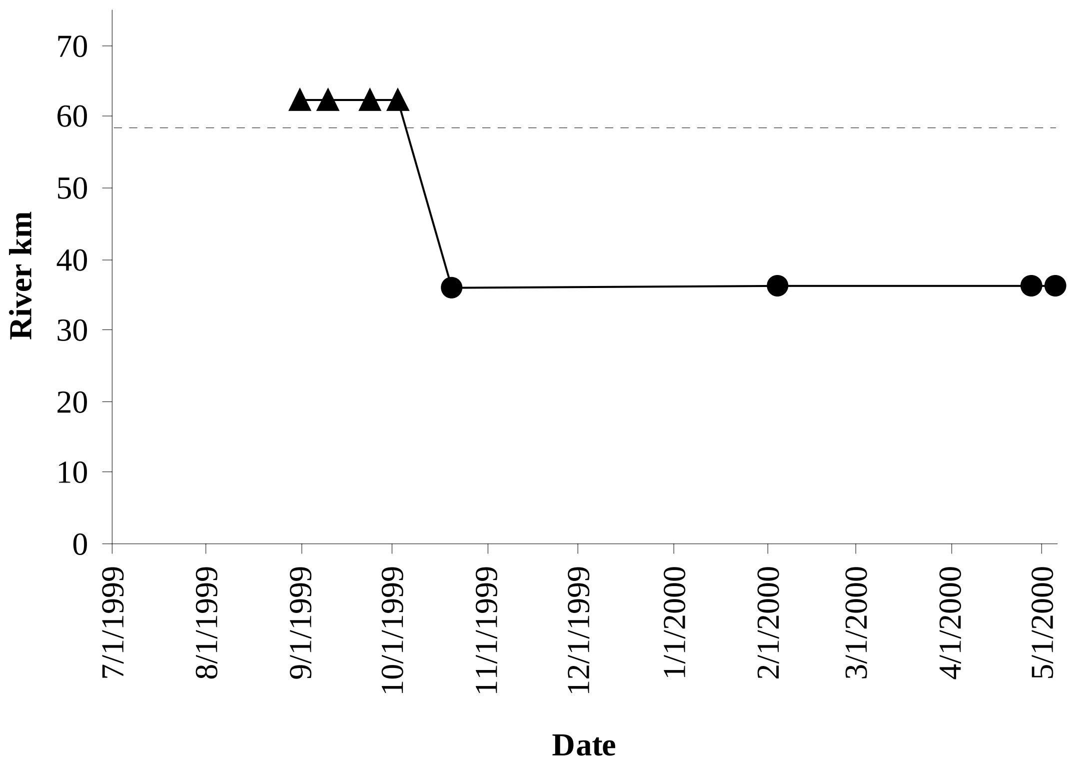

Figure 21. Migratory pattern of a 54 cm female bull trout (Code 65) in the Salmo River watershed from July 1999 to May 2000. Triangle points above the dotted gridline represent movement within the Clearwater Creek watershed (spawning location), and circle points represent locations within the Salmo River mainstem.

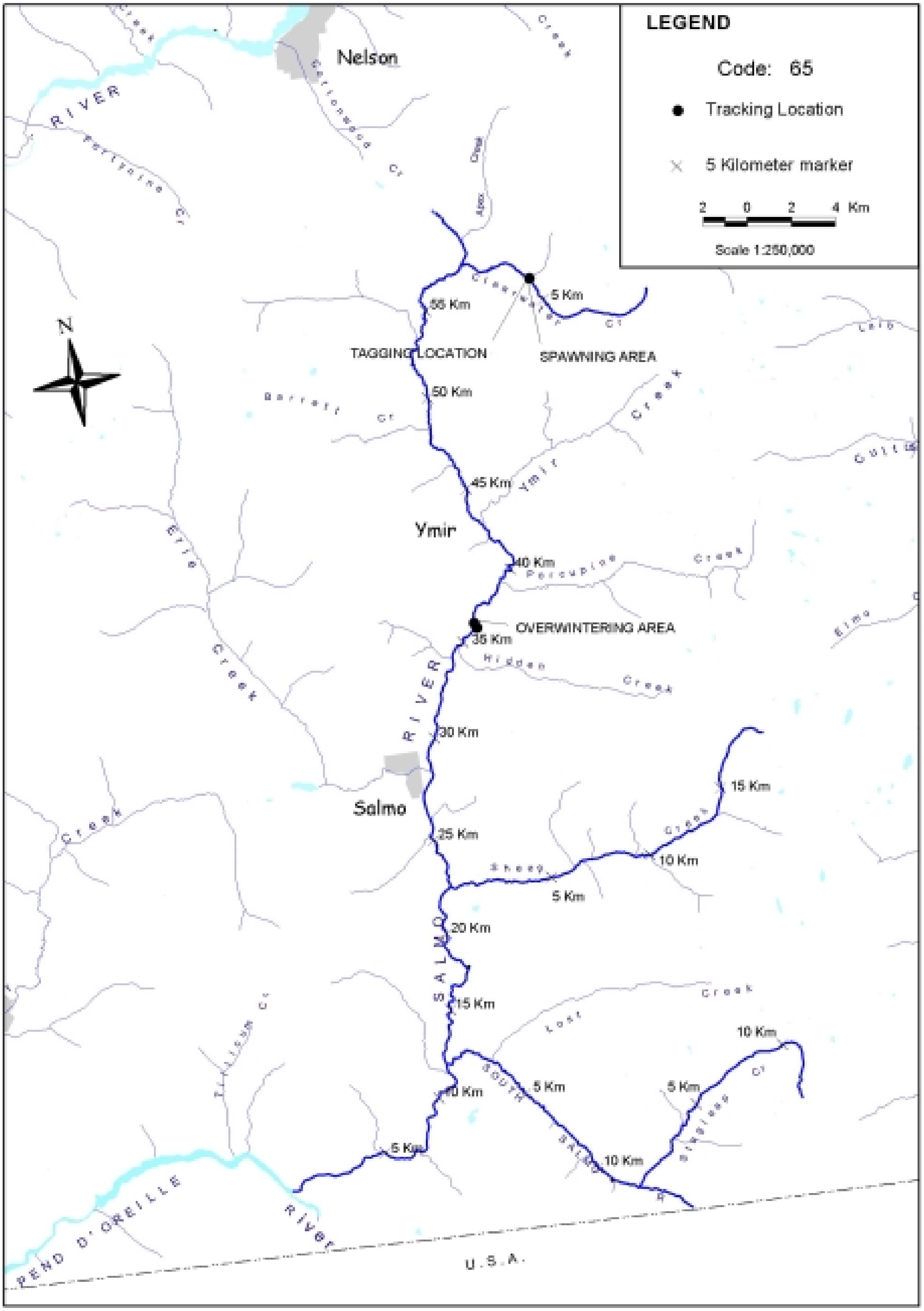

Figure 22. **Tracking locations of a 54 cm female bull trout (Code 65) within the Salmo River watershed from July 1999 to May 2000.**

3.3.1.2.8 Code 67

Code 67, a 52 cm female tagged in the Salmo River at km 17.85 on July 11 1999, held in the tagging location for two weeks, after which time it made a rapid downstream migration to the South Salmo River (see Figures 23 and 24). The fish then moved up the South Salmo River and into Stagleap Creek where it spawned 850 m upstream of the confluence likely in mid-September. The fish then held in the spawning area until the first week of October, after which it made a rapid post-spawning migration downstream into the Salmo River where it moved upstream to an overwintering location (see Figures 23 and 24).

3.3.1.2.9 Code 68

Code 68, a 50 cm female tagged in the Salmo River at km 18.45 on July 15 1999, remained in the tagging location for two weeks, after which time it made a rapid upstream migration in the Salmo River (see Figures 25 and 26). By mid-August the fish had migrated to the confluence of Clearwater Creek, and by the third week of August had moved up Clearwater Creek to its spawning location (3.8 km up Clearwater Creek). The fish then likely spawned in the first or second week of September, after which it made a rapid post-spawning migration downstream to the Salmo River in the first week of October (see Figures 25 and 26).

3.3.1.2.10 Code 70

Code 70, a 67 cm male tagged in the Salmo River at km 23.05 on July 9 1999, remained in the tagging location for three weeks until the end of August. After this period it made a gradual upstream migration in the Salmo River (see Figures 27 and 28). By the end of August the fish had migrated to 600 m upstream of the Hall Creek confluence (54.70 km up the Salmo River), its likely spawning location. The fish then moved downstream to its overwintering location by the second week of October (see Figures 27 and 28).

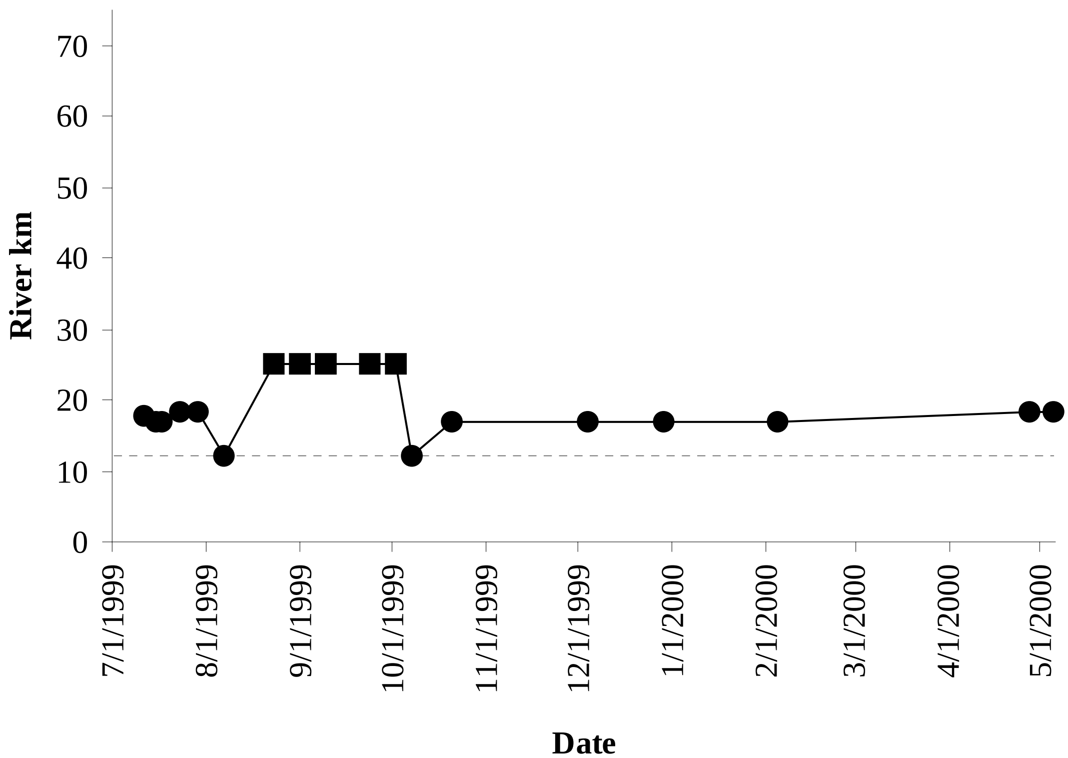

Figure 23. **Migratory pattern of a 52 cm female bull trout (Code 67) in the Salmo River watershed from July 1999 to May 2000. Square points (Stagleap Creek) above the dotted gridline represent movement within the South Salmo River watershed (spawning location), and circle points represent locations within the Salmo River mainstem.**

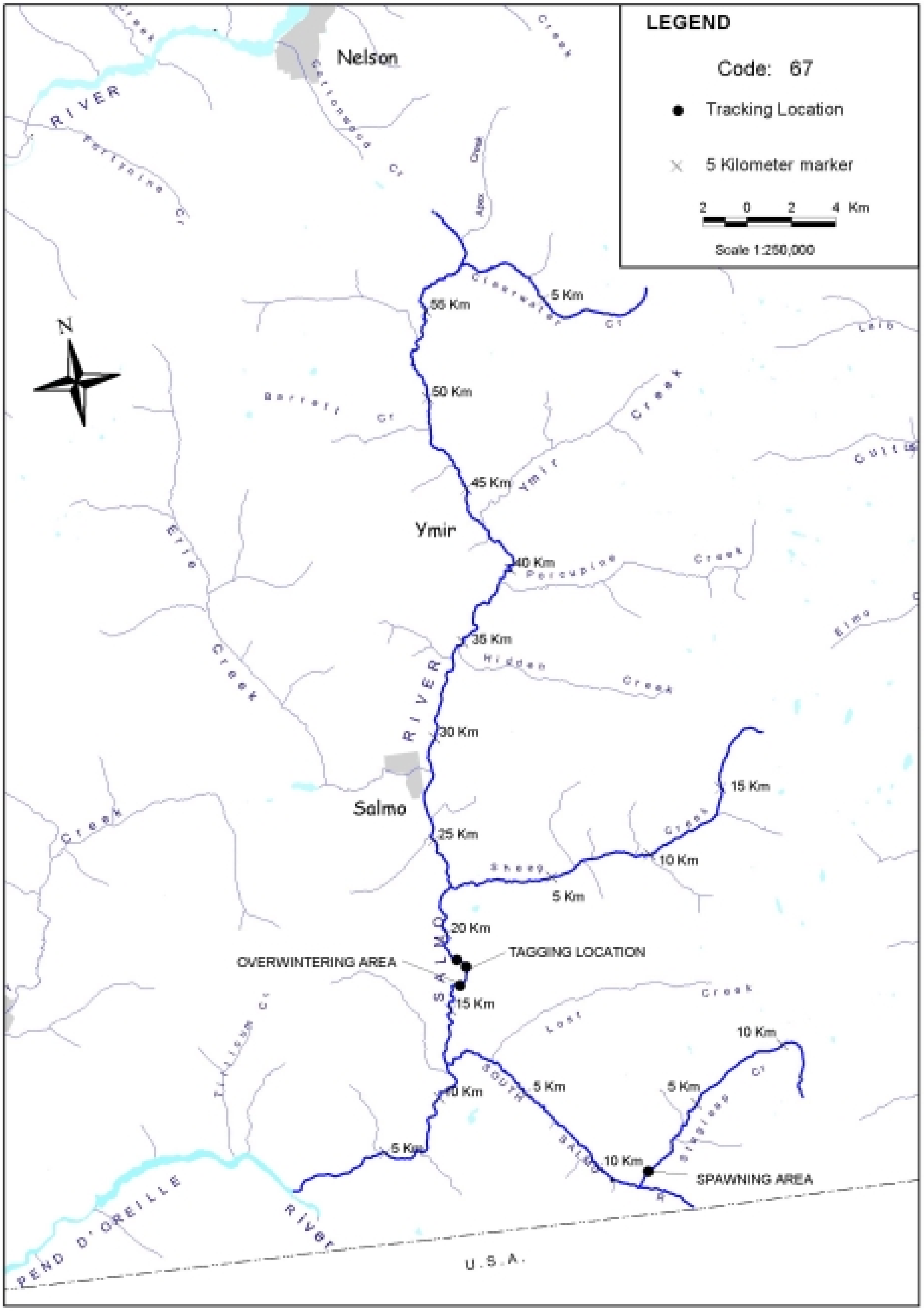

Figure 24. Tracking locations of a 52 cm female bull trout (Code 67) within the Salmo River watershed from July 1999 to May 2000.

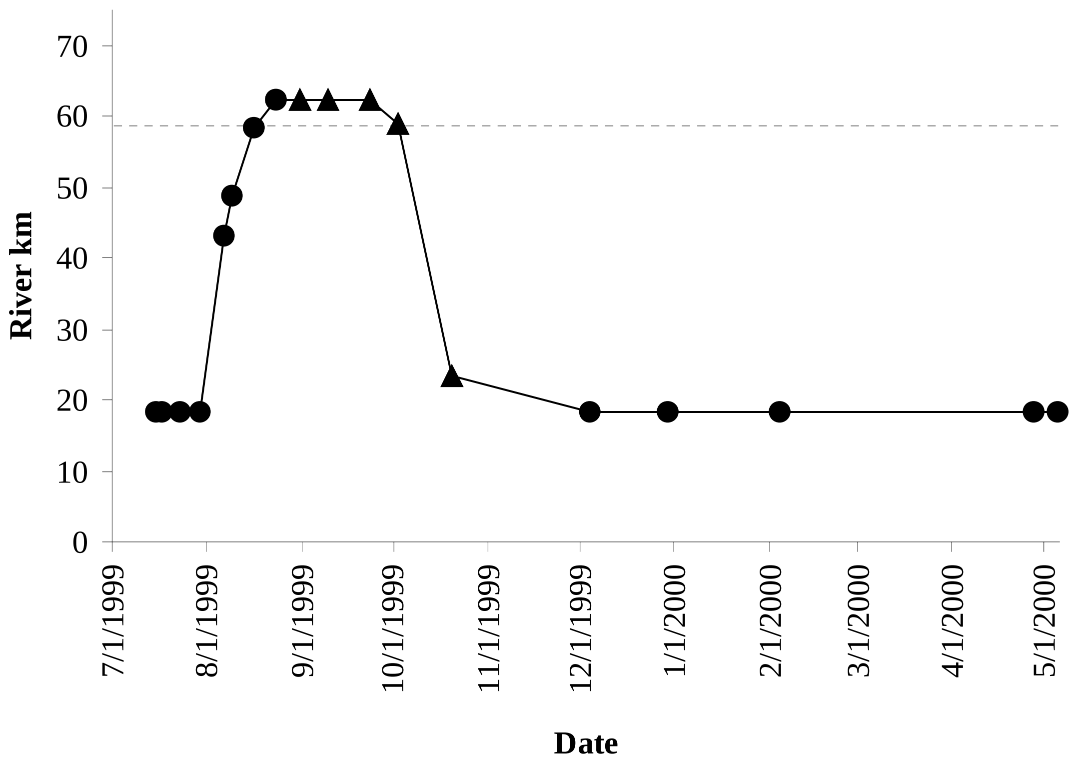

Figure 25. Migratory pattern of a 50 cm female bull trout (Code 68) in the Salmo River watershed from July 1999 to May 2000. Triangle points above the dotted gridline represent movement within the Clearwater Creek watershed (spawning location), and circle points represent locations within the Salmo River mainstem.

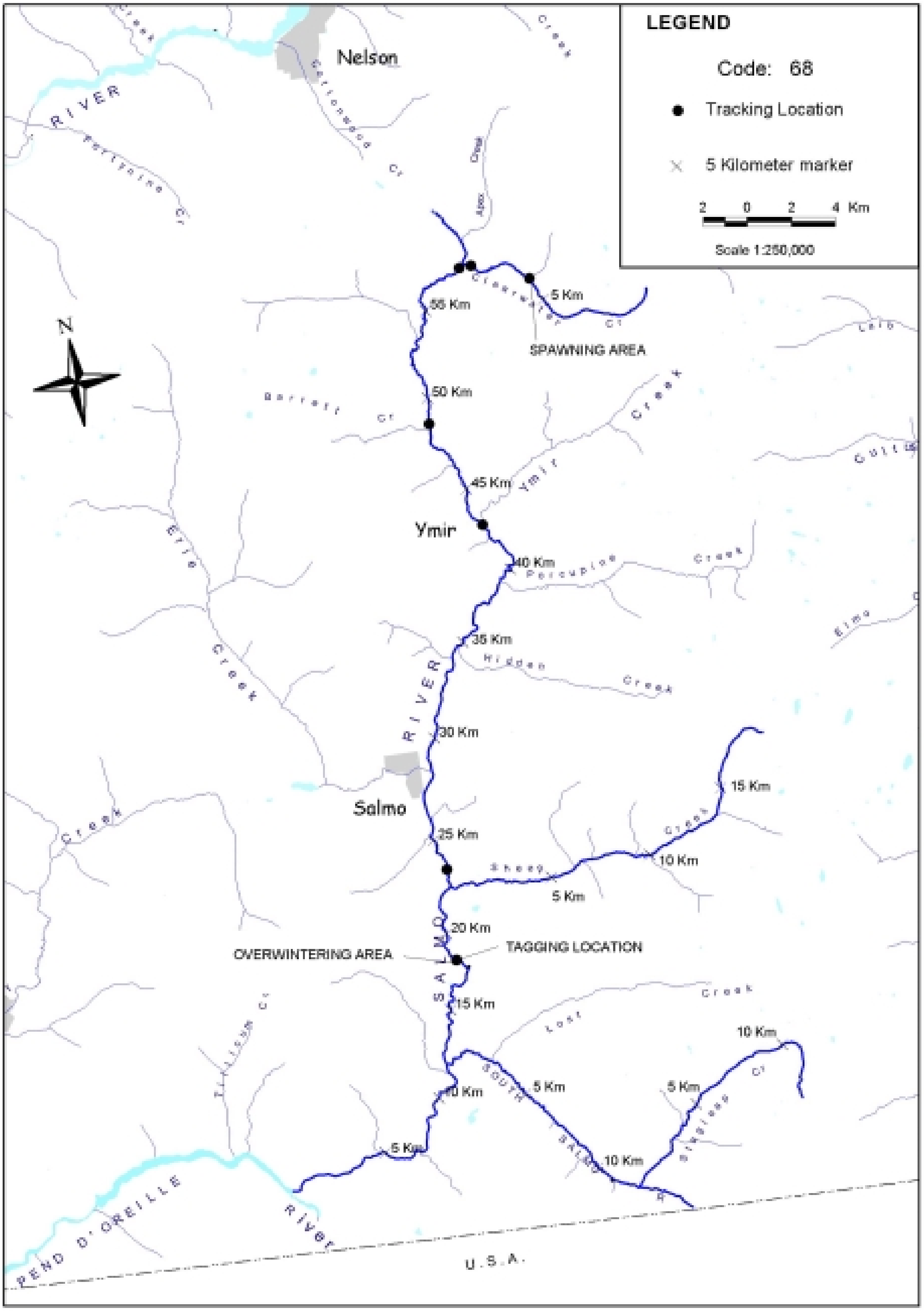

Figure 26. **Tracking locations of a 50 cm female bull trout (Code 68) within the Salmo River watershed from July 1999 to May 2000.**

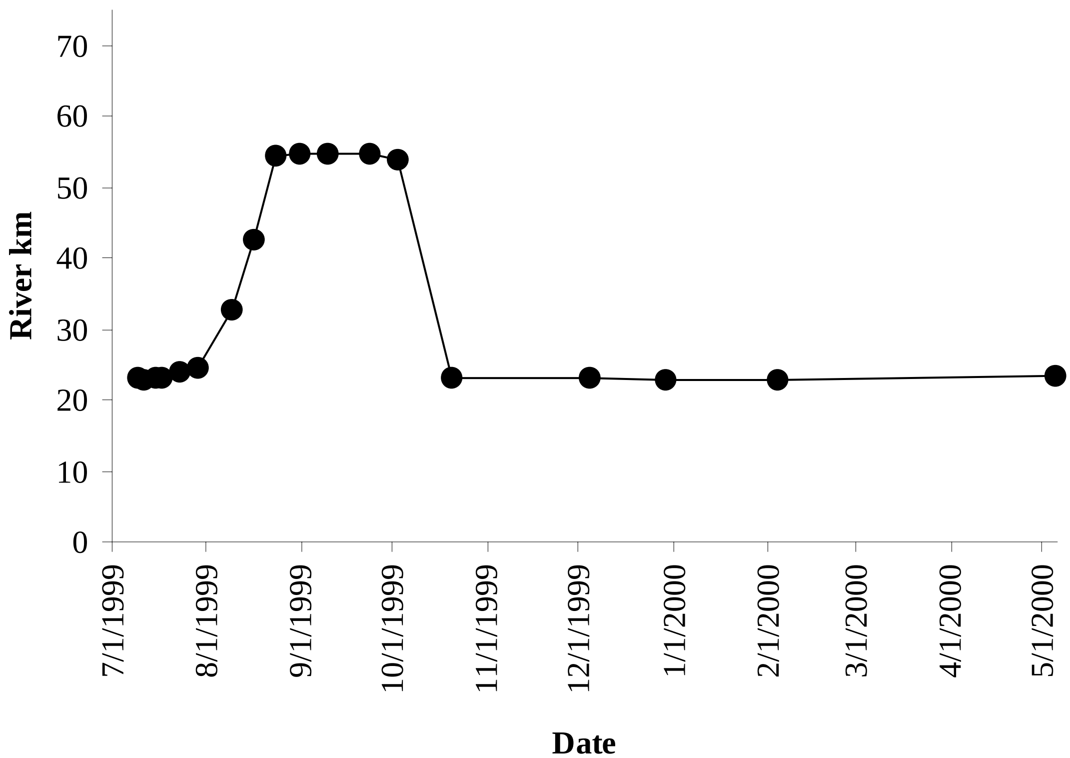

Figure 27. Migratory pattern of a 67 cm male bull trout (Code 70) in the Salmo River watershed from July 1999 to May 2000. Circle points represent locations within the Salmo River mainstem (spawning area).

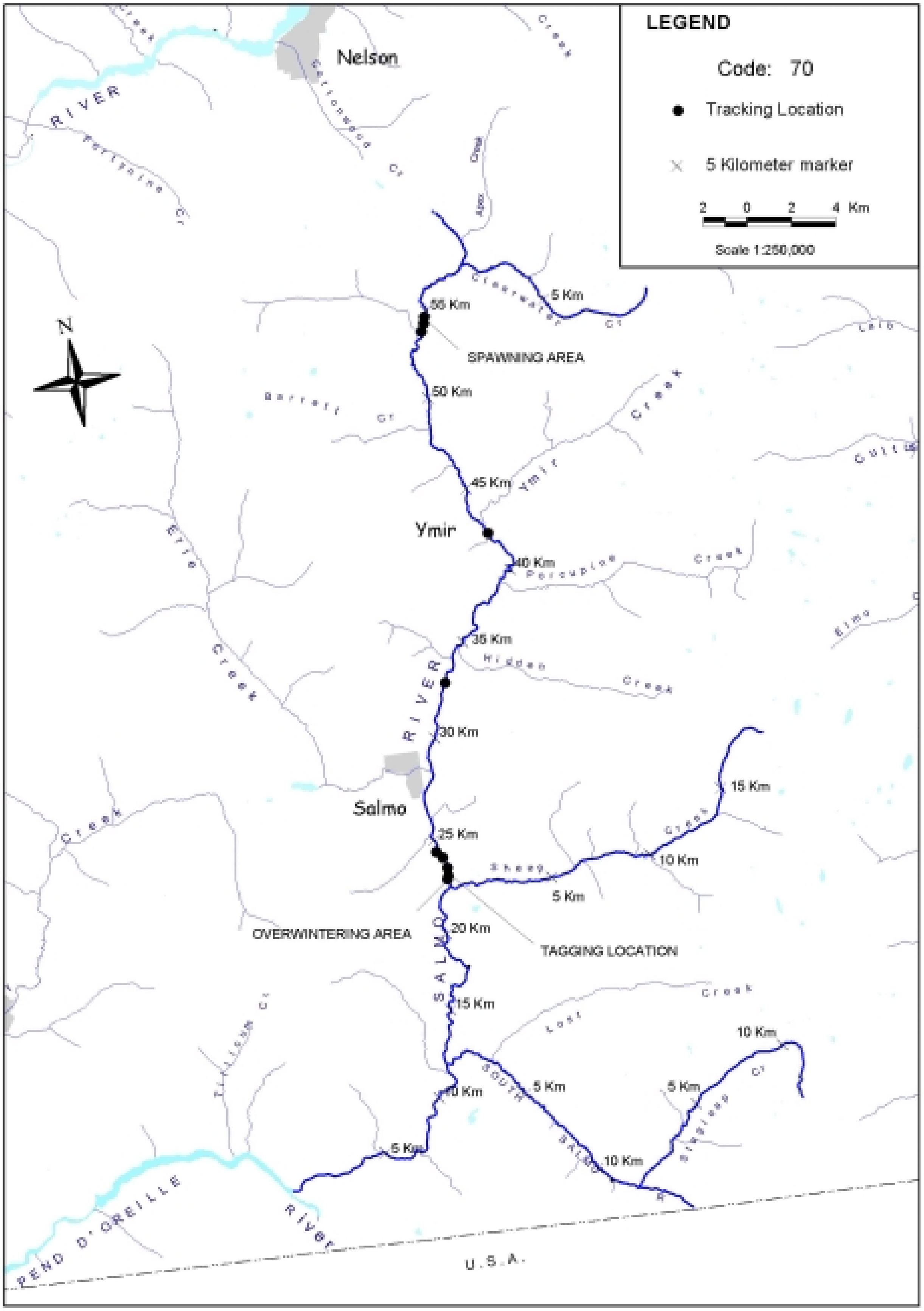

Figure 28. **Tracking locations of a 67 cm male bull trout (Code 70) within the Salmo River watershed from July 1999 to May 2000.**

3.3.2 Movement of Fish in Relation to Discharge

We considered that movements less than 2 km between tracking events were not indicative of true spawning migration events (Swanberg 1997), and were within the limits of movement that may be explained by home range behaviour. Figure 29 shows the first and last date when bull trout had begun making a spawning migration in relation to river discharge. Spawning migrations began as early as the second week of July and continued through to as late as August 10 1999. This period corresponded to a decline in the rate of water discharge decrease, generally when Salmo River mainstem flows were less than 70 $m^3 \cdot sec^{-1}$ (Figure 29).

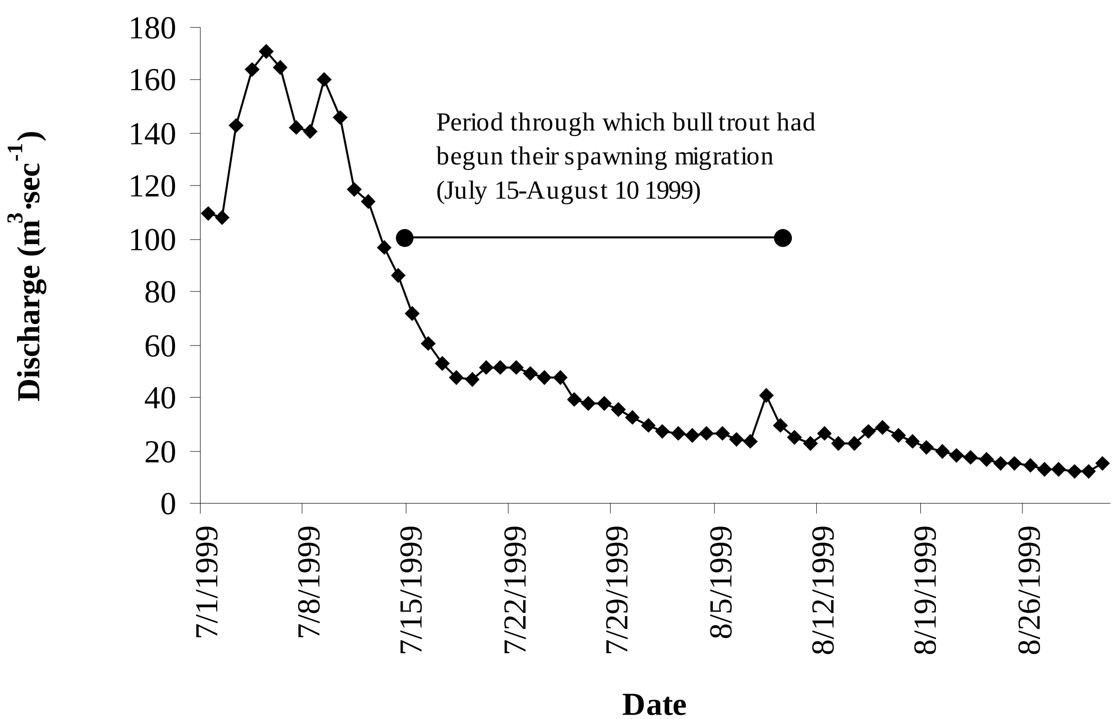

Figure 29. The relationship of the timing that bull trout had begun spawning migrations of distances 2 km or greater with regard to changes in water discharge in the Salmo River during July and August 1999.

3.3.3 Overwintering Habitat Locations

Post- spawning mortality of radio tagged bull trout appeared to be 0% as all fish made extensive downstream migrations to overwintering areas. We considered overwintering habitat use and timing to occur from the beginning of December as fish movements were limited over this period of time (most bull trout remained in a location for several months). Fish that didn't move more than 2 km during that period were identified as using an overwintering area. Of the ten radio tagged fish that were tracked during this period, all of them moved less than 2 km. Locations of fish during the overwintering period are summarized in Appendix II and Figures 9 to 28. The tracking identified that there were a number of locations that were utilized (Table 5). The locations were all in a relatively short section (11 km) of the mainstem Salmo River between 13 km and 24 km. In several cases fish moved to within 500 m of the area that they were originally tagged. Overwintering habitat was generally deep pools where the depth and velocity conditions were suitable for reduced movements during cold water temperatures.

No fish migrated past the fixed telemetry station into Seven Mile Reservoir, suggesting that the population is a fluvial (river overwintering) population, and that the vast majority of bull trout in the Salmo River do not make migrations into Seven Mile Reservoir.

Table 5. Locations where bull trout were found in overwintering areas in the Salmo River from December 1999 to May 2000.

Code	Tagging Location (km)	Overwintering Location (km)	Habitat
51	Salmo River (18.45)	Salmo River (18.45)	Pool/LWD
54	Salmo River (17.25)	Salmo River (17.75)	Pool/LWD
56	Salmo River (23.05)	Salmo River (21.05)	Pool/LWD
58	Salmo River (25.25)	Salmo River (24.00)	Pool/Boulder
60	Salmo River (21.05)	Salmo River (13.15)	Pool/LWD
61	Salmo River (25.25)	Salmo River (20.00)	Pool/LWD
65	Clearwater Creek (3.80)	Salmo River (36.35)	Pool/Bedrock
67	Salmo River (17.85)	Salmo River (16.85)	Pool/LWD
68	Salmo River (18.45)	Salmo River (18.45)	Pool/LWD
70	Salmo River (23.05)	Salmo River (23.05)	Pool/Boulder

3.4 Summary of Results

1. A total of ten bull trout (eight females and two males) were implanted with radio tags in the Salmo River watershed (nine in the mainstem Salmo River and one in Clearwater Creek).

2. The average size of tagged fish was 57.0 cm fork length and 1972 g weight.

3. Catch per unit effort averaged 0.44 bull trout per angler day, and post-surgery mortality was 0% as all bull trout underwent extensive upstream migrations to spawning areas.

4. Bull trout began migrations to their spawning areas from July 15 to August 10 during a period of reduced decline in Salmo River discharge.

5. Bull trout were tracked to a total of five spawning locations (the upper Salmo River, Clearwater Creek, Sheep Creek, the South Salmo River, and Stagleap Creek (tributary to the South Salmo River)), with one fish spawning in the United States of America (South Salmo River). During tracking four of the ten tagged fish entered the South Salmo watershed, with two fish utilizing the South Salmo River in the United States of America.

6. Bull trout entered spawning tributaries as early as the first week of August, with spawning peaking in the first or second week of September.

7. There was significantly more use of tributary habitat than mainstem habitat by radio tagged bull trout for spawning.

8. Post-spawning migrations to overwintering habitat had generally occurred by the end of November, and it appeared that post-spawning mortality was 0% as all fish had moved significant distances downstream to overwintering areas.

9. Overwintering habitat was limited to an 11 km section of the mainstem Salmo River between 13 km and 24 km, with some fish overwintering in the same pool in which they were originally tagged. Overwintering habitat was mainly in the form of deep pool in association with large woody debris or boulder.

10. No tagged bull trout migrated into Seven Mile Reservoir, suggesting that the population is a fluvial population.

4.0 DISCUSSION

A number of interesting points regarding the bull trout population of the Salmo River watershed resulted from the completion of this project. All of the initial objectives of the proposed project were met, and this short discussion will address some of the relevant information collected during this study. Through the use of radio telemetry we identified major spawning areas of bull trout in the watershed, some of which were already known (Sheep Creek, Clearwater Creek, and the upper Salmo River) and others that were suspected but unconfirmed (the South Salmo River watershed). Perhaps the most interesting result with regard to spawning locations was that 40% of our tagged fish underwent downstream migrations from their initial tagging locations and went up the South Salmo River watershed to spawn. Although it was suspected from previous work that bull trout utilized the system for spawning, no redds or adults have been observed in two years of stream walks (Baxter et al. 1998; Baxter 1999).

The use of the South Salmo River was particularly interesting in that two of the fish made migrations into the United States of America (one fish likely spawned there), making this population of bull trout of international importance. Given the fact that bull trout are highly protected in the U.S. by legislation, and are a species of special concern in British Columbia, transboundary fisheries management of this population may prove challenging. However, this identifies that funding for study on these fish may be shared between Canada and the U.S. as components of the bull trout population are in the U.S. for some portion of its life-history. Given the fact that redd and fish sightability in the South Salmo is extremely poor, the use of radio telemetry was one of the only methods that could have identified spawning locations in this watershed.

Spawning timing of this population of bull trout is similar to other populations in British Columbia (e.g., McPhail and Baxter 1996; O'Brien 1999), and although bull trout were in spawning areas by as early as the first week of August, reproduction of the population is protected by the current instream work window. Also similar to other studies, the bull trout began their spawning migrations on the descending limb of the hydrograph (Swanberg 1997).

Another aspect of the study that is extremely interesting, and maybe of concern, is the relatively small area of the mainstem river that fish hold and overwinter in. Although angling effort was expended in about 60% of the mainstem river, bull trout were only sampled in 15% of the mainstem river. This is despite the fact that there is suitable habitat in the other sections of the river. The fact that the fish generally returned to the section of river in which they were tagged to overwinter, after making migration movements in excess of 50 km in some cases, suggests the population may be extremely susceptible to angling pressure in this area post-spawning. Some fish returned to overwinter in the exact pool in which they were tagged, which again was similar to other studies (Swanberg 1997), suggesting a high site fidelity by this fluvial population of bull trout. Swanberg (1997) proposes that this indicates a precise homing mechanism, and that the fish may benefit from this type of behaviour by intimate knowledge of feeding and hiding places (Smith 1985).

For the most part this study has suggested that the population of bull trout in the Salmo River is a mainstem overwintering (fluvial) population that does not utilize Seven Mile Reservoir. None of the ten tagged fish entered Seven Mile Reservoir for any period during the study, which would be expected post-spawning if the fish were reservoir overwintering fish. The average size of spawners (~55 cm) also suggests that the population is a mainstem resident population for most of its life-history, with a 70 cm fish being the upper limit of what was tagged in this study, and that has been observed by local anglers. The fact that large bull trout accounted for less than 0.1% of the fish captured in the reservoir in past studies (R.L.&L. 1995), that no large bull trout have been sampled in recent studies (J. Shannon, Fisheries Biologist, Taylor Associates, Seattle, WA; personal communication), and that reservoir temperatures are for the most part warm, further support this contention.

There are still however anecdotal reports of bull trout being angled in Seven Mile Reservoir, and a large prey base for bull trout in the reservoir that suggests that there is a remote chance that bull trout could still be found there. To address this possibility we suggest that a radio tagging project target sampling bull trout in the lower Salmo River below the South Salmo River confluence, primarily in the canyon and reservoir impoundment. These fish could be tracked both by mobile and fixed receivers to put to rest the questions about life-history of the Salmo River bull trout population.

It has been suggested that fluvial bull trout are important ecological and recreational components of river systems (Swanberg 1997). The Salmo River bull trout population likely is the last fluvial population residing in the lower Pend d'Oreille River system, and may represent a population that could be used in the future as a donor stock for extirpated populations. Understanding the life-history, biology, and population dynamics of this population has become an important piece of the puzzle of managing this fishery, and hopefully with continued study the population will reach a level where there are many bull trout spawning in currently unused habitat in the fall. A final point is that the community in the Salmo and Ymir area (both the general community and the Salmo Watershed Streamkeepers Society) would like to, and must, play a role in community stewardship of this resource. Their energy will accomplish many projects to help rebuild bull trout stocks in the future.

The final point is that this project has shown that community groups can be effective and useful partners in watershed management. This project was a co-operative effort by a large number of organizations, and only through working together was this project completed to the degree of success that it was. We hope that future work in the Salmo River watershed will continue to seek these effective partnerships as an important component of ecosystem management.

5.0 RECOMMENDATIONS

1. Within the Salmo River watershed bull trout can enter spawning areas as early as the first week of August. As such, extra care should be taken with instream works in this watershed during the July15-August 15 work window.

2. The study identified five key spawning areas within the watershed, and these locations should be protected to the full extent of current legislation from habitat degradation.

3. As the life of the radio tags is in excess of 680 days, the tagged fish should be tracked again in 2000/2001 to further our understanding about this bull trout population. Funds are currently being sought for tracking by the authors, and a minimal tracking program will be put in place for the 2000/2001 season.

4. With planned snorkel swims in 2000, the radio tagged fish should be used to develop estimates of fish sightability. This will greatly refine the population estimates.

5. As the holding and overwintering locations that bull trout utilized were limited to a small area of the mainstem Salmo River that is highly accessible, it is likely that the population is extremely vulnerable to post-spawning angling pressure between November and April (the period where anglers are allowed to use bait in the watershed). As such, the Ministry of Environment, Lands and Parks may want to consider a possible bait ban regulation during this period to reduce possible hooking mortality on a population of bull trout that may be at levels that represent a conservation concern. If this measure is considered, public consultation should be undertaken prior to regulation amendment.

6. Although none of the tagged fish migrated to Seven Mile Reservoir, there are still anecdotal reports that bull trout are caught in the reservoir. A program of radio tagging should be targeted for the lower river (below the South Salmo River confluence) and the reservoir for the 2000/2001 season to determine if some small component of the Salmo River bull trout population migrates to the reservoir.

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Appendix I. News release and posters used in the bull trout awareness campaign by the Salmo Watershed Streamkeepers Society during the bull trout radio telemetry study in the Salmo River watershed in 1999/2000.

SALMO WATERSHED Streamkeepers SOCIETY

TELEPHONE 250 357-2630 FAX 250 357-2630

EMAIL gerry@streamkeepers.bc.ca

PO BOX 718, SALMO, BRITISH COLUMBIA V0G 1Z0

JULY 11 /99 PRESS RELEASE
SALMO WATERSHED BULL TROUT RADIO TELEMETRY STUDY

The Salmo Watershed Streamkeepers Society (SWSS) is partnering with the Columbia-Kootenay Fisheries Renewal Partnership (CKFRP), Ministry of Environment Lands & Parks, B.C. Hydro, Seattle City Power & Light and James Baxter, a local fish biologist.to conduct a radio telemetry study. Their aim is to determine overwintering and spawning areas of bull trout in the Salmo Watershed. This highly regarded sport fish is a blue listed (threatened) species. Bull trout can live as long as 15+ years and grow up to 800mm. Although long lived they do not begin to breed until they are 5-8 years old and 30 cm's in length. There are an estimated 100-200 breeding adults in the Salmo Watershed.

Our study, beginning toward the middle of July/99 will require a commitment of approximately 1 year. Ten to twenty bull trout will carry a radio tag and be tracked 4-5 times through this period. The life cycle information gathered from this activity could bring an important piece to the management plan of this species in that system. Members of SWSS will be directly involved in sampling adult bull trout and trained in tracking techniques to carry on this study effectively.

Gerry Nellestijn, President of SWSS reflected that "it is a testimonial to the concern for this fish population that our study has attracted this degree of cooperation from our partner group. It is excellent to see the amount of effort that has fallen into place to support our community group and efforts to increase bull trout populations." He also encourages anyone with questions about this study or SWSS to call 357-2630.

ATTENTION *anglers*

Salmo River & Tributaries
BULL TROUT RADIO TAGGING PROGRAM

PLEASE DO NOT KILL RADIO TAGGED FISH. RELEASE THEM UNHARMED.

In an effort to better understand the migrations and life-history of bull trout (formerly known as Dolly Varden or "dollies"), a number of these fish have been surgically implanted with radio tags. These radio tagged fish have a thin flexible wire antenna extending from the belly (see diagram above) and also have spaghetti tags (white or pink) on their backs. If you catch a bull trout with such an antenna **PLEASE RELEASE IT UNHARMED**. Please report the details of your catch to **B.C. Environment, Fisheries Branch** at **(250) 354-6344**. If you keep a radio tagged fish please forward the radio transmitter, spaghetti tag and catch information (length, weight, sex) to 401 - 333 Victoria Street, Nelson, BC V1L 4K3. All tag information is central to the success of this study.

The Salmo Watershed Streamkeepers Society is partnering with the Ministry of Environment Lands & Parks, BC Hydro, Columbia Basin Trust, Fisheries Renewal BC, Seattle City Power & Light and James Baxter, a local fish biologist to conduct this radio telemetry study.

Poster design courtesy of DND Creative Inc.
Photo courtesy of Dr. Ernest Keeley

SALMO WATERSHED Streamkeepers SOCIETY

Should you have any technical questions regarding this program or about bull trout in general, please contact
James Baxter, Fish Biologist
(250) 352-6096.

ANOTHER FISH STORY

The Salmo River has a population of Bull Trout (Dollys) **that are threatened.** Our bull trout could go either way, extinction or flourish. We control either option. ***Please practice catch and release*** and support local initiatives to help this species.

SALMO WATERSHED Streamkeepers SOCIETY

Thanks for your cooperation and consideration.

Please direct any questions or comments to Gerry Nellestijn, President/Coordinator SWSS, at 357-2630.

B.C. FISHING REGULATIONS
for the Salmo River & Tributaries

Bull Trout and Rainbow season:
June 15th - October 31st, 1999

BAIT BAN

SINGLE HOOK

BAG LIMIT
Rainbows: 2/day over 30 cm (12")

BULL TROUT
CATCH & RELEASE ONLY

Did you know that it takes 5 - 8 years for bull trout to grow 30 cm and that they do not spawn until they reach this size?

Bull Trout Photo Credit: Dr. Ernest Keeley

Appendix II. Locations of bull trout in the Salmo River watershed during radio tracking conducted in 1999 and 2000.

Sex	Female		FAYE
Length (cm)	58		
Weight (g)	2177		
Floy Tag	P-24025		
Channel	11	149.520	
Code	51		

Date	River	River km	Location Name	Location UTM Northing	Location UTM Easting	Comments	Tracking
15-Jul-99	Salmo	18.450	Ric's Pool (large LJ pool below car body run)	5439897	480701	Tagging Location	B
17-Jul-99	Salmo	18.450	Ric's Pool (large LJ pool below car body run)	5439897	480701		B
23-Jul-99	Salmo	18.450	Ric's Pool (large LJ pool below car body run)	5439897	480701		B
29-Jul-99	Salmo	18.450	Ric's Pool (large LJ pool below car body run)	5439897	480701		B
1-Aug-99						NOT FOUND	R
6-Aug-99	Salmo	21.950	500 m d/s Sheep Creek Highway Bridge	5442859	480386		R
9-Aug-99	Salmo	18.450	500 m d/s Sheep Creek Highway Bridge	5439897	480701		R
16-Aug-99	Salmo	22.250	200 m d/s Sheep Creek Highway Bridge	5443077	480596		R
23-Aug-99	Sheep Creek	1.200	1.2 km u/s mouth	5443248	481920		R
31-Aug-99	Sheep Creek	6.150	Aspen Creek confluence	5443339	486507	Spawning Area	A
9-Sep-99	Sheep Creek	6.150	Aspen Creek confluence	5443339	486507		A
23-Sep-99	Sheep Creek	6.150	Aspen Creek confluence	5443339	486507		A
2-Oct-99	Sheep Creek	9.850	200m d/s Waldie Creek confluence	5443541	489812		R
20-Oct-99	Salmo	21.850	600m d/s Sheep Creek Highway Bridge	5442770	480342		A
4-Dec-99	Salmo	18.450	Ric's Pool (large LJ pool below car body run)	5439899	480699	Overwintering Area	R
29-Dec-99	Salmo	18.450	Ric's Pool (large LJ pool below car body run)	5439899	480699		R
4-Feb-00	Salmo	18.450	Ric's Pool (large LJ pool below car body run)	5439899	480699		A
27-Apr-00	Salmo	18.450	Ric's Pool (large LJ pool below car body run)	5439899	480699		A
5-May-00	Salmo	18.450	Ric's Pool (large LJ pool below car body run)	5439899	480699		B

Sex	Female	MARTHA
Length (cm)	59.5	
Weight (g)	1860	
Floy Tag	P-24004	
Channel	11	149.520
Code	54	

Date	River	River km	Location Name	Location UTM Northing	Location UTM Easting	Comments	Tracking
7-Jul-99	Salmo	17.250	Burned Out Bridge	5438979	480985	Tagging Location	B
9-Jul-99	Salmo	17.750	Vector Pool	5439445	481156		B
11-Jul-99	Salmo	17.750	Vector Pool	5439445	481156		B
15-Jul-99	Salmo	17.650	100m below Vector Pool	5439352	481111		B
17-Jul-99	Salmo	17.650	100m below Vector Pool	5439352	481111		B
23-Jul-99	Salmo	17.650	100m below Vector Pool	5439352	481111		B
29-Jul-99	Salmo	17.650	100m below Vector Pool	5439352	481111		B
1-Aug-99						NOT FOUND	B
6-Aug-99						NOT FOUND	R
9-Aug-99						NOT FOUND	R
16-Aug-99						NOT FOUND	R
23-Aug-99	South Salmo	11.050	500m d/s Atco Forestry Bridge	5429102	486555	Spawning Area	R
31-Aug-99	South Salmo	11.050	500m d/s Atco Forestry Bridge	5429102	486555		A
9-Sep-99	South Salmo	11.050	500m d/s Atco Forestry Bridge	5429102	486555		A
23-Sep-99	South Salmo	11.050	500m d/s Atco Forestry Bridge	5429102	486555		A
2-Oct-99	South Salmo	11.050	500m d/s Atco Forestry Bridge	5429102	486555		R
20-Oct-99	Salmo	26.950	Pool d/s Lagoon Launch	5447248	480144		A
4-Dec-99						NOT FOUND	R
29-Dec-99						NOT FOUND	R
4-Feb-00						NOT FOUND	A
27-Apr-00	Salmo	17.750	Vector Pool	5439445	481156	Overwintering Area	A
5-May-00	Salmo	17.750	Vector Pool	5439445	481156		B

Sex	Male	JIMBOB
Length (cm)	60	
Weight (g)	2358	
Floy Tag	P-24007	
Channel	11	149.520
Code	56	

Date	River	River km	Location Name	Location UTM Northing	Location UTM Easting	Comments	Tracking
15-Jul-99	Salmo	23.050	Glide above Pool above Sheep Creek	5443705	480807	Tagging Location	B
17-Jul-99	Salmo	23.450	Pool above Glide above Pool above Sheep Ck	5444072	480813		B
23-Jul-99	Salmo	25.450	200m above Hellroaring Creek Confluence	5445781	480347		B
29-Jul-99						NOT FOUND	B
1-Aug-99						NOT FOUND	R
6-Aug-99						NOT FOUND	R
9-Aug-99						NOT FOUND	R
16-Aug-99						NOT FOUND	R
23-Aug-99						NOT FOUND	R
31-Aug-99	South Salmo	16.750	In USA	5426708	491424	Spawning Area	A
9-Sep-99	South Salmo	16.750	In USA	5426708	491424		A
23-Sep-99	South Salmo	17.300	In USA	5426415	491855		A
2-Oct-99						NOT FOUND	R
20-Oct-99	South Salmo	11.900	Slump u/s Atco Bridge	5428816	487278		A
4-Dec-99	Salmo	21.050	200m d/s Liness Road	5442019	480391	Overwintering Area	R
29-Dec-99	Salmo	21.050	200m d/s Liness Road	5442019	480391		R
4-Feb-00	Salmo	21.050	200m d/s Liness Road	5442019	480391		A
27-Apr-00	Salmo	23.450	Pool above Glide above Pool above Sheep Ck	5444072	480813		A
5-May-00	Salmo	23.450	Pool above Glide above Pool above Sheep Ck	5444072	480813		B

Sex	Female	SALLY
Length (cm)	60.5	
Weight (g)	2359	
Floy Tag	P-24005	
Channel	11	149.520
Code	58	

Date	River	River km	Location Name	Location UTM Northing	Location UTM Easting	Comments	Tracking
11-Jul-99	Salmo	25.250	Hellroaring Creek confluence	5445610	480247	Tagging Location	B
15-Jul-99	Salmo	24.600	Pool above rest stop	5445015	480452		B
17-Jul-99	Salmo	24.000	Pool below rest stop	5444550	480669		B
23-Jul-99	Salmo	24.000	Pool below rest stop	5444550	480669		B
29-Jul-99	Salmo	24.600	Pool above rest stop	5445015	480452		B
1-Aug-99	Salmo	24.600	Pool above rest stop	5445015	480452		R
6-Aug-99						NOT FOUND	R
9-Aug-99						NOT FOUND	R
16-Aug-99						NOT FOUND	R
23-Aug-99	Stagleap Creek	0.850	Stagleap Creek under powerlines	5429316	488076		R
31-Aug-99	Stagleap Creek	0.100	Stagleap Creek upstream confluence	5428734	487628	Spawning Area	A
9-Sep-99	South Salmo	12.200	Stagleap Creek confluence	5428654	487540		A
23-Sep-99	South Salmo	16.550	In USA	5426691	491188		A
2-Oct-99						NOT FOUND	R
20-Oct-99	Salmo	24.000	Pool below rest stop	5444550	480669	Overwintering Area	A
4-Dec-99	Salmo	24.000	Pool below rest stop	5444550	480669		R
29-Dec-99	Salmo	24.000	Pool below rest stop	5444550	480669		R
4-Feb-00	Salmo	24.000	Pool below rest stop	5444550	480669		A
27-Apr-00	Salmo	24.000	Pool below rest stop	5444550	480669		A
5-May-00	Salmo	23.450	Pool above Glide above Pool above Sheep Creek	5444072	480813		B

Sex	Female	ALICE
Length (cm)	56	
Weight (g)	1860	
Floy Tag	P-24022	
Channel	11	149.520
Code	60	

Date	River	River km	Location Name	Location UTM Northing	Location UTM Easting	Comments	Tracking
17-Jul-99	Salmo	21.050	200m d/s Liness Road	5442021	480392	Tagging Location	B
23-Jul-99	Salmo	20.750	500m d/s Liness Road	5441795	480388		B
29-Jul-99	Salmo	20.750	500m d/s Liness Road	5441795	480388		B
1-Aug-99	Salmo	22.750	200m d/s Sheep Creek confluence	5443423	480812		R
6-Aug-99	Salmo	23.400	Pool above Glide above Pool above Sheep Creek	5443987	480774		R
9-Aug-99	Salmo	23.400	Pool above Glide above Pool above Sheep Creek	5443987	480774		R
16-Aug-99	Salmo	34.150	Boulder Creek confluence	5453597	482237		R
23-Aug-99	Salmo	48.350	200m d/s Barrett Creek confluence	5463719	482511		R
31-Aug-99	Salmo	53.800	300m d/s Hall Creek confluence	5468221	482737	Spawning Area	A
9-Sep-99	Salmo	53.800	300m d/s Hall Creek confluence	5468221	482737		A
23-Sep-99	Salmo	55.000	900m u/s Hall Creek confluence	5469205	483031		A
2-Oct-99	Salmo	38.050	Labyrinth Saw Mill	5455923	484267		R
20-Oct-99	Salmo	16.850	Run 400 m below Burned Out Bridge	5438725	480709		A
4-Dec-99	Salmo	16.850	Run 400 m below Burned Out Bridge	5438725	480709		R
29-Dec-99	Salmo	13.150	1 km u/s South Salmo River confluence	5436189	479735	Overwintering Area	R
4-Feb-00	Salmo	13.150	1 km u/s South Salmo River confluence	5436189	479735		A
27-Apr-00	Salmo	19.750	Pool below Hippe Run	5440888	480391		A
5-May-00	Salmo	19.750	Pool below Hippe Run	5440888	480391		B

Sex	Female	CLEO
Length (cm)	53	
Weight (g)	1320	
Floy Tag	P-24003	
Channel	11	149.520
Code	61	

Date	River	River km	Location Name	Location UTM Northing	Location UTM Easting	Comments	Tracking
7-Jul-99	Salmo	25.250	Hellroaring Creek confluence	5445610	480247	Tagging Location	B
9-Jul-99						NOT FOUND	B
11-Jul-99						NOT FOUND	B
15-Jul-99	Salmo	23.050	Glide above Pool above Sheep Creek	5443705	480807		B
17-Jul-99	Salmo	23.050	Glide above Pool above Sheep Creek	5443705	480807		B
23-Jul-99	Salmo	21.050	200m d/s Liness Road	5442019	480391		B
29-Jul-99	Salmo	21.050	200m d/s Liness Road	5442019	480391		B
1-Aug-99						NOT FOUND	B
6-Aug-99	Sheep Creek	5.150	Site 1	5443084	485586		R
9-Aug-99	Sheep Creek	6.600	500m d/s Hedgehog Creek confluence	5443619	486816		R
16-Aug-99	Sheep Creek	6.900	200m d/s Hedgehog Creek confluence	5443670	487104		R
23-Aug-99	Sheep Creek	7.250	200m u/s Hedgehog Creek confluence	5443656	487450		R
31-Aug-99	Sheep Creek	7.550	500m u/s Hedgehog Creek confluence	5443706	487746	Spawning Area	A
9-Sep-99	Sheep Creek	7.550	500m u/s Hedgehog Creek confluence	5443706	487746		A
23-Sep-99	Sheep Creek	10.050	Waldie Creek confluence	5443476	490005		A
2-Oct-99	Sheep Creek	8.500	900m d/s Nugget Creek confluence	5443799	488638		R
20-Oct-99	Sheep Creek	1.000	1000m u/s of mouth	5443298	481743		A
4-Dec-99	Salmo	22.100	500m d/s Sheep Creek confluence	5442953	480480		R
29-Dec-99						NOT FOUND	R
4-Feb-00	Salmo	20.000	below Liness Road	5441153	480388	Overwintering Area	A
27-Apr-00	Salmo	23.050	Glide above Pool above Sheep Creek	5443705	480807		A
5-May-00	Salmo	23.450	Pool above Glide above Pool above Sheep Creek	5444072	480813		B

Sex	Female	NIN
Length (cm)	54	
Weight (g)	1750	
Floy Tag	C-000148	
Channel	11	149.520
Code	65	

Date	River	River km	Location Name	Location UTM Northing	Location UTM Easting	Comments	Tracking
31-Aug-99	Clearwater Creek	3.800	Falls	5470071	487864	Tagging Location	R
9-Sep-99	Clearwater Creek	3.800	Falls	5470071	487864	Spawning Area	A
23-Sep-99	Clearwater Creek	3.800	Falls	5470071	487864		A
2-Oct-99	Clearwater Creek	3.800	Falls	5470071	487864		R
20-Oct-99	Salmo	36.050	Pool 1 km above Gerry's Bridge	5454663	483527		A
4-Dec-99						NOT FOUND	R
29-Dec-99						NOT FOUND	R
4-Feb-00	Salmo	36.350	Pool above Gerry's Bridge	5454911	483420	Overwintering Area	A
27-Apr-00	Salmo	36.350	Pool above Gerry's Bridge	5454911	483420		A
5-May-00	Salmo	36.350	Pool above Gerry's Bridge	5454911	483420		B

Sex	Female	HENRIETTA
Length (cm)	52	
Weight (g)	1134	
Floy Tag	P-24006	
Channel	11	149.520
Code	67	

Date	River	River km	Location Name	Location UTM Northing	Location UTM Easting	Comments	Tracking
11-Jul-99	Salmo	17.850	100m above Vector Pool	5439513	481094	Tagging Location	B
15-Jul-99	Salmo	16.850	Run 400 m below Burned Out Bridge	5438719	480706		B
17-Jul-99	Salmo	16.850	Run 400 m below Burned Out Bridge	5438719	480706		B
23-Jul-99	Salmo	18.450	Ric's Pool (large LJ pool below car body run)	5439897	480701		B
29-Jul-99	Salmo	18.450	Ric's Pool (large LJ pool below car body run)	5439897	480701		B
1-Aug-99						NOT FOUND	R
6-Aug-99						NOT FOUND	R
9-Aug-99						NOT FOUND	R
16-Aug-99						NOT FOUND	R
23-Aug-99	Stagleap Creek	0.850	Stagleap Creek under powerlines	5429316	488076	Spawning Area	R
31-Aug-99	Stagleap Creek	0.850	Stagleap Creek under powerlines	5429316	488076		A
9-Sep-99	Stagleap Creek	0.850	Stagleap Creek under powerlines	5429316	488076		A
23-Sep-99	Stagleap Creek	0.850	Stagleap Creek under powerlines	5429316	488076		A
2-Oct-99	Stagleap Creek	0.850	Stagleap Creek under powerlines	5429316	488076		R
20-Oct-99	Salmo	16.850	Run 400 m below Burned Out Bridge	5438719	480706	Overwintering Area	A
4-Dec-99	Salmo	16.850	Run 400 m below Burned Out Bridge	5438719	480706		R
29-Dec-99	Salmo	16.850	Run 400 m below Burned Out Bridge	5438719	480706		R
4-Feb-00	Salmo	16.850	Run 400 m below Burned Out Bridge	5438719	480706		A
27-Apr-00	Salmo	18.450	Ric's Pool (large LJ pool below car body run)	5439897	480701		A
5-May-00	Salmo	18.450	Ric's Pool (large LJ pool below car body run)	5439897	480701		B

Sex	Female	CAROL
Length (cm)	50	
Weight (g)	1814	
Floy Tag	P-24024	
Channel	11	149.520
Code	68	

Date	River	River km	Location Name	Location UTM Northing	Location UTM Easting	Comments	Tracking
15-Jul-99	Salmo	18.450	Ric's Pool (large LJ pool below car body run)	5439898	480701	Tagging Location	B
17-Jul-99	Salmo	18.450	Ric's Pool (large LJ pool below car body run)	5439898	480701		B
23-Jul-99	Salmo	18.450	Ric's Pool (large LJ pool below car body run)	5439898	480701		B
29-Jul-99	Salmo	18.450	Ric's Pool (large LJ pool below car body run)	5439898	480701		B
1-Aug-99	Salmo					NOT FOUND	R
6-Aug-99	Salmo	43.000	Ymir	5459268	484355		R
9-Aug-99	Salmo	48.750	200m u/s Barrett Creek confluence	5464099	482542		R
16-Aug-99	Salmo	58.350	200 m d/s Clearwater Creek confluence	5470930	484773		R
23-Aug-99	Clearwater Creek	3.800	Falls	5470063	487859	Spawning Area	R
31-Aug-99	Clearwater Creek	3.800	Falls	5470063	487859		A
9-Sep-99	Clearwater Creek	3.800	Falls	5470063	487859		A
23-Sep-99	Clearwater Creek	3.800	Falls	5470063	487859		A
2-Oct-99	Clearwater Creek	0.500	500m u/s mouth	5470954	485310		R
20-Oct-99	Salmo	23.400	800m u/s Sheep Creek confluence	5443994	480776		A
4-Dec-99	Salmo	18.450	Ric's Pool (large LJ pool below car body run)	5439899	480700	Overwintering Area	R
29-Dec-99	Salmo	18.450	Ric's Pool (large LJ pool below car body run)	5439899	480700		R
4-Feb-00	Salmo	18.450	Ric's Pool (large LJ pool below car body run)	5439899	480700		A
27-Apr-00	Salmo	18.450	Ric's Pool (large LJ pool below car body run)	5439899	480700		A
5-May-00	Salmo	18.450	Ric's Pool (large LJ pool below car body run)	5439899	480700		B

Sex	Male	FINN
Length (cm)	67	
Weight (g)	3084	
Floy Tag	P-24002	
Channel	11	149.520
Code	70	

Date	River	River km	Location Name	Location UTM Northing	Location UTM Easting	Comments	Tracking
9-Jul-99	Salmo	23.050	Glide above Pool above Sheep Creek	5443705	480807	Tagging Location	B
11-Jul-99	Salmo	22.900	Pool above Sheep Creek	5443557	480750		B
15-Jul-99	Salmo	23.050	Glide above Pool above Sheep Creek	5443705	480807		B
17-Jul-99	Salmo	23.050	Glide above Pool above Sheep Creek	5443705	480807		B
23-Jul-99	Salmo	24.000	Pool below rest stop	5444550	480669		B
29-Jul-99	Salmo	24.400	Rest stop	5444832	480403		B
1-Aug-99						NOT FOUND	R
6-Aug-99						NOT FOUND	R
9-Aug-99	Salmo	32.700	2 km d/s Hidden Creek confluence	5452404	481780		R
16-Aug-99	Salmo	42.500	500m d/s Ymir	5458857	484558		R
23-Aug-99	Salmo	54.300	200m u/s Hall Creek confluence	5468640	482867		R
31-Aug-99	Salmo	54.700	600m u/s Hall Creek confluence	5468937	482910	Spawning Area	A
9-Sep-99	Salmo	54.700	600m u/s Hall Creek confluence	5468937	482910		A
23-Sep-99	Salmo	54.700	600m u/s Hall Creek confluence	5468937	482910		A
2-Oct-99	Salmo	53.900	200m d/s Hall Creek confluence	5468313	482700		R
20-Oct-99	Salmo	23.050	Glide above Pool above Sheep Creek	5443705	480807	Overwintering Area	A
4-Dec-99	Salmo	23.050	Glide above Pool above Sheep Creek	5443705	480807		R
29-Dec-99	Salmo	22.900	Pool above Sheep Creek	5443557	480750		R
4-Feb-00	Salmo	22.900	Pool above Sheep Creek	5443557	480750		A
27-Apr-00						NOT FOUND	A
5-May-00	Salmo	23.450	Pool above Glide above Pool above Sheep Creek	5444072	480813		B