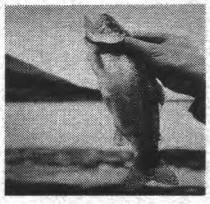
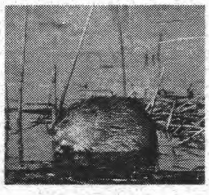
Canada Alberta Northwest Territories

Northern River Basins Study





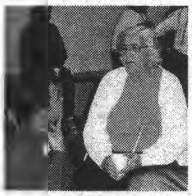


NORTHERN RIVER BASINS STUDY PROJECT REPORT NO. 33

SEASONAL MOVEMENTS OF RADIO TAGGED FISH

UPPER ATHABASCA RIVER
AUGUST, 1992 TO MARCH, 1993



Prepared for the
Northern River Basins Study
under Project 3121-B2

by
Terry Clayton and Curtiss McLeod
R.L. & L. Environmental Services Ltd.

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PREFACE:

The Northern River Basins Study was initiated through the "Canada-Alberta-Northwest Territories Agreement Respecting the Peace-Athabasca-Slave River Basin Study, Phase II - Technical Studies" which was signed September 27, 1991. The purpose of the Study is to understand and characterize the cumulative effects of development on the water and aquatic environment of the Study Area by coordinating with existing programs and undertaking appropriate new technical studies.

This publication reports the method and findings of particular work conducted as part of the Northern River Basins Study. As such, the work was governed by a specific terms of reference and is expected to contribute information about the Study Area within the context of the overall study as described by the Study Final Report. This report has been reviewed by the Study Science Advisory Committee in regards to scientific content and has been approved by the Study Board of Directors for public release.

It is explicit in the objectives of the Study to report the results of technical work regularly to the public. This objective is served by distributing project reports to an extensive network of libraries, agencies, organizations and interested individuals and by granting universal permission to reproduce the material.

NORTHERN RIVER BASINS STUDY
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Whereas the above publication is the result of work conducted under the Northern River Basins Study and the terms of reference for that project are deemed to be fulfilled,
IT IS THEREFORE REQUESTED BY THE STUDY OFFICE THAT;
this publication be subjected to proper and responsible review and be considered for release to the public.

F. J. Wrona — 28-JAN 94

(Dr. F.J. Wrona, Ph.D., Science Director) (Date)

Whereas it is an explicit term of reference of the Science Advisory Committee "to review, for scientific content, material for publication by the Board",
IT IS HERE ADVISED BY THE SCIENCE ADVISORY COMMITTEE THAT;
this publication has been reviewed for scientific content and that the scientific practices represented in the report are acceptable given the specific purposes of the project and subject to the field conditions encountered.
SUPPLEMENTAL COMMENTARY HAS BEEN ADDED TO THIS PUBLICATION: [ ] Yes [✓] No

P. A. Larkin — 14 Feb 94

(Dr. P. A. Larkin, Ph.D., Chair) (Date)

Whereas the Study Board is satisfied that this publication has been reviewed for scientific content and for immediate health implications,
IT IS HERE APPROVED BY THE BOARD OF DIRECTORS THAT;
this publication be released to the public, and that this publication be designated for: **[ ] STANDARD AVAILABILITY [ ] EXPANDED AVAILABILITY**

Bev Burns — April 7/94

(Bev Burns, Co-chair) (Date)

Lucille Partington — April 7/94

(Lucille Partington, Co-chair) (Date)

SEASONAL MOVEMENTS OF RADIO TAGGED FISH, UPPER ATHABASCA RIVER, AUGUST, 1992 TO MARCH, 1993

STUDY PERSPECTIVE

The distribution and movement of fish species in the watersheds of the Peace, Athabasca, and Slave rivers are major areas of interest to the Northern River Basins Study. Determination of where fish spend their time (rearing, spawning and feeding) and when fish are most likely to be exposed to alterations in natural water quality are important to understanding the relationship between fish exposure, fish health, contaminant body burdens, and physiological changes. An understanding of the seasonal behaviour (eg. migrations and homing) of fish is an important component in defining contaminant pathways.

Related Study Questions

6) What is the distribution and movement of fish species in the watersheds of the Peace, Athabasca and Slave river? Where and when are they most likely to be exposed to changes in water quality and where are their important habitats?

12) What native traditional knowledge exists to enhance the physical science studies in all areas of enquiry?

13b) What are the cumulative effects of man made discharges on the water and aquatic environment?

14) What long term monitoring programs and predictive models are required to provide an ongoing assessment of the state of the aquatic ecosystems?

The size and length of the Peace, Athabasca and Slave rivers, in addition to the limited baseline information on the fish community of these rivers, make a monumental task of identifying, monitoring and describing fish movement. An investigation to assess and demonstrate the feasibility of radio tagging fish commonly found in these northern rivers was initiated in May 1992, on the upper Athabasca River between Jasper National Park and the Windfall Bridge. Prior to this time much of the telemetry work had been done with larger sized species or specimens. There was some question whether the species likely to be monitored could survive the capture and tag insertion. The objective was to implant transmitters and monitor several species (bull trout, mountain whitefish, burbot, rainbow trout, arctic grayling and lake whitefish) of radio tagged fish.

In addition to confirming the worthiness of radio telemetry technology for monitoring fish movement, the field investigations revealed movements of bull trout, mountain whitefish and burbot upstream and into Jasper National Park. These movements coincided with the period when the species under investigation are known to spawn. Continued monitoring indicated that the majority of the fish returned downstream. Movements of 122 and 100 kilometres were noted for mountain whitefish and bull trout respectively.

An initial project report (Northern River Basins Report No. 11) confirmed the practicality of using this technology in addition to identifying some of the requirements related to transmitter quality, battery life, and handling of small fish that should be incorporated in any subsequent investigations. This report concludes that future radio telemetry work should likely focus on measuring the behavioural response of fish to effluent plumes, and the relationship between exposure history and body burden concentrations of contaminants. Additional work is also needed in determining the interrelationship of mainstream and tributary fish populations plus the identification of critical habitats, e.g., overwintering, spawning, feeding.

REPORT SUMMARY

In summer 1992, the Northern River Basins Study requested that R.L. & L. Environmental Services Ltd. continue to monitor movements of fish previously radio tagged in the upper Athabasca River during Sub-Project 3121. Inherent in this program was a demonstration of the utility of radio telemetry to determine fish movements during the under-ice overwintering period, and the ability of this technique to identify the location of important habitats.

During the extended study period from August 1992 to March 1993, movements of six species were monitored. Of the 35 transmitters utilized, the majority were implanted in bull trout, mountain whitefish, and burbot. Other species radio tagged were lake whitefish, Arctic grayling and rainbow trout.

All monitored bull trout moved upstream during late summer into the Jasper National Park portion of the Athabasca River drainage. It was suspected that the majority of this migration was spawning related, with spawning taking place in the Snake Indian and Rocky rivers. The greatest upstream movement by a bull trout in the study area was 100 km. After spawning, some bull trout returned downstream to the same area of the Athabasca River where they were initially captured in spring 1992.

The maximum upstream movement by a mountain whitefish was 122 km. Movement patterns for this species were complex and inconsistent between individuals. Mountain whitefish were suspected to have spawned in both the mainstem Athabasca River and the Rocky River.

Burbot remained in their home range for most of the study period, undertaking relatively short-distance migrations. These excursions occurred under-ice in mid-January to mid-February, and were consistent with spawning behaviour.

There were 15 fish that spent a portion of the study period in the mixing zone downstream of the Hinton/Weldwood effluent diffuser. Of these, 40% resided in the mixing zone for greater than one half of the total time monitored. In addition to obtaining data on movements and critical habitats of target fish species, this study also identifies the potential use of radio telemetry to document exposure times of fish to contaminants.

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1.0 INTRODUCTION

Radio telemetry is an effective methodology for monitoring fish movements and obtaining behavioural information in stream systems. Stream fishes are difficult to study and habitat utilization data collected by conventional means are often biased by gear type and collection method. Telemetry provides the opportunity to search large areas to find mobile species, to track multiple species and many individuals, and is rarely affected by seasonal conditions (e.g., ice cover). Winter (1992) noted that telemetry was an effective technique for determining activity patterns of fish (e.g., presence near an effluent plume, behaviour relative to environmental parameters), identifying home range and habitat use (e.g., migration, spawning areas), and testing assumptions in population estimates (e.g., are fish mixing randomly?).

A technical assessment of radio telemetry using representative fish species from the Athabasca River was undertaken in summer and fall 1992. Appropriate techniques, equipment and protocols to be employed in capturing fish, implanting radio transmitters, and monitoring movements were documented in the Fish Radio Telemetry Demonstration Project Report prepared for the Northern River Basins Study (R.L. & L. Environmental Services Ltd. 1993).

Fish movements over the short term (i.e., May 1992 to late July 1992) were described in the above report. In order to optimize the availability of active radio transmitters from the project, and evaluate the efficacy of radio telemetry in all seasons, the data collection was extended by the Northern River Basins Study to cover the September 1992 to March 1993 period (Terms of Reference, Appendix A). Contracts were not in place at the completion of Sub-Project 3121, therefore movement data were not collected for most of August 1992. The continued movements of six radio tagged fish species were monitored in the upper Athabasca River drainage using both a ground station and aerial reconnaissance from late August 1992 to March 1993. Results of the continuation of the monitoring program are described in this data report.

1.1 OBJECTIVES

The overall purpose of the study extension was to obtain further information on the movements of important fish species in the upper reaches of the Athabasca River and to obtain data on the location of critical habitats (i.e., spawning, overwintering) for these species. Inherent in this program was a further demonstration of the feasibility of telemetry to monitor fish movements during the low flow, under-ice overwintering period for fish in the mainstem Athabasca River.

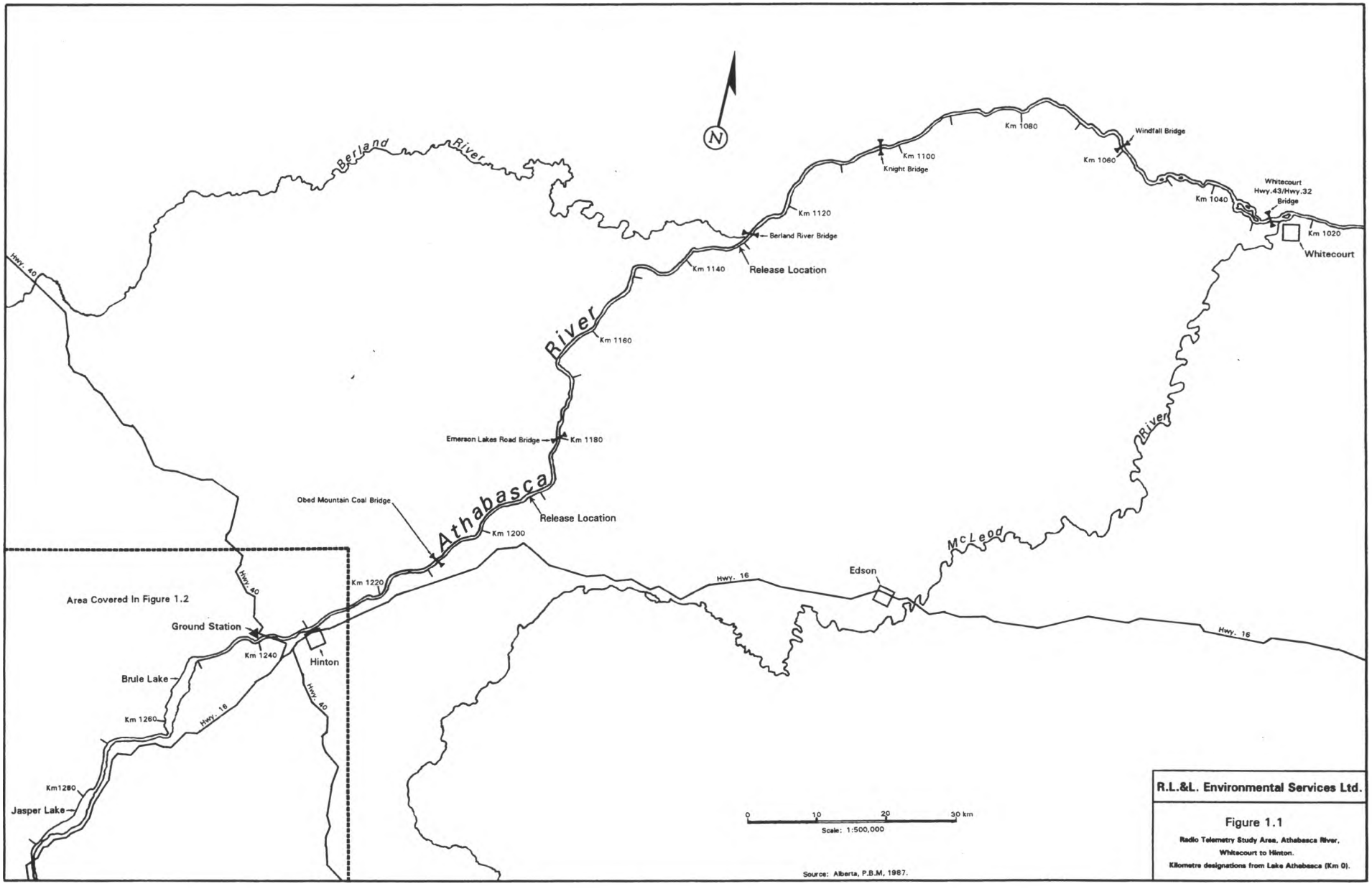
The specific objectives of extending the radio telemetry program were to collect additional information on the following:

- Spawning sites and movement patterns of bull trout (*Salvelinus confluentus*)
- Spawning sites and movement patterns of mountain whitefish (*Prosopium williamsoni*)
- Overwintering sites and behaviour of all radio tagged species

Habitat utilization was to be inferred from tracking data only; ground truthing or site specific sampling was not an objective of the program. The scope of the study did not include collection of supportive data and as such, the interpretation of biological aspects and habitat utilization should be regarded as preliminary, and subject to verification.

1.2 STUDY AREA

The study was conducted in the upper reaches of the Athabasca River above Whitecourt, encompassing 322 km of mainstem river (Figures 1.1 and 1.2). The survey area extended upstream to Athabasca Falls (an impassable barrier to upstream fish movement) in Jasper National Park, and included lower reaches of major tributaries (i.e., Fiddle River, Snake Indian River, Rocky River, Snaring River) above Brule Lake. Lower reaches of several downstream tributaries (i.e., Solomon Creek, Oldman Creek, and the Berland River) also were surveyed. A fixed ground station was established on the mainstem Athabasca River near the location of Old Entrance, 11.5 km upstream of the combined Hinton/Weldwood Mill effluent discharge.

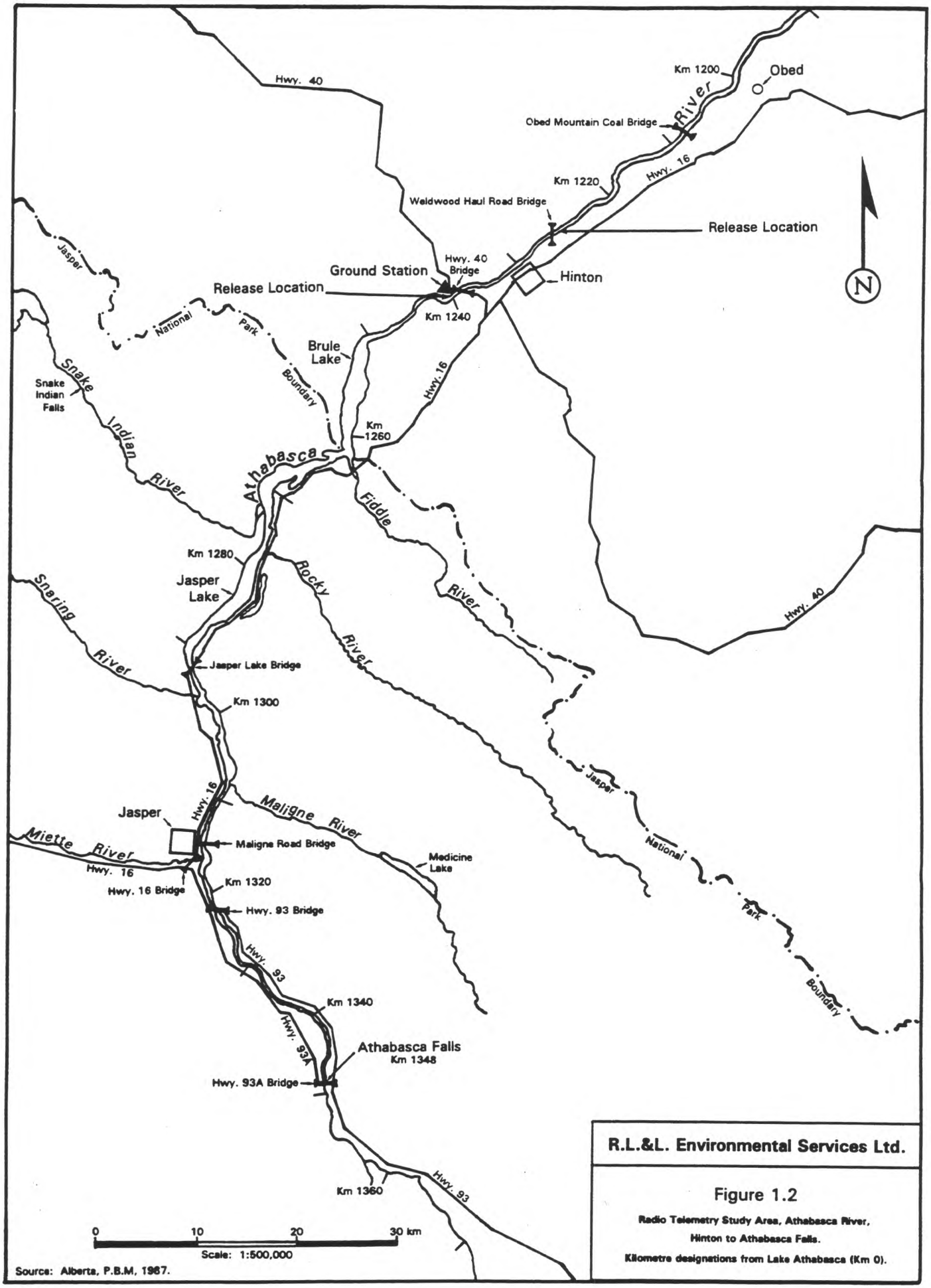


R.L.&L. Environmental Services Ltd.

Figure 1.1

Radio Telemetry Study Area, Athabasca River, Whitecourt to Hinton.

Kilometre designations from Lake Athabasca (Km 0).



R.L.&L. Environmental Services Ltd.

Figure 1.2

Radio Telemetry Study Area, Athabasca River, Hinton to Athabasca Falls.

Kilometre designations from Lake Athabasca (Km 0).

2.0 METHODS

2.1 FISH COLLECTION AND TAGGING

A detailed description of equipment and techniques used was provided in the Fish Radio Telemetry Demonstration Project report (R.L. & L. Environmental Services Ltd. 1993); these methods are summarized briefly in the following section.

Transmitters utilized weighed 10.5 g in air, and had a life expectancy of 270 days. Transmitters were digitally encoded, allowing up to 50 transmitters to be used on a single frequency. Frequencies between 148.0 and 150.0 MHz were employed.

All fish were collected by boat electrofishing. Captured individuals were immediately placed in an onboard holding tank equipped with a recirculating water and aeration system to minimize holding stress. Prior to surgery, fish were anesthetized with tricaine methane sulfonate at a concentration of 143 mg/L (5 g in 35 L H_20). The surgical implantation procedure was a modification of techniques described by Bidgood (1980) and Knecht et al. (1981). A 3-4 cm longitudinal incision was made approximately 1-2 cm from the mid-ventral line, anterior to the pelvic fins. The transmitter was then inserted into the body cavity, and the incision closed with individual sutures spaced at approximately 1 cm intervals. Suture ends were secured with a square knot, using an instrument tie.

Following surgery, the fish was removed from the operating table directly to the recirculating holding tank. The fish was subsequently transferred to a holding cage in the river and monitored periodically. Fish were held for one to two hours and then released if exhibiting normal swimming behaviour and no disorientation. Minimal holding of surgically-treated fish has been noted by other researchers (e.g., Hart and Summerfelt 1975) to reduce trauma.

2.2 TRACKING

A fixed ground station and aircraft tracking were the principal techniques employed to systematically identify movements of tagged individuals within the project area.

The fixed station was located east of Old Entrance (GPS reading 53°22'09.09" N, 117°42'46.1" W), 11.5 km upstream of the Weldwood Mill in Hinton. This site was selected for a number of reasons, including ease of access for servicing, elevation above the river, clear line of sight across the river, narrow channel width, shallow depths, and secluded setting. Fixed station equipment consisted of two nine-element Yagi antennae and a data logger, with the data logger and batteries housed in a weather-proof security cabinet. The data logger was a model SRX-400 Telemetry Receiver manufactured by Lotek Engineering Inc.[1], with antennae switching to allow identification of upstream and downstream movements of fish. It was powered by two deep-cycle 120 ampere-hour 12-V batteries. Data from fish passing the fixed station were captured and stored in the data logger until downloading. Data were downloaded

[1] Use of a company's name, or equipment identification does not necessarily constitute endorsement.

into an IBM-compatible 386 notebook computer every two to three weeks during servicing and battery replacement.

A Cessna 172 aircraft, with a single four-element Yagi antenna mounted on the pilot's side of the aircraft at a 60° angle below the horizon, was utilized for aerial tracking. An SRX-400 receiver was used during aerial tracking. The position of telemetered fish was recorded on 1:50,000 scale topographic maps of the river area searched. Twenty-three aerial surveys were carried out as weather permitted, from mid-June 1992 to March 1993 (Table 2.1). Most tracking flights included the mainstem Athabasca River from Whitecourt to Athabasca Falls, above Jasper. Major tributaries were flown also, primarily to monitor bull trout spawning movements. Airspeeds ranged from 130 to 170 km/h at altitudes from 150 to 425 m agl, depending on the area searched (e.g., canyon, broad valley), weather conditions, and signal reception. Flights at higher altitudes increased the range at which audio signals could be detected, but in most instances low level passes were needed to acquire the transmitter code.

Table 2.1 Summary of Athabasca River mainstem and tributary distances surveyed during aerial tracking flights, June 1992 to March 1993. Due to local weather conditions and aircraft fuel capacity, the entire mainstem and all tributaries were not surveyed on all tracking flights.

Survey Date	Mainstem Athabasca River (km)	Tributaries (km)										
		Berland River	Oldman Creek	Solomon Creek	Fiddle River	Moosehorn River	Snake Indian River	Rocky River	Snaring River	Maligne River	Miette River	Whirlpool River
20-Jun-92	234											
24-Jun-92	213											
28-Jun-92	227	2		2	5							
02-Jul-92	271				5	2	5	5				
18-Jul-92	236	2										
22-Jul-92	252						5	5				
29-Jul-92	231				12		23	8	5	3	12	
31-Aug-92	286	6	10				36	8			25	25
08-Sep-92	320				5		36	8	5			
16-Sep-92	265	6					12	8				
23-Sep-92	268						36	11				
29-Sep-92	296						10	7				
14-Oct-92	325											
21-Oct-92	165				5		36	12	5			
28-Oct-92	176						15	7			20	25
02-Nov-92	241											
23-Nov-92	338											
19-Dec-92	187											
15-Jan-93	121											
29-Jan-93	298											
22-Feb-93	228											
01-Mar-93	149											
30-Mar-93	332											

3.0 RESULTS

3.1 INTRODUCTION

3.1.1 Radio Tagged Fish

Information on movements and habitat selection was recorded from observations of 35 fish. Data were obtained for six species; mountain whitefish comprised the majority (17 fish), followed by bull trout (9 fish), burbot (*Lota lota*) (5 fish), rainbow trout (*Oncorhynchus mykiss*) (2 fish), and single specimens of lake whitefish (*Coregonus clupeaformis*) and Arctic grayling (*Thymallus arcticus*). Species, numbers tagged, and fish size are indicated in Table 3.1. Transmitter location, release date, and individual fish movement data are presented in Appendix B.

Table 3.1 Summary of radio tagged fish released in the Athabasca River Project Area, 25 May - 12 June 1993.

Species	Number	Fish Size	
		Mean Length/Range (mm)	Mean Weight/Range (g)
Mountain whitefish	17	399 (362-435)	808 (633-1205)
Bull trout	9	488 (385-570)	1287 (520-2070)
Burbot	5	692 (545-890)	2452 (910-5500)
Rainbow trout	2	348 (329-366)	507 (423-591)
Lake whitefish	1	501	-
Arctic grayling	1	304	369
All Species	**35**		

Fish were tagged and released at several locations in the study area to optimize collection of movement data. These locations also reflected access to the river and the availability of suitable fish. Twenty-three (66%) of the fish were released at Sites 2 and 3 within or near a 30 km priority area downstream of the combined Hinton/Weldwood effluent discharge point; the remaining fish were released at Old Entrance (Site 4) and near the Berland River (Site 1; Table 3.2).

Table 3.2 Location and number of radio tagged fish released at each site.

Site (Distance)[1]	Number of Fish Radio Tagged					
	Bull Trout	Mountain Whitefish	Burbot	Rainbow Trout	Lake Whitefish	Arctic Grayling
1. Upstream of Berland River (Km 1129)	-	1	1	1	-	-
2. Obed "Ford" (Km 1192)	1	8	-	1	-	1
3. Weldwood Bridge (Hinton) (Km 1227)	4	6	1	-	1	-
4. Old Entrance (Km 1239)	4	2	3	-	-	-

[1]Distance from Km 0.0 at confluence of Athabasca River and Lake Athabasca.

3.1.2 Transmitter Function

The transmitters utilized had an expected life span of approximately nine months, and batteries were therefore anticipated to last until at least mid-February 1993. Approximately 32% of the transmitters were still operating at the end of January, and 18% were still functional at the end of March (Table 3.3).

Table 3.3 Number and percentage of transmitter signals received at the end of each two month period during aerial and ground surveys conducted on the upper Athabasca River, June 1992 to March 1993.

Species	Total No. Transmitters	Number and Percentage of Functioning Transmitters									
		31 July		30 September		30 November		31 January		31 March	
		No.	%	No.	%	No.	%	No.	%	No.	%
Bull trout	8[a]	5	63	5	63	5	63	4	50	1	13
Mountain whitefish	17	8	47	6	35	3	18	3	18	1	6
Burbot	5	3	60	2	40	2	40	2	40	2	40
Rainbow trout	2	2	100	0	0	0	0	0	0	0	0
Lake whitefish	1	1	100	1	100	1	100	1	100	1	100
Arctic grayling	1	1	100	1	100	1	100	1	100	1	100
Totals	**34**	**20**	**59**	**15**	**44**	**12**	**35**	**11**	**32**	**6**	**18**

[a] Nine bull trout were radio tagged and released, but one was captured by an angler in early July.

The maximum number of transmitters located on any given flight was 24 (i.e., 24 June), representing 69% of the available transmitters. Assuming all possible movement ranges of fish were covered during the surveys, this indicated that 31% of the transmitters failed within the first month, and by the end of the fourth month (i.e., September) 56% of the transmitters had ceased to operate. Transmitter failure is discussed in detail in the Fish Radio Telemetry Demonstration Project report (R.L. & L. Environmental Services Ltd. 1993).

Data for each species are presented in the following sections. Movements of individual fish are described from the initiation of tracking in May 1992, but the discussion is limited to those telemetered fish for which three or more data points were available (i.e., does not include transmitters which failed early in the study). Suspected critical habitats (i.e., spawning and overwintering) are noted on individual figures in Appendix B.

Caution should also be exercised when interpreting data on individual flights, and number of signals acquired, which are presented in Appendix C. Local weather conditions, particularly in the mountains upstream of Brule Lake, sometimes resulted in tributaries or reaches of the mainstem not being surveyed (e.g., due to high winds).

3.2 BULL TROUT

Little information has been documented for bull trout movements in large rivers in western Canada. In some northern studies, completed prior to the designation of bull trout as a separate species in 1980 (American Fisheries Society 1980), it was unclear if the author was referring to bull trout or anadromous Dolly Varden (*Salvelinus malma*). Most of the previous studies on bull trout in northern environs surveyed juvenile populations, or focused on fish use of smaller tributaries. Leggett (1969) noted that adult bull trout entered Meadow and John creeks (Kootenay Lake drainage, B.C.) in late July and all had left the creeks before the end of September. It was suggested by Alberta Fish and Wildlife Division (1985) that bull trout may select spawning substrates somewhat larger than those utilized by other salmonid species, and that their spawning streams are often subject to flash floods. The only study reviewed on bull trout in the present study area (Sterling 1978) did not present movement data.

Some data on large river movements are available from radio telemetry studies of bull trout in the Peace River, B.C. (R.L. & L. Environmental Services Ltd. 1991). Several telemetered bull trout in the Peace River mainstem subsequently migrated into the Halfway River, followed by movements into smaller spawning tributaries 200 km upstream. After spawning, most fish returned downstream to overwinter in the mainstem Peace River.

3.2.1 Chronology and Extent of Movement

Of the fish species monitored in this study, bull trout displayed the greatest average extent of movement. Figure 3.1 indicates the extent of movement and days-at-large for the bull trout monitored during this study. Locations of individual bull trout during aerial monitoring are illustrated in Appendix B, Figures B1 to B6. After release in late May - early June, 60% of the bull trout underwent a downstream movement, the maximum distance of which was 12 km. This movement was likely related to stress from capture and surgery. By July, all bull trout had initiated upstream movements. One fish (i.e., transmitter code 20-10) was captured by an angler from the Fiddle River mouth in early July. Another bull trout (i.e., transmitter code 20-44) ascended the Athabasca River until it was approximately two kilometres above the Jasper National Park Boundary on 18 July; the signals from this transmitter were received throughout the study period, although it ceased further movement (it is suspected that this transmitter was expelled).

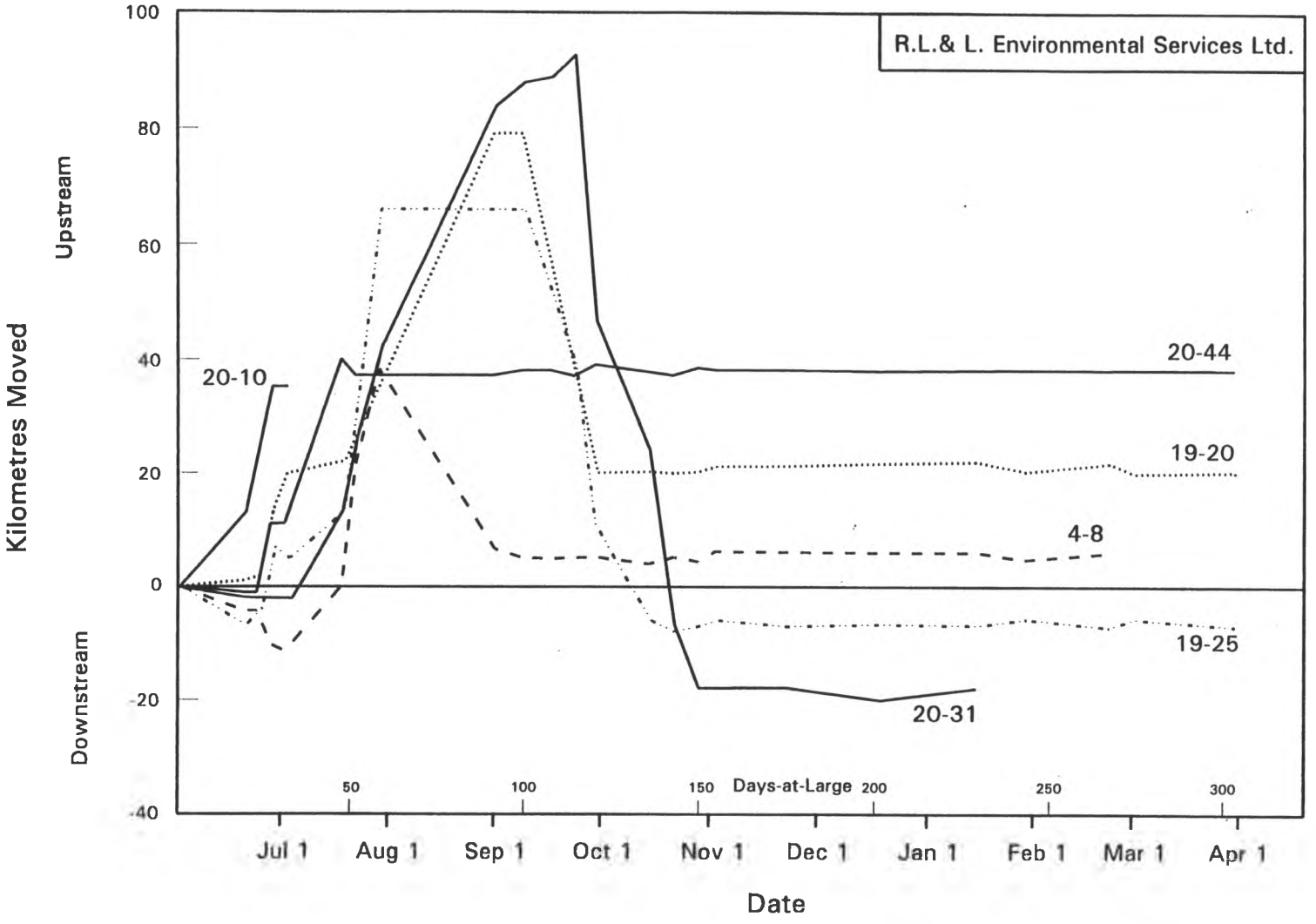


Figure 3.1. Movements of six bull trout in the Athabasca River from June 1992 to March 1993.

The remaining four bull trout continued upstream movement throughout July. Downstream movements began in late August for one individual (i.e., transmitter code 4-8) while the remaining three bull trout commenced downstream movements in mid- to late September. All bull trout had reached their overwintering areas prior to November, and thereafter exhibited only short distance movements through to the end of the study period (or to the time of transmitter battery failure).

The greatest upstream distance moved was 100 km (transmitter code 20-31). This individual was initially captured near Emerson Creek (Km 1181) and released at the Obed "Ford" site (Km 1192). It began upstream movement in early July and reached the Rocky River by the end of August. Downstream movements for this fish began in late September, and it returned to the Emerson Creek area, its original capture site, by late October.

3.2.2 Spawning Migrations

Four bull trout (i.e., transmitter codes 20-31, 19-20, 19-25, and 4-8) exhibited distinct upstream migrations that were consistent with spawning-related behaviour. The earliest arrival at a suspected spawning area was the end of July, while the latest was late August (Figures 3.2 to 3.7). Suspected post-spawning movements commenced in mid-August and concluded in mid- to late September. Tracking was discontinued from 30 July to 30 August (due to contract renewal), resulting in uncertainty as to when some bull trout entered the tributaries.

The bull trout bearing transmitter 20-31 commenced an upstream movement in early July, and passed the fixed station on 29 July (Figure 3.2). This fish was next located approximately 1 km below the confluence of the Athabasca and Rocky rivers on 31 August. On the subsequent tracking flight on 8 September, it was located in the Rocky River, and it remained in this tributary until at least 23 September. Its position was not determined during the 29 September flight. The next recorded position of this fish was at the fixed station on 9 October, and by 28 October it had reached its suspected overwintering area near Km 1174.

Early spawning-related movements of bull trout 19-20 were difficult to discern, due to the absence of tracking data from 2 July to 29 August (Figure 3.3). On 2 July this fish was located immediately below Brule Lake, while at the end of August it was found 33.5 km up the Snake Indian River (upstream movement of 66 km). Signals from this individual were received at the same location on 8 September, but on the 16 September flight, the fish could not be located. On the 23 September flight, the fish was found in the Athabasca mainstem below Brule Lake (i.e., Km 1247), and it remained at this location throughout the autumn.

Bull trout 4-8 initially underwent a protracted downstream movement for approximately 12 km, and downstream movement appeared to end when the fish entered the Hinton-Weldwood discharge mixing zone (Figure 3.4). From 2 July to 29 July, this fish moved upstream at an average rate of 1.7 km/day, and on 29 July, was located at Km 5.5 in the Snake Indian River. The rate of 1.7 km/day is a minimum, since the actual date of departure from one location and arrival at another location cannot be precisely determined from aerial tracking data. Movement out of the Snake Indian River apparently occurred in August (non-survey period) and on the 31 August flight, this individual was found in the mainstem Athabasca River below

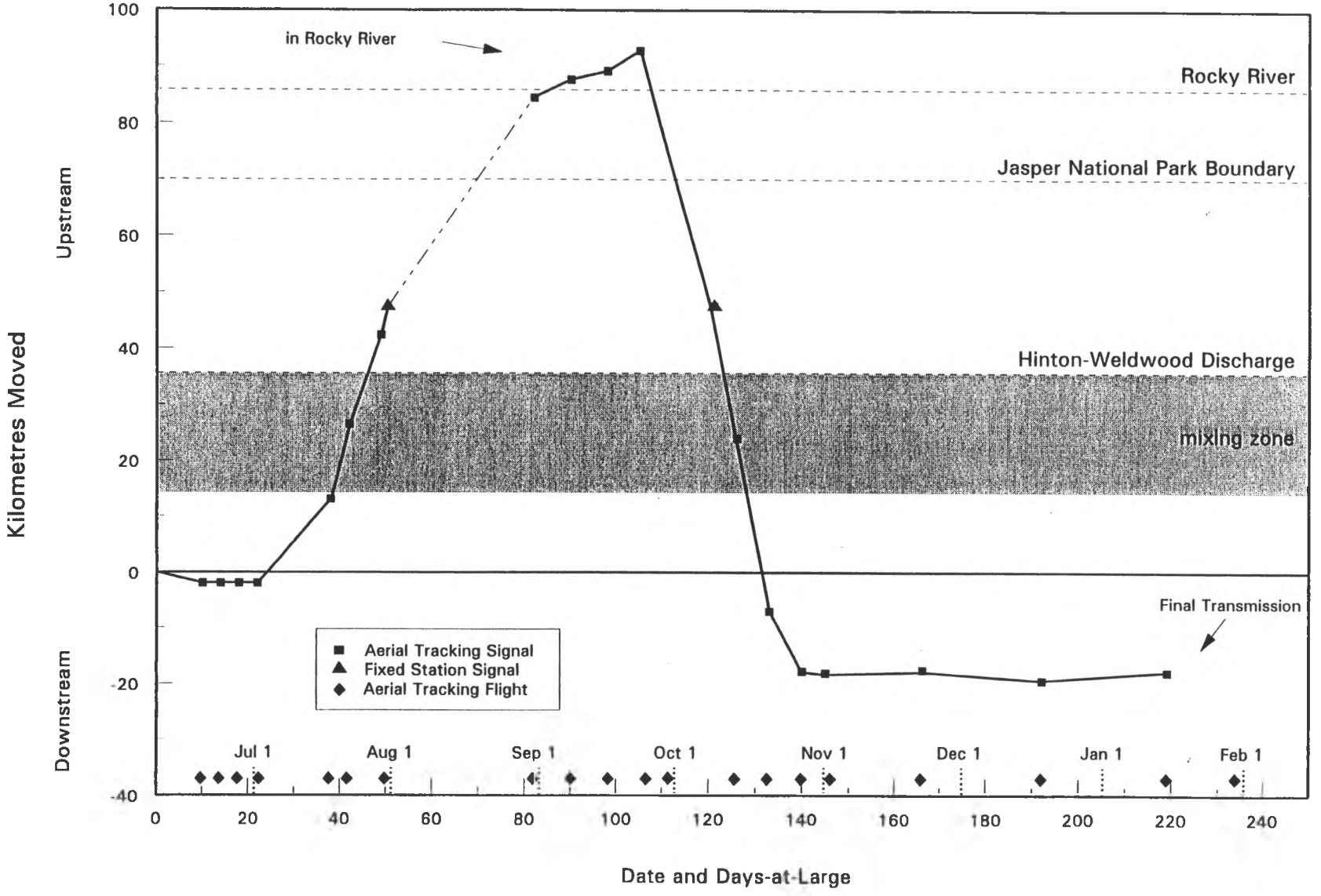


Figure 3.2. Movements of a bull trout (transmitter 20-31) in the Athabasca River from June 1992 to January 1993. Released on 10 June 1992 at location Km 1192 (Obed "Ford"). Tracking discontinued (---) from 30 July to 30 August 1992.

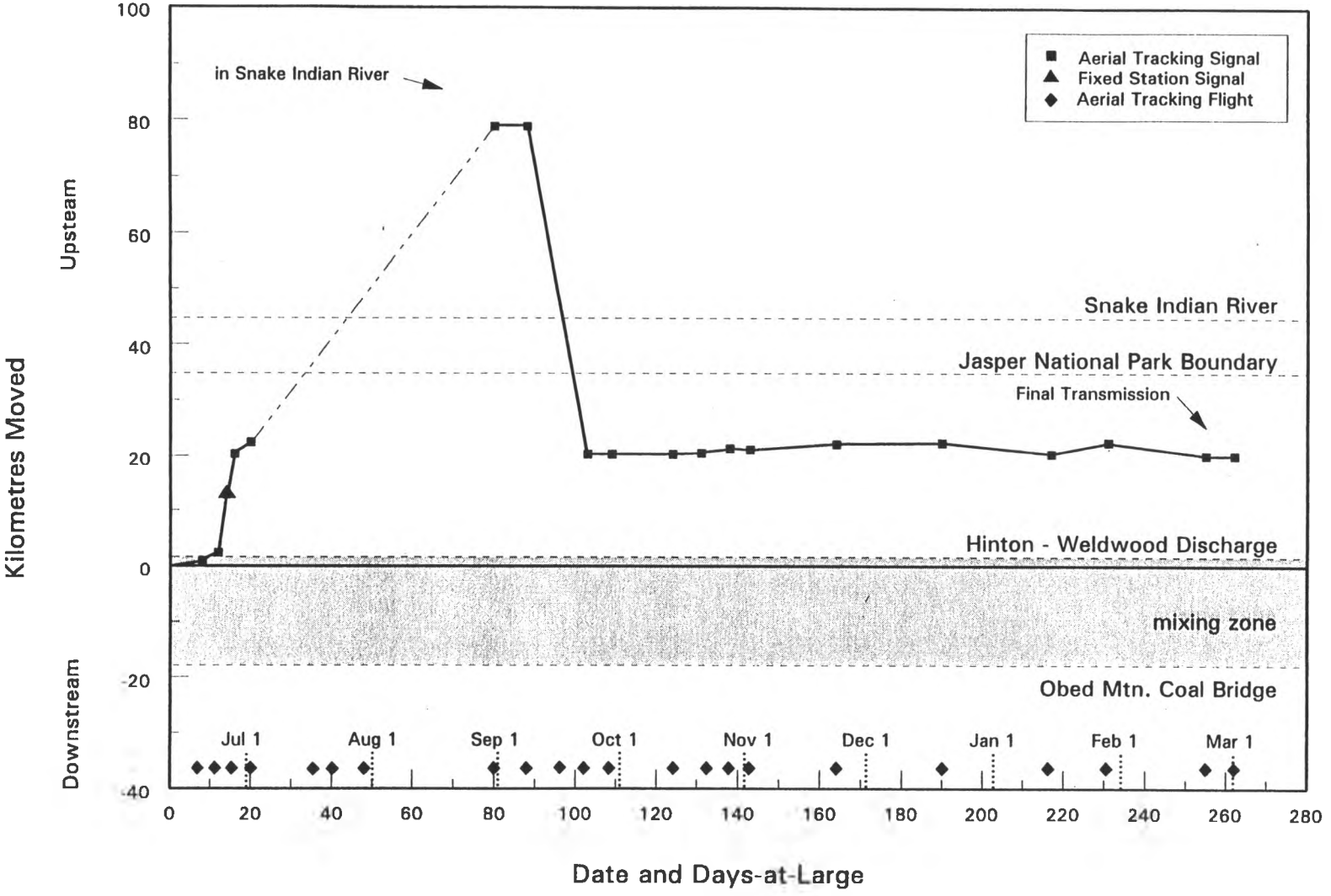


Figure 3.3. Movements of a bull trout (transmitter 19-20) in the Athabasca River from June 1992 to March 1993. Released on 12 June 1992 at location Km 1226.7 (Weldwood Bridge). Tracking discontinued(---) from 30 July to 30 August 1992.

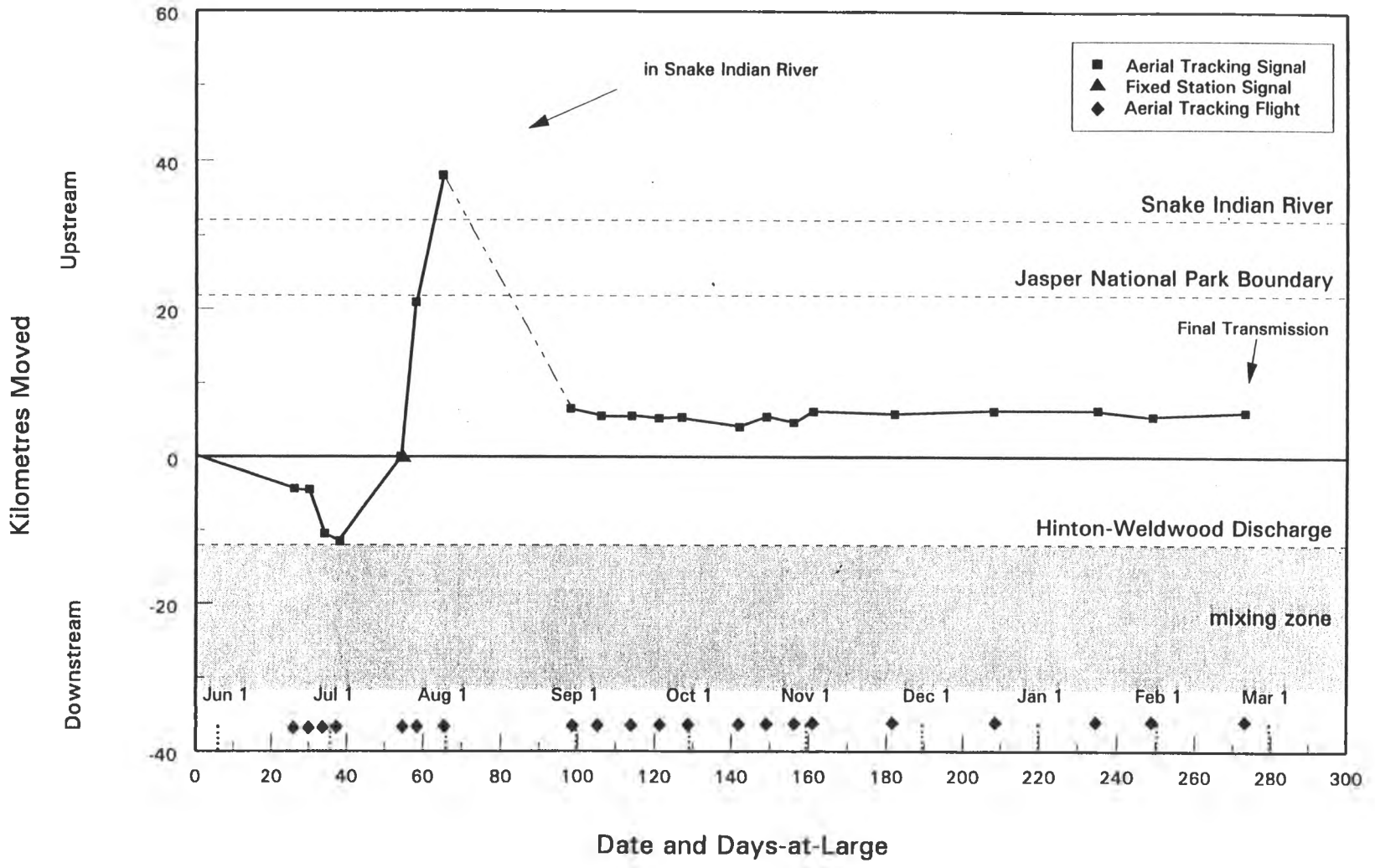


Figure 3.4. Movements of a bull trout (transmitter 4-8) in the Athabasca River from May 1992 to February 1993. Released on 25 May 1992 at location Km 1239.5 (fixed station). Tracking discontinued (---) from 30 July to 30 August 1992.

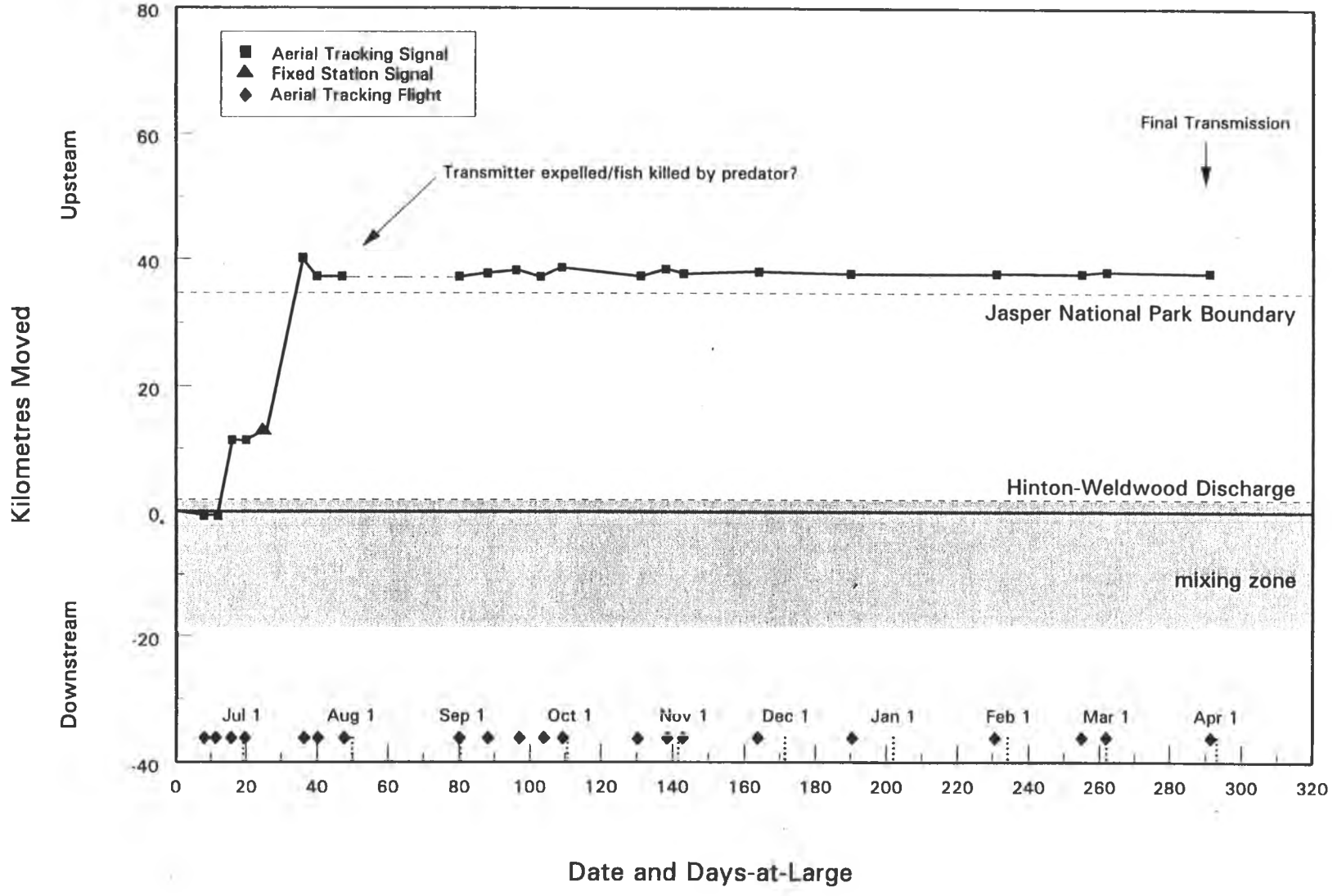


Figure 3.5. Movements of a bull trout (transmitter 20-44) in the Athabasca River from June 1992 to March 1993. Released on 12 June 1992 at location Km 1226.7 (Weldwood Bridge). Tracking discontinued (---) from 30 July to 30 August 1992.

Brule Lake. Signals from Tag 4-8 were consistently received in this area (i.e., Km 1246) until the start of March, when the transmitter ceased to function.

Bull trout 20-44 began its upstream movement in late June (Figure 3.5). From 24 June to 18 July 1992 it moved 41 km to an area approximately 3 km above Brule Lake, averaging an upstream movement of 1.7 km/day. Signals were consistently received from this transmitter at this location throughout the remainder of the study. It is suspected that the transmitter was lost (expelled) in this location, although the fish may also have been killed by a predator.

Bull trout 19-25 passed the fixed station on 3 July 1992 and it was located on 29 July at Km 20.5 in the Snake Indian River (Figure 3.6). This individual travelled upstream at a minimum rate of 2.0 km/day. Rapid upstream migration is often exhibited during the spawning period; movements of 7.1 km/day were recorded in the Peace River system (R.L. & L. Environmental Services Ltd. 1991). This fish apparently remained in the Snake Indian River from mid-July to mid-September. The 8 September reconnaissance indicated it was inhabiting the same area (i.e., Km 20.5) as on 29 July, but by 16 September it was undergoing post-spawning fallback and was located in the mainstem Athabasca River at Km 1266. The fish continued downstream for the remainder of September, and was located at Km 1220 on 29 September. It remained in this vicinity throughout the winter.

The movements of bull trout 20-10 were terminated with its capture by an angler at the mouth of the Fiddle River on 5 July 1992 (Figure 3.7). This individual had moved upstream at an average rate of 2.2 km/day.

It is suspected that bull trout spawning occurs in some Athabasca River tributaries located within Jasper National Park since movements into the Snake Indian River and Rocky River were documented during the spawning period. One bull trout (transmitter code 19-20) was located on two occasions approximately 3 km below the Snake Indian Falls (i.e., 33.5 km above confluence with Athabasca River). A second bull trout was located on three occasions approximately 16 km below Snake Indian Falls (i.e., 20.5 km above confluence with Athabasca River). A third bull trout was found on one occasion approximately 5 km above the confluence with the Athabasca River. The presence of these three fish in the Snake Indian River during the spawning period for bull trout (i.e., late summer), and the absence of any recorded additional movements by these fish up other tributaries, suggests that this tributary provides spawning habitat for this species.

One bull trout (i.e., transmitter code 20-31) moved into the Rocky River in early September. Since signals from this individual were recorded from this tributary on three separate occasions during the reported spawning period for bull trout, it seems likely that the Rocky River also contains spawning habitat. The suspected spawning area was between Km 3 and the Makwa River confluence (Km 7).

Other tributaries of the upper Athabasca River in Jasper National Park were surveyed on an opportunistic basis (Table 2.1). None of the radio tagged bull trout were detected in these areas, although suitable spawning habitat appeared to be present in some tributaries (i.e., Snaring River).

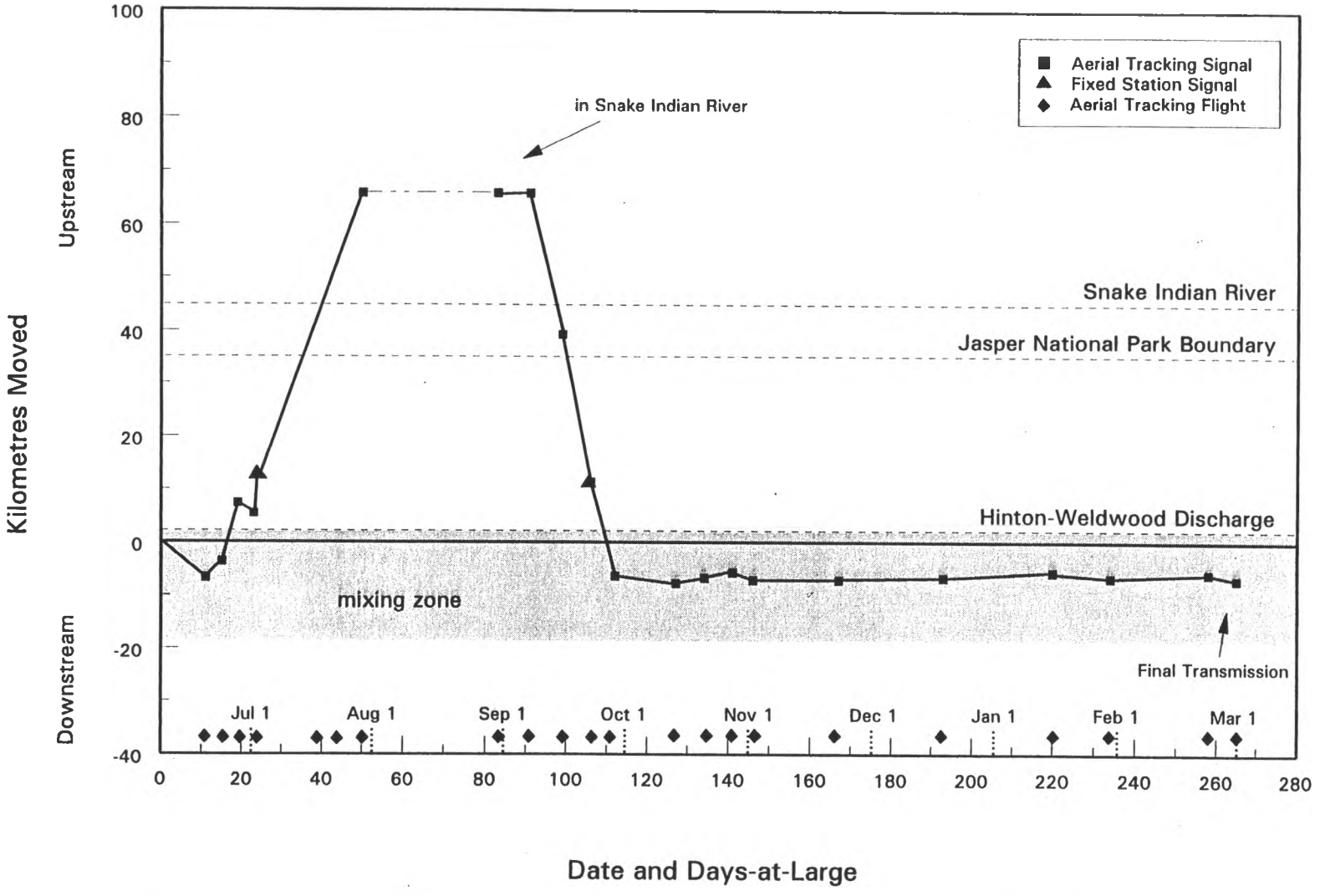


Figure 3.6. Movements of a bull trout (transmitter 19-25) in the Athabasca River from June 1992 to March 1993. Released on 9 June 1992 at location 1226.7 (Weldwood Bridge). Tracking discontinued (---) from 30 July to 30 August 1992.

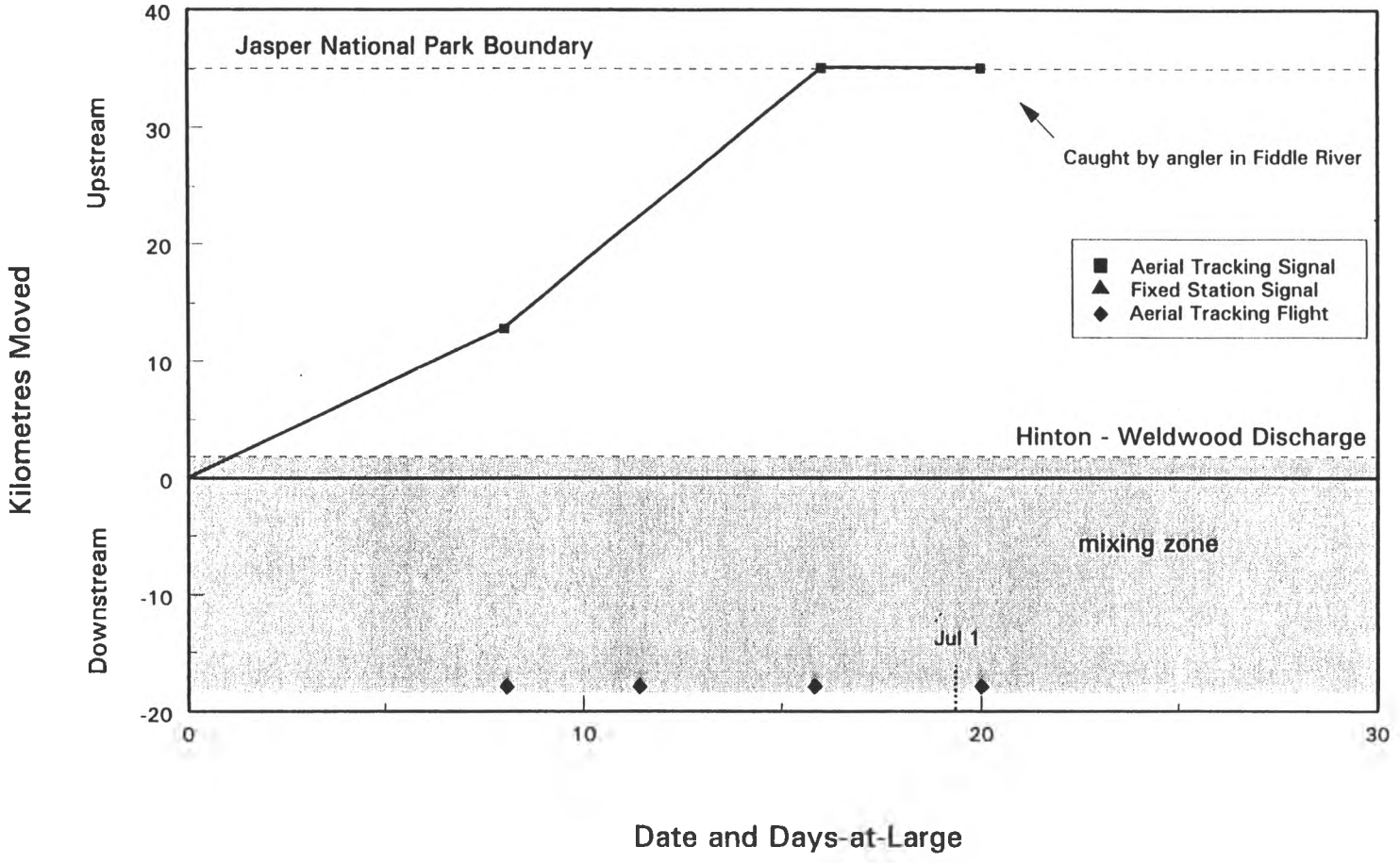


Figure 3.7. Movements of a bull trout (transmitter 20-10) in the Athabasca River from June 1992 to July 1992. Released on 12 June 1992 at location Km 1226.7 (Weldwood Bridge).

3.2.3 Overwintering

After post-spawning fallback, bull trout exhibited little movement in their mainstem habitats from late October through winter. Bull trout 20-31 reached its overwintering territory (Km 1174) near the end of October (Figure 3.2). This area was located approximately 1 km below Oldman Creek, approximately 10 km downstream of its initial capture location in early June. Signals from this fish were received on all aerial tracking flights from 23 November 1992 to 29 January 1993, with the fish maintaining a relatively static position during this period.

Bull trout 19-20 moved in mid-September to an area approximately 3 km below Brule Lake (i.e., Km 1247). Signals were received in this general vicinity (i.e., railway bridge to Brule Lake) from 23 September 1992 to 1 March 1993 (Figure 3.3).

Bull trout 4-8 returned to the area in which it was initially captured near the vicinity of the railway bridge, approximately 5 km below Brule Lake. This fish was monitored at this location until 1 March 1993 (Figure 3.4).

Upon release near the Weldwood Haul Road Bridge, bull trout 19-25 moved downstream approximately 7 km (i.e., Km 1220), and after completing spawning-related movements, returned to this vicinity where it was monitored until 1 March 1993 (Figure 3.6).

3.3 MOUNTAIN WHITEFISH

The movements of mountain whitefish are complex and have not been well described or understood in the Athabasca River drainage. Davies and Thompson (1976) documented the movements of mountain whitefish in the Sheep River watershed, a tributary of the Bow River. In the Sheep River, a downstream pre-spawning movement of adults peaked in late September, coinciding with an upstream movement of young-of-the-year and yearlings. The adults tended to concentrate in deep pools prior to commencing the downstream movement. Most of the adult mountain whitefish moved extensively, and the average distance moved was 27 km. Once spawning was completed, the mountain whitefish continued downstream, travelling considerable distances to suitable overwintering areas. Mountain whitefish in eastern slope streams usually spawn in October, prior to freeze-up.

3.3.1 Chronology and Extent of Movement

The movement patterns of radio telemetered mountain whitefish in the Athabasca River were difficult to interpret, particularly for those individuals which only moved in a downstream direction. Table 3.3 indicated that only eight of the original 17 transmitters (47%) were operating after approximately two months, and six of the eight mountain whitefish displayed upstream movements. At the end of the nine month period that the transmitters were expected to function, 18% of the fish were located. Only one mountain whitefish was located on the final study flight (i.e,. 30 March).

Of the three principal species monitored, mountain whitefish undertook the longest movements. A majority of the mountain whitefish tracked had moved upstream by the end of July. The greatest extent of upstream movement was 122 km for fish 20-24. This individual was released at Km 1192 (Obed "Ford") and located three times near the Jasper townsite (Km 1314). A maximum downstream movement of 103 km by fish 1-3 was recorded. This individual was last located at Whitecourt, near the confluence with the McLeod River, which was the downstream boundary of the study area.

3.3.2 Movement Patterns

Discussion of movements for mountain whitefish must be considered in light of published information that suggests this species often undertakes downstream spawning migrations (Davies and Thompson 1976). This is apparently preceded by protracted upstream feeding-related movements throughout the spring and summer. As such, it is difficult to interpret which movements were spawning-related as opposed to feeding-related or movement to overwintering areas for mountain whitefish in the Athabasca River.

Mountain whitefish 1-3 was initially located 10 km below its release point (Figure 3.8) and remained in that area until the end of August, when it undertook a relatively rapid downstream movement averaging 3.9 km/day. This may have indicated pre-spawning movement to spawning habitat. Last transmission for this fish was near Whitecourt, 102 km downstream. In spite of further searching of the mainstem downstream of this location, and in the lower McLeod River, this fish was not located in subsequent flights and it is suspected that the transmitter failed, or the fish was caught (i.e., predator or angler).

After transmitter implantation, mountain whitefish 4-2 moved downstream into the general vicinity of the Hinton/Weldwood effluent discharge point (Figure 3.9). It began an upstream movement (indication of feeding behaviour) in early July and by the end of July, was located over 50 km upstream at the Highway 16 bridge crossing of the upper Athabasca River (Km 1294) in Jasper National Park. The mean rate of ascent was 2.3 km/day. During August, the fish commenced downstream movement, passing the fixed station on 26 August, and on the 8 September flight was located at Km 1220, below Hinton. Signals from this transmitter were not received after this date. Reasons for the sudden downstream movement are unclear, although it may have been an early pre-spawning migration similar to that exhibited by fish 1-3.

Signals were received from fish 4-3 until 2 July (Figure 3.10), after which the transmitter apparently failed. This fish had moved approximately 10 km downstream from its release point.

Mountain whitefish 4-4 remained within a range of 10 km below Hinton throughout the period it was tracked (Figure 3.11). Signals from the transmitter ceased after 21 October.

Only four signals were received from transmitter 4-5 prior to apparent failure in early July (Figure 3.12). All of the signals were acquired within 5 km of the release point.

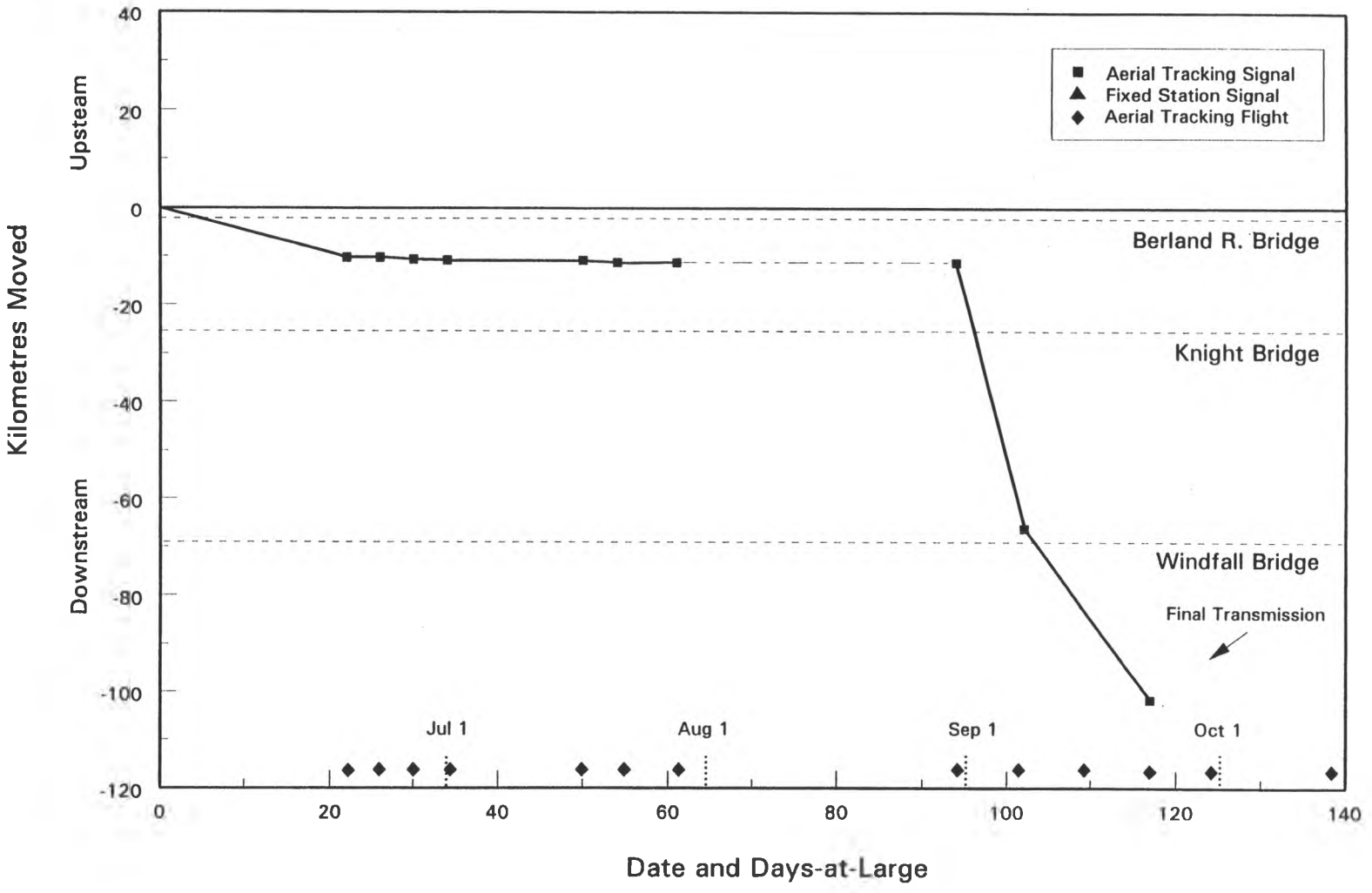


Figure 3.8. Movements of a mountain whitefish (transmitter 1-3) in the Athabasca River from May 1992 to September 1992. Released 29 May 1992 at location Km 1129.3 (Berland River). Tracking discontinued (---) from 30 July to 30 August 1992.

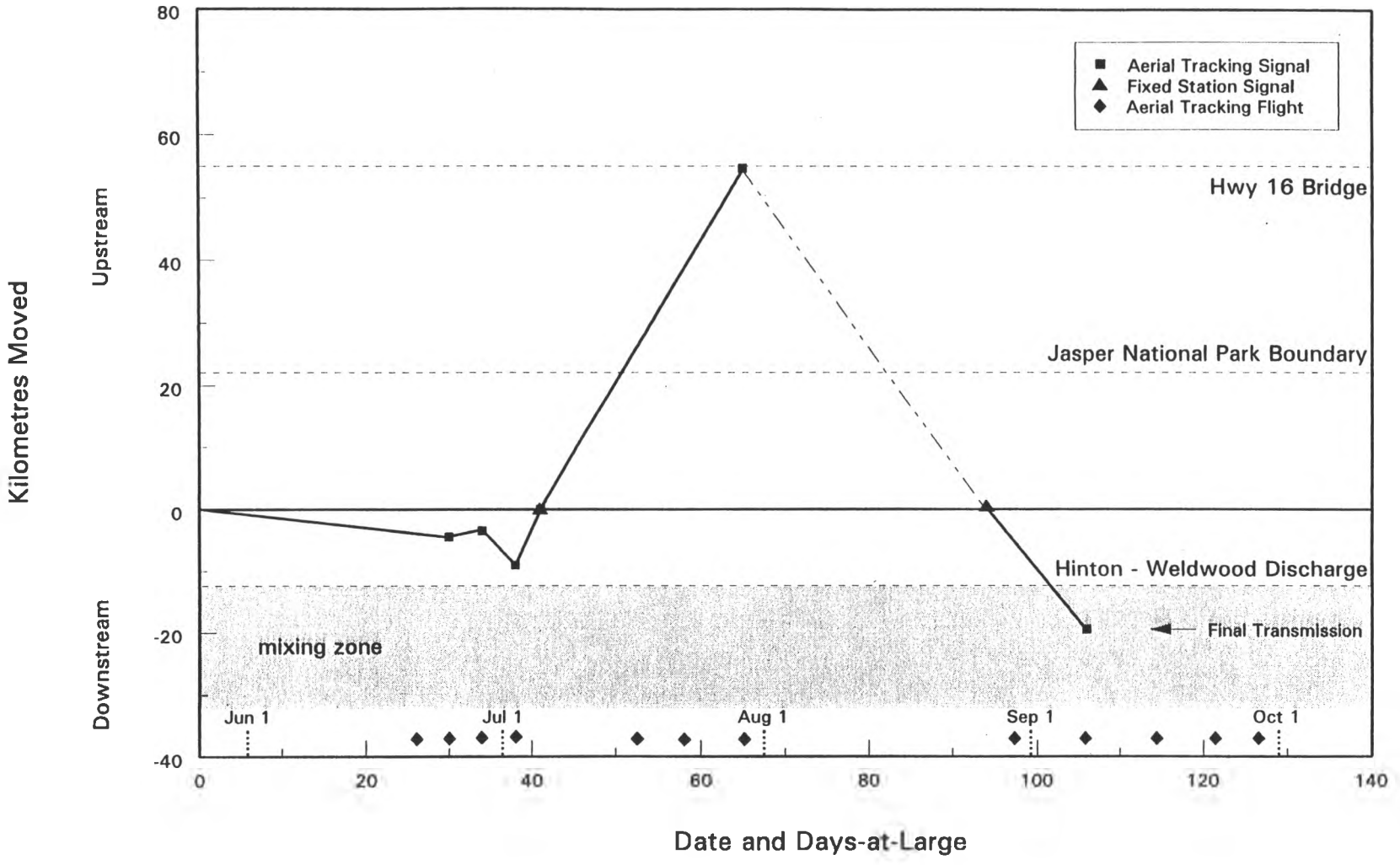


Figure 3.9. Movements of a mountain whitefish (transmitter 4-2) in the Athabasca River from May 1992 to September 1992. Released 25 May 1992 at location Km 1239.5 (fixed station). Tracking discontinued (---) from 30 July to 30 August1992.

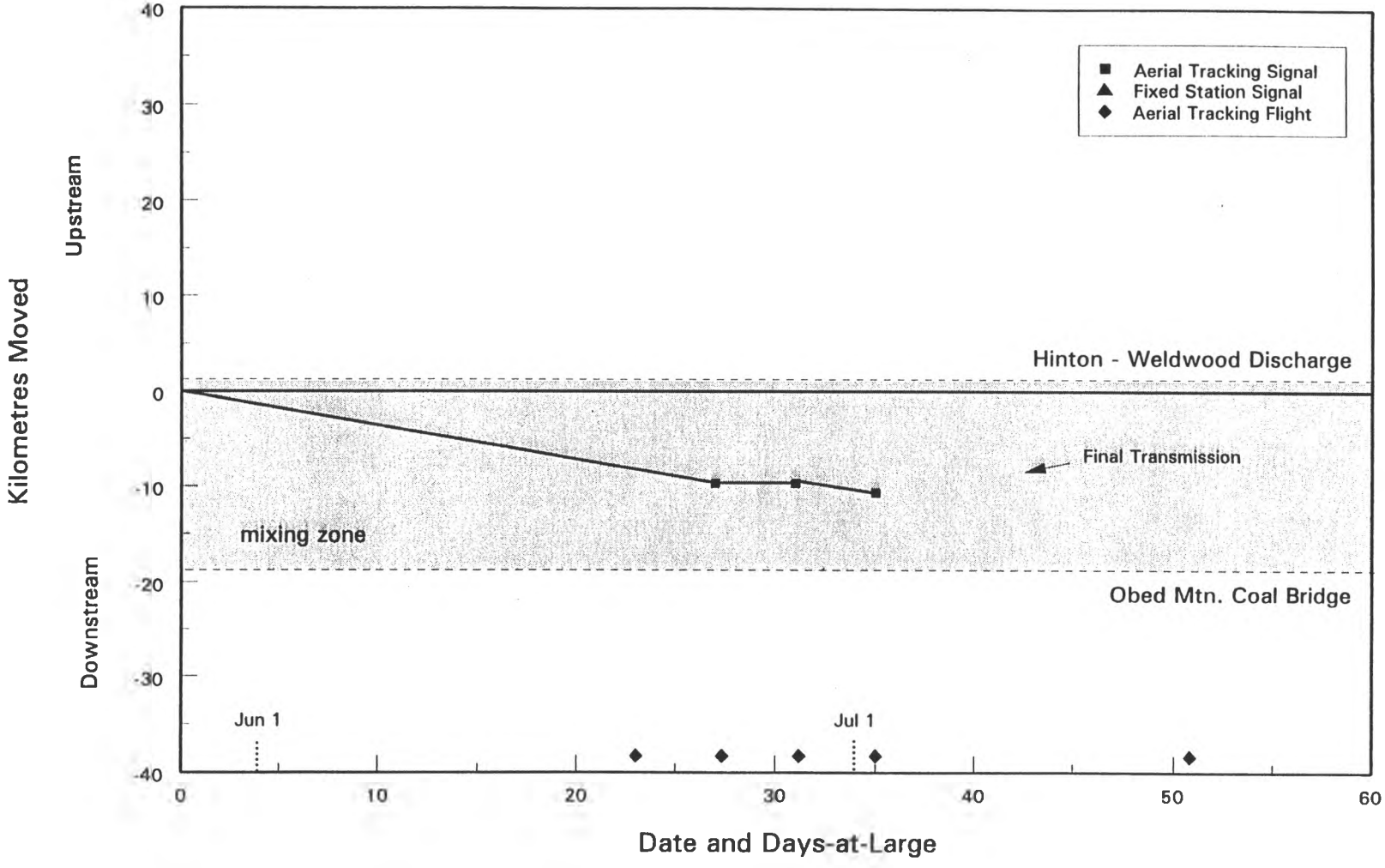


Figure 3.10. Movements of a mountain whitefish (transmitter 4-3) in the Athabasca River from May 1992 to July 1992. Released 28 May 1992 at location Km 1226.7 (Weldwood Bridge). Tracking discontinued (---) from 30 July to 30 August 1992.

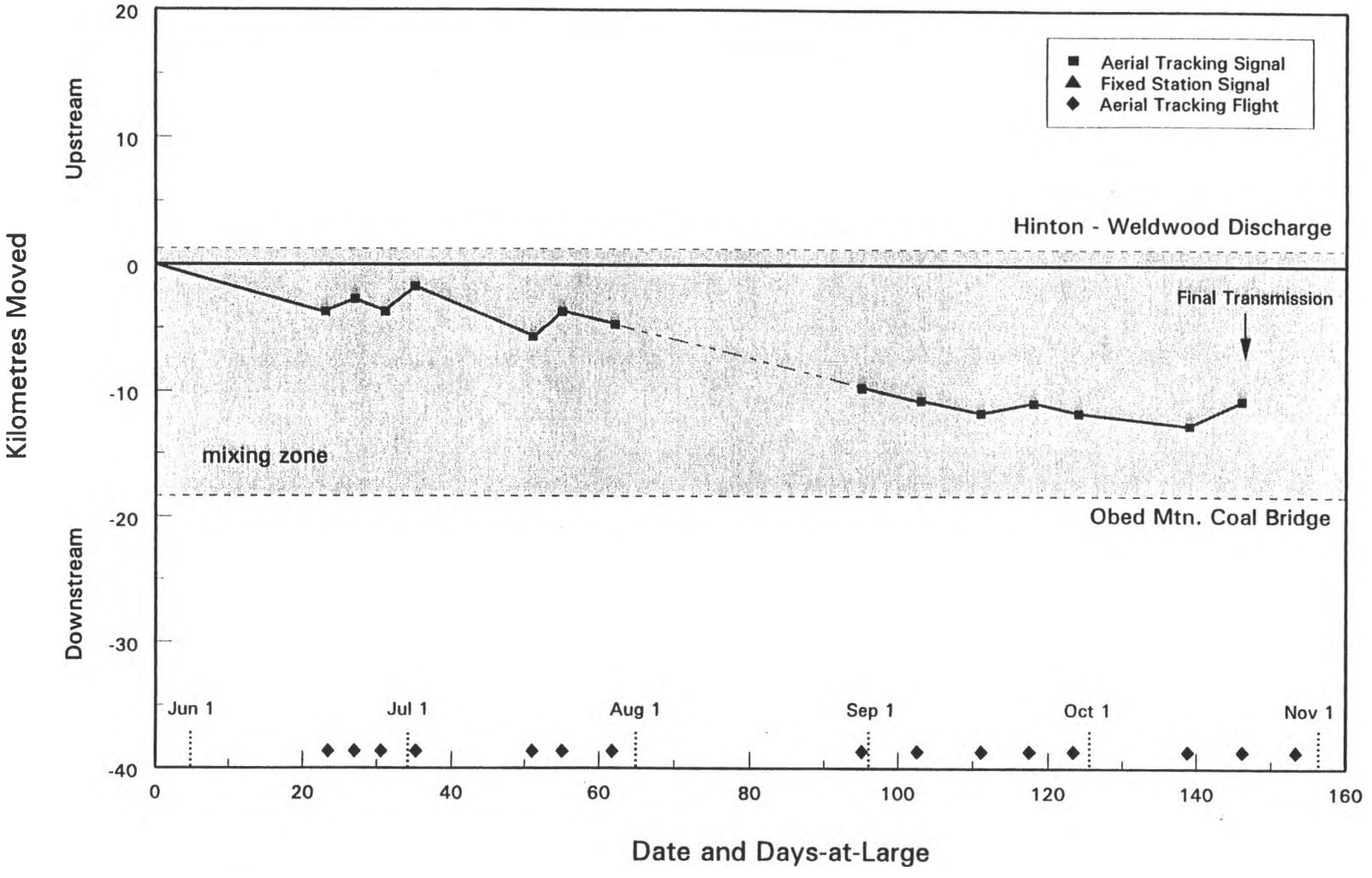


Figure 3.11. Movements of a mountain whitefish (transmitter 4-4) in the Athabasca River from May 1992 to October 1992. Released 28 May 1992 at Km 1226.7 (Weldwood Bridge). Tracking discontinued (---) from 30 July to 30 August 1992.

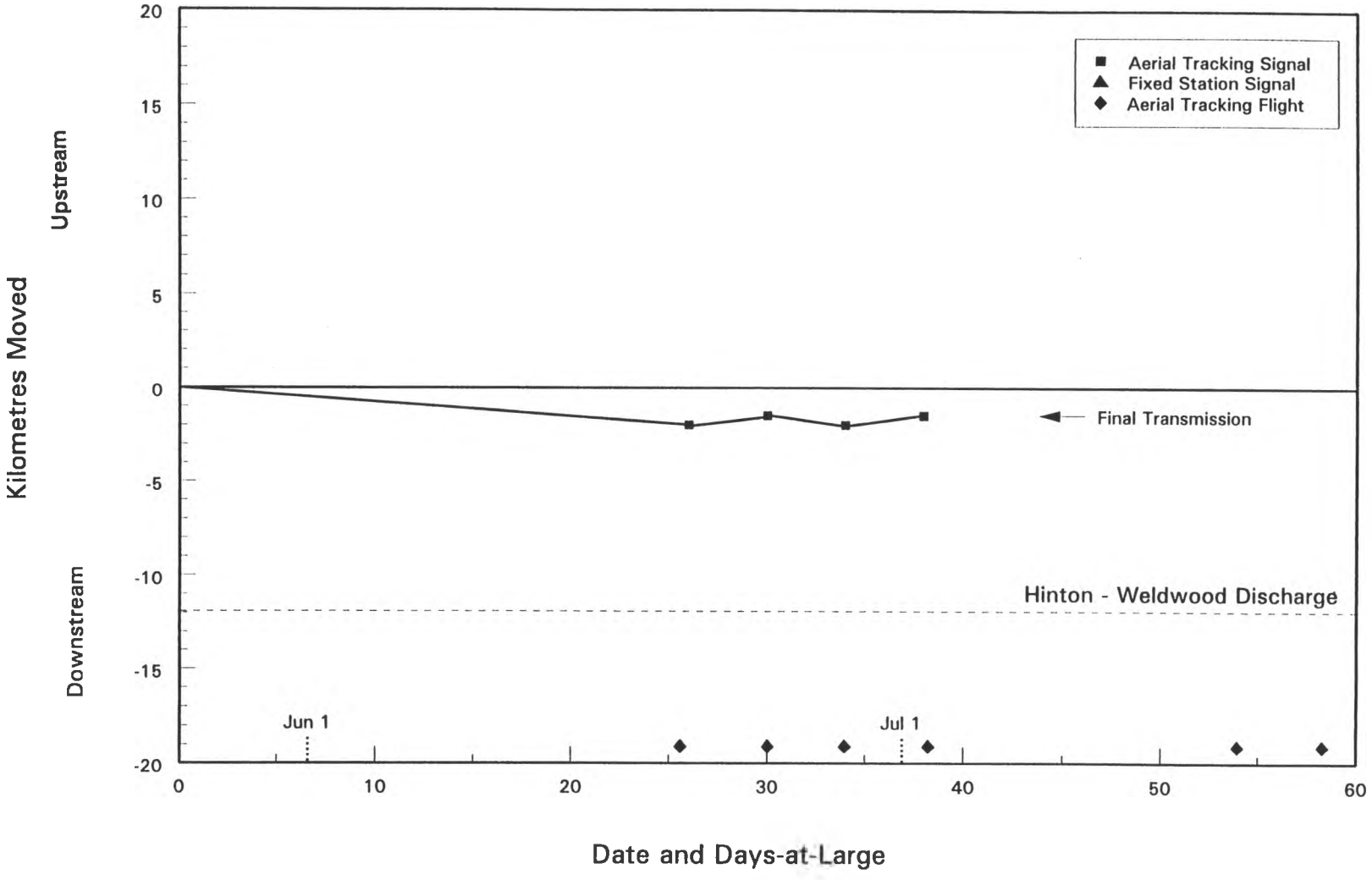


Figure 3.12. Movements of a mountain whitefish (transmitter 4-5) in the Athabasca River from May 1992 to July 1992. Released 25 May 1992 at location Km 1239.5 (fixed station). Tracking discontinued (---) from 30 July to 30 August 1992.

The movements of mountain whitefish 19-23 are illustrated in Figure 3.13. From 20 June to 29 July, this fish moved downstream followed by slow, protracted, upstream movements commencing in August. Rapid upstream movement began in October, with a mean rate of movement over 67 km of 2.2 km/day. The final signal acquired for this individual was at the fixed station on 15 November, when it was apparently migrating back downstream.

Mountain whitefish 19-27 was monitored from 20 June 1992 to 1 March 1993 (Figure 3.14). This fish was located at the release point on 2 July but subsequently moved upstream (mean rate of 2.0 km/day) to Km 1224 by 18 July. After 18 July, the fish apparently resided in the mixing zone for the remainder of the study, exhibiting only small changes in location.

The signals received from fish 19-33 were all located within 5 km of the release point for this individual (Figure 3.15), indicating only localized movements throughout the period of tracking. Some movement activity was monitored in late October, followed by gradual downstream fallback.

Only four data points were acquired from fish 20-11 prior to transmitter failure (Figure 3.16), less than 45 days after implantation. All locations were within 10 km of the release point.

Mountain whitefish 20-12 moved over 80 km upstream in early July from the Obed "Ford" site (Km 1192) to a side channel of the Rocky River in Jasper National Park (Figure 3.17). This fish passed the fixed station on 13 July, covering the remaining 34.5 km distance to the side channel in 5 days (mean rate of 6.9 km/day). This side channel of the Rocky River departed from the mainstem approximately 3 km above the confluence with the Athabasca River, and did not have visible surface flow from the Rocky River from July to October. The presence of the fish in the side channel was confirmed by ground tracking. This individual remained in the side channel until early September, at which time it returned to the Athabasca River and then moved upriver approximately 2 km to the main outflow of the Rocky River. The fish was located in the Rocky River on the 29 September flight, after which it moved rapidly downstream. This behaviour probably indicated that the fish spawned in the Rocky River, followed by post-spawning fallback. On 17 October the fish passed the fixed station and reached the Emerson Lakes Road Bridge area (Km 1180; 12 km below its release location) by mid-November, where it overwintered for the remainder of the study.

Fish 20-24 remained at the release site until late July before initiating a slow upstream migration (Figure 3.18). Distinct upstream movements commenced in early September, and continued until mid-October. The rate of upstream migration between 31 August and 16 September averaged 3.6 km/day. In total, this mountain whitefish moved upstream 122 km, to the vicinity of the Jasper townsite, where it was located on three tracking flights. Signals from the transmitter ceased on 2 November, presumably before the fish began any downstream movements. The transmitter apparently failed or may have been damaged (i.e., broken antennae wire) during spawning.

Signals from mountain whitefish 20-43 were received only until 29 July (Figure 3.19). During this period, movements were localized and within 5 km of the release site.

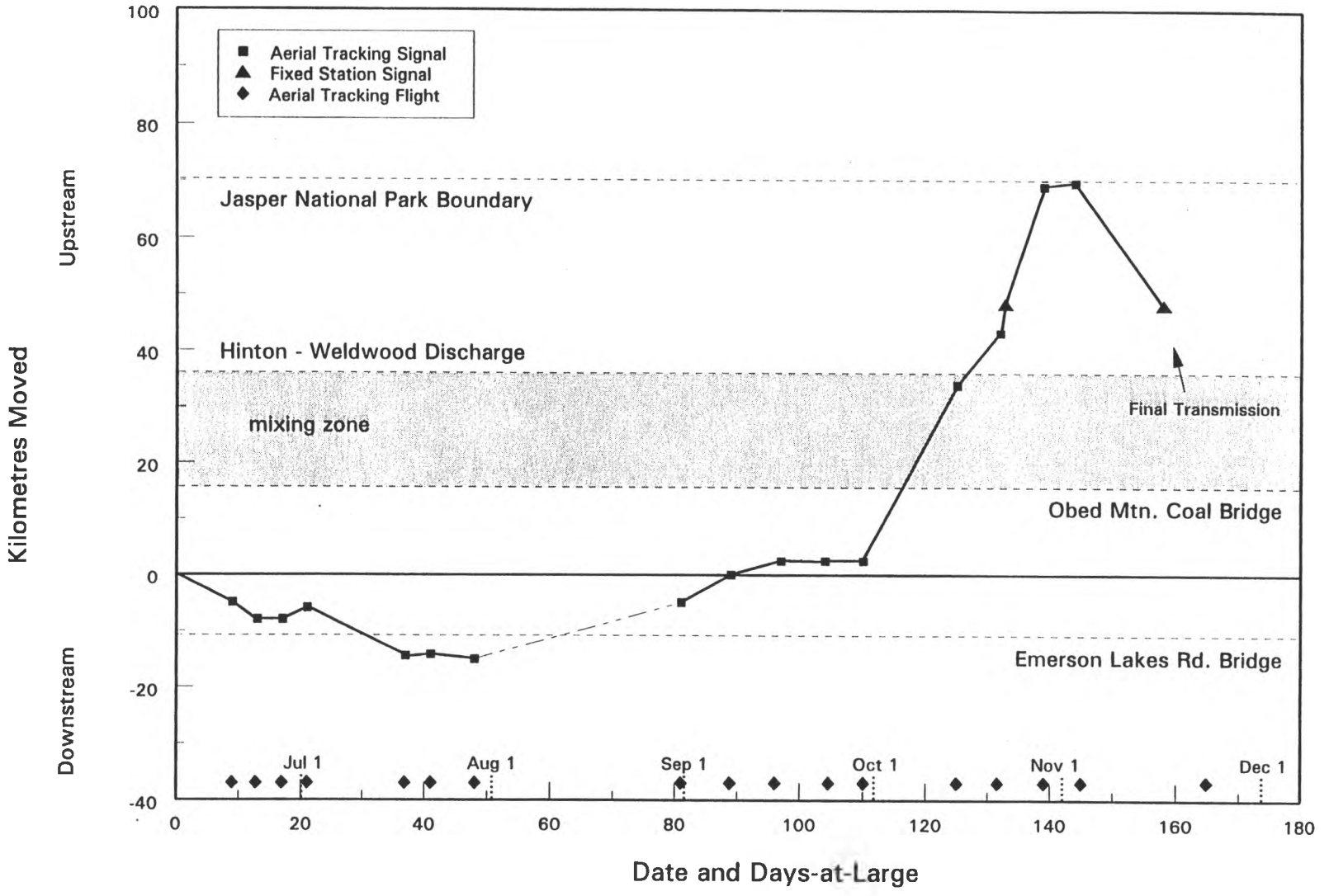
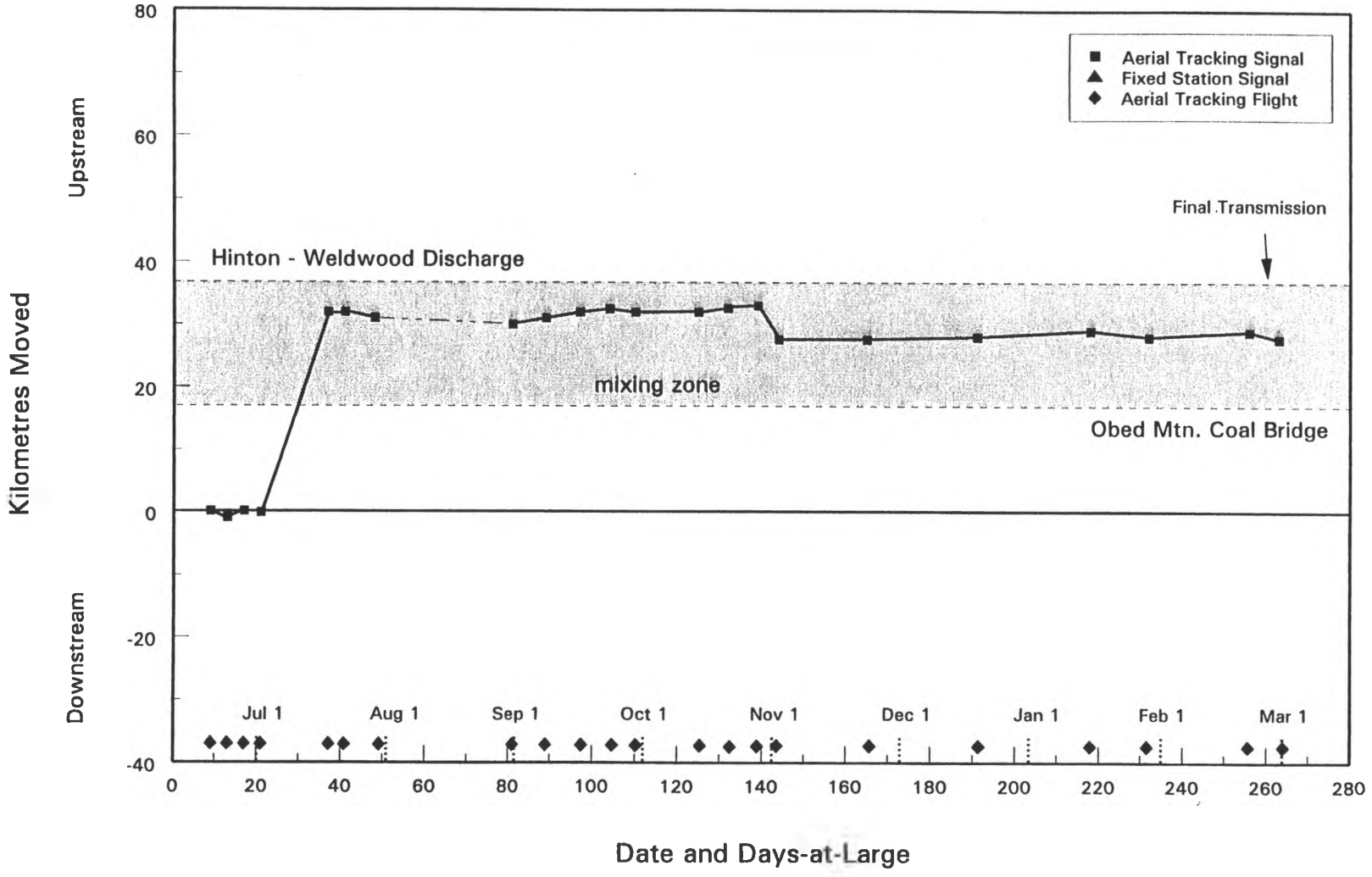


Figure 3.13. Movements of a mountain whitefish (transmitter 19-23) in the Athabasca River from June 1992 to November 1992. Released 11 June 1992 at location Km 1192.0 (Obed "Ford"). Tracking discontinued (---) from 30 July to 30 August 1992.



Figrue 3.14. Movements of a mountain whitefish (transmitter 19-27) in the Athabasca River from June 1992 to March 1993. Released 11 June 1992 at location Km 1192.0 (Obed "Ford"). Tracking discontinued (---) from 30 July to 30 August 1992.

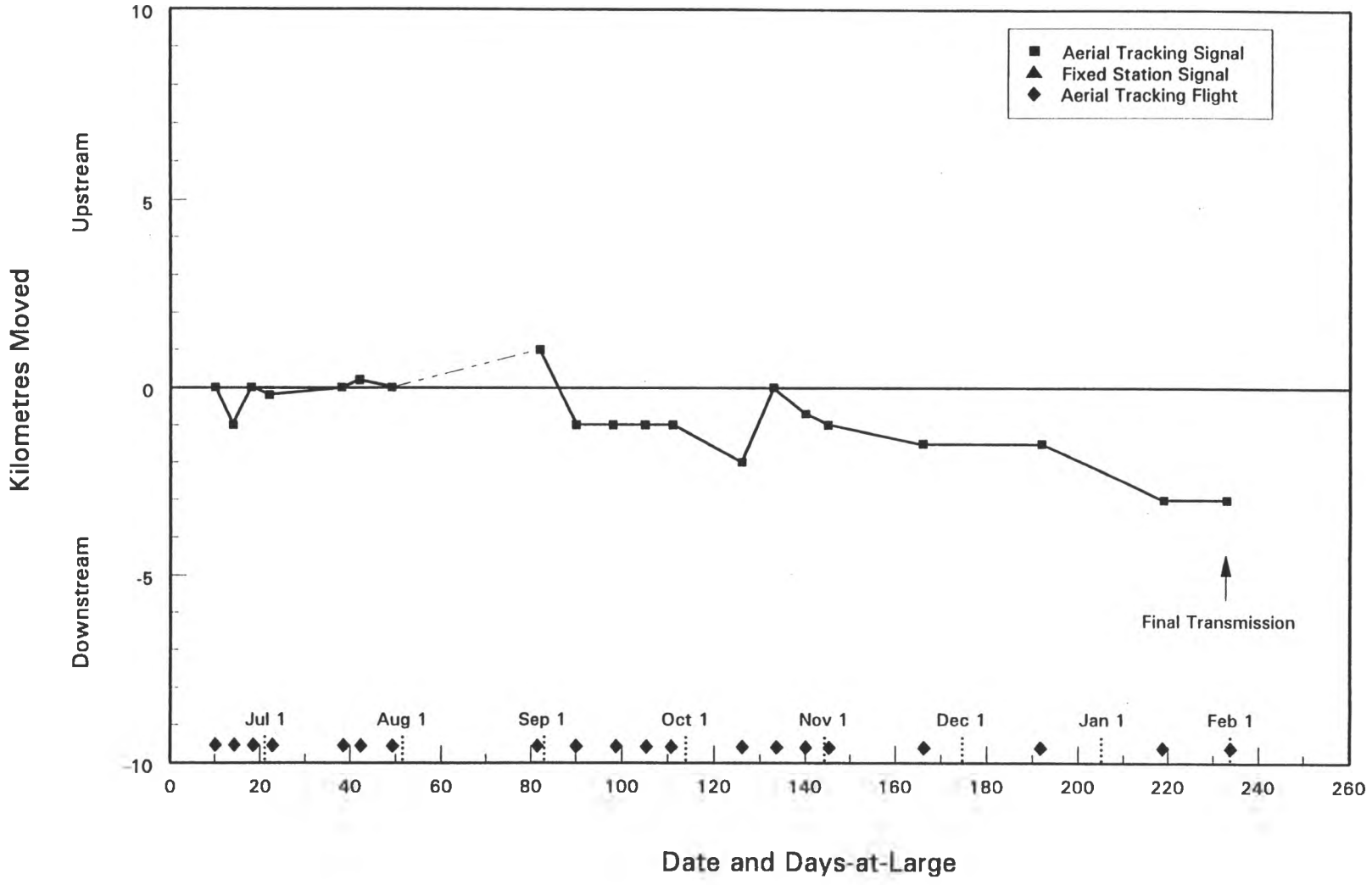


Figure 3.15. Movements of a mountain whitefish (transmitter 19-33) in the Athabasca River from June 1992 to January 1993. Released 10 June 1992 at location Km 1192.0 (Obed "Ford"). Tracking discontinued (---) from 30 July to 30 August 1992.

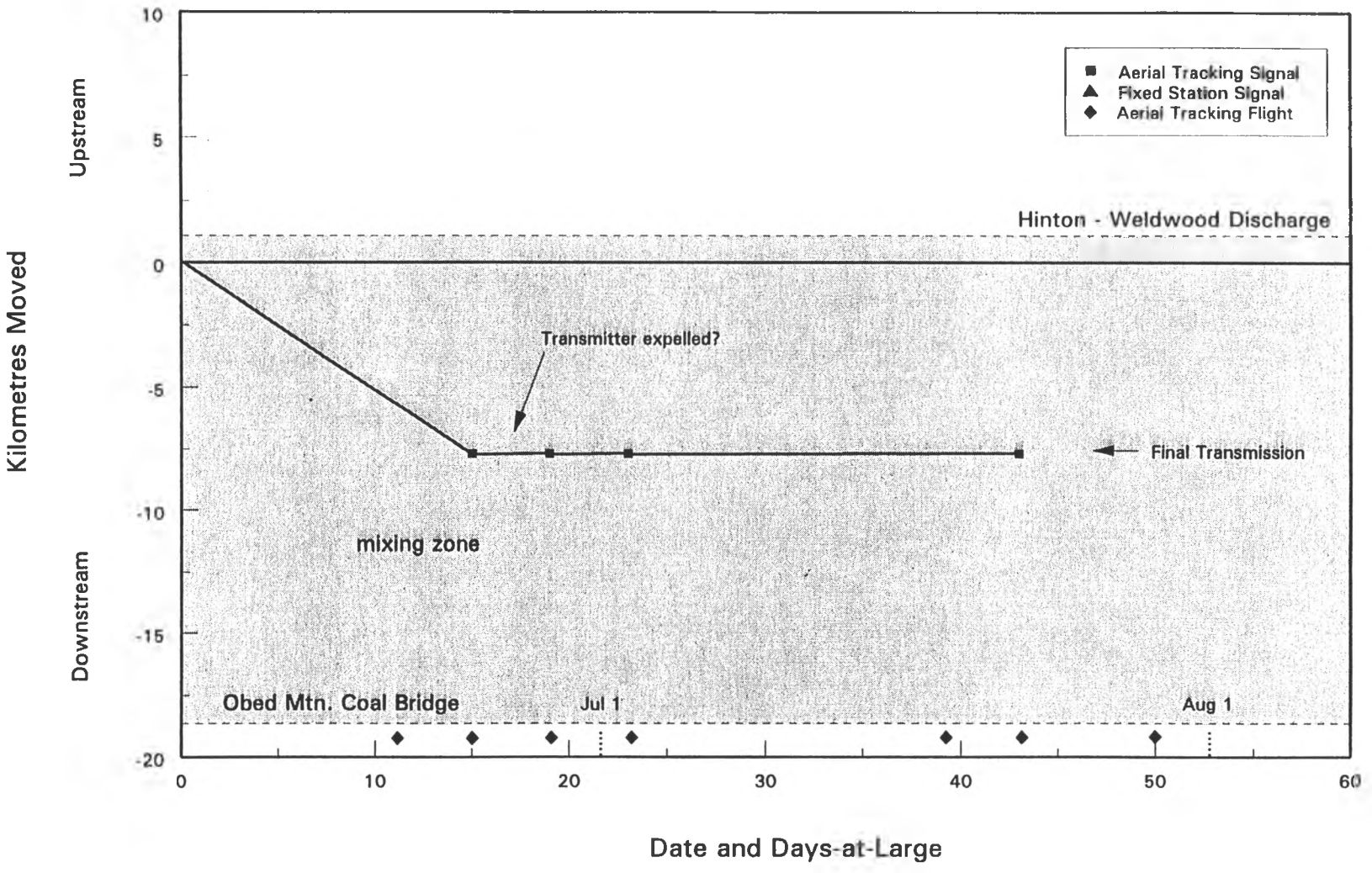


Figure 3.16. Movements of a mountain whitefish (transmitter 20-11) in the Athabasca River from June 1992 to July 1992. Released 9 June 1992 at location Km 1226.7 (Weldwood Bridge). Tracking discontinued (---) from 30 July to 30 August 1992.

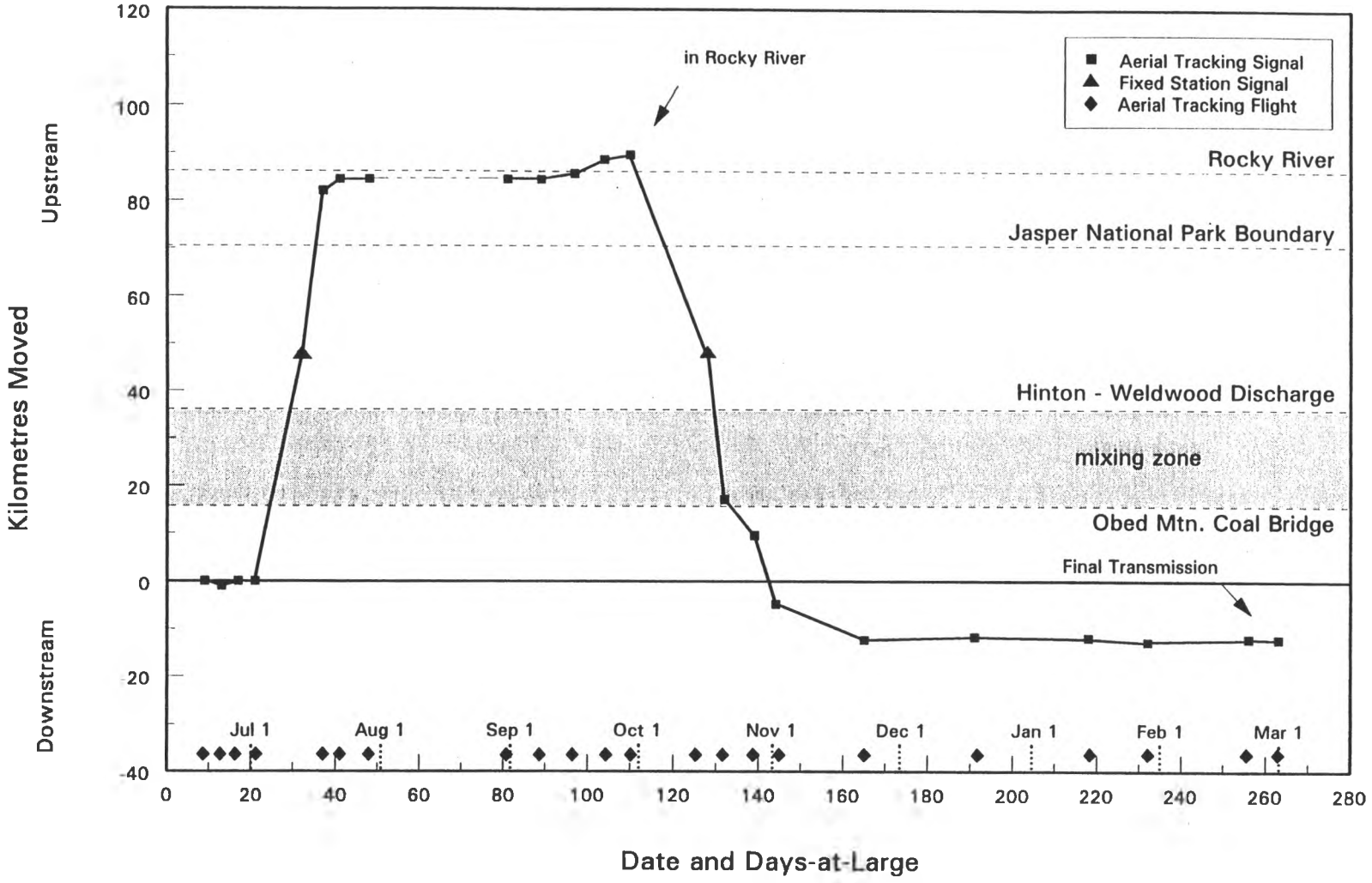


Figure 3.17. Movements of a mountain whitefish (transmitter 20-12) in the Athabasca River from June 1992 March 1993. Released 11 June 1992 at location Km 1192.0 (Obed "Ford"). Tracking discontinued (---) from 30 July to 30 August 1992.

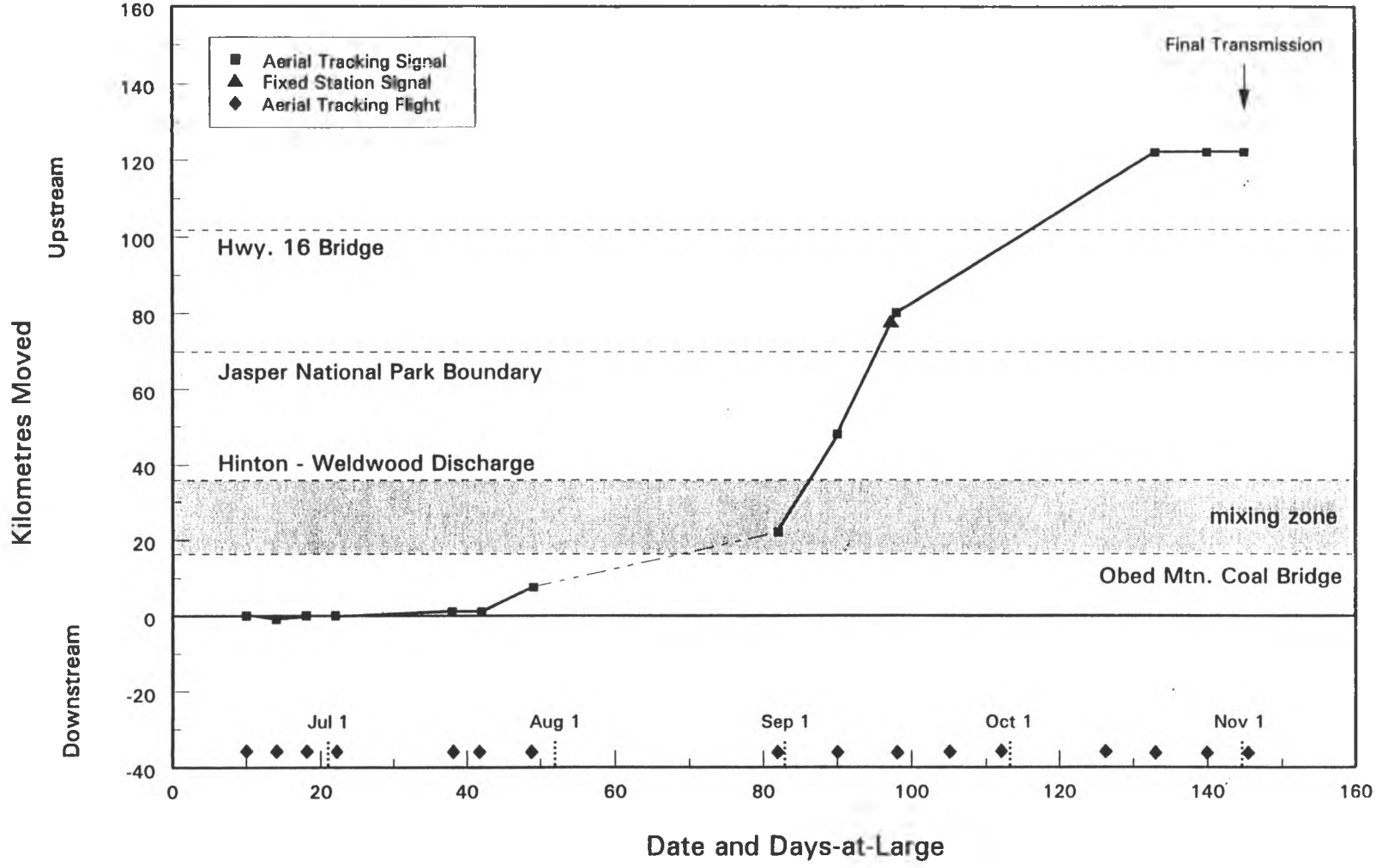


Figure 3.18. Movements of a mountain whitefish (transmiter 20-24) in the Athabasca River from June 1992 to November 1992. Released 10 June 1992 at location Km 1192.0 (Obed "Ford"). Tracking discontinued (---) from 30 July to 30 August 1992.

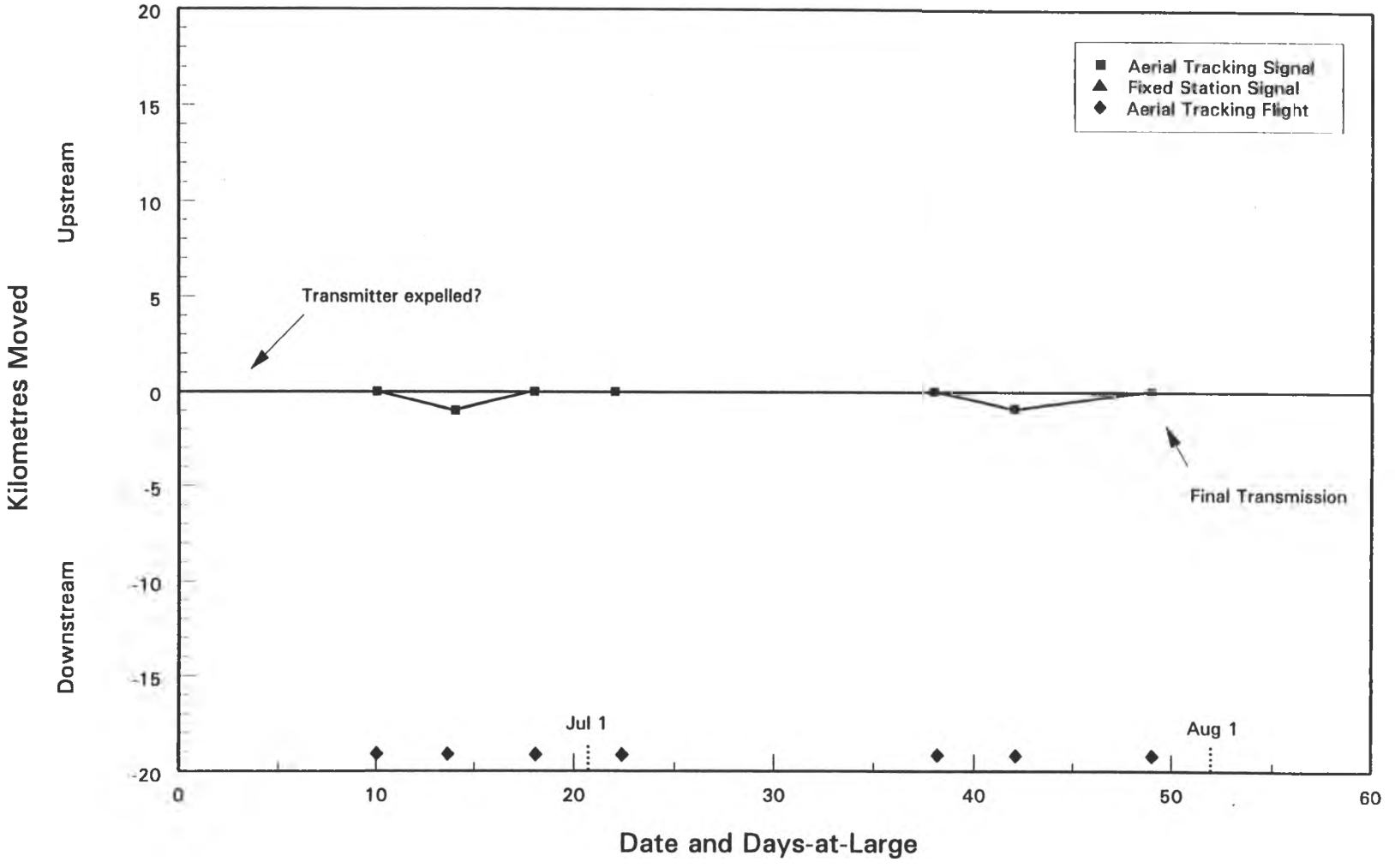


Figure 3.19. Movements of a mountain whitefish (transmitter 20-43) in the Athabasca River from June 1992 to July 1992. Released 10 June 1992 at location Km 1192.0 (Obed "Ford"). Tracking discontinued (---) from 30 July to 30 August 1992.

Spawning Areas

The behaviour and movement patterns of mountain whitefish suggest spawning occurs in a number of locations in the mainstem Athabasca River and in at least one of the tributaries in Jasper National Park (i.e., Rocky River). The lower Snaring River is also a known spawning area (R.L. & L, pers. observations), although none of the radio telemetered fish were found there. One criterion used for identifying suspected spawning areas was a rapid downstream movement during September and/or October, which conforms with post-spawning fallback reported by Davies and Thompson (1976) for Sheep River mountain whitefish.

Mountain whitefish 19-23 moved upstream throughout late summer and fall to an area immediately upstream of Brule Lake; rapid downstream movement from this area commenced in early November. This behaviour suggests the fish may have spawned in the vicinity of the Jasper Park boundary, followed by post-spawning fallback in early November. Another suspected spawning location was in the vicinity of the Jasper townsite, since a mountain whitefish (i.e., transmitter code 20-24) was recorded there on three flights in late October/early November. Fish 20-12 presumably spawned in the Rocky River; it began a rapid downstream fallback from this tributary in early October. The cooler water temperatures of tributary streams in comparison with the mainstem are thought to be responsible for spawning occurring relatively early (i.e., late September versus late October).

Mountain whitefish 1-3 moved downstream from the Berland River bridge area to Whitecourt during September. Signals ceased from this transmitter after 23 September, and it is possible that this individual continued moving downstream to a spawning site outside the study area or entered the McLeod River and moved to locations farther upstream in this tributary.

The remainder of the mountain whitefish tracked during the fall did not exhibit distinct movement patterns; however, what appeared to be suitable spawning habitat for this species was observed in the mainstem throughout the study area. Movement activity in late October suggested that mountain whitefish 19-33 may have spawned in the vicinity of Km 1192 (Obed "Ford").

3.4 BURBOT

Movements of burbot in the upper Athabasca River are previously undescribed. Radio telemetry was used to determine the movements of this species in the Slave River, N.W.T. (R.L. & L./EMA 1985). The results indicated that burbot moved only short distances from their home range during the open-water season, and that individuals do not always undertake distinct feeding or spawning related movements in all years. The maximum distance travelled by a burbot in the Slave River was 280 km, and six of the fish (N=14) undertook movements of 40 km or more. Other tagged individuals, however, remained near the release site.

3.4.1 Movement Patterns

Signals from two of the five radio telemetered burbot in the Athabasca River were received throughout the duration of the study, while a third burbot was monitored only until 29 July 1992 (Figures 3.20 to 3.22). Most summer and fall movements were localized, with one of the burbot not moving more than 3 km between mid-June 1992 and late January 1993. These movement patterns indicate a relatively small summer/fall feeding territory. Under-ice movements from December to February were likely related to pre-spawning staging or spawning activity.

From time of release in late May to late July, burbot 1-2 (Figure 3.20) remained near the release point and was often within the range of the fixed station. A protracted upstream movement was recorded for this fish from mid-July to mid-November. It was resident in Brule Lake from late September to mid-December and on 19 December it was located near the mouth of Brule Lake. This fish passed the fixed station on 1 January moving downstream, and was located in the canyon area at the Highway 40 bridge on 15 January. It then moved quickly upstream, passing the fixed station on 20 January, and on 22 February was located in a deep pool above Brule Lake, 31 km upriver. By the end of March, it was again resident in Brule Lake.

Burbot 1-7 moved downstream approximately 2 km from its release point at Old Entrance to the deep pools of the canyon below the Highway 40 bridge. It remained within a kilometre of this area until late January when it began an upstream movement (Figure 3.21), passing the fixed station on 5 February. During the 1 March flight it was located at Km 1243, near the railway bridge over the Athabasca River; by the end of March, it was 1 km downstream of this point (i.e., Km 1242).

Burbot 3-24 was located within 6 km of the release site when tracked in June and July (Figure 3.22). The transmitter apparently failed between the 29 July and 31 August surveys, as the signal was never found upon re-initiation of the survey.

Spawning Areas

Both telemetered burbot (i.e., transmitter codes 1-2 and 1-7) migrated upstream under-ice between mid-January and mid-February. The larger of the two individuals moved to an area approximately 2 km upstream of Old Entrance, whereas the other burbot moved upstream of Brule Lake. These movements are suspected to have been associated with spawning, which is known to occur around this time period in other areas.

3.5 OTHER SPECIES

Lake Whitefish

From mid-June to early September the lake whitefish (transmitter code 5-15) exhibited only localized movements (Figure 3.23). Rapid upstream migration in mid-September is suspected to have been spawning related. On 8 September this fish was located at Km 1220, and by 29 September was at Km 1260, 40 km farther upstream. From the start of October to the end

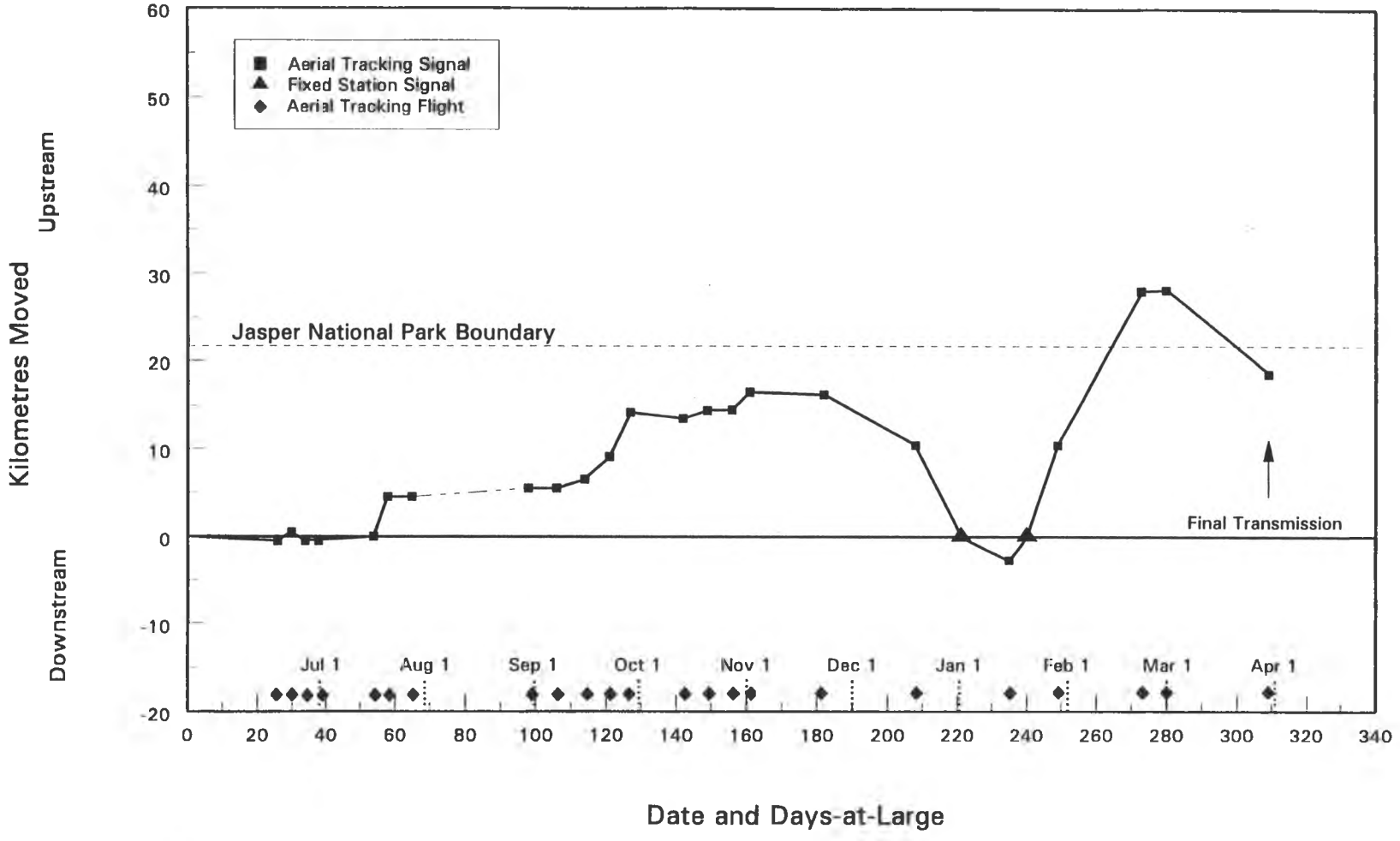


Figure 3.20 Movements of a burbot (transmitter 1-2) in the Athabasca River from May 1992 to March 1993. Released on 25 May 1992 at location Km 1239.5 (fixed station). Tracking discontinued (---) from 30 July to 30 August 1992.

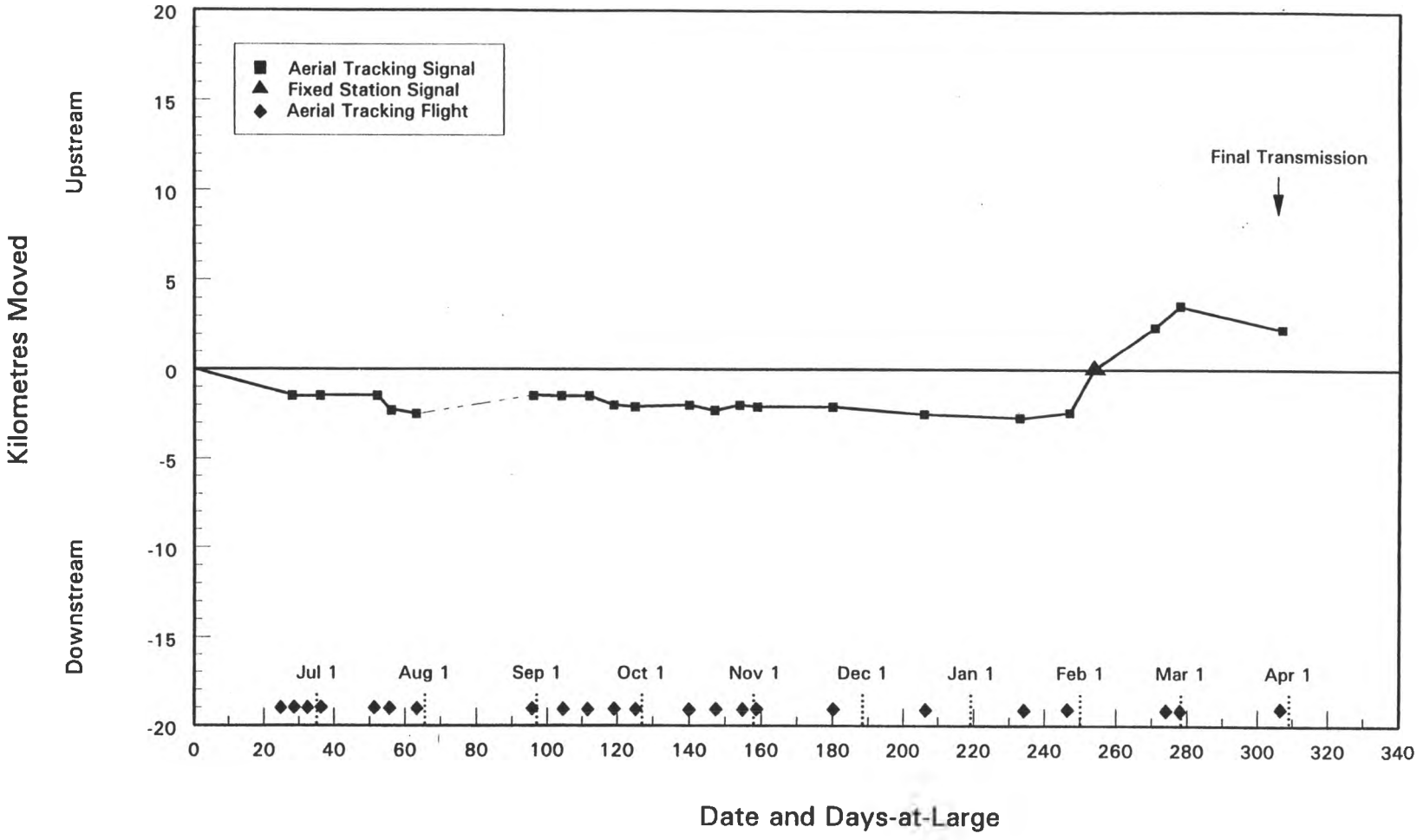


Figure 3.21. Movements of a burbot (transmitter 1-7) in the Athabasca River from May 1992 to March 1993. Released on 27 May 1992 at location Km 1239.5 (fixed station). Tracking discontinued (---) from 30 July to 30 August 1992.

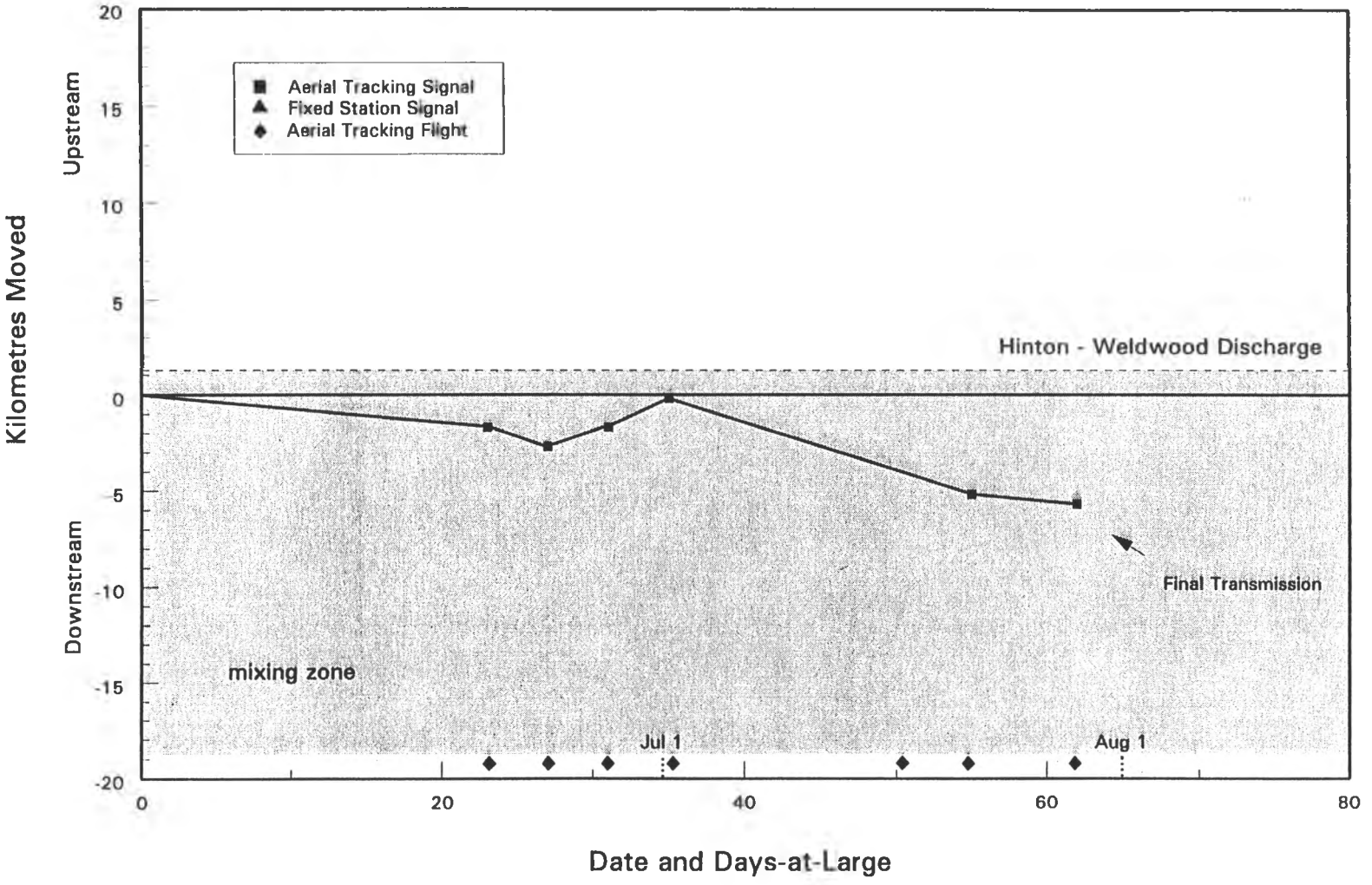


Figure 3.22. Movements of a burbot (transmitter 3-24) in the Athabasca River from May 1992 to July 1992. Released on 28 May 1992 at location Km 1226.7 (Weldwood Bridge). Tracking discontinued (---) from 30 July to 30 August 1992.

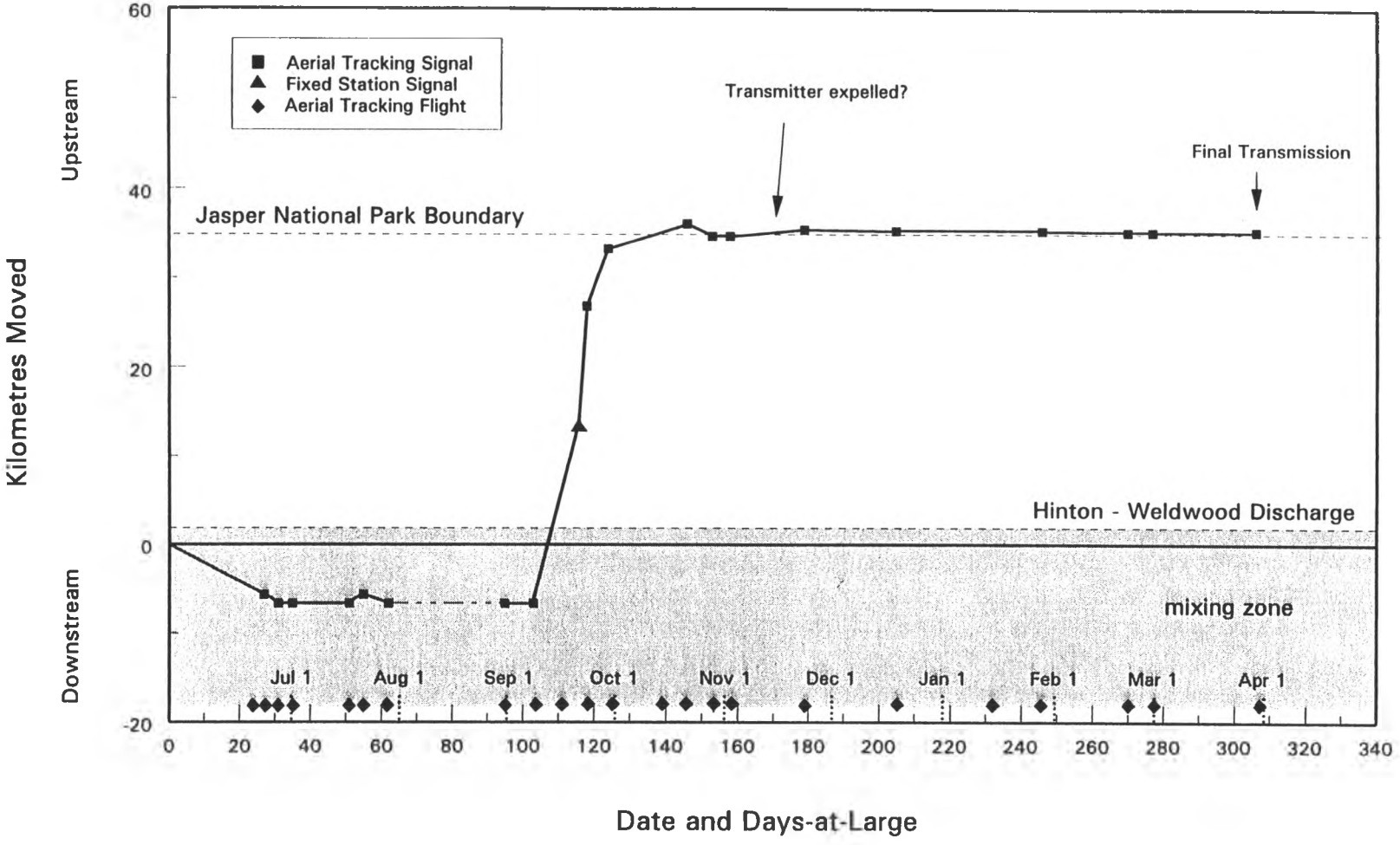


Figure 3.23. Movements of a lake whitefish (transmitter 5-15) in the Athabasca River from May 1992 to March 1993. Released on 28 May 1992 at location Km 1226.7 (Weldwood Bridge). Tracking discontinued (---) from 30 July to 30 August 1992.

of March, signals were received from a location near the upstream end of Brule Lake. The absence of late fall downstream movements suggests that the transmitter may have been expelled from the fish at this point, possibly during spawning.

Arctic Grayling

The transmitter placed in the Arctic grayling (i.e., transmitter code 20-26) was functional throughout the duration of the study (Figure 3.24). Downstream movement occurred after release, and by 28 June the fish was at Km 1153. Signals were received from this location until the end of March. The movement behaviour and signal patterns suggest that the transmitter was expelled, or that the fish had succumbed after the implant.

Rainbow Trout

Both rainbow trout exhibited localized movements, consistent with feeding in a home range (Figures 3.25 and 3.26).

Rainbow trout 4-6 was released near the Berland River, and moved upstream to the general vicinity of its capture site (i.e., Nosehill Creek). It remained at this location throughout late June and July (Figure 3.25). The location of this fish could not be determined throughout late summer, fall, or winter surveys, and transmitter failure or fish mortality (i.e., predator or angler) is suspected.

The movements of rainbow trout 19-28 were all within a 5 km range (Figure 3.26). The fish initially dropped downstream approximately one kilometre after release, after which it moved upstream approximately 3 to 4 km, remaining in this area until the final signal was received in early September.

3.6 MIXING ZONE AND EXPOSURE TIMES

In addition to providing data on movement patterns, the aerial tracking data can be used to estimate the length of time each fish spent in the mixing zone. The NRBS has determined that the mixing zone for the combined Hinton/Weldwood discharge effluent extends from the diffuser (1 km above the Weldwood Bridge at Km 1226.8) to near the Obed Mountain Coal Bridge (Km 1208), a distance of approximately 20 km. The mixing zone is defined as the river reach from the effluent diffuser downstream to "where complete mixing of effluent with the water column during recorded low flow periods is likely to occur" (Appendix A, Terms of Reference). The period spent in the mixing zone was estimated from the fish movement figures (e.g., Figure 3.18) by subtracting the Julian date on entry to the zone from the Julian date at exit from the zone. These dates are approximate, since the exact date of entry to or exit from the zone cannot be precisely determined from aerial tracking data. The margin of error in these calculations is increased for fish that entered or exited during the 30 July to 30 August period when aerial tracking was discontinued.

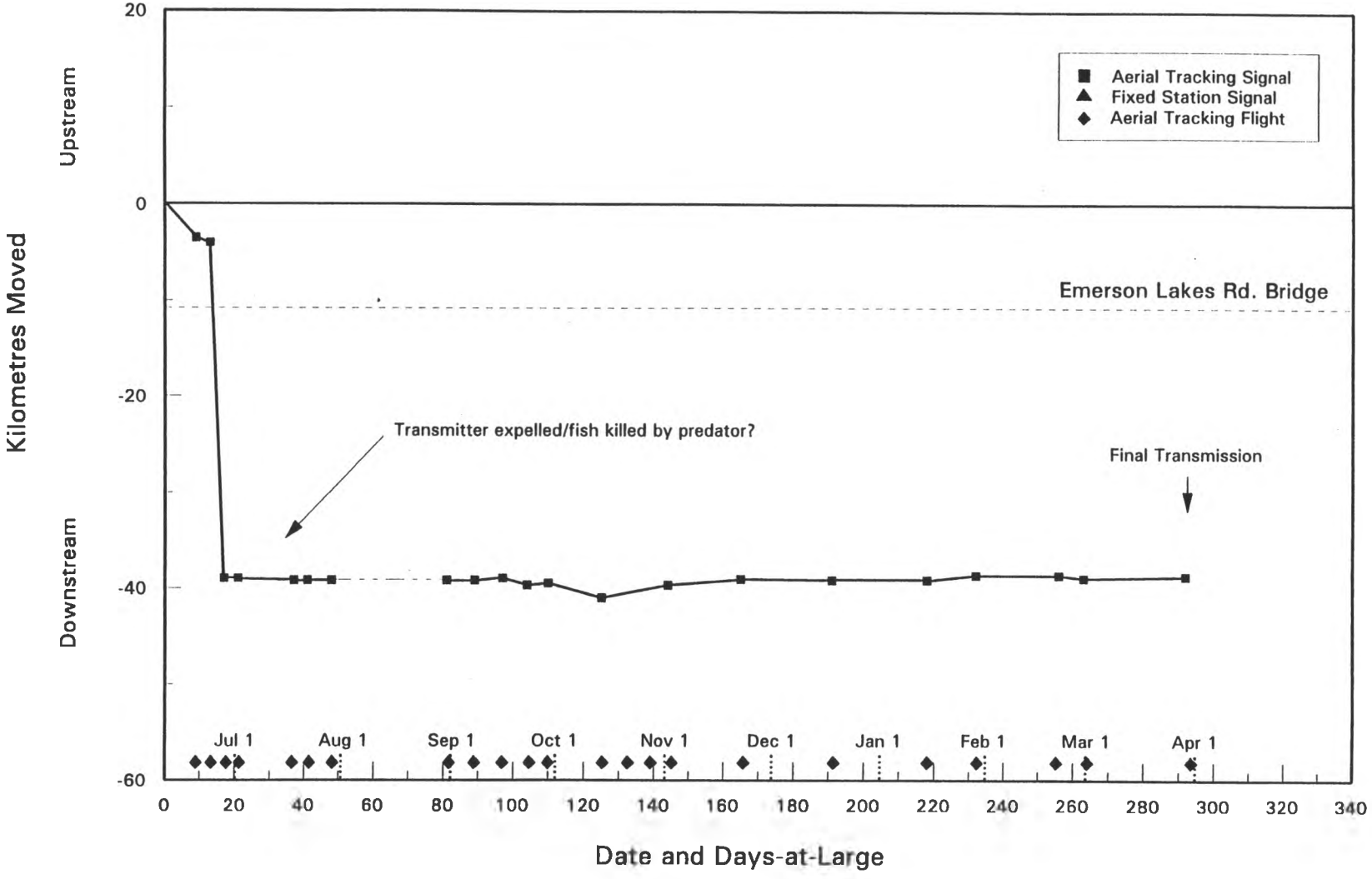


Figure 3.24. Movements of an Arctic grayling (transmitter 20-26) in the Athabasca River from May 1992 to March 1993. Released on 11 June 1992 at location Km 1192.0 (Obed "Ford"). Tracking discontinued (---) from 30 July to 30 August 1992.

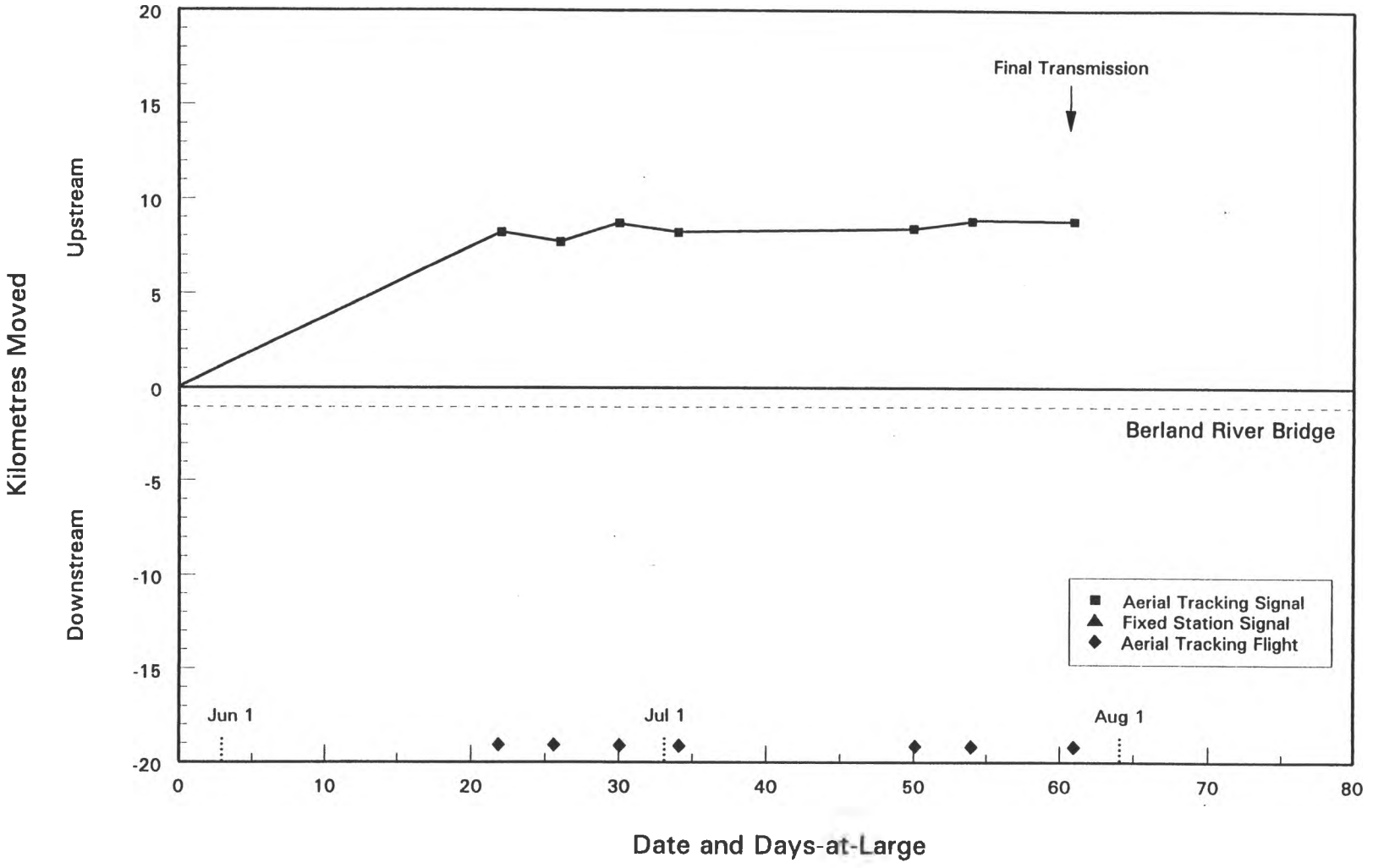


Figure 3.25. Movements of a rainbow trout (transmiter 4-6) in the Athabasca River from May 1992 to July 1992. Released 29 May 1992 at location Km 1129.3 (Berland River).

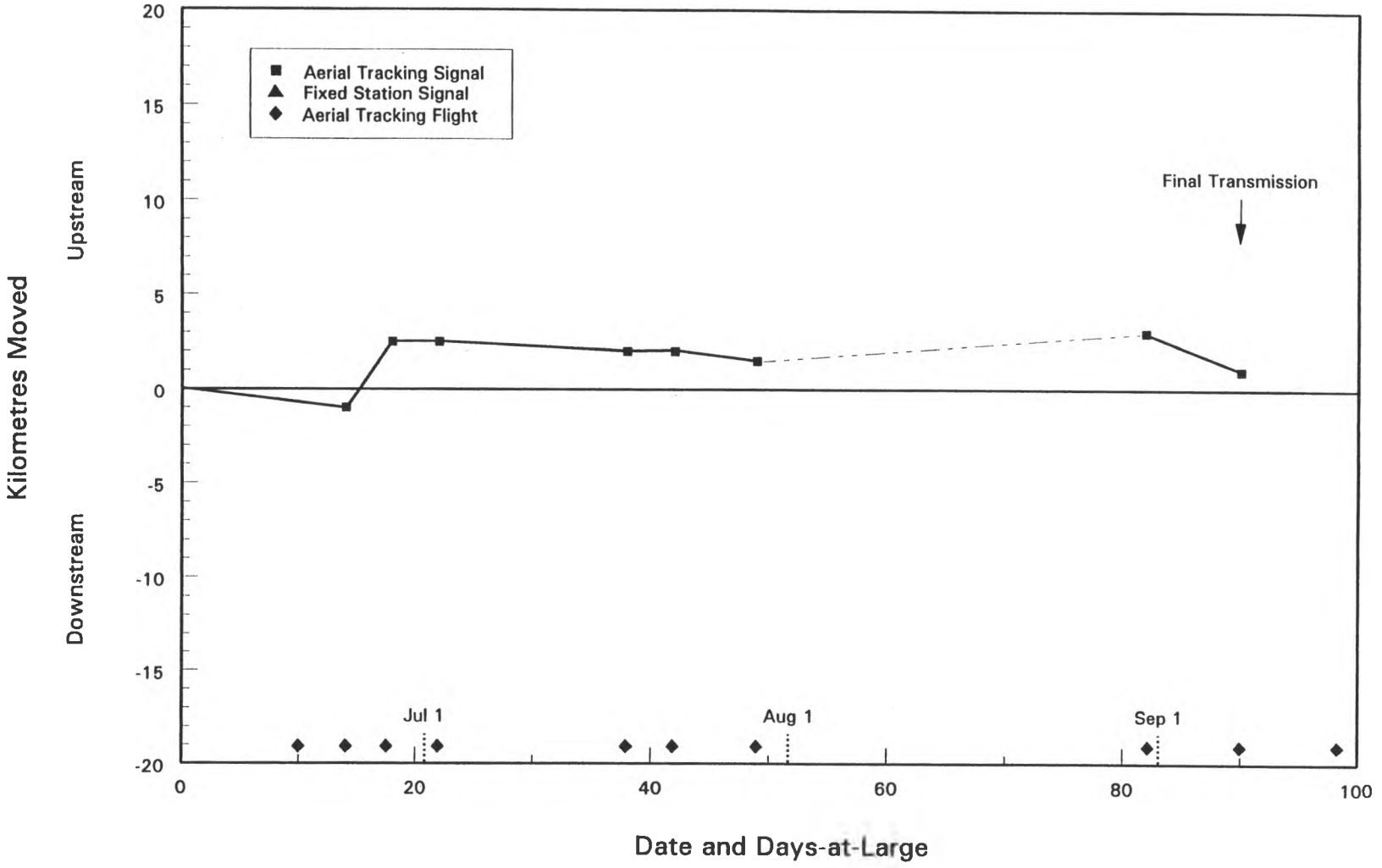


Figure 3.26. Movements of a rainbow trout (transmiter 19-28) in the Athabasca River from June 1992 to September 1992. Released 10 June 1992 at location Km 1192.0 (Obed "Ford"). Tracking discontinued (---) from 30 July to 30 August 1992.

Table 3.4 provides data on the estimated portion of time each fish spent in the mixing zone, and indicates the utility of radio telemetry for monitoring movements in an effluent plume. Of the 15 fish that spent at least some portion of their time in this zone, six fish (40%) resided there for greater than 50% of the total time monitored.

Table 3.4 Approximate percentage of time radio tagged fish were located in the mixing zone (between Weldwood/Hinton discharge and Obed Mountain Coal Bridge) in the upper Athabasca River, 1992 and 1993.

Species	Transmitter Code	Release Location in Mixing Zone[1]	Total Days Monitored	Approximate Time Spent in Mixing Zone (Days)	Percentage of Time Spent in Mixing Zone
Bull Trout	19-20	Yes	262	9	3
	19-25	Yes	265	173	65
	20-10	Yes	20	1	5
	20-44	Yes	291	13	4
	20-31	No-d.s.	219	14	6
Mountain Whitefish	4-3	Yes	35	35	100
	4-4	Yes	147	147	100
	20-11	Yes	43	43	100
	4-2	No-u.s.	106	4	4
	19-23	No-d.s.	144	11	8
	19-27	No-d.s.	263	232	88
	20-12	No-d.s.	263	7	3
	20-24	No-d.s.	145	17	12
Lake Whitefish	5-15	Yes	307	108	35
Burbot	3-24	Yes	62	62	100

[1] Yes Fish released at Km 1226.6, within 100 m downstream of Weldwood Haul Road Bridge.
No-u.s. Fish released at fixed station (Km 1239.5), approximately 12 km upstream of diffuser (mixing zone).
No-d.s. Fish released at Obed "Ford" (Km 1192), approximately 15 km downstream of mixing zone.

Five bull trout spent some time in the mixing zone, although four of the five left the area within six days. The fish (i.e., transmitter code 19-25) that spent the majority (65%) of the monitoring period in the zone also overwintered in this area (Figure 3.6). A sixth bull trout (i.e., transmitter code 4-8) was located once at the upstream boundary of the zone, and may have spent a short amount of time within the mixing zone. Based on the data available, it appeared that bull trout on average spent little time in the mixing zone. This may indicate that the study fish actively avoided the mixing zone, but alternatively may reflect that most of these bull trout were originally captured in upstream areas, released in the mixing zone, and were returning to their former territories.

Eight mountain whitefish spent a portion of the study time in the mixing zone. The three mountain whitefish that were released in the mixing zone resided there for 100% of the time monitored (Table 3.4). The mountain whitefish released upstream of the mixing zone (i.e.,

transmitter code 4-2; released at Old Entrance) resided in the zone for approximately 4% of the total time monitored; all of this time was in September, about three months after its release. Of the four mountain whitefish released downstream of the zone, fish 19-27 was the only individual which moved upstream and resided in the mixing zone until contact ceased. Fish 19-23 and 20-24 passed through the zone moving upstream. Contact with these individuals was lost prior to the end of the study; these fish may have again moved downstream through the mixing zone after contact was lost. Fish 20-12 passed through the mixing zone in both an upstream and downstream direction.

One burbot (i.e., transmitter code 3-24), monitored for 62 days, spent 100% of its time in the mixing zone (Table 3.4). The other two burbot monitored were released at Old Entrance, and did not move below the canyon at the Highway 40 bridge crossing. The burbot which resided in the mixing zone throughout the period of contact was resident in the zone prior to capture, and was released in the same area. In comparison with other upper Athabasca River species burbot are more sedentary, particularly in seasons other than winter.

The only lake whitefish radio tagged spent approximately 35% of its time in the mixing zone. All of this time was prior to early September, at which time this individual apparently commenced pre-spawning upstream movement.

4.0 SUMMARY AND DISCUSSION

The movements of 12 fish were monitored through summer and fall 1992, until the fish reached their overwintering areas after freeze-up. The percentage of active transmitters at the end of six months were 63% (bull trout), 40% (burbot) and 18% (mountain whitefish). Transmitter failure was suspected to have been the primary reason for the inability to track all fish, although a few individuals may have left the study area. Data were collected from 11 fish until the end of the predicted life-span of the transmitters in mid-February 1993.

The greatest upstream distance moved by a bull trout in the study area was 100 km. Bull trout migrated upstream throughout the summer and entered Athabasca River tributaries in mid to late summer. All monitored bull trout moved upstream through Brule Lake and entered Jasper National Park waters. It was suspected that the bull trout used the Snake Indian and Rocky rivers for spawning purposes, although this was not confirmed by either egg collection or capture of spent fish. By the end of October, all bull trout had moved to their overwintering locations, and only localized movements were recorded between November and the end of March. Some bull trout returned to the immediate area where they were initially captured in spring 1992.

Mountain whitefish undertook the longest movements in the study area; one individual (i.e., transmitter code 20-24) was released 38 km below Hinton and moved 122 km upstream to the vicinity of Jasper townsite. Relating the movement patterns of mountain whitefish to published information on their preferred spawning habitats was problematic, since some transmitters failed prematurely and the tagged fish exhibited variable behaviour patterns. Movement patterns and behaviour of this species in the upper Athabasca River appears complex.

Burbot remained in their home range for most of the study period, undertaking relatively short-distance excursions in mid-winter under ice. These movements were likely spawning related.

The present study demonstrated that radio telemetry is an effective method to determine the time spent by fish in an effluent mixing zone, and that ground stations set at the upstream and downstream boundaries of a plume would allow researchers to document the interval spent in a mixing zone. Potentially, a specific fish could be pin-pointed and recovered after inhabiting the mixing zone area for a period of time, should it be required for contaminant analysis purposes.

Aerial tracking is particularly applicable for searching large areas and locations difficult to access on the ground. Fixed stations are more applicable for monitoring time spent and behavioral patterns in a particular area, since continuous coverage can be applied to the area, and it is more cost-effective than aerial tracking for a small area. Ground/boat surveys using hand-held antennas can be used to confirm presence in a particular area and to verify habitat selection. In large, often turbid, river systems where conventional fish sampling techniques are ineffective, radio telemetry may be the only technique available to obtain valid information on fish behaviour and exposure to effluent discharges.

5.0 LITERATURE CITED

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APPENDIX A

TERMS OF REFERENCE

RADIO TELEMETRY EXTENSION

SCHEDULE A - TERMS OF REFERENCE

1.0 BACKGROUND

During the 1992 spring-summer Radio Telemetry Demonstration Study, a total of 35 fish were implanted with radio transmitters. The life span of these transmitters is approximately 9 months, thus allowing data collection beyond the completion of the demonstration study.

2.0 OBJECTIVES

The overall purpose of the study extension is to track the movements of important fish species already radio tagged in the upper reaches of the Athabasca River and obtain data on the location of critical habitats (i.e. spawning, overwintering) for these species.

The specific objectives of extending the radio telemetry program will be to collect further information on the following:

- Spawning sites/movement patterns of bull trout
- Spawning sites/movement patterns of mountain whitefish
- Overwintering movement/habitat selection of all species

Inherent in this program is also a further demonstration of the feasibility of telemetry, especially during the low flow, critical overwintering period for fish in the mainstem Athabasca River.

It may be possible to obtain incidental data on burbot and lake whitefish spawning; however, the sample size for these species is small. The battery life of the transmitters will not likely be sufficient to collect spring spawning data (i.e. rainbow trout, Arctic grayling) in 1993.

3.0 WORK PROGRAM

The work program will include the following basic components:

- Aircraft tracking
- Ground station tracking
- Data analysis and reporting

1. Aircraft Tracking

Aerial tracking will be carried out on a scheduled basis using fixed wing aircraft, primarily based from Edmonton. Occasional surveys may also be initiated from Hinton, if practical, during other activities (i.e. ground station servicing) and to take advantage of local weather conditions.

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Tracking flights will be conducted weekly as weather permits from late August to late October , thereafter the frequency will be reduced to bi-weekly in November and December and monthly in January, February and March 1993. Tracking schedules are identified in Table 1. Additional flights will be included during the potential spawning period for bull trout, mountain whitefish and burbot (i.e. a minimum of two each for bull trout and mountain whitefish; one for burbot).

The survey area will include the mainstem Athabasca River from approximately Whitecourt upstream to Athabasca Falls (Jasper National Park). Selected major upstream tributaries also will be surveyed during the fall period (primarily for bull trout spawning) including, but not limited to, the lower reaches of the Snake Indian River, Fiddle River, Rocky River and Snaring River. The extent of tributary surveys will depend upon weather, safety and flight times available. Intercept locations of fish will be plotted and recorded using 1:50,000 scale NTS maps of the river basin.

2. Ground Station Tracking

The ground station located at Old Entrance, above Hinton, will be serviced from late August to February 1993 (Table 1). Data will be downloaded bi-weekly onto a laptop computer and the batteries for the station power supply replaced.

It may also be desirable to confirm identifications/spawning locations of some fish from the ground in fall 1992. If time/access and budget allow, a ground or boat inspection of selected locations will be attempted based on communication provided to and in consultation with the Department's Technical Officer.

3. Reporting

Data will be tabulated and graphed in a manner similar to the Demonstration study report, and presented as an addendum to this report. Text will include a brief interpretation of results, recommendations and methodologies (if altered).

A short verbal and written (memo) report on the results of the tracking will be submitted monthly to assist with the decision to continue or terminate the surveys. The final report will be submitted within one month of the final surveys.

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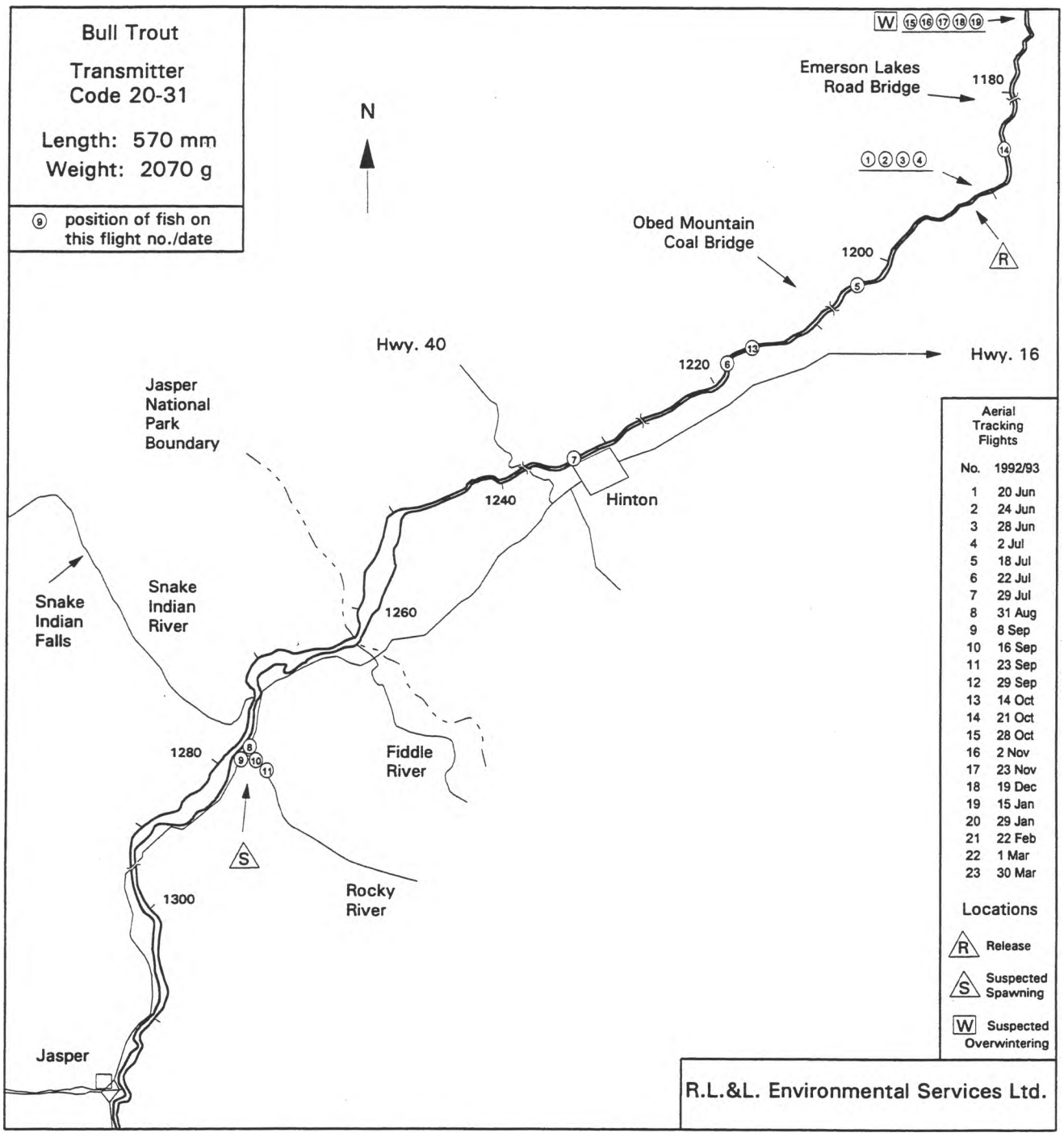
TABLE 1

Table 1. Schedule for aerial tracking and fixed ground station servicing.

TRACKING	DATES																											
	AUGUST				SEPTEMBER				OCTOBER				NOVEMBER				DECEMBER				JANUARY 1993				FEBRUARY				MARCH	
AIRCRAFT																												
Basic			x	x	x	x	x	x	x	x	x		x		x		x		x			x				x			x
Spawning						x	x			x	x							x											
GROUND			x		x		x		x		x		x		x		x		x		x		x		x				

APPENDIX B

FISH MOVEMENT DATA

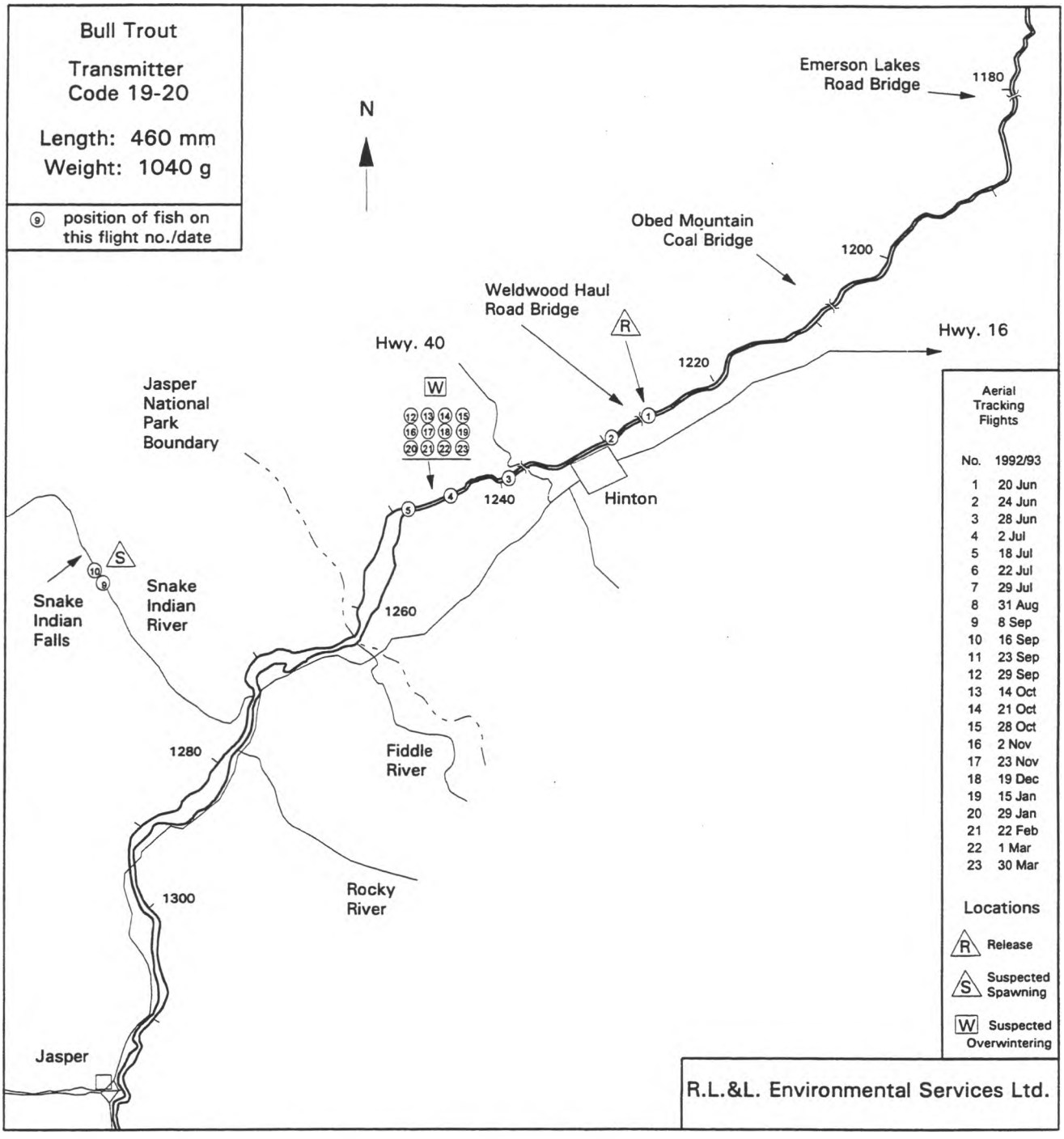


Appendix B, Figure B1. Locations of a bull trout (code 20-31) in the upper Athabasca River, monitored by aerial tracking from June 1992 to January 1993.

Appendix B, Table B1. Signal acquisition, location of signal, movements, and days-at-large for a bull trout (Tag 20-31) from the Athabasca River, June 1992 to January 1993.

Release Date: 10-Jun-92
Release Location: 1192.0

Signal Acquisition	Location (Km)	Distance from Release	Days at Large	Comment/Suspected Habitat Use
20-Jun-92	1190.0	-2.0	10	
24-Jun-92	1190.0	-2.0	14	
28-Jun-92	1190.0	-2.0	18	
02-Jul-92	1190.0	-2.0	22	
18-Jul-92	1205.0	13.0	38	
22-Jul-92	1218.5	26.5	42	
29-Jul-92	1234.4	42.4	49	
30-Jul-92	1239.5	47.5	50	at ground station
31-Aug-92	1276.4	84.4	82	Rocky R. side channel
08-Sep-92	2.0	87.6	90	Rocky R.; spawning
16-Sep-92	3.3	89.1	98	Rocky R.; spawning
23-Sep-92	7.1	92.7	105	Rocky R.; spawning
09-Oct-92	1239.5	47.5	121	at ground station
14-Oct-92	1216.0	24.0	126	
21-Oct-92	1185.0	-7.0	133	
28-Oct-92	1174.2	-17.8	140	mainstem overwintering
02-Nov-92	1173.9	-18.1	145	mainstem overwintering
23-Nov-92	1174.4	-17.6	166	mainstem overwintering
19-Dec-92	1172.5	-19.5	192	mainstem overwintering
15-Jan-93	1174.0	-18.0	219	mainstem overwintering
end of records				

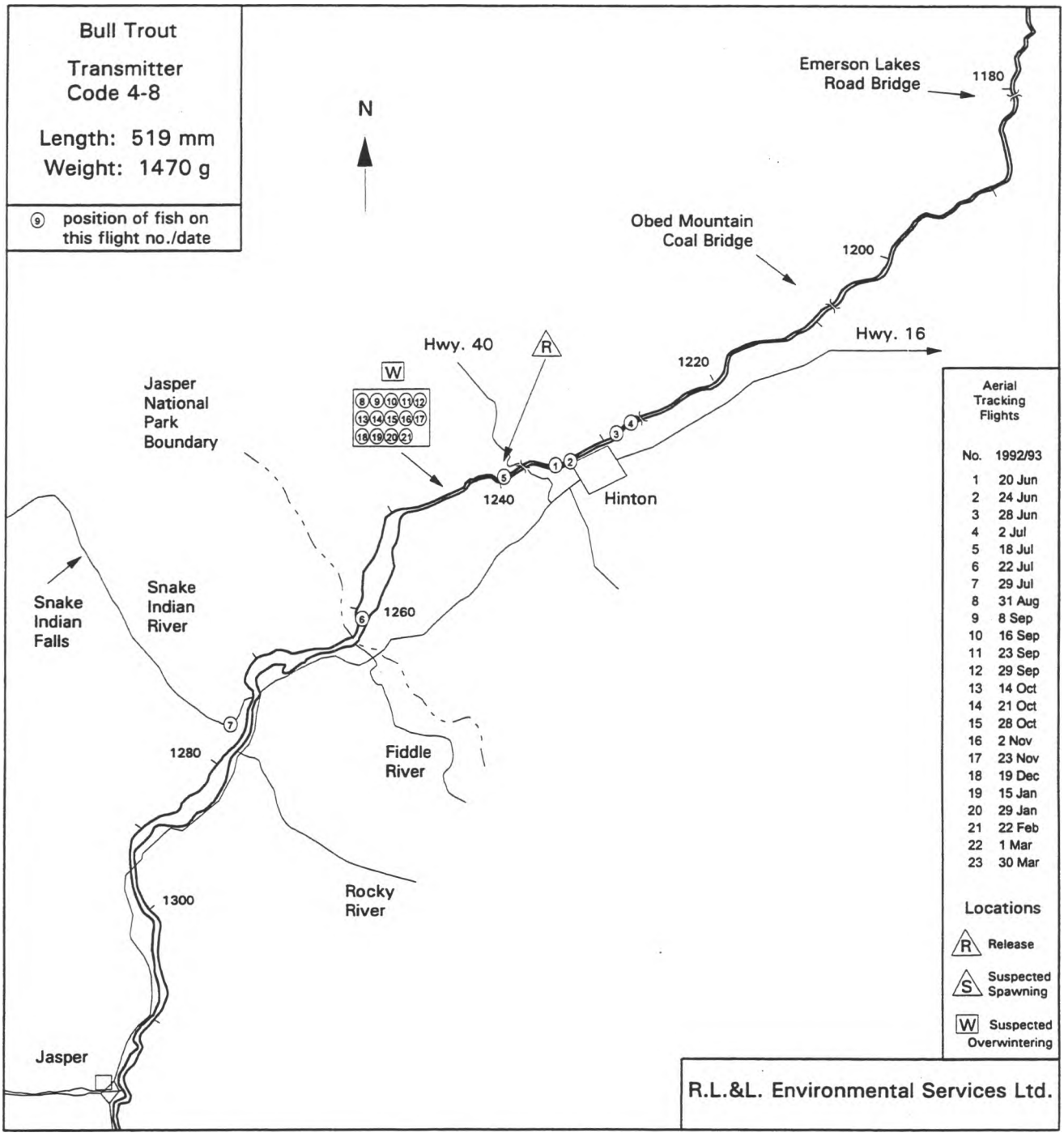


Appendix B, Figure B2. Locations of a bull trout (code 19-20) in the upper Athabasca River, monitored by aerial tracking from June 1992 to March 1993.

Appendix B, Table B2. Signal acquisition, location of signal, movements, and days-at-large for a bull trout (Tag 19-20) from the Athabasca River, June 1992 to March 1993.

Release Date: 12-Jun-92
Release Location: 1226.7

Signal Acquisition	Location (Km)	Distance from Release	Days at Large	Comment/Suspected Habitat Use
20-Jun-92	1227.5	0.8	8	
24-Jun-92	1229.0	2.3	12	
26-Jun-92	1239.5	12.8	14	at ground station
28-Jun-92	1247.0	20.3	16	
02-Jul-92	1249.1	22.4	20	
18-Jul-92		transmitter not located		
22-Jul-92		transmitter not located		
29-Jul-92		transmitter not located		
31-Aug-92	33.5	78.8	80	Snake Indian R./spawning
08-Sep-92	33.5	78.8	88	Snake Indian R./spawning
16-Sep-92		transmitter not located		
23-Sep-92	1247.0	20.3	103	mainstem overwintering
29-Sep-92	1247.0	20.3	109	mainstem overwintering
14-Oct-92	1247.0	20.3	124	mainstem overwintering
21-Oct-92	1247.2	20.5	131	mainstem overwintering
28-Oct-92	1248.0	21.3	138	mainstem overwintering
02-Nov-92	1247.8	21.1	143	mainstem overwintering
23-Nov-92	1248.8	22.1	164	mainstem overwintering
19-Dec-92	1249.0	22.3	190	mainstem overwintering
15-Jan-93	1247.0	20.3	217	mainstem overwintering
29-Jan-93	1249.1	22.4	231	mainstem overwintering
22-Feb-93	1246.7	20.0	255	mainstem overwintering
01-Mar-93	1246.7	20.0	262	mainstem overwintering
end of records				

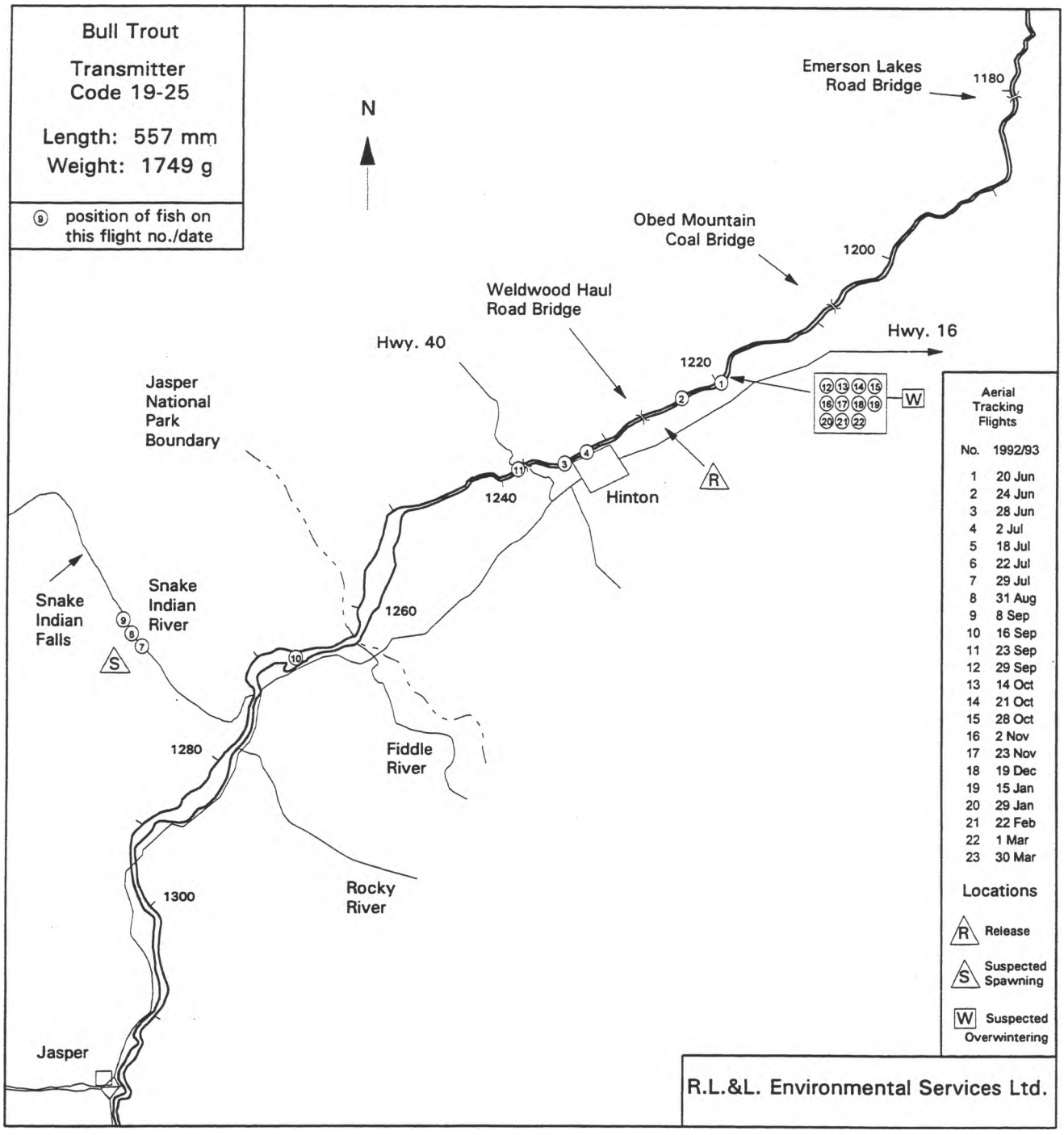


Appendix B, Figure B3. Locations of a bull trout (code 4-8) in the upper Athabasca River, monitored by aerial tracking from June 1992 to February 1993.

Appendix B, Table B3. Signal acquisition, location of signal, movements, and days-at-large for a bull trout (Tag 4-8) from the Athabasca River, May 1992 to February 1993.

Release Date: 25-May-92
Release Location: 1239.5

Signal Acquisition	Location (Km)	Distance from Release	Days at Large	Comment/Suspected Habitat Use
20-Jun-92	1235.1	-4.4	26	
24-Jun-92	1235.0	-4.5	30	
28-Jun-92	1229.0	-10.5	34	
02-Jul-92	1228.0	-11.5	38	
18-Jul-92	1239.5	0.0	54	at ground station
22-Jul-92	1260.4	20.9	58	
29-Jul-92	5.5	38.0	65	Snake Indian R.;
31-Aug-92	1246.0	6.5	98	spawning completed?
08-Sep-92	1245.0	5.5	106	
16-Sep-92	1245.0	5.5	114	
23-Sep-92	1244.7	5.2	121	
29-Sep-92	1244.8	5.3	127	
14-Oct-92	1243.5	4.0	142	
21-Oct-92	1244.9	5.4	149	
28-Oct-92	1244.1	4.6	156	
02-Nov-92	1245.6	6.1	161	mainstem overwintering
23-Nov-92	1245.3	5.8	182	mainstem overwintering
19-Dec-92	1245.7	6.2	208	mainstem overwintering
15-Jan-93	1245.8	6.3	235	mainstem overwintering
29-Jan-93	1244.9	5.4	249	mainstem overwintering
22-Feb-93	1245.5	6.0	273	mainstem overwintering
end of records				

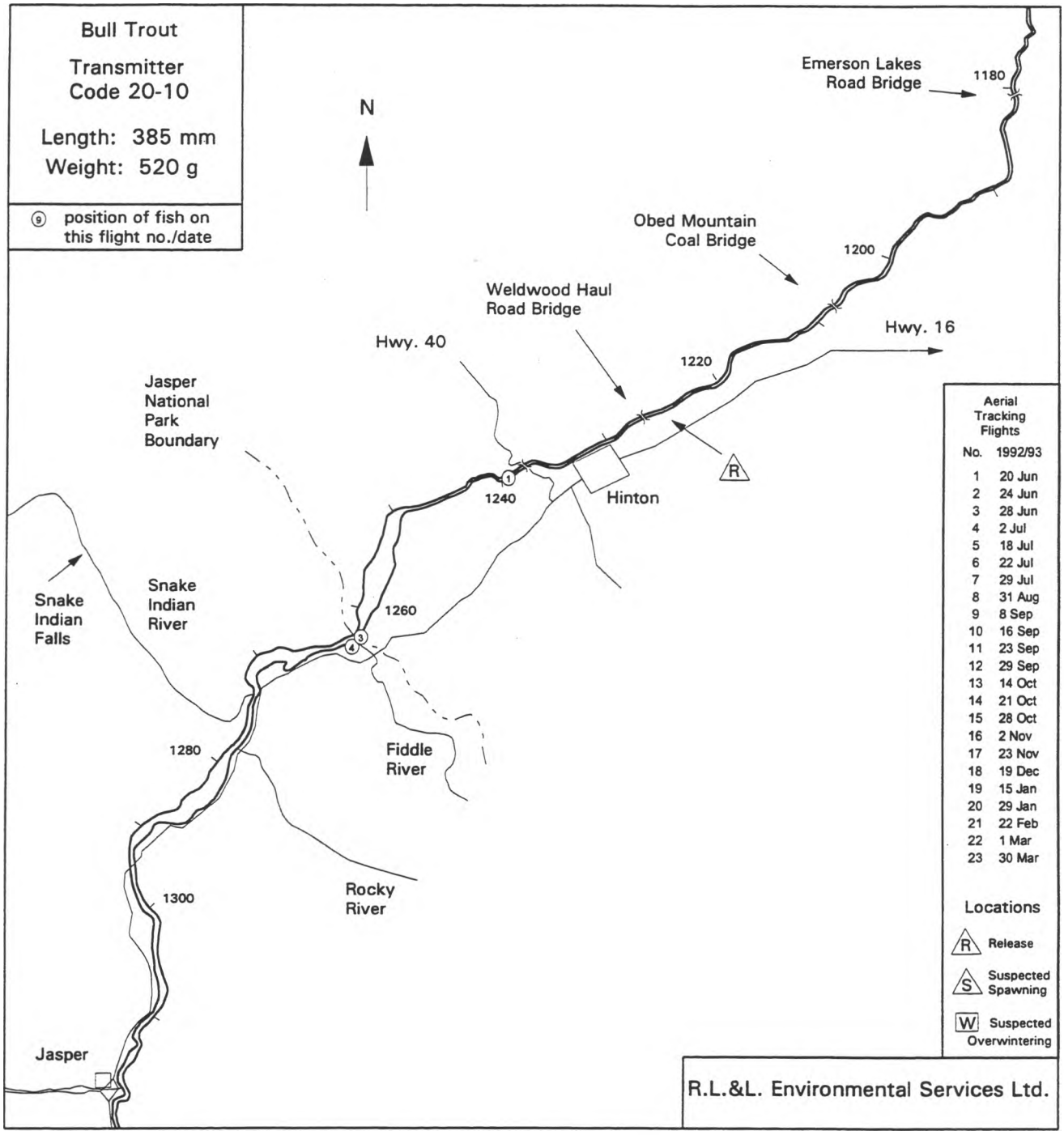


Appendix B, Figure B4. Locations of a bull trout (code 19-25) in the upper Athabasca River, monitored by aerial tracking from June 1992 to March 1993.

Appendix B, Table B4. Signal acquisition, location of signal, movements, and days-at-large for a bull trout (Tag 19-25) from the Athabasca River, June 1992 to March 1993.

Release Date: 09-Jun-92
Release Location: 1226.7

Signal Acquisition	Location (Km)	Distance from Release	Days at Large	Comment/Suspected Habitat Use
20-Jun-92	1220.0	-6.7	11	
24-Jun-92	1223.0	-3.7	15	
28-Jun-92	1234.0	7.3	19	
02-Jul-92	1232.0	5.3	23	
03-Jul-92	1239.5	12.8	24	at ground station
18-Jul-92		transmitter not located		
22-Jul-92		transmitter not located		
29-Jul-92	20.5	65.8	50	Snake Indian R.; spawning
31-Aug-92	20.5	65.8	83	Snake Indian R.; spawning
08-Sep-92	20.5	65.8	91	Snake Indian R.; spawning
16-Sep-92	1266.0	39.3	99	
23-Sep-92	1239.5	12.8	106	at ground station
23-Sep-92	1238.0	11.3	106	
29-Sep-92	1220.3	-6.4	112	
14-Oct-92	1219.0	-7.7	127	
21-Oct-92	1220.0	-6.7	134	
28-Oct-92	1221.0	-5.7	141	
02-Nov-92	1219.6	-7.1	146	mainstem overwintering
23-Nov-92	1219.6	-7.1	167	mainstem overwintering
19-Dec-92	1220.0	-6.7	193	mainstem overwintering
15-Jan-93	1221.0	-5.7	220	mainstem overwintering
29-Jan-93	1220.0	-6.7	234	mainstem overwintering
22-Feb-93	1220.8	-5.9	258	mainstem overwintering
01-Mar-93	1219.7	-7.0	265	mainstem overwintering
end of records				

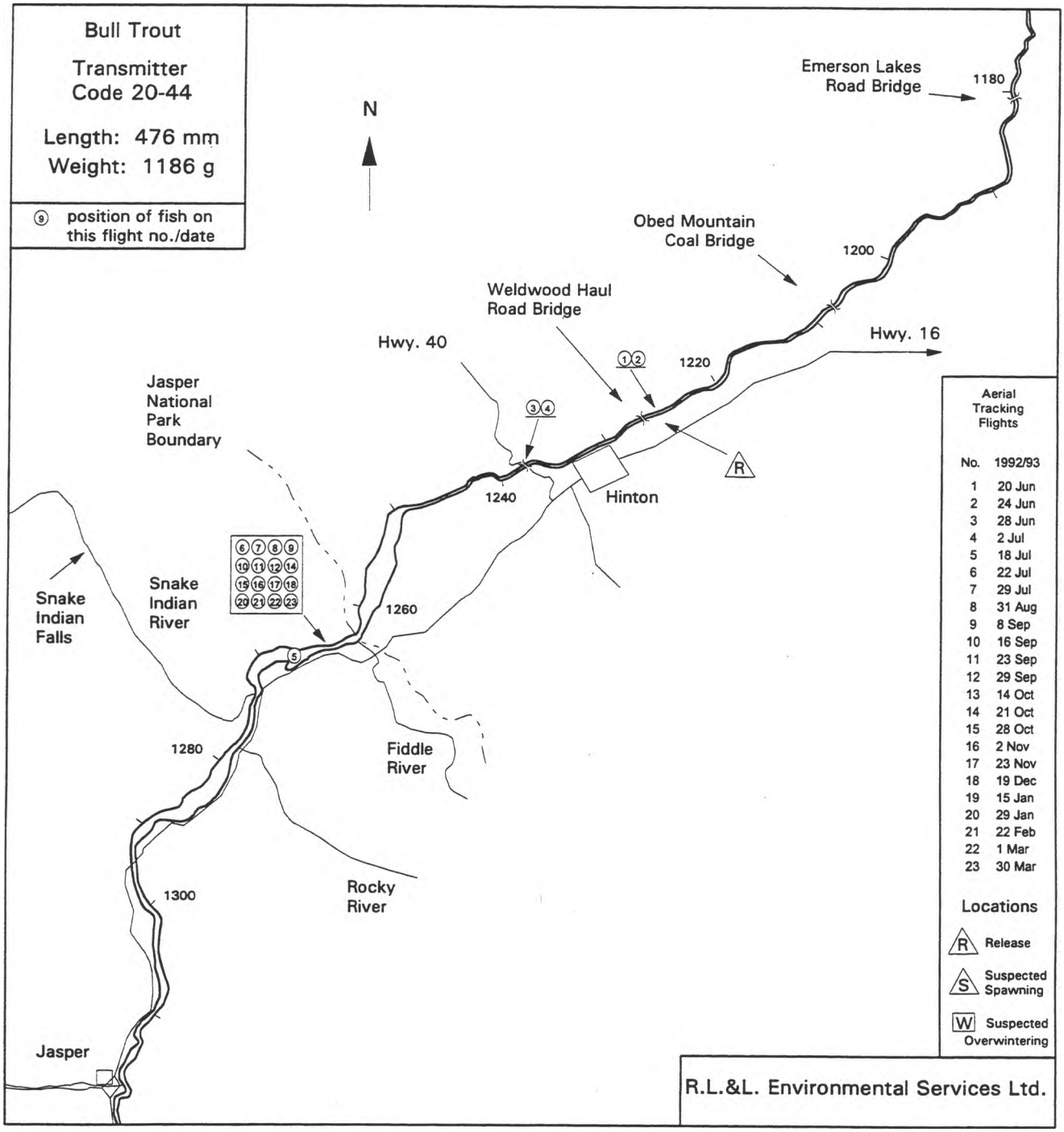


Appendix B, Figure B5. Locations of a bull trout (code 20-10) in the upper Athabasca River, monitored by aerial tracking from June 1992 to July 1992.

Appendix B, Table B5. Signal acquisition, location of signal, movements, and days-at-large for a bull trout (Tag 20-10) from the Athabasca River, June to July 1992.

Release Date: 12-Jun-92
Release Location: 1226.7

Signal Acquisition	Location (Km)	Distance from Release	Days at Large	Comment/Suspected Habitat Use
20-Jun-92	1239.5	12.8	8	
28-Jun-92	1261.8	35.1	16	
02-Jul-92	1261.8	35.1	20	
end of records		Caught by angler at mouth of Fiddle R.		

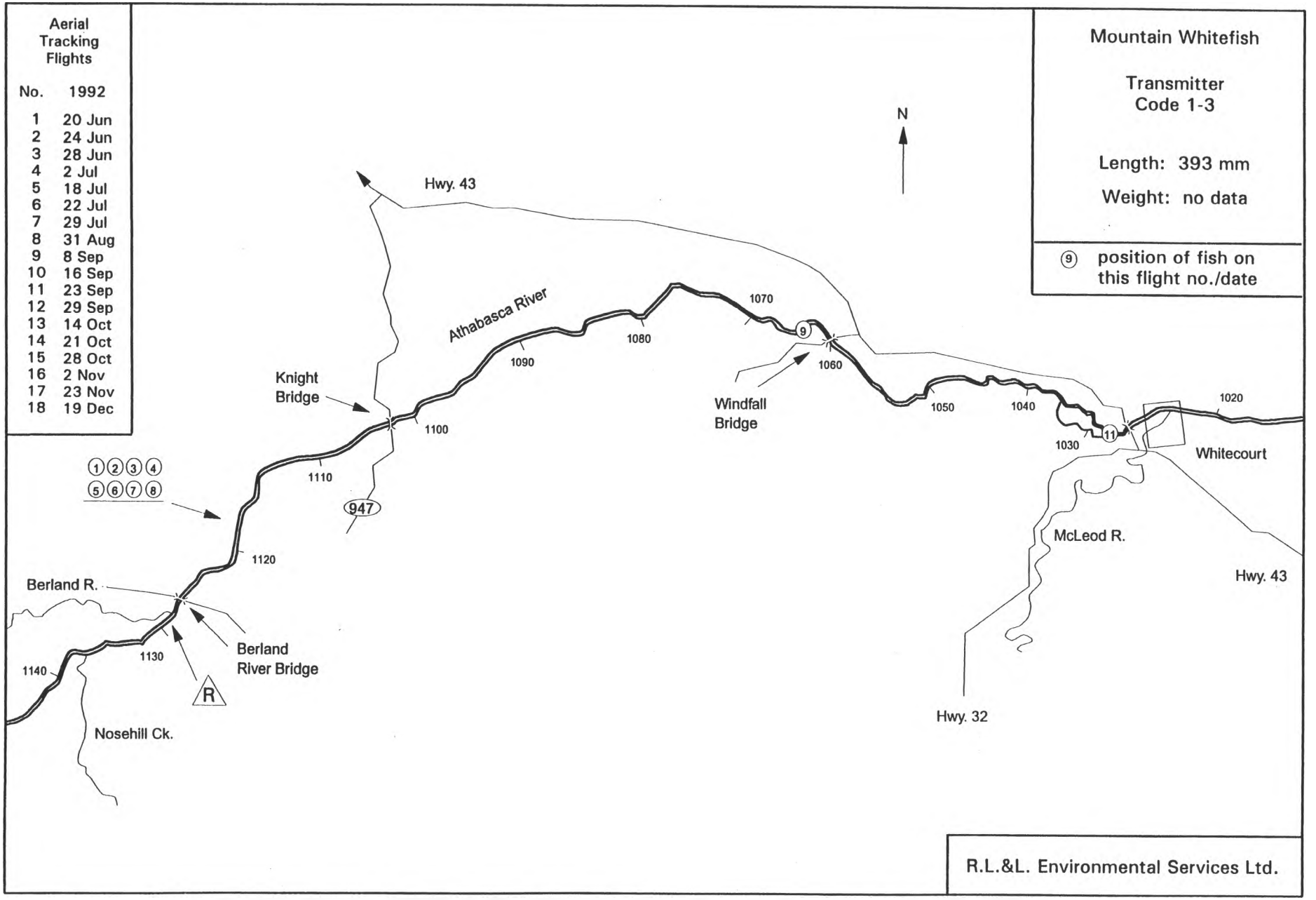


Appendix B, Figure B6. Locations of a bull trout (code 20-44) in the upper Athabasca River, monitored by aerial tracking from June 1992 to March 1993.

Appendix B, Table B6. Signal acquisition, location of signal, movements, and days-at-large for a bull trout (Tag 20-44) from the Athabasca River, June 1992 to March 1993.

Release Date: 12-Jun-92
Release Location: 1226.7

Signal Acquisition	Location (Km)	Distance from Release	Days at Large	Comment/Suspected Habitat Use
20-Jun-92	1226.0	-0.7	8	
24-Jun-92	1226.0	-0.7	12	
28-Jun-92	1238.0	11.3	16	
02-Jul-92	1238.0	11.3	20	
07-Jul-92	1239.5	12.8	25	at ground station
18-Jul-92	1266.9	40.2	36	
22-Jul-92	1264.0	37.3	40	
29-Jul-92	1264.0	37.3	47	transmitter shed?
31-Aug-92	1264.0	37.3	80	transmitter shed?
08-Sep-92	1264.5	37.8	88	transmitter shed?
16-Sep-92	1265.0	38.3	96	transmitter shed?
23-Sep-92	1264.0	37.3	103	transmitter shed?
29-Sep-92	1265.4	38.7	109	transmitter shed?
14-Oct-92	transmitter not located			transmitter shed?
21-Oct-92	1264.1	37.4	131	transmitter shed?
28-Oct-92	1265.2	38.5	138	transmitter shed?
02-Nov-92	1264.5	37.8	143	transmitter shed?
23-Nov-92	1264.8	38.1	164	transmitter shed?
19-Dec-92	1264.5	37.8	190	transmitter shed?
15-Jan-93	transmitter not located			transmitter shed?
29-Jan-93	1264.5	37.8	231	transmitter shed?
22-Feb-93	1264.5	37.8	255	transmitter shed?
01-Mar-93	1264.8	38.1	262	transmitter shed?
30-Mar-93	1264.6	37.9	291	transmitter shed?
end of records				

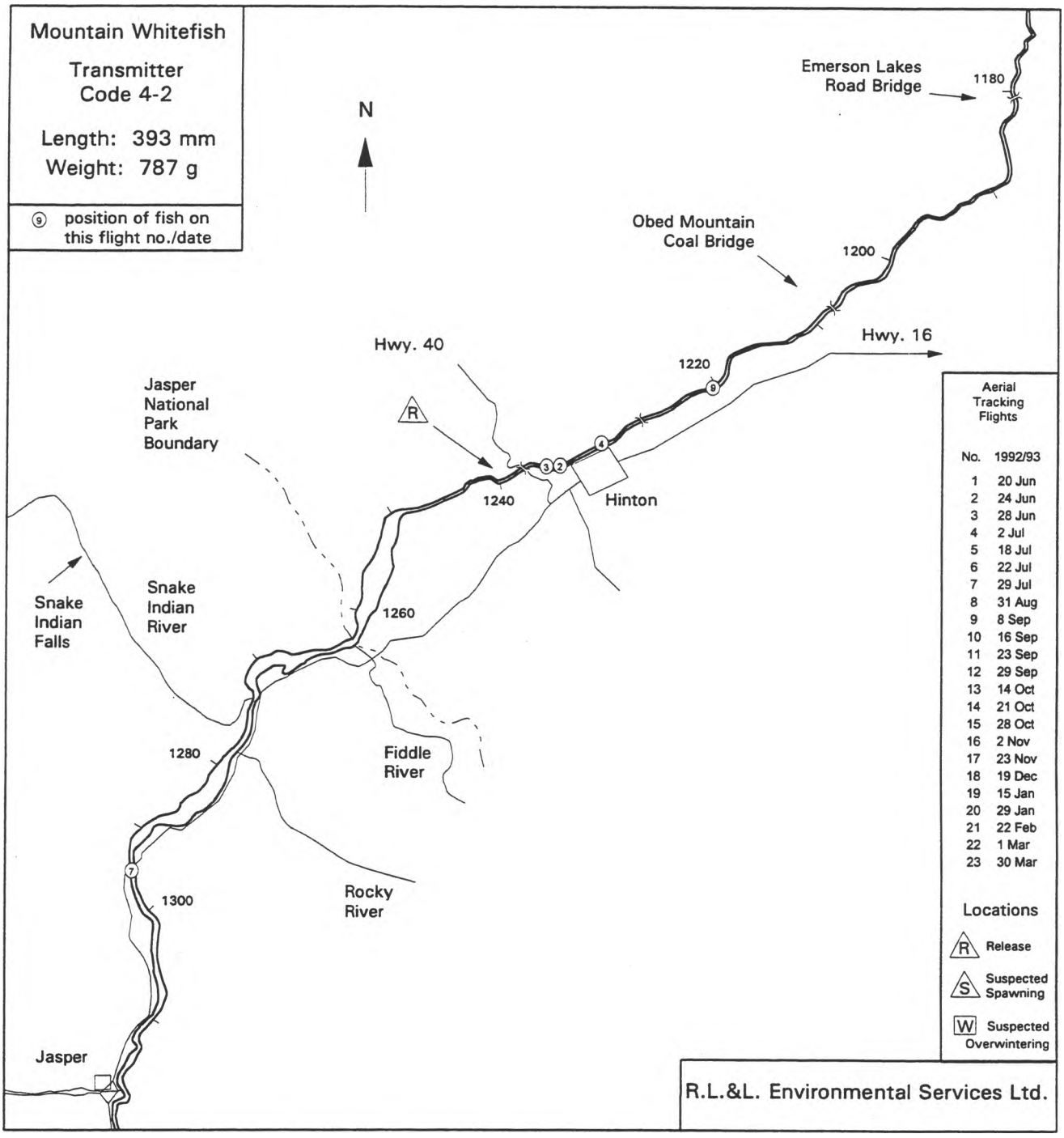


Appendix B, Figure B7. Locations of a mountain whitefish (code 1-3) in the upper Athabasca River, monitored by aerial tracking from June 1992 to September 1992.

Appendix B, Table B7. Signal acquisition, location of signal, movements, and days-at-large for a mountain whitefish (Tag 1-3) from the Athabasca River, May to September 1992.

Release Date: 29-May-92
Release Location: 1129.3

Signal Acquisition	Location (Km)	Distance from Release	Days at Large	Comment/Suspected Habitat Use
20-Jun-92	1119.0	-10.3	22	
24-Jun-92	1119.0	-10.3	26	
28-Jun-92	1118.6	-10.7	30	
02-Jul-92	1118.4	-10.9	34	
18-Jul-92	1118.4	-10.9	50	
22-Jul-92	1118.0	-11.3	54	
29-Jul-92	1118.0	-11.3	61	
31-Aug-92	1118.0	-11.3	94	
08-Sep-92	1063.0	-66.3	102	
16-Sep-92	transmitter not located			
23-Sep-92	1027.5	-101.8	117	left study area?
end of records				

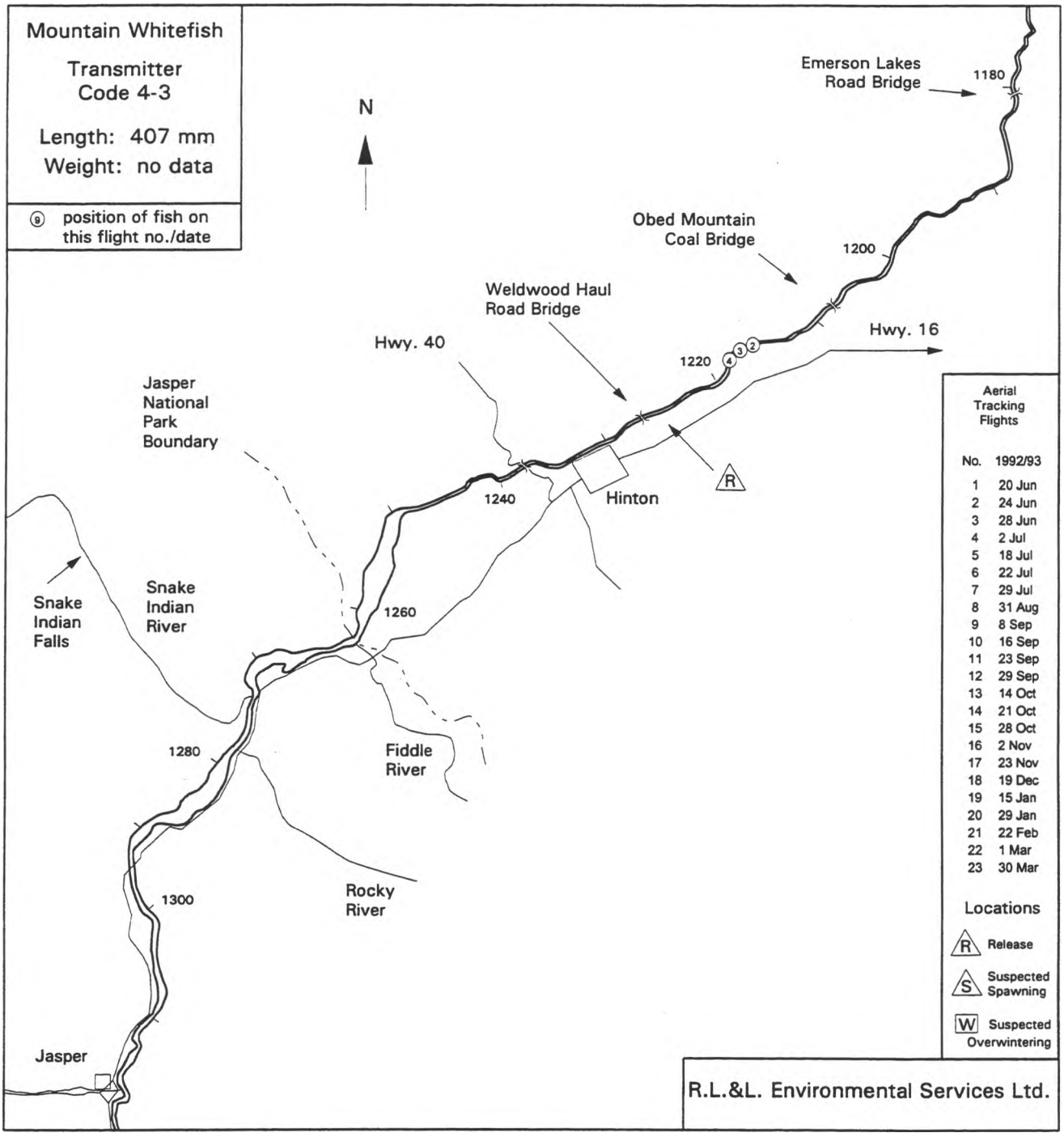


Appendix B, Figure B8. Locations of a mountain whitefish (code 4-2) in the upper Athabasca River, monitored by aerial tracking from May 1992 to September 1992.

Appendix B, Table B8. Signal acquisition, location of signal, movements, and days-at-large for a mountain whitefish (Tag 4-2) from the Athabasca River, May to September 1992.

Release Date: 25-May-92
Release Location: 1239.5

Signal Acquisition	Location (Km)	Distance from Release	Days at Large	Comment/Suspected Habitat Use
20-Jun-92	transmitter not located			
24-Jun-92	1235.0	-4.5	30	
28-Jun-92	1236.0	-3.5	34	
02-Jul-92	1230.5	-9.0	38	
05-Jul-92	1239.5	0.0	41	at ground station
18-Jul-92	transmitter not located			
22-Jul-92	transmitter not located			
29-Jul-92	1294.2	54.7	65	
26-Aug-92	1239.5	0.0	93	at ground station
31-Aug-92	transmitter not located			
08-Sep-92	1220.0	-19.5	106	
end of records				

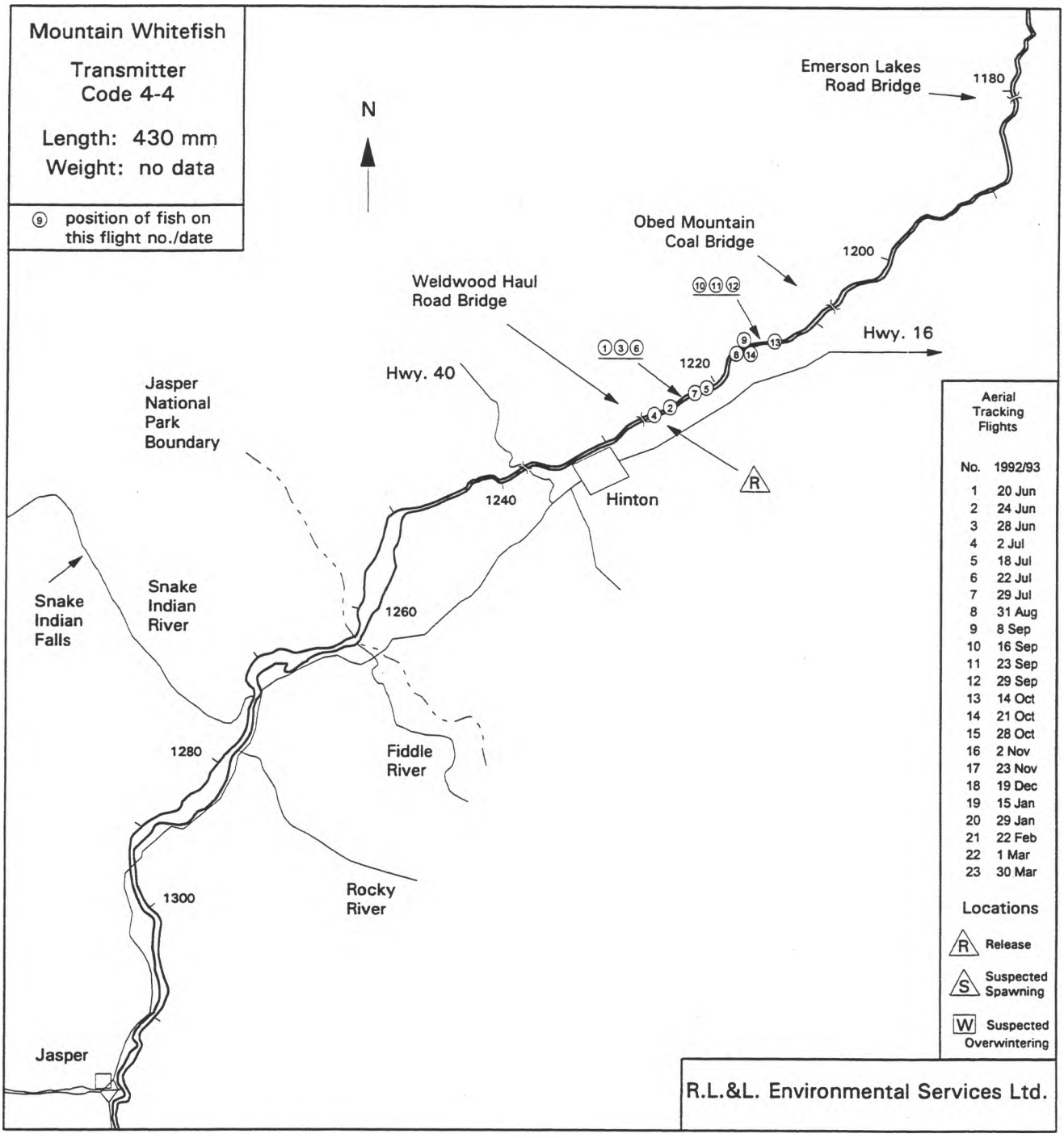


Appendix B, Figure B9. Locations of a mountain whitefish (code 4-3) in the upper Athabasca River, monitored by aerial tracking from May 1992 to July 1992.

Appendix B, Table B9. Signal acquisition, location of signal, movements, and days-at-large for a mountain whitefish (Tag 4-3) from the Athabasca River, May to July 1992.

Release Date: 28-May-92
Release Location: 1226.7

Signal Acquisition	Location (Km)	Distance from Release	Days at Large	Comment/Suspected Habitat Use
20-Jun-92	transmitter not located			
24-Jun-92	1217.0	-9.7	27	
28-Jun-92	1217.0	-9.7	31	
02-Jul-92	1216.0	-10.7	35	
end of records				

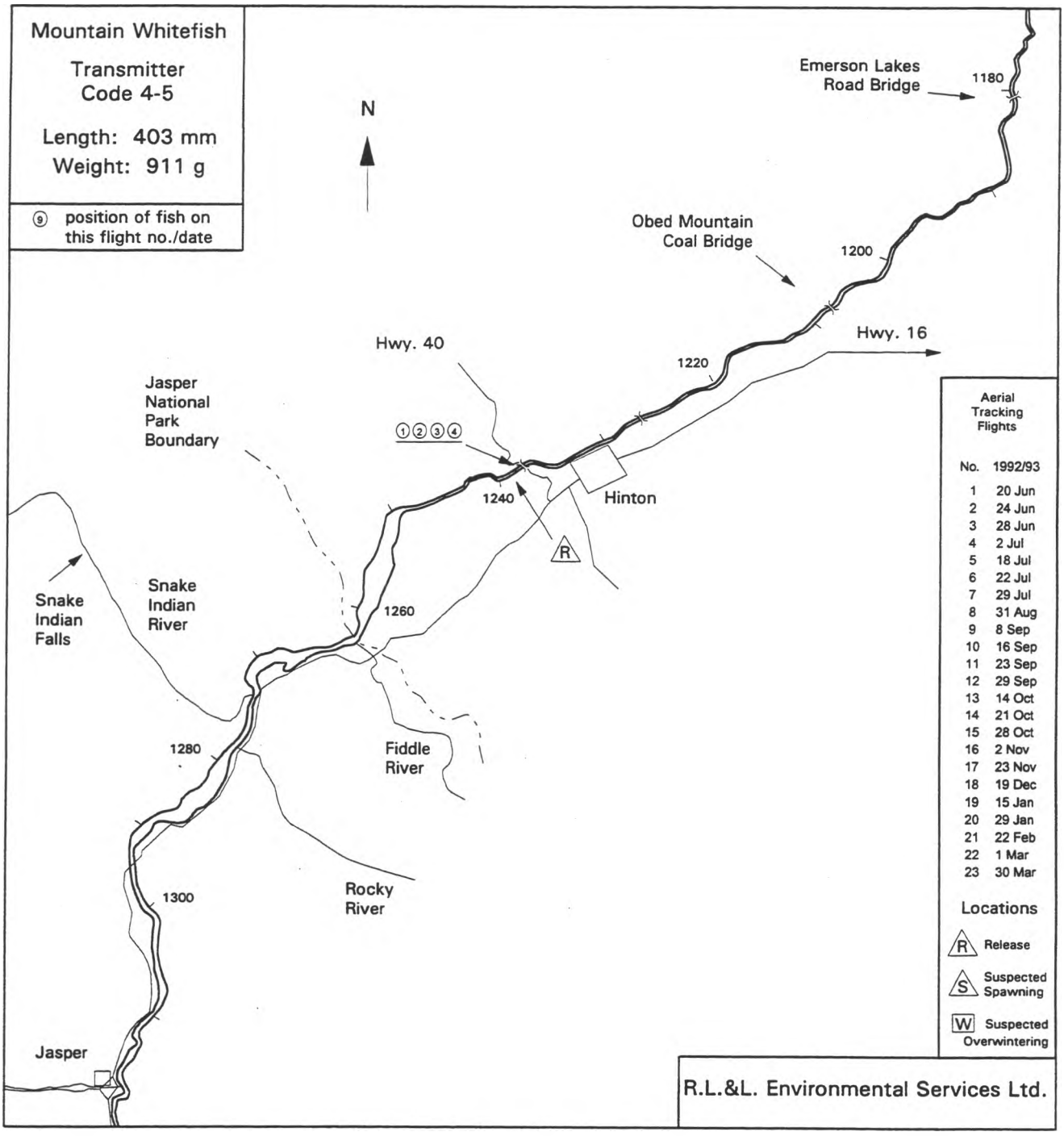


Appendix B, Figure B10. Locations of a mountain whitefish (code 4-4) in the upper Athabasca River, monitored by aerial tracking from May 1992 to October 1992.

Appendix B, Table B10. Signal acquisition, location of signal, movements, and days-at-large for a mountain whitefish (Tag 4-4) from the Athabasca River, May to October 1992.

Release Date: 28-May-92
Release Location: 1226.7

Signal Acquisition	Location (Km)	Distance from Release	Days at Large	Comment/Suspected Habitat Use
20-Jun-92	1223.0	-3.7	23	
24-Jun-92	1224.0	-2.7	27	
28-Jun-92	1223.0	-3.7	31	
02-Jul-92	1225.0	-1.7	35	upstream movement
18-Jul-92	1221.0	-5.7	51	
22-Jul-92	1223.0	-3.7	55	
29-Jul-92	1222.0	-4.7	62	
31-Aug-92	1217.0	-9.7	95	
08-Sep-92	1216.0	-10.7	103	
16-Sep-92	1215.0	-11.7	111	
23-Sep-92	1215.8	-10.9	118	
29-Sep-92	1215.0	-11.7	124	
14-Oct-92	1214.0	-12.7	139	
21-Oct-92	1216.0	-10.7	146	upstream movement
end of records				

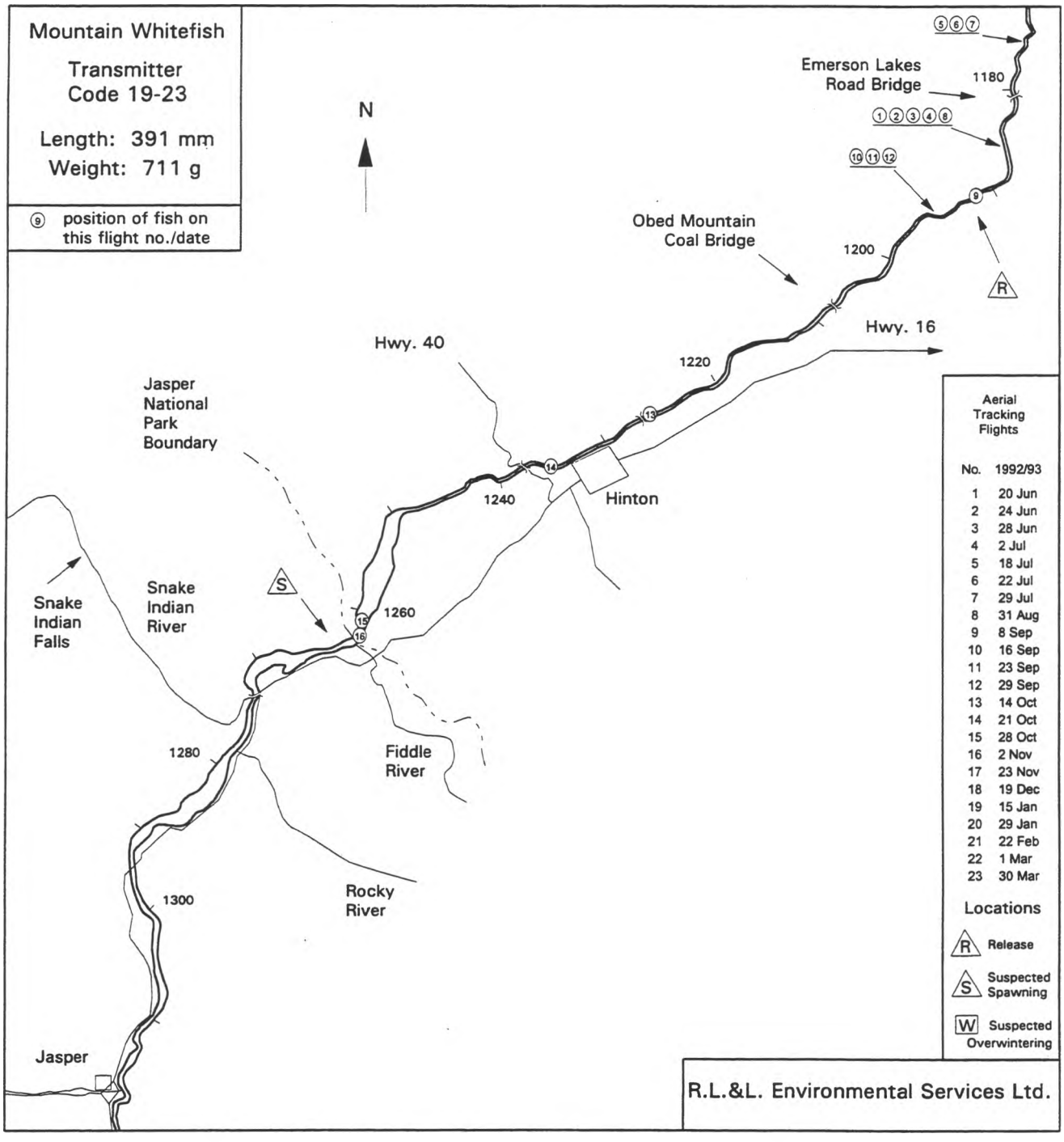


Appendix B, Figure B11. Locations of a mountain whitefish (code 4-5) in the upper Athabasca River, monitored by aerial tracking from May 1992 to July 1992.

Appendix B, Table B11. Signal acquisition, location of signal, movements, and days-at-large for a mountain whitefish (Tag 4-5) from the Athabasca River, May to July 1992.

Release Date: 25-May-92
Release Location: 1239.5

Signal Acquisition	Location (Km)	Distance from Release	Days at Large	Comment/Suspected Habitat Use
20-Jun-92	1237.5	-2.0	26	
24-Jun-92	1238.0	-1.5	30	
28-Jun-92	1237.5	-2.0	34	
02-Jul-92	1238.0	-1.5	38	
end of records				

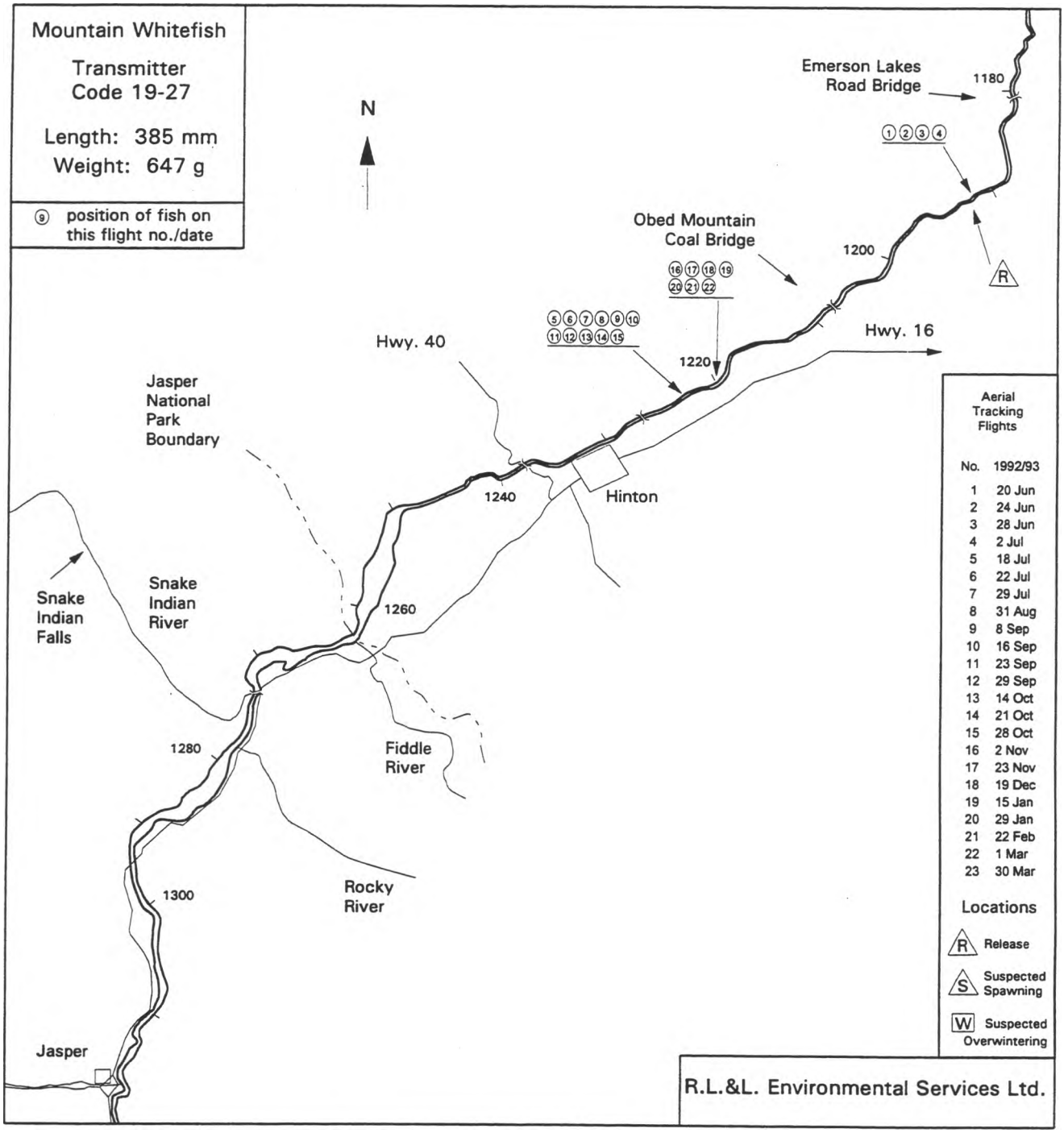


Appendix B, Figure B12. Locations of a mountain whitefish (code 19-23) in the upper Athabasca River, monitored by aerial tracking from June 1992 to November 1992.

Appendix B, Table B12. Signal acquisition, location of signal, movements, and days-at-large for a mountain whitefish (Tag 19-23) from the Athabasca River, June to November 1992.

Release Date: 11-Jun-92
Release Location: 1192.0

Signal Acquisition	Location (Km)	Distance from Release	Days at Large	Comment/Suspected Habitat Use
20-Jun-92	1187.0	-5.0	9	
24-Jun-92	1184.0	-8.0	13	
28-Jun-92	1184.0	-8.0	17	
02-Jul-92	1186.0	-6.0	21	
18-Jul-92	1177.6	-14.4	37	
22-Jul-92	1177.8	-14.2	41	
29-Jul-92	1177.0	-15.0	48	
31-Aug-92	1187.0	-5.0	81	
08-Sep-92	1192.0	0.0	89	
16-Sep-92	1194.5	2.5	97	
23-Sep-92	1194.5	2.5	104	
29-Sep-92	1194.5	2.5	110	
14-Oct-92	1226.0	34.0	125	
21-Oct-92	1235.2	43.2	132	
22-Oct-92	1239.5	47.5	133	at ground station
28-Oct-92	1261.2	69.2	139	spawning habitat?
02-Nov-92	1261.8	69.8	144	spawning habitat?
15-Nov-92	1239.5	47.5	157	at ground station
end of records				

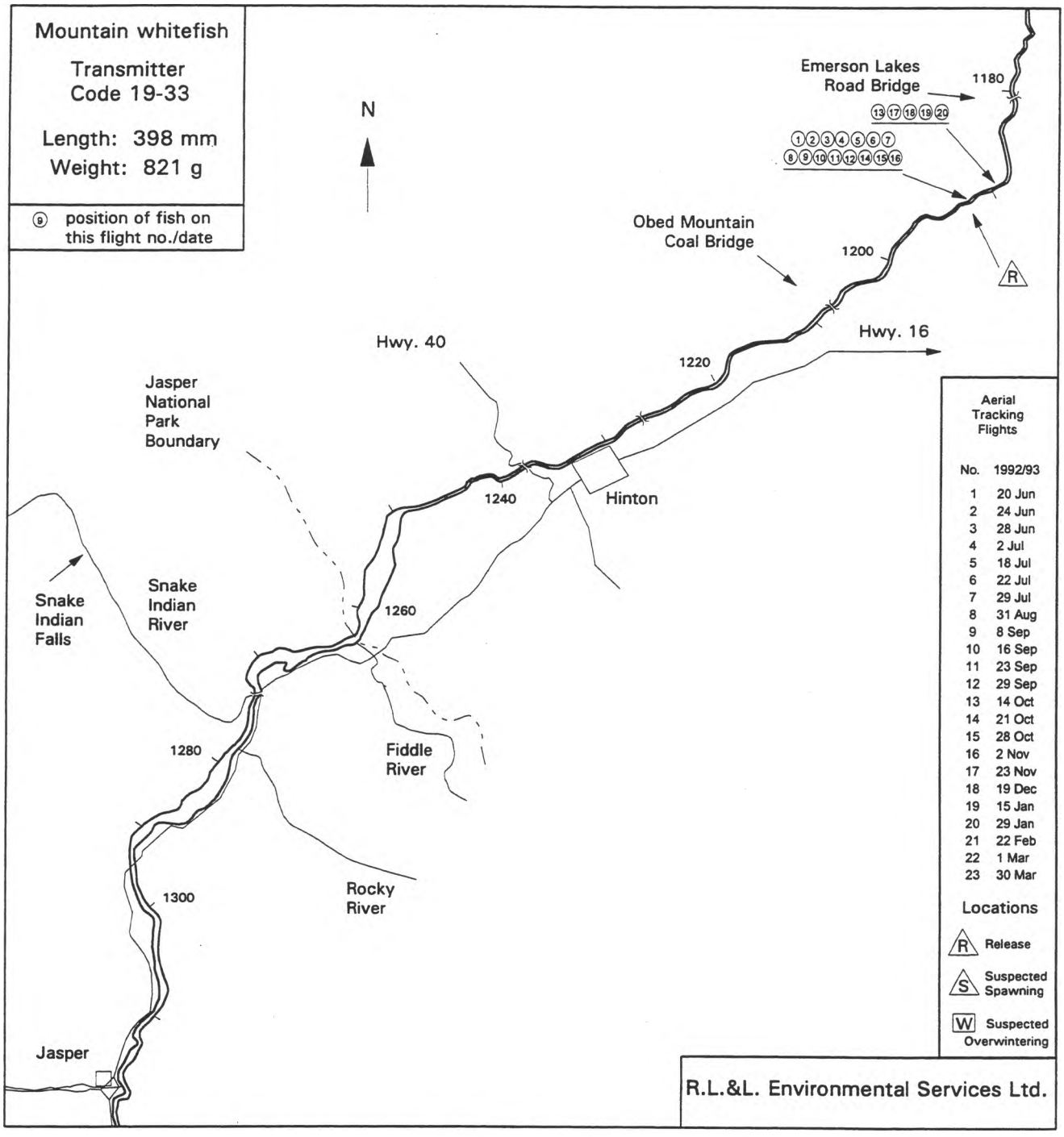


Appendix B, Figure B13. Locations of a mountain whitefish (code 19-27) in the upper Athabasca River, monitored by aerial tracking from June 1992 to March 1993.

Appendix B, Table B13. Signal acquisition, location of signal, movements, and days-at-large for a mountain whitefish (Tag 19-27) from the Athabasca River, June 1992 to March 1993.

Release Date: 11-Jun-92
Release Location: 1192.0

Signal Acquisition	Location (Km)	Distance from Release	Days at Large	Comment/Suspected Habitat Use
20-Jun-92	1192.0	0.0	9	
24-Jun-92	1191.0	-1.0	13	
28-Jun-92	1192.0	0.0	17	
02-Jul-92	1191.8	-0.2	21	
18-Jul-92	1224.0	32.0	37	
22-Jul-92	1224.0	32.0	41	
29-Jul-92	1223.0	31.0	48	
31-Aug-92	1222.0	30.0	81	
08-Sep-92	1223.0	31.0	89	
16-Sep-92	1224.0	32.0	97	
23-Sep-92	1224.5	32.5	104	
29-Sep-92	1224.0	32.0	110	
14-Oct-92	1224.0	32.0	125	
21-Oct-92	1224.6	32.6	132	
28-Oct-92	1225.0	33.0	139	
02-Nov-92	1219.6	27.6	144	
23-Nov-92	1219.6	27.6	165	mainstem overwintering
19-Dec-92	1220.0	28.0	191	mainstem overwintering
15-Jan-93	1221.0	29.0	218	mainstem overwintering
29-Jan-93	1220.0	28.0	232	mainstem overwintering
22-Feb-93	1220.8	28.8	256	mainstem overwintering
01-Mar-93	1219.7	27.7	263	mainstem overwintering
end of records				

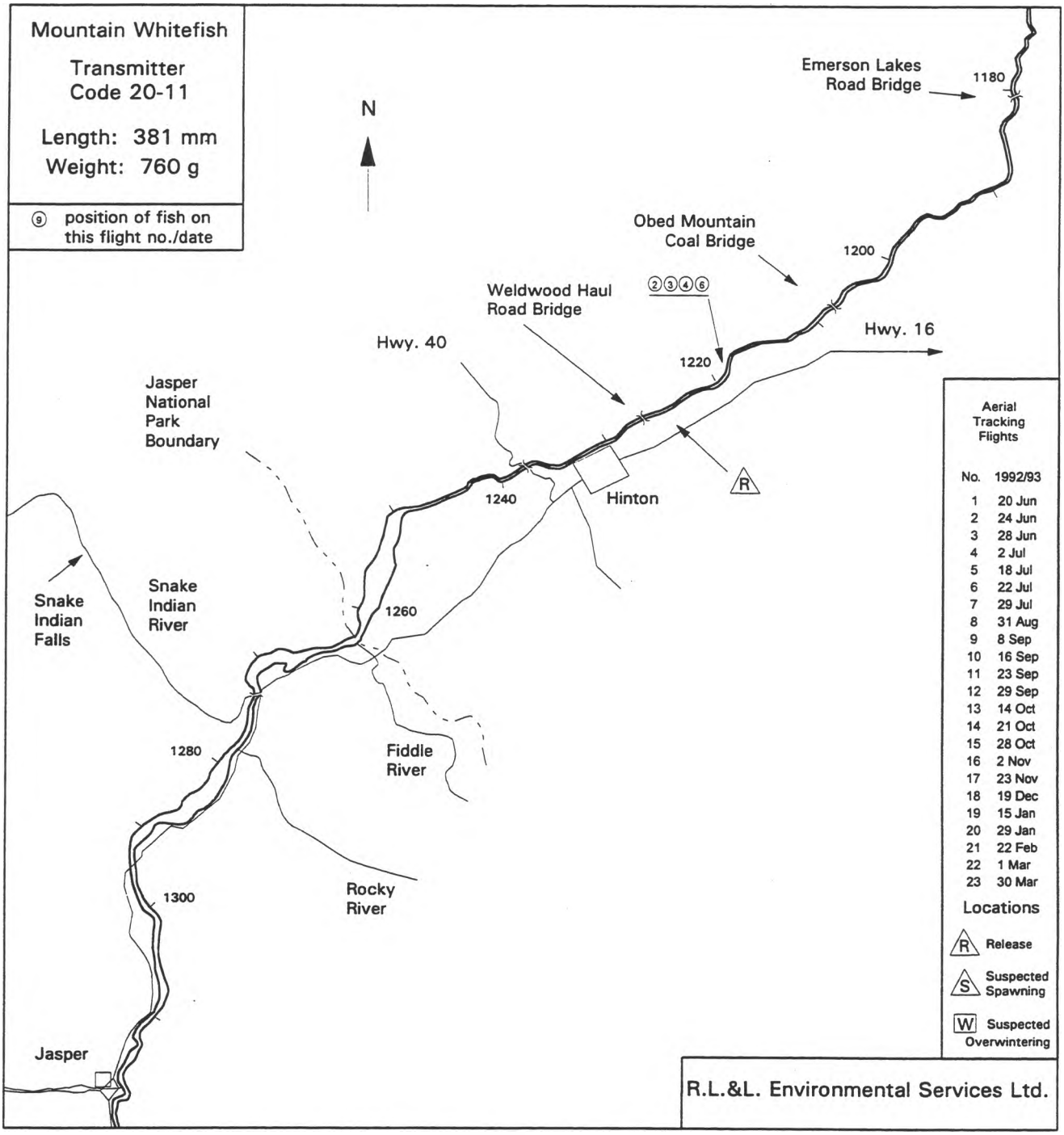


Appendix B, Figure B14. Locations of a mountain whitefish (code 19-33) in the upper Athabasca River, monitored by aerial tracking from June 1992 to January 1993.

Appendix B, Table B14. Signal acquisition, location of signal, movements, and days-at-large for a mountain whitefish (Tag 19-33) from the Athabasca River, June 1992 to January 1993.

Release Date: 10-Jun-92
Release Location: 1192.0

Signal Acquisition	Location (Km)	Distance from Release	Days at Large	Comment/Suspected Habitat Use
20-Jun-92	1192.0	0.0	10	
24-Jun-92	1191.0	-1.0	14	
28-Jun-92	1192.0	0.0	18	
02-Jul-92	1191.8	-0.2	22	
18-Jul-92	1192.0	0.0	38	
22-Jul-92	1192.2	0.2	42	
29-Jul-92	1192.0	0.0	49	
31-Aug-92	1193.0	1.0	82	
08-Sep-92	1191.0	-1.0	90	
16-Sep-92	1191.0	-1.0	98	
23-Sep-92	1191.0	-1.0	105	
29-Sep-92	1191.0	-1.0	111	
14-Oct-92	1190.0	-2.0	126	
21-Oct-92	1192.0	0.0	133	
28-Oct-92	1191.3	-0.7	140	tag shed or fish mortality ?
02-Nov-92	1191.0	-1.0	145	tag shed or fish mortality ?
23-Nov-92	1190.5	-1.5	166	tag shed or fish mortality ?
19-Dec-92	1190.5	-1.5	192	tag shed or fish mortality ?
15-Jan-93	1189.0	-3.0	219	tag shed or fish mortality ?
29-Jan-93	1189.0	-3.0	233	tag shed or fish mortality ?
end of records				

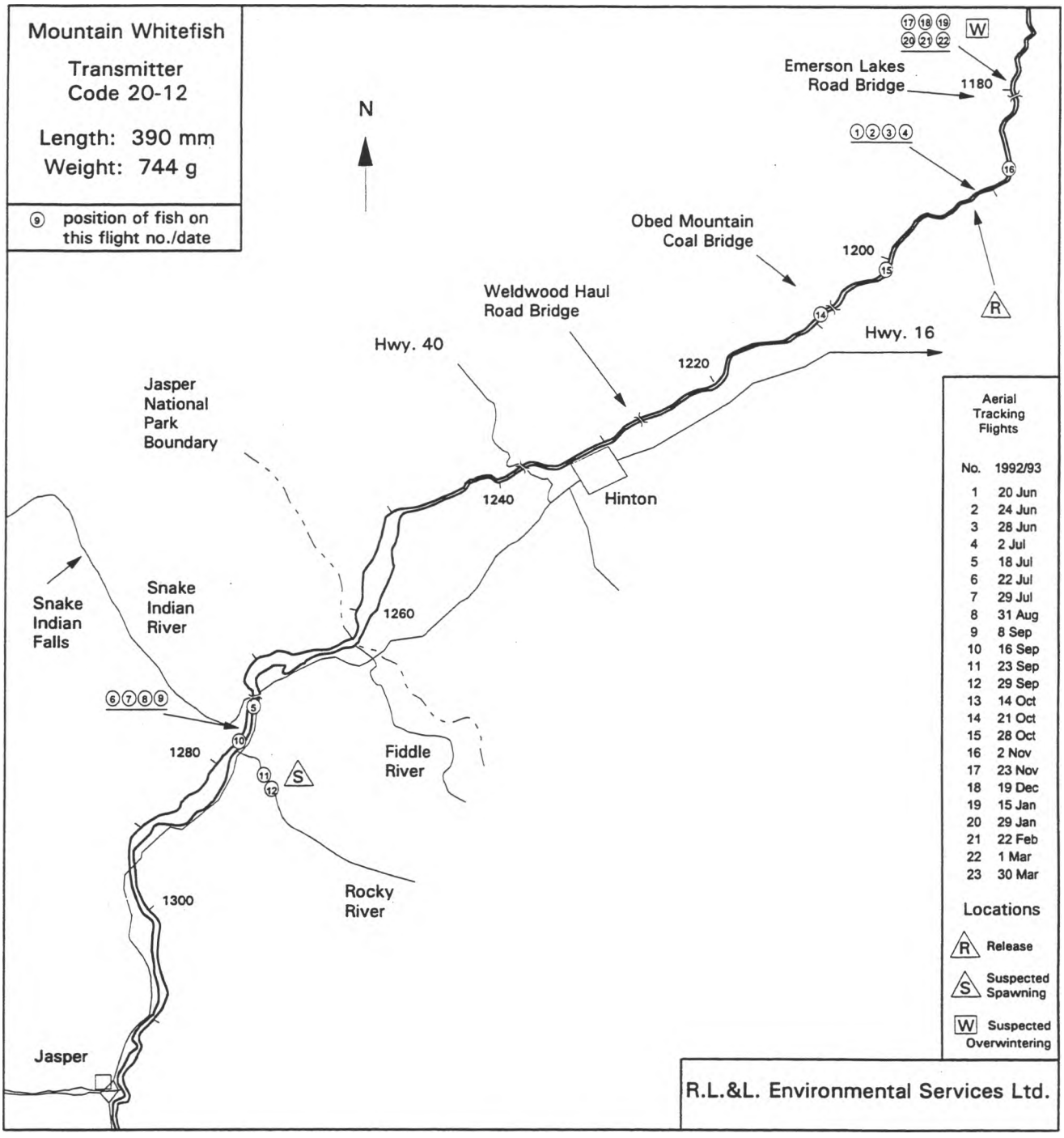


Appendix B, Figure B15. Locations of a mountain whitefish (code 20-11) in the upper Athabasca River, monitored by aerial tracking from June 1992 to July 1992.

Appendix B, Table B15. Signal acquisition, location of signal, movements, and days-at-large for a mountain whitefish (Tag 20-11) from the Athabasca River, June to July 1992.

Release Date: 09-Jun-92
Release Location: 1226.7

Signal Acquisition	Location (Km)	Distance from Release	Days at Large	Comment/Suspected Habitat Use
20-Jun-92		transmitter not located		
24-Jun-92	1219.0	-7.7	15	
28-Jun-92	1219.0	-7.7	19	transmitter shed?
02-Jul-92	1219.0	-7.7	23	transmitter shed?
18-Jul-92		transmitter not located		
22-Jul-92	1219.0	-7.7	43	transmitter shed?
end of records				

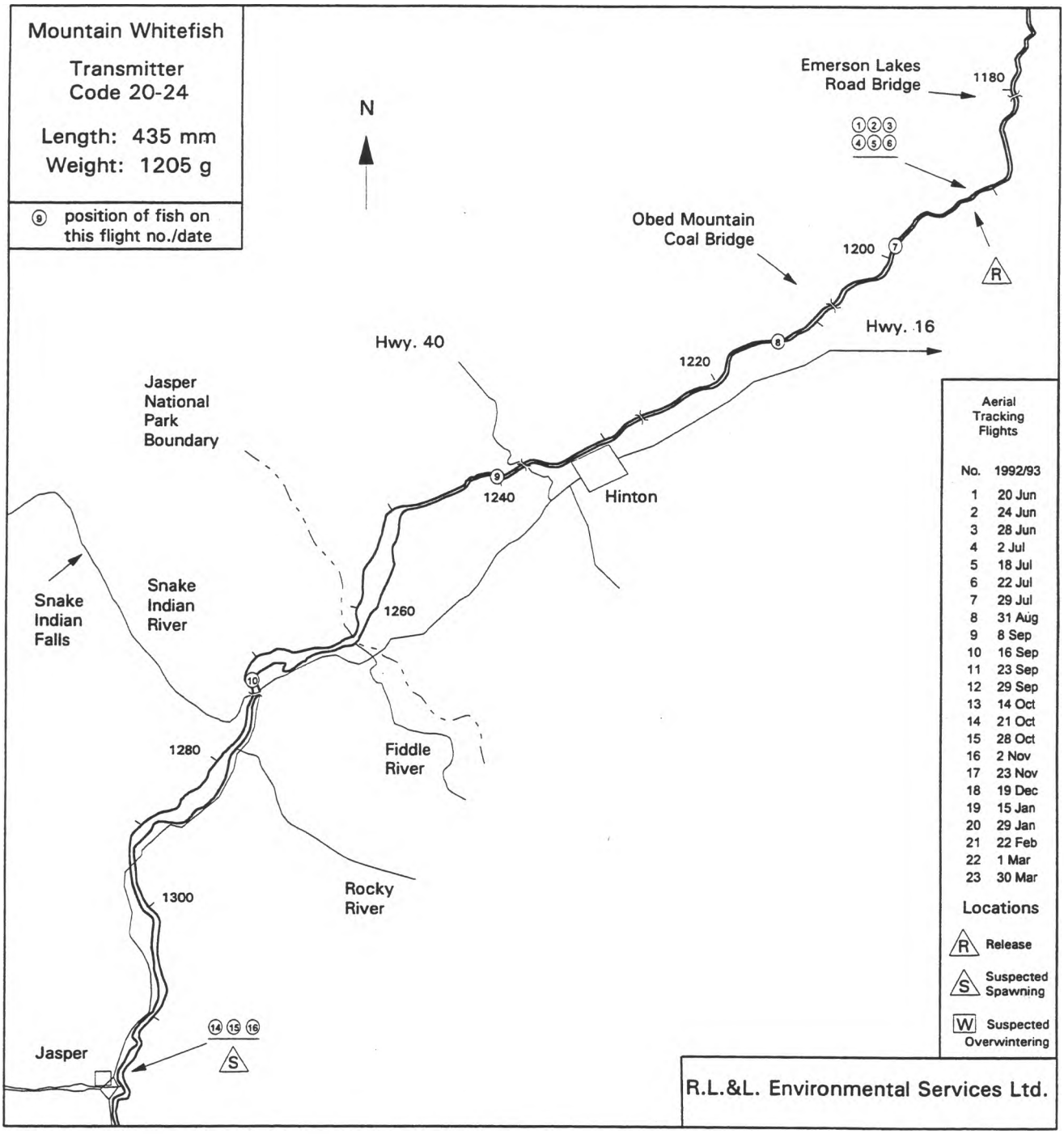


Appendix B, Figure B16. Locations of a mountain whitefish (code 20-12) in the upper Athabasca River, monitored by aerial tracking from June 1992 to March 1993.

Appendix B, Table B16. Signal acquisition, location of signal, movements, and days-at-large for a mountain whitefish (Tag 20-12) from the Athabasca River, June 1992 to March 1993.

Release Date: 11-Jun-92
Release Location: 1192.0

Signal Acquisition	Location (Km)	Movement	Days at Large	Comment/Suspected Habitat Use
20-Jun-92	1192.0	0.0	9	
24-Jun-92	1191.0	-1.0	13	
28-Jun-92	1192.0	0.0	17	
02-Jul-92	1192.0	0.0	21	
13-Jul-92	1239.5	47.5	32	at ground station
18-Jul-92	1274.0	82.0	37	
22-Jul-92	1276.4	84.4	41	Rocky R. side channel
29-Jul-92	1276.4	84.4	48	Rocky R. side channel
31-Aug-92	1276.4	84.4	81	Rocky R. side channel
08-Sep-92	1276.4	84.4	89	Rocky R. side channel
16-Sep-92	1277.6	85.6	97	
23-Sep-92	3.0	88.6	104	in Rocky River; spawning?
29-Sep-92	4.0	89.6	110	in Rocky River; spawning?
14-Oct-92	transmitter not located			
17-Oct-92	1239.5	47.5	128	at ground station
21-Oct-92	1209.1	17.1	132	
28-Oct-92	1201.5	9.5	139	
02-Nov-92	1187.2	-4.8	144	
23-Nov-92	1179.7	-12.3	165	
19-Dec-92	1180.3	-11.7	191	
15-Jan-93	1180.1	-11.9	218	
29-Jan-93	1179.2	-12.8	232	
22-Feb-93	1179.9	-12.1	256	
01-Mar-93	1179.8	-12.2	263	
end of records				

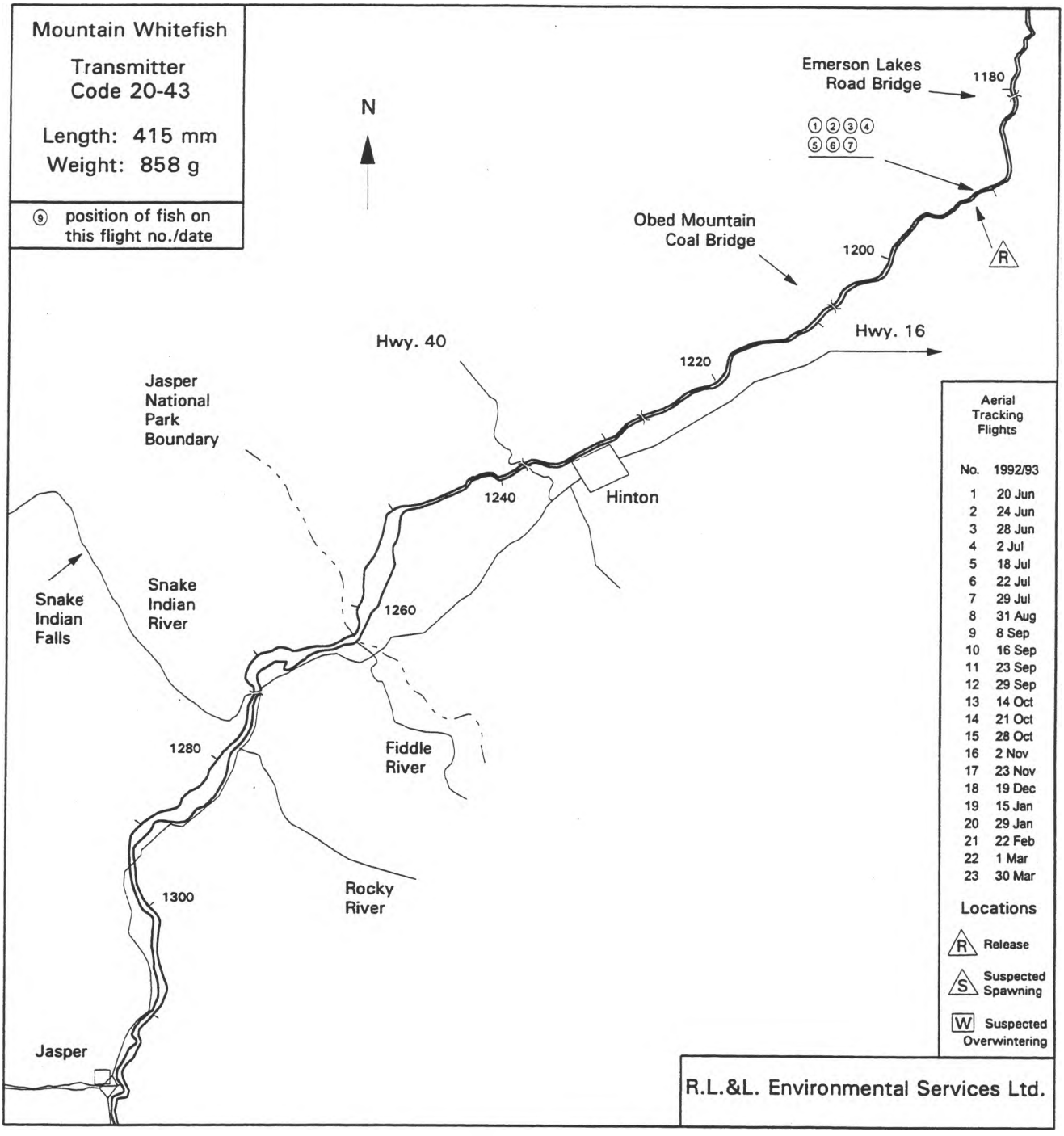


Appendix B, Figure B17. , Locations of a mountain whitefish (code 20-24) in the upper Athabasca River, monitored by aerial tracking from June 1992 to November 1992.

Appendix B, Table B17. Signal acquisition, location of signal, movements, and days-at-large for a mountain whitefish (Tag 20-24) from the Athabasca River, June to November 1992.

Release Date: 10-Jun-92
Release Location: 1192.0

Signal Acquisition	Location (Km)	Distance from Release	Days at Large	Comment/Suspected Habitat Use
20-Jun-92	1192.0	0.0	10	
24-Jun-92	1191.0	-1.0	14	
28-Jun-92	1192.0	0.0	18	
02-Jul-92	1192.0	0.0	22	
18-Jul-92	1193.0	1.0	38	
22-Jul-92	1193.0	1.0	42	
29-Jul-92	1199.5	7.5	49	
31-Aug-92	1214.0	22.0	82	
07-Sep-92	1239.5	47.5	89	at ground station
08-Sep-92	1240.0	48.0	90	
16-Sep-92	1272.0	80.0	98	
23-Sep-92		transmitter not located		
29-Sep-92		transmitter not located		
14-Oct-92		transmitter not located		
21-Oct-92	1314.0	122.0	133	spawning in vicinity?
28-Oct-92	1314.0	122.0	140	spawning in vicinity?
02-Nov-92	1314.0	122.0	145	
end of records				

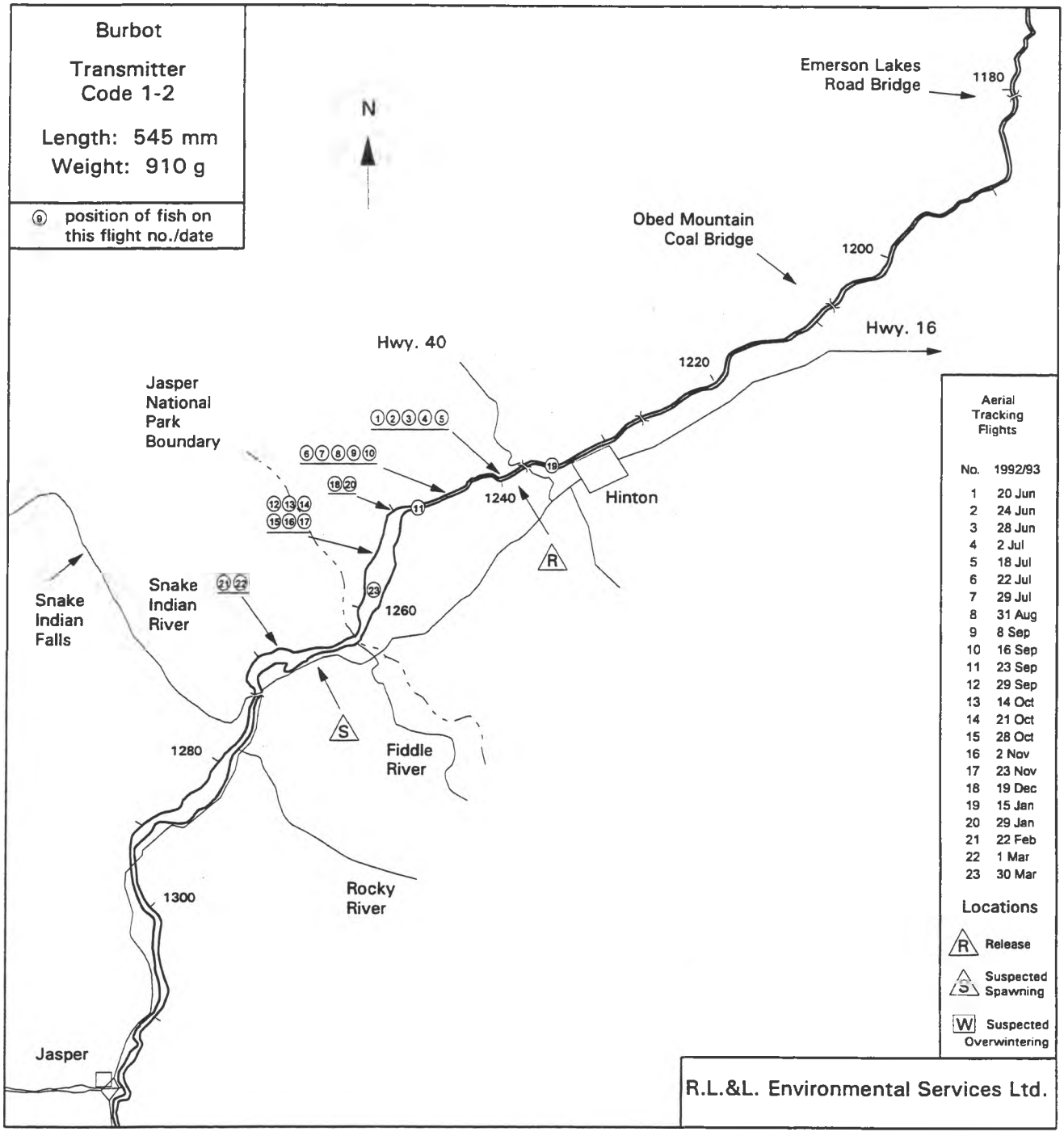


Appendix B, Figure B18. Locations of a mountain whitefish (code 20-43) in the upper Athabasca River, monitored by aerial tracking from June 1992 to July 1992.

Appendix B, Table B18. Signal acquisition, location of signal, movements, and days-at-large for a mountain whitefish (Tag 20-43) from the Athabasca River, June to July 1992.

Release Date: 10-Jun-92
Release Location: 1192.0

Signal Acquisition	Location (Km)	Distance from Release	Days at Large	Comment/Suspected Habitat Use
20-Jun-92	1192.0	0.0	10	transmitter shed?
24-Jun-92	1191.0	-1.0	14	transmitter shed?
28-Jun-92	1192.0	0.0	18	transmitter shed?
02-Jul-92	1192.0	0.0	22	transmitter shed?
18-Jul-92	1192.0	0.0	38	transmitter shed?
22-Jul-92	1191.1	-0.9	42	transmitter shed?
29-Jul-92	1192.0	0.0	49	transmitter shed?
end of records				

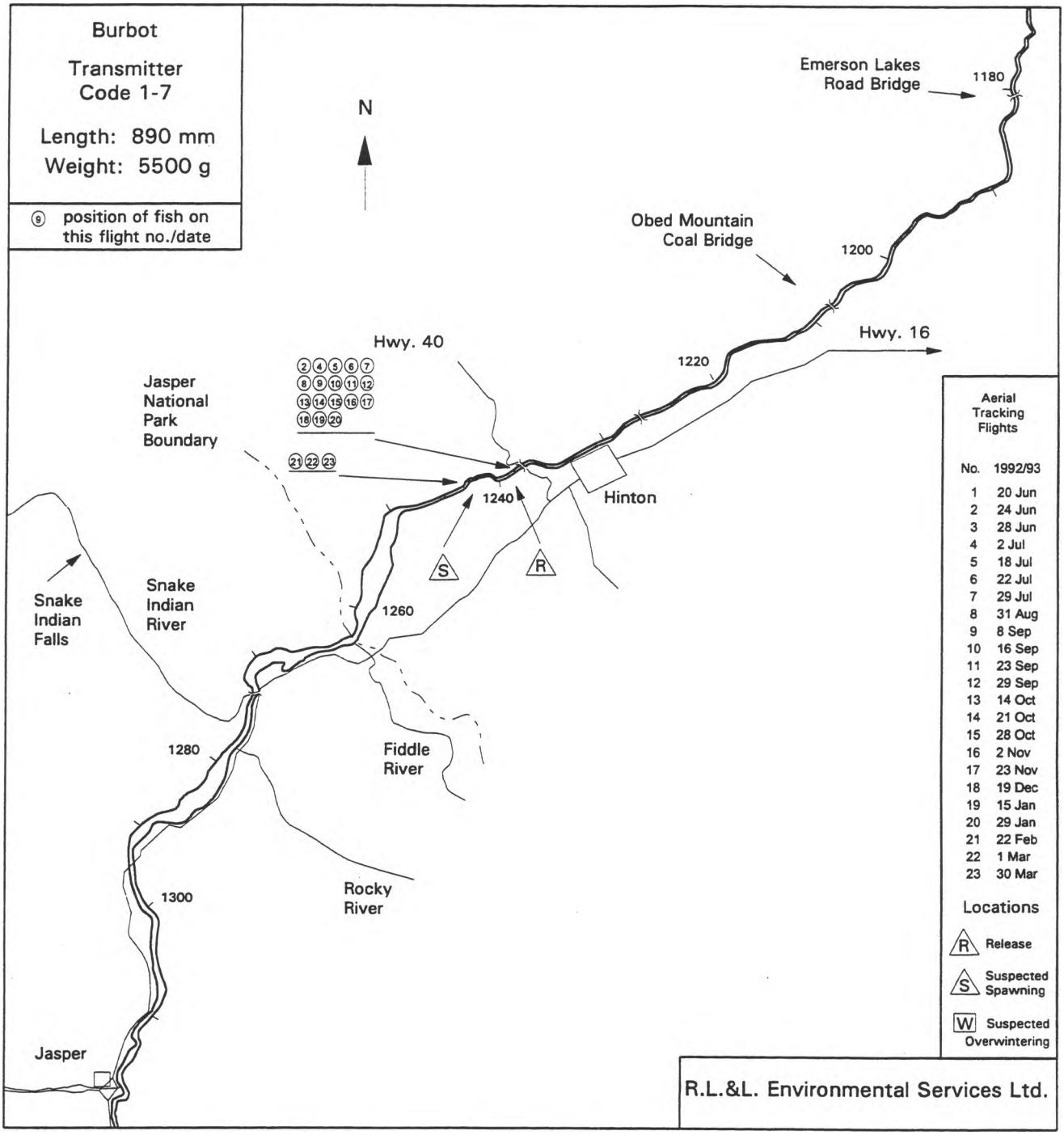


Appendix B, Figure B19. Locations of a burbot (code 1-2) in the upper Athabasca River, monitored by aerial tracking from May 1992 to March 1993.

Appendix B, Table B19. Signal acquisition, location of signal, movements, and days-at-large for a burbot (Tag 1-2) from the Athabasca River, May 1992 to March 1993.

Release Date: 25-May-92
Release Location: 1239.5

Signal Acquisition	Location (Km)	Distance from Release	Days at Large	Comment/Suspected Habitat Use
20-Jun-92	1239.0	-0.5	26	
24-Jun-92	1240.0	0.5	30	
28-Jun-92	1239.0	-0.5	34	
02-Jul-92	1239.0	-0.5	38	
18-Jul-92	1239.5	0.0	54	
22-Jul-92	1244.0	4.5	58	
29-Jul-92	1244.0	4.5	65	
31-Aug-92	1245.0	5.5	98	
08-Sep-92	1245.0	5.5	106	
16-Sep-92	1246.0	6.5	114	
23-Sep-92	1248.6	9.1	121	
29-Sep-92	1253.7	14.2	127	
14-Oct-92	1253.0	13.5	142	
21-Oct-92	1253.9	14.4	149	
28-Oct-92	1254.0	14.5	156	
02-Nov-92	1256.0	16.5	161	
23-Nov-92	1255.7	16.2	182	
19-Dec-92	1249.9	10.4	208	
01-Jan-93	1239.5	0.0	221	at fixed station
15-Jan-93	1236.8	-2.7	235	
20-Jan-93	1239.5	0.0	240	at fixed station
29-Jan-93	1249.9	10.4	249	
22-Feb-93	1267.5	28.0	273	spawning in area?
01-Mar-93	1267.6	28.1	280	spawning in area?
30-Mar-93	1258.0	18.5	309	
end of records				

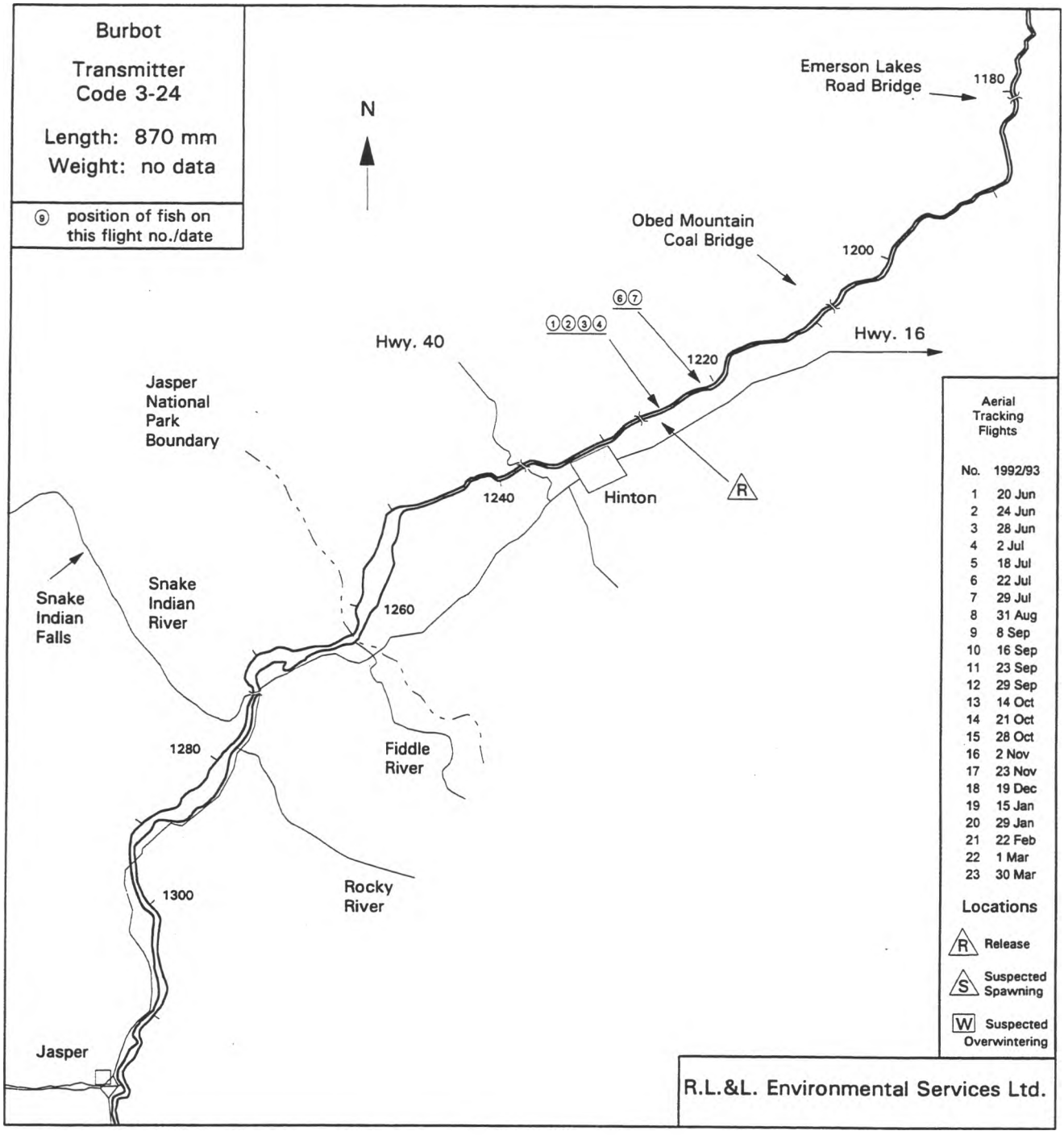


Appendix B, Figure B20. Locations of a burbot (code 1-7) in the upper Athabasca River, monitored by aerial tracking from May 1992 to March 1993.

Appendix B, Table B20. Signal acquisition, location of signal, movements, and days-at-large for a burbot (Tag 1-7) from the Athabasca River, May 1992 to March 1993.

Release Date: 27-May-92
Release Location: 1239.5

Signal Acquisition	Location (Km)	Distance from Release	Days at Large	Comment/Suspected Habitat Use
20-Jun-92	transmitter not located		24	
24-Jun-92	1238.0	-1.5	28	
28-Jun-92	transmitter not located		32	
02-Jul-92	1238.0	-1.5	36	
18-Jul-92	1238.0	-1.5	52	
22-Jul-92	1237.2	-2.3	56	
29-Jul-92	1237.0	-2.5	63	
31-Aug-92	1238.0	-1.5	96	
08-Sep-92	1238.0	-1.5	104	
16-Sep-92	1238.0	-1.5	112	
23-Sep-92	1237.5	-2.0	119	
29-Sep-92	1237.4	-2.1	125	
14-Oct-92	1237.5	-2.0	140	
21-Oct-92	1237.2	-2.3	147	
28-Oct-92	1237.5	-2.0	154	
02-Nov-92	1237.4	-2.1	159	
23-Nov-92	1237.4	-2.1	180	
19-Dec-92	1237.0	-2.5	206	
15-Jan-93	1236.8	-2.7	233	
29-Jan-93	1237.1	-2.4	247	
05-Feb-93	1239.5	0.0	254	at fixed station
22-Feb-93	1241.9	2.4	271	spawning area?
01-Mar-93	1243.1	3.6	278	spawning area?
30-Mar-93	1241.8	2.3	307	
end of records				

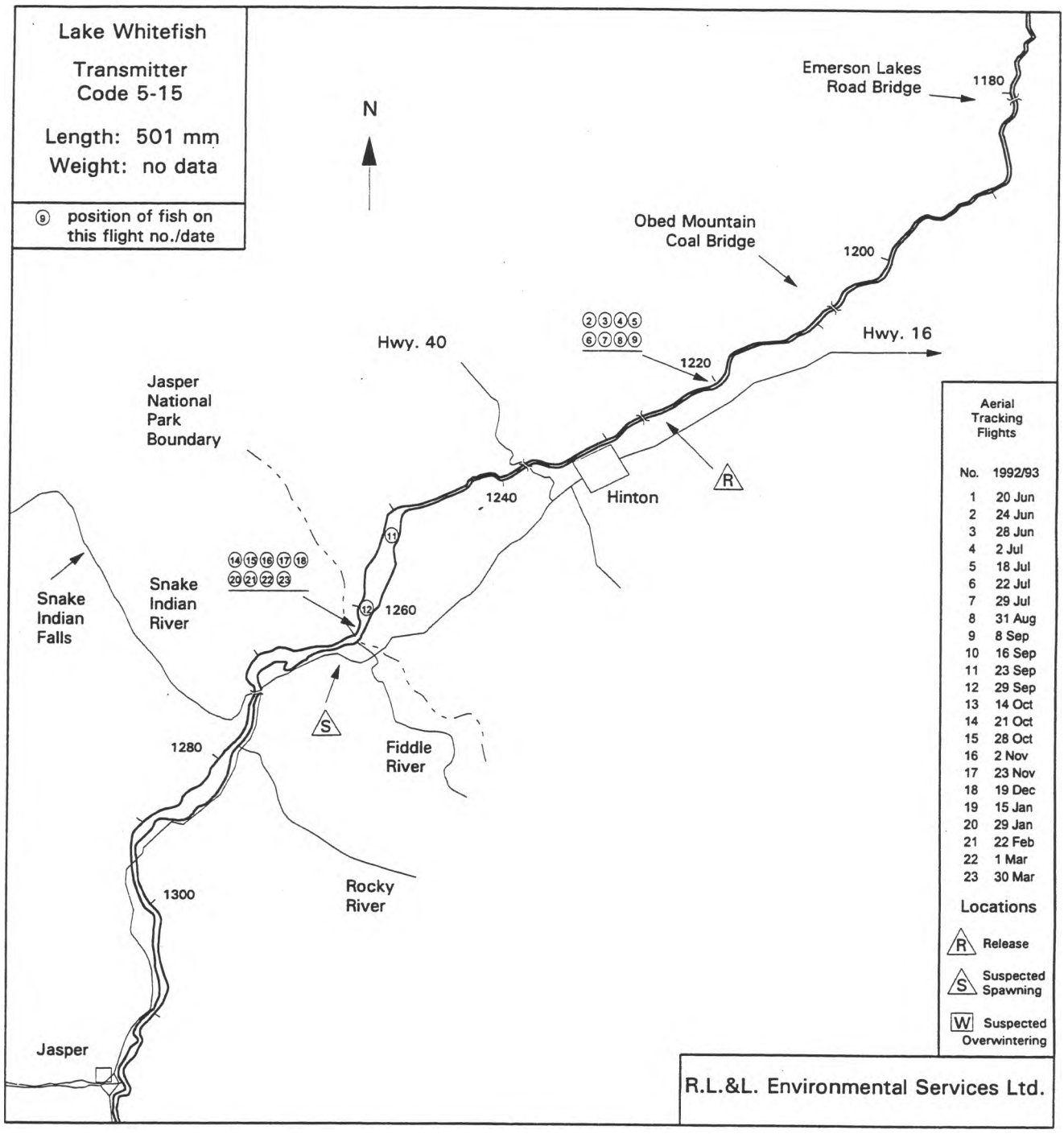


Appendix B, Figure B21. Locations of a burbot (code 3-24) in the upper Athabasca River, monitored by aerial tracking from May 1992 to July 1992.

Appendix B, Table B21. Signal acquisition, location of signal, movements, and days-at-large for a burbot (Tag 3-24) from the Athabasca River, May to July 1992.

Release Date: 28-May-92
Release Location: 1226.7

Signal Acquisition	Location (Km)	Distance from Release	Days at Large	Comment/Suspected Habitat Use
20-Jun-92	1225.0	-1.7	23	
24-Jun-92	1224.0	-2.7	27	
28-Jun-92	1225.0	-1.7	31	
02-Jul-92	1226.5	-0.2	35	
18-Jul-92	transmitter not located		51	
22-Jul-92	1221.5	-5.2	55	
29-Jul-92	1221.0	-5.7	62	
end of records				

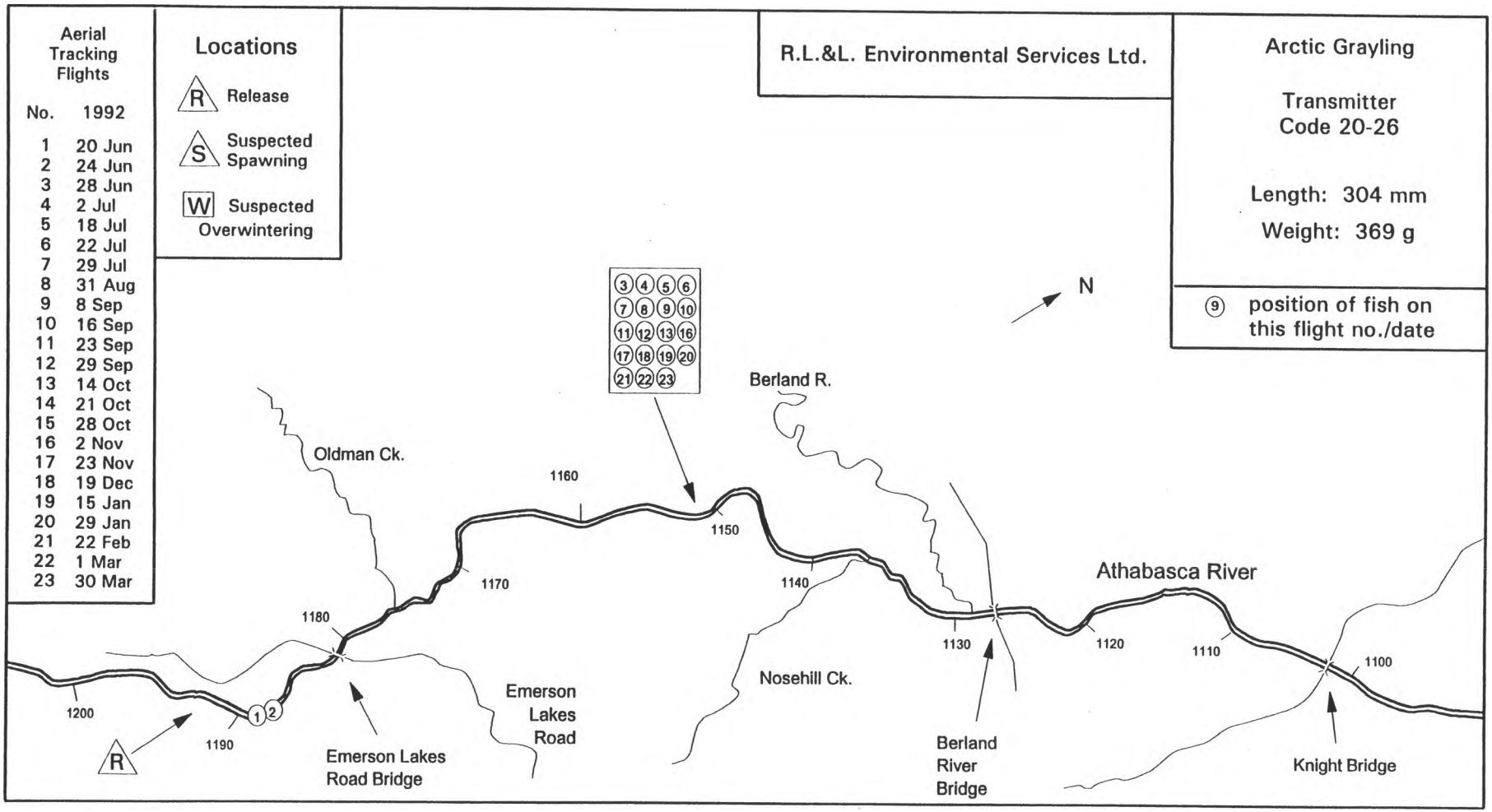


Appendix B, Figure B22. Locations of a lake whitefish (code 5-15) in the upper Athabasca River, monitored by aerial tracking from May 1992 to March 1993.

Appendix B, Table B22. Signal acquisition, location of signal, movements, and days-at-large for a lake whitefish (Tag 5-15) from the Athabasca River, May 1992 to March 1993.

Release Date: 28-May-92
Release Location: 1226.7

Signal Acquisition	Location (Km)	Distance from Release	Days at Large	Comment/Suspected Habitat Use
20-Jun-92	transmitter not located		23	
24-Jun-92	1221.0	-5.7	27	
28-Jun-92	1220.0	-6.7	31	
02-Jul-92	1220.0	-6.7	35	
18-Jul-92	1220.0	-6.7	51	
22-Jul-92	1221.0	-5.7	55	
29-Jul-92	1220.0	-6.7	62	
31-Aug-92	1220.0	-6.7	95	
08-Sep-92	1220.0	-6.7	103	
16-Sep-92	transmitter not located		111	
23-Sep-92	1253.6	26.9	118	
29-Sep-92	1260.0	33.3	124	
14-Oct-92	transmitter not located		139	
21-Oct-92	1262.8	36.1	146	
28-Oct-92	1261.4	34.7	153	
02-Nov-92	1261.4	34.7	158	transmitter shed?
23-Nov-92	1262.1	35.4	179	transmitter shed?
19-Dec-92	1262.0	35.3	205	transmitter shed?
15-Jan-93	transmitter not located		232	transmitter shed?
29-Jan-93	1262.0	35.3	246	transmitter shed?
22-Feb-93	1261.8	35.1	270	transmitter shed?
01-Mar-93	1261.8	35.1	277	transmitter shed?
30-Mar-93	1261.9	35.2	306	transmitter shed?
end of records				

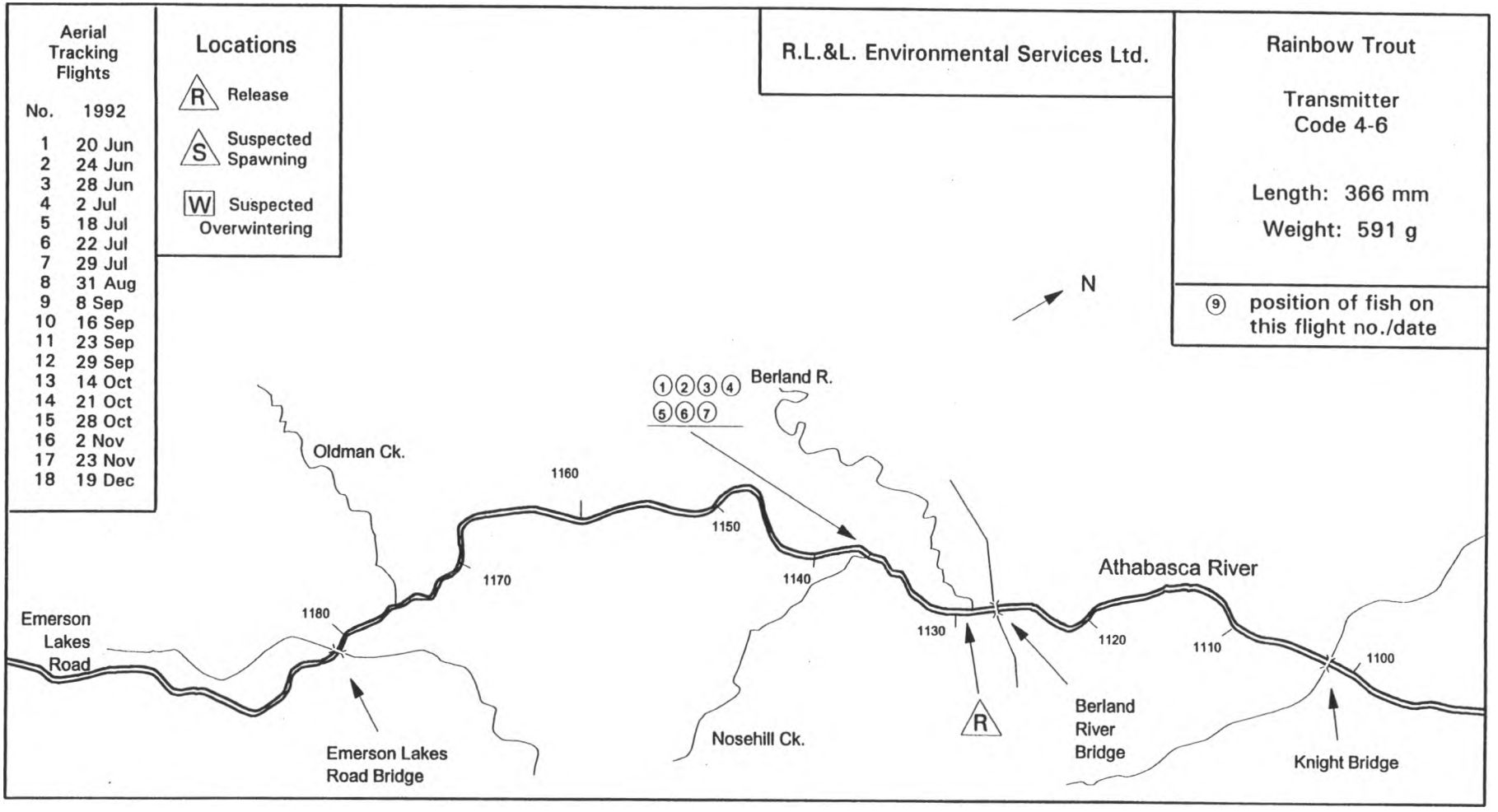


Appendix B, Figure B23. Locations of an Arctic grayling (code 20-26) in the upper Athabasca River, monitored by aerial tracking from June 1992 to March 1993.

Appendix B, Table B23. Signal acquisition, location of signal, movements, and days-at-large for an Arctic grayling (Tag 20-26) from the Athabasca River, June 1992 to March 1993.

Release Date: 11-Jun-92
Release Location: 1192.0

Signal Acquisition	Location (Km)	Distance from Release	Days at Large	Comment/Suspected Habitat Use
20-Jun-92	1188.5	-3.5	9	
24-Jun-92	1188.0	-4.0	13	
28-Jun-92	1153.0	-39.0	17	
02-Jul-92	1153.0	-39.0	21	transmitter shed?
18-Jul-92	1152.8	-39.2	37	transmitter shed?
22-Jul-92	1152.8	-39.2	41	transmitter shed?
29-Jul-92	1152.8	-39.2	48	transmitter shed?
31-Aug-92	1152.8	-39.2	81	transmitter shed?
08-Sep-92	1152.8	-39.2	89	transmitter shed?
16-Sep-92	1153.0	-39.0	97	transmitter shed?
23-Sep-92	1152.3	-39.7	104	transmitter shed?
29-Sep-92	1152.5	-39.5	110	transmitter shed?
14-Oct-92	1151.0	-41.0	125	transmitter shed?
21-Oct-92	transmitter not located		132	transmitter shed?
28-Oct-92	transmitter not located		139	transmitter shed?
02-Nov-92	1152.3	-39.7	144	transmitter shed?
23-Nov-92	1152.9	-39.1	165	transmitter shed?
19-Dec-92	1152.8	-39.2	191	transmitter shed?
15-Jan-93	1152.8	-39.2	218	transmitter shed?
29-Jan-93	1153.3	-38.7	232	transmitter shed?
22-Feb-93	1153.3	-38.7	256	transmitter shed?
01-Mar-93	1153.0	-39.0	263	transmitter shed?
30-Mar-93	1153.2	-38.8	292	transmitter shed?
end of records				

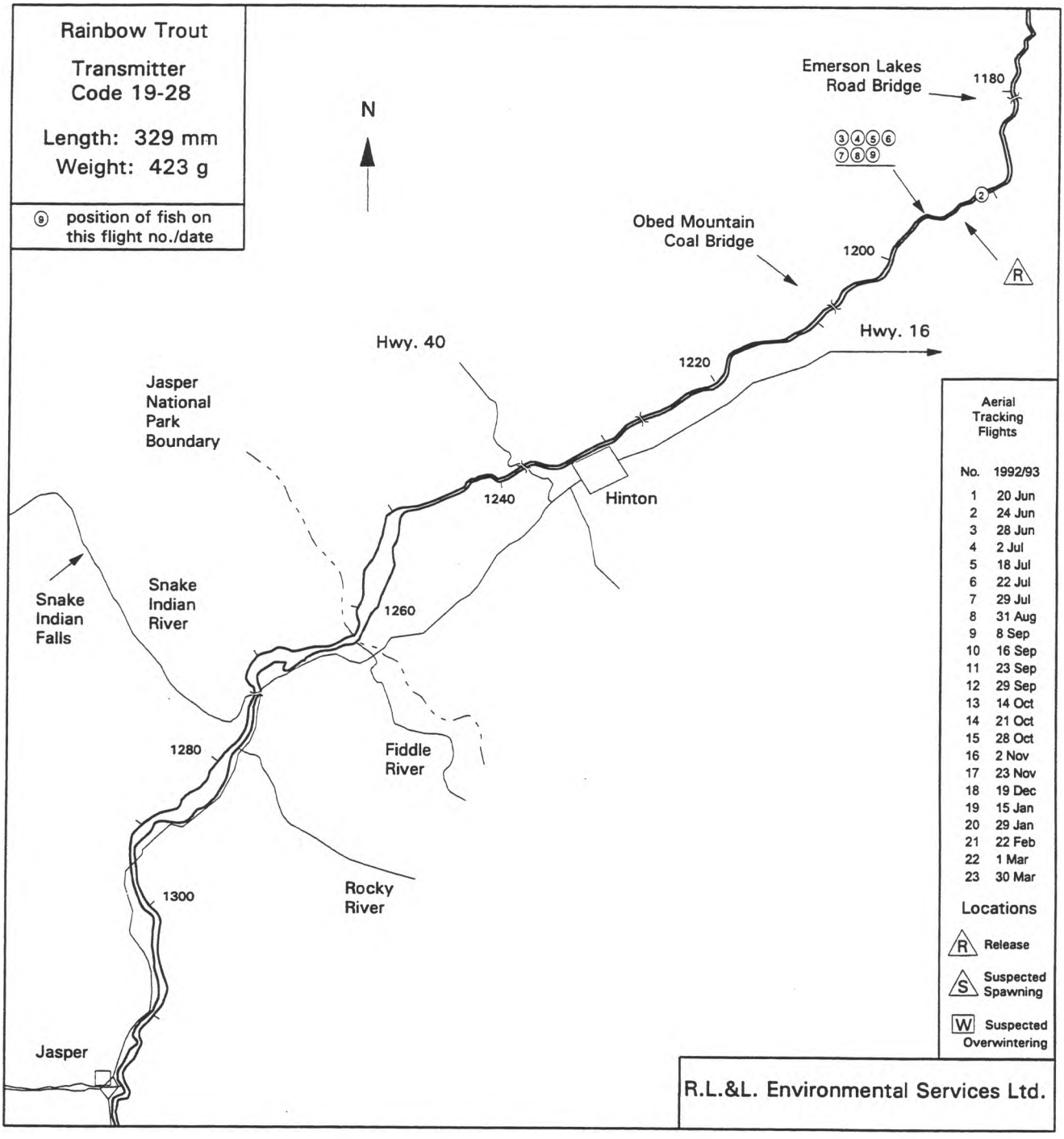


Appendix B, Figure B24. Locations of a rainbow trout (code 4-6) in the upper Athabasca River, monitored by aerial tracking from June 1992 to July 1992.

Appendix B, Table B24. Signal acquisition, location of signal, movements, and days-at-large for a rainbow trout (Tag 4-6) from the Athabasca River, May to July 1992.

Release Date: 29-May-92
Release Location: 1129.3

Signal Acquisition	Location (Km)	Distance from Release	Days at Large	Comment/Suspected Habitat Use
20-Jun-92	1137.5	8.2	22	
24-Jun-92	1137.0	7.7	26	
28-Jun-92	1138.0	8.7	30	
02-Jul-92	1137.5	8.2	34	
18-Jul-92	1137.7	8.4	50	
22-Jul-92	1138.1	8.8	54	
29-Jul-92	1138.1	8.8	61	
end of records				



Appendix B, Figure B25. Locations of a rainbow trout (code 19-28) in the upper Athabasca River, monitored by aerial tracking from June 1992 to September 1992.

Appendix B, Table B25. Signal acquisition, location of signal, movements, and days-at-large for a rainbow trout (Tag 19-28) from the Athabasca River, June to September 1992.

Release Date: 10-Jun-92
Release Location: 1192.0

Signal Acquisition	Location (Km)	Distance from Release	Days at Large	Comment
20-Jun-92	transmitter not located		10	
24-Jun-92	1191.0	-1.0	14	
28-Jun-92	1194.5	2.5	18	
02-Jul-92	1194.5	2.5	22	
18-Jul-92	1194.0	2.0	38	
22-Jul-92	1194.0	2.0	42	
29-Jul-92	1193.5	1.5	49	
31-Aug-92	1195.0	3.0	82	
08-Sep-92	1193.0	1.0	90	
end of records				

APPENDIX C

RADIO TELEMETRY FLIGHT DATA

Appendix C, Table 1. List of radio transmitters and associated fish data.

Species	Channel	Code	Frequency	Length (mm)	Weight (g)	Release Date	Release	
							Km	Location
Burbot	1	2	148.850	545	910	25-May-92	1239.5	Fixed Station
Mountain Whitefish	1	3	148.850	393	n.d.*	29-May-92	1129.3	Berland River
Burbot	1	7	148.850	890	5500	27-May-92	1239.5	Fixed Station
Mountain Whitefish	2	11	148.950	429	n.d.*	28-May-92	1226.7	Weldwood Bridge
Burbot	2	13	148.950	580	n.d.*	29-May-92	1129.3	Berland River
Bull Trout	3	20	149.015	413	687	27-May-92	1239.5	Fixed Station
Mountain Whitefish	3	22	149.015	396	n.d.*	28-May-92	1226.7	Weldwood Bridge
Burbot	3	24	149.015	870	n.d.*	28-May-92	1226.7	Weldwood Bridge
Bull Trout	4	1	149.071	524	1458	25-May-92	1239.5	Fixed Station
Mountain Whitefish	4	2	149.071	393	787	25-May-92	1239.5	Fixed Station
Mountain Whitefish	4	3	149.071	407	n.d.*	28-May-92	1226.7	Weldwood Bridge
Mountain Whitefish	4	4	149.071	430	n.d.*	28-May-92	1226.7	Weldwood Bridge
Mountain Whitefish	4	5	149.071	403	911	25-May-92	1239.5	Fixed Station
Rainbow Trout	4	6	149.071	366	591	29-May-92	1129.3	Berland River
Mountain Whitefish	4	7	149.071	365	n.d.*	28-May-92	1226.7	Weldwood Bridge
Bull Trout	4	8	149.071	519	1470	25-May-92	1239.5	Fixed Station
Burbot	5	9	149.251	573	946	27-May-92	1239.5	Fixed Station
Bull Trout	5	14	149.251	491	1400	27-May-92	1239.5	Fixed Station
Lake Whitefish	5	15	149.251	501	n.d.*	28-May-92	1226.7	Weldwood Bridge
Mountain Whitefish	6	15	149.340	362	633	11-Jun-92	1192.0	Obed/Ford
Bull Trout	19	20	149.680	460	1040	12-Jun-92	1226.7	Weldwood Bridge
Mountain Whitefish	19	23	149.680	391	711	11-Jun-92	1192.0	Obed/Ford
Bull Trout	19	25	149.680	557	1749	09-Jun-92	1226.7	Weldwood Bridge
Mountain Whitefish	19	26	149.680	410	812	11-Jun-92	1192.0	Obed/Ford
Mountain Whitefish	19	27	149.680	385	647	11-Jun-92	1192.0	Obed/Ford
Rainbow Trout	19	28	149.680	329	423	10-Jun-92	1192.0	Obed/Ford
Mountain Whitefish	19	33	149.680	398	821	10-Jun-92	1192.0	Obed/Ford
Bull Trout	20	10	149.700	385	520	12-Jun-92	1226.7	Weldwood Bridge
Mountain Whitefish	20	11	149.700	381	760	09-Jun-92	1226.7	Weldwood Bridge
Mountain Whitefish	20	12	149.700	390	744	11-Jun-92	1192.0	Obed/Ford
Mountain Whitefish	20	24	149.700	435	1205	10-Jun-92	1192.0	Obed/Ford
Arctic Grayling	20	26	149.700	304	369	11-Jun-92	1192.0	Obed/Ford
Bull Trout	20	31	149.700	570	2070	10-Jun-92	1192.0	Obed/Ford
Mountain Whitefish	20	43	149.700	415	858	10-Jun-92	1192.0	Obed/Ford
Bull Trout	20	44	149.700	476	1186	12-Jun-92	1226.7	Weldwood Bridge

n.d.* - These fish released without weights or Floy tags to reduce handling stress and operating time.

Appendix C, Table 2. Summary of radio telemetry flight on 20 June 1992.

Day	Month	Year	Freq	Chan	Code	Km	Species
20	6	92	148.850	1	3	1119.0	MNWH
20	6	92	149.015	3	22	1225.0	MNWH
20	6	92	149.015	3	24	1225.0	BURB
20	6	92	149.071	4	4	1223.0	MNWH
20	6	92	149.071	4	5	1237.5	MNWH
20	6	92	149.071	4	6	1137.5	RNTR
20	6	92	149.071	4	8	1235.1	BLTR
20	6	92	149.680	19	20	1227.5	BLTR
20	6	92	149.680	19	23	1187.0	MNWH
20	6	92	149.680	19	25	1220.0	BLTR
20	6	92	149.680	19	27	1192.0	MNWH
20	6	92	149.680	19	33	1192.0	MNWH
20	6	92	149.700	20	10	1239.0	BLTR
20	6	92	149.700	20	12	1192.0	MNWH
20	6	92	149.700	20	24	1192.0	MNWH
20	6	92	149.700	20	26	1188.5	ARGR
20	6	92	149.700	20	31	1190.0	BLTR
20	6	92	149.700	20	43	1192.0	MNWH
20	6	92	149.700	20	44	1226.0	BLTR

Total Fish Tracked = 19

ies, channel, code

Day	Month	Year	Freq	Chan	Code	Km	Species
20	6	92	149.700	20	26	1188.5	ARGR
20	6	92	149.071	4	8	1235.1	BLTR
20	6	92	149.680	19	20	1227.5	BLTR
20	6	92	149.680	19	25	1220.0	BLTR
20	6	92	149.700	20	10	1239.0	BLTR
20	6	92	149.700	20	31	1190.0	BLTR
20	6	92	149.700	20	44	1226.0	BLTR
20	6	92	149.015	3	24	1225.0	BURB
20	6	92	148.850	1	3	1119.0	MNWH
20	6	92	149.015	3	22	1225.0	MNWH
20	6	92	149.071	4	4	1223.0	MNWH
20	6	92	149.071	4	5	1237.5	MNWH
20	6	92	149.680	19	23	1187.0	MNWH
20	6	92	149.680	19	27	1192.0	MNWH
20	6	92	149.680	19	33	1192.0	MNWH
20	6	92	149.700	20	12	1192.0	MNWH
20	6	92	149.700	20	24	1192.0	MNWH
20	6	92	149.700	20	43	1192.0	MNWH
20	6	92	149.071	4	6	1137.5	RNTR

Species Recorded:	No.	Total	%
Arctic grayling (ARGR)	1	1	100
Bull trout (BLTR)	6	9	67
Burbot (BURB)	1	5	20
Lake Whitefish (LKWH)	0	1	0
Mountain Whitefish (MNWH)	10	17	59
Rainbow Trout (RNTR)	1	2	50
Total	19	35	54

Appendix C, Table 3. Summary of radio telemetry flight on 24 June 1992.

Day	Month	Year	Freq	Chan	Code	Km	Species
24	6	92	148.850	1	2	1240.0	BURB
24	6	92	148.850	1	3	1119.0	MNWH
24	6	92	148.850	1	7	1238.0	BURB
24	6	92	149.015	3	24	1224.0	BURB
24	6	92	149.071	4	2	1235.0	MNWH
24	6	92	149.071	4	3	1217.0	MNWH
24	6	92	149.071	4	4	1224.0	MNWH
24	6	92	149.071	4	5	1238.0	MNWH
24	6	92	149.071	4	6	1137.0	RNTR
24	6	92	149.071	4	8	1235.0	BLTR
24	6	92	149.251	5	15	1221.0	LKWH
24	6	92	149.680	19	20	1229.0	BLTR
24	6	92	149.680	19	23	1184.0	MNWH
24	6	92	149.680	19	25	1223.0	BLTR
24	6	92	149.680	19	27	1191.0	MNWH
24	6	92	149.680	19	28	1191.0	RNTR
24	6	92	149.680	19	33	1191.0	MNWH
24	6	92	149.700	20	11	1219.0	MNWH
24	6	92	149.700	20	12	1191.0	MNWH
24	6	92	149.700	20	24	1191.0	MNWH
24	6	92	149.700	20	26	1188.0	ARGR
24	6	92	149.700	20	31	1190.0	BLTR
24	6	92	149.700	20	43	1191.0	MNWH
24	6	92	149.700	20	44	1226.0	BLTR

Total Fish Tracked = 24

sort by species, channel, code

Day	Month	Year	Freq	Chan	Code	Km	Species
24	6	92	149.700	20	26	1188.0	ARGR
24	6	92	149.071	4	8	1235.0	BLTR
24	6	92	149.680	19	20	1229.0	BLTR
24	6	92	149.680	19	25	1223.0	BLTR
24	6	92	149.700	20	31	1190.0	BLTR
24	6	92	149.700	20	44	1226.0	BLTR
24	6	92	148.850	1	2	1240.0	BURB
24	6	92	148.850	1	7	1238.0	BURB
24	6	92	149.015	3	24	1224.0	BURB
24	6	92	149.251	5	15	1221.0	LKWH
24	6	92	148.850	1	3	1119.0	MNWH
24	6	92	149.071	4	2	1235.0	MNWH
24	6	92	149.071	4	3	1217.0	MNWH
24	6	92	149.071	4	4	1224.0	MNWH
24	6	92	149.071	4	5	1238.0	MNWH
24	6	92	149.680	19	23	1184.0	MNWH
24	6	92	149.680	19	27	1191.0	MNWH
24	6	92	149.680	19	33	1191.0	MNWH
24	6	92	149.700	20	11	1219.0	MNWH
24	6	92	149.700	20	12	1191.0	MNWH
24	6	92	149.700	20	24	1191.0	MNWH
24	6	92	149.700	20	43	1191.0	MNWH
24	6	92	149.071	4	6	1137.0	RNTR
24	6	92	149.680	19	28	1191.0	RNTR

Species Recorded:	No.	Total	%
Arctic grayling (ARGR)	1	1	100
Bull trout (BLTR)	5	9	56
Burbot (BURB)	3	5	60
Lake Whitefish (LKWH)	1	1	100
Mountain Whitefish (MNWH)	12	17	71
Rainbow Trout (RNTR)	2	2	100
Total	24	35	69

Appendix C, Table 4. Summary of radio telemetry flight on 28 June 1992.

Day	Month	Year	Freq	Chan	Code	Km	Species	Comment
28	6	92	148.850	1	2	1239.0	BURB	
28	6	92	148.850	1	3	1118.6	MNWH	
28	6	92	149.015	3	24	1225.0	BURB	
28	6	92	149.071	4	2	1236.0	MNWH	
28	6	92	149.071	4	3	1217.0	MNWH	
28	6	92	149.071	4	4	1223.0	MNWH	
28	6	92	149.071	4	5	1237.5	MNWH	
28	6	92	149.071	4	6	1138.0	RNTR	
28	6	92	149.071	4	8	1229.0	BLTR	
28	6	92	149.251	5	15	1220.0	LKWH	
28	6	92	149.680	19	20	1247.0	BLTR	
28	6	92	149.680	19	23	1184.0	MNWH	
28	6	92	149.680	19	25	1234.0	BLTR	
28	6	92	149.680	19	27	1192.0	MNWH	
28	6	92	149.680	19	28	1194.5	RNTR	
28	6	92	149.680	19	33	1192.0	MNWH	
28	6	92	149.700	20	10	1261.8	BLTR	Fiddle R. mouth
28	6	92	149.700	20	11	1219.0	MNWH	
28	6	92	149.700	20	12	1192.0	MNWH	
28	6	92	149.700	20	24	1192.0	MNWH	
28	6	92	149.700	20	26	1153.0	ARGR	
28	6	92	149.700	20	31	1190.0	BLTR	
28	6	92	149.700	20	43	1192.0	MNWH	
28	6	92	149.700	20	44	1238.0	BLTR	

Total Fish Tracked = 24

sort by species, channel, code

Day	Month	Year	Freq	Chan	Code	Km	Species	Comment
28	6	92	149.700	20	26	1153.0	ARGR	
28	6	92	149.071	4	8	1229.0	BLTR	
28	6	92	149.680	19	20	1247.0	BLTR	
28	6	92	149.680	19	25	1234.0	BLTR	
28	6	92	149.700	20	10	1261.8	BLTR	Fiddle R. mouth
28	6	92	149.700	20	31	1190.0	BLTR	
28	6	92	149.700	20	44	1238.0	BLTR	
28	6	92	148.850	1	2	1239.0	BURB	
28	6	92	149.015	3	24	1225.0	BURB	
28	6	92	149.251	5	15	1220.0	LKWH	
28	6	92	148.850	1	3	1118.6	MNWH	
28	6	92	149.071	4	2	1236.0	MNWH	
28	6	92	149.071	4	3	1217.0	MNWH	
28	6	92	149.071	4	4	1223.0	MNWH	
28	6	92	149.071	4	5	1237.5	MNWH	
28	6	92	149.680	19	23	1184.0	MNWH	
28	6	92	149.680	19	27	1192.0	MNWH	
28	6	92	149.680	19	33	1192.0	MNWH	
28	6	92	149.700	20	11	1219.0	MNWH	
28	6	92	149.700	20	12	1192.0	MNWH	
28	6	92	149.700	20	24	1192.0	MNWH	
28	6	92	149.700	20	43	1192.0	MNWH	
28	6	92	149.071	4	6	1138.0	RNTR	
28	6	92	149.680	19	28	1194.5	RNTR	

Species Recorded:	No.	Total	%
Arctic grayling (ARGR)	1	1	100
Bull trout (BLTR)	6	9	67
Burbot (BURB)	2	5	40
Lake Whitefish (LKWH)	1	1	100
Mountain Whitefish (MNWH)	12	17	71
Rainbow Trout (RNTR)	2	2	100
Total	24	35	69

Appendix C, Table 5. Summary of radio telemetry flight on 2 July 1992.

Day	Month	Year	Freq	Chan	Code	Km	Species	Comment
2	7	92	148.850	1	2	1239.0	BURB	
2	7	92	148.850	1	3	1118.4	MNWH	
2	7	92	149.015	3	24	1226.5	BURB	
2	7	92	149.071	4	2	1230.3	MNWH	
2	7	92	149.071	4	3	1216.0	MNWH	
2	7	92	149.071	4	4	1225.0	MNWH	
2	7	92	149.071	4	5	1238.0	MNWH	
2	7	92	149.071	4	6	1137.5	RNTR	
2	7	92	149.071	4	8	1228.0	BLTR	
2	7	92	149.251	5	15	1220.0	LKWH	
2	7	92	149.680	19	20	1249.1	BLTR	
2	7	92	149.680	19	23	1186.0	MNWH	
2	7	92	149.680	19	25	1232.0	BLTR	
2	7	92	149.680	19	27	1191.8	MNWH	
2	7	92	149.680	19	28	1194.5	RNTR	
2	7	92	149.680	19	33	1191.8	MNWH	
2	7	92	149.700	20	10	1261.8	BLTR	Fiddle R. mouth
2	7	92	149.700	20	11	1219.0	MNWH	
2	7	92	149.700	20	12	1192.0	MNWH	
2	7	92	149.700	20	24	1192.0	MNWH	
2	7	92	149.700	20	26	1153.0	ARGR	
2	7	92	149.700	20	31	1190.0	BLTR	
2	7	92	149.700	20	43	1192.0	MNWH	
2	7	92	149.700	20	44	1238.0	BLTR	

Total Fish Tracked = 24

sort by species, channel, code

Day	Month	Year	Freq	Chan	Code	Km	Species	Comment
2	7	92	149.700	20	26	1153.0	ARGR	
2	7	92	149.071	4	8	1228.0	BLTR	
2	7	92	149.680	19	20	1249.1	BLTR	
2	7	92	149.680	19	25	1232.0	BLTR	
2	7	92	149.700	20	10	1261.8	BLTR	Fiddle R. mouth
2	7	92	149.700	20	31	1190.0	BLTR	
2	7	92	149.700	20	44	1238.0	BLTR	
2	7	92	148.850	1	2	1239.0	BURB	
2	7	92	149.015	3	24	1226.5	BURB	
2	7	92	149.251	5	15	1220.0	LKWH	
2	7	92	148.850	1	3	1118.4	MNWH	
2	7	92	149.071	4	2	1230.3	MNWH	
2	7	92	149.071	4	3	1216.0	MNWH	
2	7	92	149.071	4	4	1225.0	MNWH	
2	7	92	149.071	4	5	1238.0	MNWH	
2	7	92	149.680	19	23	1186.0	MNWH	
2	7	92	149.680	19	27	1191.8	MNWH	
2	7	92	149.680	19	33	1191.8	MNWH	
2	7	92	149.700	20	11	1219.0	MNWH	
2	7	92	149.700	20	12	1192.0	MNWH	
2	7	92	149.700	20	24	1192.0	MNWH	
2	7	92	149.700	20	43	1192.0	MNWH	
2	7	92	149.071	4	6	1137.5	RNTR	
2	7	92	149.680	19	28	1194.5	RNTR	

Species Recorded:	No.	Total	%
Arctic grayling (ARGR)	1	1	100
Bull trout (BLTR)	6	9	67
Burbot (BURB)	2	5	40
Lake Whitefish (LKWH)	1	1	100
Mountain Whitefish (MNWH)	12	17	71
Rainbow Trout (RNTR)	2	2	100
Total	24	35	69

Appendix C, Table 6. Summary of radio telemetry flight on 18 July 1992.

Day	Month	Year	Freq	Chan	Code	Km	Species
18	7	92	148.850	1	2	1243.5	BURB
18	7	92	148.850	1	3	1118.4	MNWH
18	7	92	148.850	1	7	1238.0	BURB
18	7	92	149.071	4	4	1221.0	MNWH
18	7	92	149.071	4	6	1137.7	RNTR
18	7	92	149.071	4	8	1238.5	BLTR
18	7	92	149.251	5	15	1220.0	LKWH
18	7	92	149.680	19	23	1177.6	MNWH
18	7	92	149.680	19	27	1224.0	MNWH
18	7	92	149.680	19	28	1194.0	RNTR
18	7	92	149.680	19	33	1192.0	MNWH
18	7	92	149.700	20	12	1273.6	MNWH
18	7	92	149.700	20	24	1193.0	MNWH
18	7	92	149.700	20	26	1152.8	ARGR
18	7	92	149.700	20	31	1205.0	BLTR
18	7	92	149.700	20	43	1192.0	MNWH
18	7	92	149.700	20	44	1266.9	BLTR

Total Fish Tracked = 17

sort by species, channel, code

Day	Month	Year	Freq	Chan	Code	Km	Species
18	7	92	149.700	20	26	1152.8	ARGR
18	7	92	149.071	4	8	1238.5	BLTR
18	7	92	149.700	20	31	1205.0	BLTR
18	7	92	149.700	20	44	1266.9	BLTR
18	7	92	148.850	1	2	1243.5	BURB
18	7	92	148.850	1	7	1238.0	BURB
18	7	92	149.251	5	15	1220.0	LKWH
18	7	92	148.850	1	3	1118.4	MNWH
18	7	92	149.071	4	4	1221.0	MNWH
18	7	92	149.680	19	23	1177.6	MNWH
18	7	92	149.680	19	27	1224.0	MNWH
18	7	92	149.680	19	33	1192.0	MNWH
18	7	92	149.700	20	12	1273.6	MNWH
18	7	92	149.700	20	24	1193.0	MNWH
18	7	92	149.700	20	43	1192.0	MNWH
18	7	92	149.071	4	6	1137.7	RNTR
18	7	92	149.680	19	28	1194.0	RNTR

Species Recorded:	No.	Total	%
Arctic grayling (ARGR)	1	1	100
Bull trout (BLTR)	3	8	38
Burbot (BURB)	2	5	40
Lake Whitefish (LKWH)	1	1	100
Mountain Whitefish (MNWH)	8	17	47
Rainbow Trout (RNTR)	2	2	100
Total	17	34	50

Appendix C, Table 7. Summary of radio telemetry flight on 22 July 1992.

Day	Month	Year	Freq	Chan	Code	Km	Species	Comment
22	7	92	148.850	1	2	1243.5	BURB	
22	7	92	148.850	1	3	1118.2	MNWH	
22	7	92	148.850	1	7	1238.0	BURB	
22	7	92	149.015	3	24	1221.5	BURB	
22	7	92	149.071	4	4	1223.0	MNWH	
22	7	92	149.071	4	6	1138.1	RNTR	
22	7	92	149.071	4	8	1260.4	BLTR	
22	7	92	149.251	5	15	1221.0	LKWH	
22	7	92	149.680	19	23	1177.8	MNWH	
22	7	92	149.680	19	27	1224.0	MNWH	
22	7	92	149.680	19	28	1194.0	RNTR	
22	7	92	149.680	19	33	1192.2	MNWH	
22	7	92	149.700	20	11	1218.5	MNWH	
22	7	92	149.700	20	12	1277.6	MNWH	Rocky R. side channel
22	7	92	149.700	20	24	1193.0	MNWH	
22	7	92	149.700	20	26	1152.8	ARGR	
22	7	92	149.700	20	31	1218.5	BLTR	
22	7	92	149.700	20	43	1191.1	MNWH	
22	7	92	149.700	20	44	1264.0	BLTR	

Total Fish Tracked = 19

sort by species, channel, code

Day	Month	Year	Freq	Chan	Code	Km	Species	Comment
22	7	92	149.700	20	26	1152.8	ARGR	
22	7	92	149.071	4	8	1260.4	BLTR	
22	7	92	149.700	20	31	1218.5	BLTR	
22	7	92	149.700	20	44	1264.0	BLTR	
22	7	92	148.850	1	2	1243.5	BURB	
22	7	92	148.850	1	7	1238.0	BURB	
22	7	92	149.015	3	24	1221.5	BURB	
22	7	92	149.251	5	15	1221.0	LKWH	
22	7	92	148.850	1	3	1118.2	MNWH	
22	7	92	149.071	4	4	1223.0	MNWH	
22	7	92	149.680	19	23	1177.8	MNWH	
22	7	92	149.680	19	27	1224.0	MNWH	
22	7	92	149.680	19	33	1192.2	MNWH	
22	7	92	149.700	20	11	1218.5	MNWH	
22	7	92	149.700	20	12	1277.6	MNWH	Rocky R. side channel
22	7	92	149.700	20	24	1193.0	MNWH	
22	7	92	149.700	20	43	1191.1	MNWH	
22	7	92	149.071	4	6	1138.1	RNTR	
22	7	92	149.680	19	28	1194.0	RNTR	

Species Recorded:	No.	Total	%
Arctic grayling (ARGR)	1	1	100
Bull trout (BLTR)	3	8	38
Burbot (BURB)	3	5	60
Lake Whitefish (LKWH)	1	1	100
Mountain Whitefish (MNWH)	9	17	53
Rainbow Trout (RNTR)	2	2	100
Total	19	34	56

Appendix C, Table 8. Summary of radio telemetry flight on 29 July 1992.

Day	Month	Year	Freq	Chan	Code	Km	Species	Comment
29	7	92	148.850	1	2	1244.0	BURB	
29	7	92	148.850	1	3	1118.2	MNWH	
29	7	92	148.850	1	7	1237.5	BURB	
29	7	92	149.015	3	24	1221.0	BURB	
29	7	92	149.071	4	2	1294.2	MNWH	Hwy 16 Bridge
29	7	92	149.071	4	4	1222.0	MNWH	
29	7	92	149.071	4	6	1138.1	RNTR	
29	7	92	149.071	4	8	1272.0	BLTR	5.5 km up Snake Indian R.
29	7	92	149.251	5	15	1220.0	LKWH	
29	7	92	149.680	19	23	1177.0	MNWH	
29	7	92	149.680	19	25	1272.0	BLTR	20.5 km up Snake Indian R.
29	7	92	149.680	19	27	1223.0	MNWH	
29	7	92	149.680	19	28	1193.5	RNTR	
29	7	92	149.680	19	33	1192.2	MNWH	
29	7	92	149.700	20	12	1277.6	MNWH	Rocky R. side channel
29	7	92	149.700	20	24	1199.5	MNWH	
29	7	92	149.700	20	26	1152.8	ARGR	
29	7	92	149.700	20	31	1234.4	BLTR	
29	7	92	149.700	20	43	1192.0	MNWH	
29	7	92	149.700	20	44	1264.0	BLTR	

Total Fish Tracked = 20

sort by species, channel, code

Day	Month	Year	Freq	Chan	Code	Km	Species	Comment
29	7	92	149.700	20	26	1152.8	ARGR	
29	7	92	149.071	4	8	1272.0	BLTR	5.5 km up Snake Indian R.
29	7	92	149.680	19	25	1272.0	BLTR	20.5 km up Snake Indian R.
29	7	92	149.700	20	31	1234.4	BLTR	
29	7	92	149.700	20	44	1264.0	BLTR	
29	7	92	148.850	1	2	1244.0	BURB	
29	7	92	148.850	1	7	1237.5	BURB	
29	7	92	149.015	3	24	1221.0	BURB	
29	7	92	149.251	5	15	1220.0	LKWH	
29	7	92	148.850	1	3	1118.2	MNWH	
29	7	92	149.071	4	2	1294.2	MNWH	Hwy 16 Bridge
29	7	92	149.071	4	4	1222.0	MNWH	
29	7	92	149.680	19	23	1177.0	MNWH	
29	7	92	149.680	19	27	1223.0	MNWH	
29	7	92	149.680	19	33	1192.2	MNWH	
29	7	92	149.700	20	12	1277.6	MNWH	Rocky R. side channel
29	7	92	149.700	20	24	1199.5	MNWH	
29	7	92	149.700	20	43	1192.0	MNWH	
29	7	92	149.071	4	6	1138.1	RNTR	
29	7	92	149.680	19	28	1193.5	RNTR	

Species Recorded:	No.	Total	%
Arctic grayling (ARGR)	1	1	100
Bull trout (BLTR)	4	8	50
Burbot (BURB)	3	5	60
Lake Whitefish (LKWH)	1	1	100
Mountain Whitefish (MNWH)	9	17	53
Rainbow Trout (RNTR)	2	2	100
Total	20	34	59

Appendix C, Table 9. Summary of radio telemetry flight on 31 August 1992.

Day	Month	Year	Freq	Chan	Code	Km	Species	Comment
31	8	92	148.850	1	2	1245.0	BURB	
31	8	92	148.850	1	3	1118.2	MNWH	
31	8	92	148.850	1	7	1237.5	BURB	
31	8	92	149.071	4	4	1217.0	MNWH	
31	8	92	149.071	4	8	1246.0	BLTR	
31	8	92	149.251	5	15	1220.0	LKWH	
31	8	92	149.680	19	20	1272.0	BLTR	33.5 km up Snake Indian R.
31	8	92	149.680	19	23	1187.0	MNWH	
31	8	92	149.680	19	25	1272.0	BLTR	20.5 km up Snake Indian R.
31	8	92	149.680	19	27	1222.0	MNWH	
31	8	92	149.680	19	28	1195.0	RNTR	
31	8	92	149.680	19	33	1193.0	MNWH	
31	8	92	149.700	20	12	1277.6	MNWH	Rocky R. side channel
31	8	92	149.700	20	24	1214.0	MNWH	
31	8	92	149.700	20	26	1152.8	ARGR	
31	8	92	149.700	20	31	1277.6	BLTR	Rocky R. side channel
31	8	92	149.700	20	44	1264.0	BLTR	

Total Fish Tracked = 17

sort by species, channel, code

Day	Month	Year	Freq	Chan	Code	Km	Species	Comment
31	8	92	149.700	20	26	1152.8	ARGR	
31	8	92	149.071	4	8	1246.0	BLTR	
31	8	92	149.680	19	20	1272.0	BLTR	33.5 km up Snake Indian R.
31	8	92	149.680	19	25	1272.0	BLTR	20.5 km up Snake Indian R.
31	8	92	149.700	20	31	1277.6	BLTR	Rocky R. side channel
31	8	92	149.700	20	44	1264.0	BLTR	
31	8	92	148.850	1	2	1245.0	BURB	
31	8	92	148.850	1	7	1237.5	BURB	
31	8	92	149.251	5	15	1220.0	LKWH	
31	8	92	148.850	1	3	1118.2	MNWH	
31	8	92	149.071	4	4	1217.0	MNWH	
31	8	92	149.680	19	23	1187.0	MNWH	
31	8	92	149.680	19	27	1222.0	MNWH	
31	8	92	149.680	19	33	1193.0	MNWH	
31	8	92	149.700	20	12	1277.6	MNWH	Rocky R. side channel
31	8	92	149.700	20	24	1214.0	MNWH	
31	8	92	149.680	19	28	1195.0	RNTR	

Species Recorded:	No.	Total	%
Arctic grayling (ARGR)	1	1	100
Bull trout (BLTR)	5	8	63
Burbot (BURB)	2	5	40
Lake Whitefish (LKWH)	1	1	100
Mountain Whitefish (MNWH)	7	17	41
Rainbow Trout (RNTR)	1	2	50
Total	17	34	50

Appendix C, Table 10. Summary of radio telemetry flight on 8 September 1992.

Day	Month	Year	Freq	Chan	Code	Km	Species	Comment
8	9	92	148.850	1	2	1245.0	BURB	
8	9	92	148.850	1	3	1063.0	MNWH	
8	9	92	148.850	1	7	1237.5	BURB	
8	9	92	149.071	4	2	1220.0	MNWH	
8	9	92	149.071	4	4	1216.0	MNWH	
8	9	92	149.071	4	8	1245.0	BLTR	
8	9	92	149.251	5	15	1220.0	LKWH	
8	9	92	149.680	19	20	1272.0	BLTR	33.5 km up Snake Indian R.
8	9	92	149.680	19	23	1192.0	MNWH	
8	9	92	149.680	19	25	1272.0	BLTR	20.5 km up Snake Indian R.
8	9	92	149.680	19	27	1223.0	MNWH	
8	9	92	149.680	19	28	1193.0	RNTR	
8	9	92	149.680	19	33	1191.0	MNWH	
8	9	92	149.700	20	12	1277.6	MNWH	Rocky R. side channel
8	9	92	149.700	20	24	1240.0	MNWH	
8	9	92	149.700	20	26	1152.8	ARGR	
8	9	92	149.700	20	31	1278.0	BLTR	2.0 km up Rocky R.
8	9	92	149.700	20	44	1264.4	BLTR	

Total Fish Tracked = 18

sort by species, channel, code

Day	Month	Year	Freq	Chan	Code	Km	Species	Comment
8	9	92	149.700	20	26	1152.8	ARGR	
8	9	92	149.071	4	8	1245.0	BLTR	
8	9	92	149.680	19	20	1272.0	BLTR	33.5 km up Snake Indian R.
8	9	92	149.680	19	25	1272.0	BLTR	20.5 km up Snake Indian R.
8	9	92	149.700	20	31	1277.6	BLTR	2.0 km up Rocky R.
8	9	92	149.700	20	44	1264.4	BLTR	
8	9	92	148.850	1	2	1245.0	BURB	
8	9	92	148.850	1	7	1237.5	BURB	
8	9	92	149.251	5	15	1220.0	LKWH	
8	9	92	148.850	1	3	1063.0	MNWH	
8	9	92	149.071	4	2	1220.0	MNWH	
8	9	92	149.071	4	4	1216.0	MNWH	
8	9	92	149.680	19	23	1192.0	MNWH	
8	9	92	149.680	19	27	1223.0	MNWH	
8	9	92	149.680	19	33	1191.0	MNWH	
8	9	92	149.700	20	12	1277.6	MNWH	Rocky R. side channel
8	9	92	149.700	20	24	1240.0	MNWH	
8	9	92	149.680	19	28	1193.0	RNTR	

Species Recorded:	No.	Total	%
Arctic grayling (ARGR)	1	1	100
Bull trout (BLTR)	5	8	63
Burbot (BURB)	2	5	40
Lake Whitefish (LKWH)	1	1	100
Mountain Whitefish (MNWH)	8	17	47
Rainbow Trout (RNTR)	1	2	50
Total	18	34	53

Appendix C, Table 11. Summary of radio telemetry flight on 16 September 1992.

Day	Month	Year	Freq	Chan	Code	Km	Species	Comment
16	9	92	148.850	1	2	1246.0	BURB	
16	9	92	148.850	1	7	1237.5	BURB	
16	9	92	149.071	4	4	1215.0	MNWH	
16	9	92	149.071	4	8	1245.0	BLTR	
16	9	92	149.680	19	23	1194.5	MNWH	
16	9	92	149.680	19	25	1266.0	BLTR	
16	9	92	149.680	19	27	1224.0	MNWH	
16	9	92	149.680	19	33	1191.0	MNWH	
16	9	92	149.700	20	12	1277.6	MNWH	
16	9	92	149.700	20	24	1272.0	MNWH	
16	9	92	149.700	20	26	1152.5	ARGR	
16	9	92	149.700	20	31	1277.6	BLTR	3.5 km up Rocky R.
16	9	92	149.700	20	44	1265.0	BLTR	

Total Fish Tracked = 13.0

sort by species, channel, code

Day	Month	Year	Freq	Chan	Code	Km	Species	
16	9	92	149.700	20	26	1152.5	ARGR	
16	9	92	149.071	4	8	1245.0	BLTR	
16	9	92	149.680	19	25	1266.0	BLTR	
16	9	92	149.700	20	31	1277.6	BLTR	3.5 km up Rocky R.
16	9	92	149.700	20	44	1265.0	BLTR	
16	9	92	148.850	1	2	1246.0	BURB	
16	9	92	148.850	1	7	1237.5	BURB	
16	9	92	149.071	4	4	1215.0	MNWH	
16	9	92	149.680	19	23	1194.5	MNWH	
16	9	92	149.680	19	27	1224.0	MNWH	
16	9	92	149.680	19	33	1191.0	MNWH	
16	9	92	149.700	20	12	1277.6	MNWH	
16	9	92	149.700	20	24	1272.0	MNWH	

Species Recorded:	No.	Total	%
Arctic grayling (ARGR)	1	1	100
Bull trout (BLTR)	4	8	50
Burbot (BURB)	2	5	40
Lake Whitefish (LKWH)	0	1	0
Mountain Whitefish (MNWH)	6	17	35
Rainbow Trout (RNTR)	0	2	0
Total	13	34	38

Appendix C, Table 12. Summary of radio telemetry flight on 23 September 1992.

Day	Month	Year	Freq	Chan	Code	Km	Species	Comment
23	9	92	148.850	1	2	1248.6	BURB	
23	9	92	148.850	1	3	1027.5	MNWH	
23	9	92	148.850	1	7	1237.2	BURB	
23	9	92	149.071	4	4	1215.8	MNWH	
23	9	92	149.071	4	8	1244.7	BLTR	
23	9	92	149.251	5	5	1253.6	LKWH	
23	9	92	149.680	19	20	1247.0	BLTR	
23	9	92	149.680	19	23	1194.5	MNWH	
23	9	92	149.680	19	25	1238.0	BLTR	
23	9	92	149.680	19	27	1224.5	MNWH	
23	9	92	149.680	19	33	1191.0	MNWH	
23	9	92	149.700	20	12	1277.6	MNWH	3.0 km up Rocky R.
23	9	92	149.700	20	26	1152.3	ARGR	
23	9	92	149.700	20	31	1277.6	BLTR	7.1 km up Rocky R.
23	9	92	149.700	20	44	1264.0	BLTR	

Total Fish Tracked = 15

sort by species, channel, code

Day	Month	Year	Freq	Chan	Code	Km	Species	Comment
23	9	92	149.700	20	26	1152.3	ARGR	
23	9	92	149.071	4	8	1244.7	BLTR	
23	9	92	149.680	19	20	1247.0	BLTR	
23	9	92	149.680	19	25	1238.0	BLTR	
23	9	92	149.700	20	31	1277.6	BLTR	7.1 km up Rocky R.
23	9	92	149.700	20	44	1264.0	BLTR	
23	9	92	148.850	1	2	1248.6	BURB	
23	9	92	148.850	1	7	1237.2	BURB	
23	9	92	149.251	5	5	1253.6	LKWH	
23	9	92	148.850	1	3	1027.5	MNWH	
23	9	92	149.071	4	4	1215.8	MNWH	
23	9	92	149.680	19	23	1194.5	MNWH	
23	9	92	149.680	19	27	1224.5	MNWH	
23	9	92	149.680	19	33	1191.0	MNWH	
23	9	92	149.700	20	12	1277.6	MNWH	3.0 km up Rocky R.

Species Recorded:	No.	Total	%
Arctic grayling (ARGR)	1	1	100
Bull trout (BLTR)	5	8	63
Burbot (BURB)	2	5	40
Lake Whitefish (LKWH)	1	1	100
Mountain Whitefish (MNWH)	6	17	35
Rainbow Trout (RNTR)	0	2	0
Total	15	34	44

Appendix C, Table 13. Summary of radio telemetry flight on 29 September 1992.

Day	Month	Year	Freq	Chan	Code	Km	Species	Comment
29	9	92	148.850	1	2	1253.7	BURB	
29	9	92	148.850	1	7	1237.4	BURB	
29	9	92	149.071	4	4	1215.0	MNWH	
29	9	92	149.071	4	8	1244.8	BLTR	
29	9	92	149.251	5	15	1260.0	LKWH	
29	9	92	149.680	19	20	1247.0	BLTR	
29	9	92	149.680	19	23	1194.5	MNWH	
29	9	92	149.680	19	25	1220.3	BLTR	
29	9	92	149.680	19	27	1224.0	MNWH	
29	9	92	149.680	19	33	1191.0	MNWH	
29	9	92	149.700	20	12	1277.6	MNWH	4 km up Rocky R.
29	9	92	149.700	20	26	1152.5	ARGR	
29	9	92	149.700	20	44	1265.7	BLTR	

Total Fish Tracked = 13

sort by species, channel, code

Day	Month	Year	Freq	Chan	Code	Km	Species	Comment
29	9	92	149.700	20	26	1152.5	ARGR	
29	9	92	149.071	4	8	1244.8	BLTR	
29	9	92	149.680	19	20	1247.0	BLTR	
29	9	92	149.680	19	25	1220.3	BLTR	
29	9	92	149.700	20	44	1265.7	BLTR	
29	9	92	148.850	1	2	1253.7	BURB	
29	9	92	148.850	1	7	1237.4	BURB	
29	9	92	149.251	5	15	1260.0	LKWH	
29	9	92	149.071	4	4	1215.0	MNWH	
29	9	92	149.680	19	23	1194.5	MNWH	
29	9	92	149.680	19	27	1224.0	MNWH	
29	9	92	149.680	19	33	1191.0	MNWH	
29	9	92	149.700	20	12	1277.6	MNWH	4 km up Rocky R.

Species Recorded:	No.	Total	%
Arctic grayling (ARGR)	1	1	100
Bull trout (BLTR)	4	8	50
Burbot (BURB)	2	5	40
Lake Whitefish (LKWH)	1	1	100
Mountain Whitefish (MNWH)	5	17	29
Rainbow Trout (RNTR)	0	2	0
Total	13	34	38

Appendix C, Table 14. Summary of radio telemetry flight on 14 October 1992.

Day	Month	Year	Freq	Chan	Code	Km	Species
14	10	92	148.850	1	2	1253.0	BURB
14	10	92	148.850	1	7	1237.5	BURB
14	10	92	149.071	4	4	1214.0	MNWH
14	10	92	149.071	4	8	1243.5	BLTR
14	10	92	149.680	19	20	1247.0	BLTR
14	10	92	149.680	19	23	1226.0	MNWH
14	10	92	149.680	19	25	1219.0	BLTR
14	10	92	149.680	19	27	1224.0	MNWH
14	10	92	149.680	19	33	1190.0	MNWH
14	10	92	149.700	20	26	1151.0	ARGR
14	10	92	149.700	20	31	1216.0	BLTR

Total Fish Tracked = 11

sort by species, channel, code

Day	Month	Year	Freq	Chan	Code	Km	Species
14	10	92	149.700	20	26	1151.0	ARGR
14	10	92	149.071	4	8	1243.5	BLTR
14	10	92	149.680	19	20	1247.0	BLTR
14	10	92	149.680	19	25	1219.0	BLTR
14	10	92	149.700	20	31	1216.0	BLTR
14	10	92	148.850	1	2	1253.0	BURB
14	10	92	148.850	1	7	1237.5	BURB
14	10	92	149.071	4	4	1214.0	MNWH
14	10	92	149.680	19	23	1226.0	MNWH
14	10	92	149.680	19	27	1224.0	MNWH
14	10	92	149.680	19	33	1190.0	MNWH

Species Recorded:	No.	Total	%
Arctic grayling (ARGR)	1	1	100
Bull trout (BLTR)	4	8	50
Burbot (BURB)	2	5	40
Lake Whitefish (LKWH)	0	1	0
Mountain Whitefish (MNWH)	4	17	24
Rainbow Trout (RNTR)	0	2	0
Total	11	34	32

Appendix C, Table 15. Summary of radio telemetry flight on 21 October 1992.

Day	Month	Year	Freq	Chan	Code	Km	Species
21	10	92	148.850	1	2	1253.9	BURB
21	10	92	148.850	1	7	1237.2	BURB
21	10	92	149.071	4	4	1216.0	MNWH
21	10	92	149.071	4	8	1244.9	BLTR
21	10	92	149.251	5	15	1262.8	LKWH
21	10	92	149.680	19	20	1247.2	BLTR
21	10	92	149.680	19	23	1235.2	MNWH
21	10	92	149.680	19	25	1220.0	BLTR
21	10	92	149.680	19	27	1224.6	MNWH
21	10	92	149.680	19	33	1192.0	MNWH
21	10	92	149.700	20	12	1209.1	MNWH
21	10	92	149.700	20	24	1314.0	MNWH
21	10	92	149.700	20	31	1185.0	BLTR
21	10	92	149.700	20	44	1264.1	BLTR

Total Fish Tracked = 14

sort by species, channel, code

Day	Month	Year	Freq	Chan	Code	Km	Species
21	10	92	149.071	4	8	1244.9	BLTR
21	10	92	149.680	19	20	1247.2	BLTR
21	10	92	149.680	19	25	1220.0	BLTR
21	10	92	149.700	20	31	1185.0	BLTR
21	10	92	149.700	20	44	1264.1	BLTR
21	10	92	148.850	1	2	1253.9	BURB
21	10	92	148.850	1	7	1237.2	BURB
21	10	92	149.251	5	15	1262.8	LKWH
21	10	92	149.071	4	4	1216.0	MNWH
21	10	92	149.680	19	23	1235.2	MNWH
21	10	92	149.680	19	27	1224.6	MNWH
21	10	92	149.680	19	33	1192.0	MNWH
21	10	92	149.700	20	12	1209.1	MNWH
21	10	92	149.700	20	24	1314.0	MNWH

Species Recorded:	No.	Total	%
Arctic grayling (ARGR)	0	1	0
Bull trout (BLTR)	5	8	63
Burbot (BURB)	2	5	40
Lake Whitefish (LKWH)	1	1	100
Mountain Whitefish (MNWH)	6	17	35
Rainbow Trout (RNTR)	0	2	0
Total	14	34	41

Appendix C, Table 16. Summary of radio telemetry flight on 28 October 1992.

Day	Month	Year	Freq	Chan	Code	Km	Species	Comment
28	10	92	148.850	1	2	1254.0	BURB	
28	10	92	148.850	1	7	1237.3	BURB	
28	10	92	149.071	4	8	1244.1	BLTR	near railroad bridge
28	10	92	149.251	5	15	1261.4	LKWH	
28	10	92	149.680	19	20	1248.0	BLTR	
28	10	92	149.680	19	23	1261.2	MNWH	
28	10	92	149.680	19	25	1221.0	BLTR	
28	10	92	149.680	19	27	1225.0	MNWH	
28	10	92	149.680	19	33	1191.3	MNWH	
28	10	92	149.700	20	12	1201.5	MNWH	
28	10	92	149.700	20	24	1314.0	MNWH	Jasper sewage ponds
28	10	92	149.700	20	31	1174.2	BLTR	d.s. Oldman Creek
28	10	92	149.700	20	44	1265.2	BLTR	

Total Fish Tracked = 13

sort by species, channel, code

Day	Month	Year	Freq	Chan	Code	Km	Species	Comment
28	10	92	149.071	4	8	1244.1	BLTR	near railroad bridge
28	10	92	149.680	19	20	1248.0	BLTR	
28	10	92	149.680	19	25	1221.0	BLTR	
28	10	92	149.700	20	31	1174.2	BLTR	d.s. Oldman Creek
28	10	92	149.700	20	44	1265.2	BLTR	
28	10	92	148.850	1	2	1254.0	BURB	
28	10	92	148.850	1	7	1237.3	BURB	
28	10	92	149.251	5	15	1261.4	LKWH	
28	10	92	149.680	19	23	1261.2	MNWH	
28	10	92	149.680	19	27	1225.0	MNWH	
28	10	92	149.680	19	33	1191.3	MNWH	
28	10	92	149.700	20	12	1201.5	MNWH	
28	10	92	149.700	20	24	1314.0	MNWH	Jasper sewage ponds

Species Recorded:	No.	Total	%
Arctic grayling (ARGR)	0	1	0
Bull trout (BLTR)	5	8	63
Burbot (BURB)	2	5	40
Lake Whitefish (LKWH)	1	1	100
Mountain Whitefish (MNWH)	5	17	29
Rainbow Trout (RNTR)	0	2	0
Total	13	34	38

Appendix C, Table 17. Summary of radio telemetry flight on 2 November 1992.

Day	Month	Year	Freq	Chan	Code	Km	Species	Comment
2	11	92	148.850	1	2	1256.0	BURB	
2	11	92	148.850	1	7	1237.4	BURB	
2	11	92	149.071	4	8	1245.6	BLTR	railroad bridge
2	11	92	149.251	5	15	1261.1	LKWH	
2	11	92	149.680	19	20	1247.8	BLTR	
2	11	92	149.680	19	23	1261.6	MNWH	
2	11	92	149.680	19	25	1219.6	BLTR	
2	11	92	149.680	19	27	1225.0	MNWH	
2	11	92	149.680	19	33	1191.0	MNWH	
2	11	92	149.700	20	12	1187.2	MNWH	
2	11	92	149.700	20	24	1314.1	MNWH	Jasper sewage ponds
2	11	92	149.700	20	26	1152.3	ARGR	
2	11	92	149.700	20	31	1173.9	BLTR	d.s. Oldman Creek
2	11	92	149.700	20	44	1264.5	BLTR	

Total Fish Tracked = 14

sort by species, channel, code

Day	Month	Year	Freq	Chan	Code	Km	Species	Comment
2	11	92	149.700	20	26	1152.3	ARGR	
2	11	92	149.071	4	8	1245.6	BLTR	railroad bridge
2	11	92	149.680	19	20	1247.8	BLTR	
2	11	92	149.680	19	25	1219.6	BLTR	
2	11	92	149.700	20	31	1173.9	BLTR	d.s. Oldman Creek
2	11	92	149.700	20	44	1264.5	BLTR	
2	11	92	148.850	1	2	1256.0	BURB	
2	11	92	148.850	1	7	1237.4	BURB	
2	11	92	149.251	5	15	1261.1	LKWH	
2	11	92	149.680	19	23	1261.6	MNWH	
2	11	92	149.680	19	27	1225.0	MNWH	
2	11	92	149.680	19	33	1191.0	MNWH	
2	11	92	149.700	20	12	1187.2	MNWH	
2	11	92	149.700	20	24	1314.1	MNWH	Jasper sewage ponds

Species Recorded:	No.	Total	%
Arctic grayling (ARGR)	1	1	100
Bull trout (BLTR)	5	8	63
Burbot (BURB)	2	5	40
Lake Whitefish (LKWH)	1	1	100
Mountain Whitefish (MNWH)	5	17	29
Rainbow Trout (RNTR)	0	2	0
Total	14	34	41

Appendix C, Table 18. Summary of radio telemetry flight on 23 November 1992.

Day	Month	Year	Freq	Chan	Code	Km	Species	Comment
23	11	92	148.850	1	2	1255.7	BURB	
23	11	92	148.850	1	7	1237.4	BURB	
23	11	92	149.071	4	8	1245.3	BLTR	railroad bridge
23	11	92	149.251	5	15	1262.1	LKWH	
23	11	92	149.680	19	20	1248.8	BLTR	
23	11	92	149.680	19	25	1219.6	BLTR	
23	11	92	149.680	19	27	1224.5	MNWH	
23	11	92	149.680	19	33	1190.5	MNWH	
23	11	92	149.700	20	12	1179.7	MNWH	
23	11	92	149.700	20	26	1152.9	ARGR	
23	11	92	149.700	20	31	1174.4	BLTR	d.s. Oldman Creek
23	11	92	149.700	20	44	1264.8	BLTR	

Total Fish Tracked = 12

sort by species, channel, code

Day	Month	Year	Freq	Chan	Code	Km	Species	Comment
23	11	92	149.700	20	26	1152.9	ARGR	
23	11	92	149.071	4	8	1245.3	BLTR	railroad bridge
23	11	92	149.680	19	20	1248.8	BLTR	
23	11	92	149.680	19	25	1219.6	BLTR	
23	11	92	149.700	20	31	1174.4	BLTR	d.s. Oldman Creek
23	11	92	149.700	20	44	1264.8	BLTR	
23	11	92	148.850	1	2	1255.7	BURB	
23	11	92	148.850	1	7	1237.4	BURB	
23	11	92	149.251	5	15	1262.1	LKWH	
23	11	92	149.680	19	27	1224.5	MNWH	
23	11	92	149.680	19	33	1190.5	MNWH	
23	11	92	149.700	20	12	1179.7	MNWH	

Species Recorded:	No.	Total	%
Arctic grayling (ARGR)	1	1	100
Bull trout (BLTR)	5	8	63
Burbot (BURB)	2	5	40
Lake Whitefish (LKWH)	1	1	100
Mountain Whitefish (MNWH)	3	17	18
Rainbow Trout (RNTR)	0	2	0
Total	12	34	35

Appendix C, Table 19. Summary of radio telemetry flight on 19 December 1992.

Day	Month	Year	Freq	Chan	Code	Km	Species	Comment
19	12	92	148.850	1	2	1249.9	BURB	
19	12	92	148.850	1	7	1237.0	BURB	
19	12	92	149.071	4	8	1245.7	BLTR	railroad bridge
19	12	92	149.251	5	15	1262.0	LKWH	
19	12	92	149.680	19	20	1249.0	BLTR	
19	12	92	149.680	19	25	1220.0	BLTR	
19	12	92	149.680	19	27	1225.8	MNWH	
19	12	92	149.680	19	33	1190.5	MNWH	
19	12	92	149.700	20	12	1180.3	MNWH	
19	12	92	149.700	20	26	1152.8	ARGR	
19	12	92	149.700	20	31	1172.5	BLTR	d.s. Oldman Creek
19	12	92	149.700	20	44	1264.5	BLTR	

Total Fish Tracked = 12

sort by species, channel, code

Day	Month	Year	Freq	Chan	Code	Km	Species	Comment
19	12	92	149.700	20	26	1152.8	ARGR	
19	12	92	149.071	4	8	1245.7	BLTR	railroad bridge
19	12	92	149.680	19	20	1249.0	BLTR	
19	12	92	149.680	19	25	1220.0	BLTR	
19	12	92	149.700	20	31	1172.5	BLTR	d.s. Oldman Creek
19	12	92	149.700	20	44	1264.5	BLTR	
19	12	92	148.850	1	2	1249.9	BURB	
19	12	92	148.850	1	7	1237.0	BURB	
19	12	92	149.251	5	15	1262.0	LKWH	
19	12	92	149.680	19	27	1225.8	MNWH	
19	12	92	149.680	19	33	1190.5	MNWH	
19	12	92	149.700	20	12	1180.3	MNWH	

Species Recorded:	No.	Total	%
Arctic grayling (ARGR)	1	1	100
Bull trout (BLTR)	5	8	63
Burbot (BURB)	2	5	40
Lake Whitefish (LKWH)	1	1	100
Mountain Whitefish (MNWH)	3	17	18
Rainbow Trout (RNTR)	0	2	0
Total	12	34	35

Appendix C, Table 20. Summary of radio telemetry flight on 15 January 1993.

Day	Month	Year	Freq	Chan	Code	Km	Species	Comment
15	1	93	148.850	1	2	1236.8	BURB	
15	1	93	148.850	1	7	1236.8	BURB	
15	1	93	149.071	4	8	1245.8	BLTR	railroad bridge
15	1	93	149.680	19	20	1247.0	BLTR	
15	1	93	149.680	19	25	1221.0	BLTR	
15	1	93	149.680	19	27	1225.0	MNWH	
15	1	93	149.680	19	33	1189.0	MNWH	
15	1	93	149.700	20	12	1180.1	MNWH	
15	1	93	149.700	20	26	1152.8	ARGR	
15	1	93	149.700	20	31	1174.0	BLTR	d.s. Oldman Creek

Total Fish Tracked = 10

sort by species, channel, code

Day	Month	Year	Freq	Chan	Code	Km	Species	Comment
15	1	93	149.700	20	26	1152.8	ARGR	
15	1	93	149.071	4	8	1245.8	BLTR	railroad bridge
15	1	93	149.680	19	20	1247.0	BLTR	
15	1	93	149.680	19	25	1221.0	BLTR	
15	1	93	149.700	20	31	1174.0	BLTR	d.s. Oldman Creek
15	1	93	148.850	1	2	1236.8	BURB	
15	1	93	148.850	1	7	1236.8	BURB	
15	1	93	149.680	19	27	1225.0	MNWH	
15	1	93	149.680	19	33	1189.0	MNWH	
15	1	93	149.700	20	12	1180.1	MNWH	

Species Recorded:	No.	Total	%
Arctic grayling (ARGR)	1	1	100
Bull trout (BLTR)	4	8	50
Burbot (BURB)	2	5	40
Lake Whitefish (LKWH)	0	1	0
Mountain Whitefish (MNWH)	3	17	18
Rainbow Trout (RNTR)	0	2	0
Total	10	34	29

Appendix C, Table 21. Summary of radio telemetry flight on 29 January 1993.

Day	Month	Year	Freq	Chan	Code	Km	Species	Comment
28	1	93	148.850	1	2	1249.9	BURB	
28	1	93	148.850	1	7	1237.1	BURB	
28	1	93	149.071	4	8	1244.9	BLTR	railroad bridge
28	1	93	149.251	5	15	1262.0	LKWH	
28	1	93	149.680	19	20	1249.1	BLTR	
28	1	93	149.680	19	25	1220.0	BLTR	
28	1	93	149.680	19	27	1224.5	MNWH	
28	1	93	149.680	19	33	1189.0	MNWH	
28	1	93	149.700	20	12	1179.2	MNWH	
28	1	93	149.700	20	26	1153.3	ARGR	
28	1	93	149.700	20	44	1264.5	BLTR	

Total Fish Tracked = 11

sort by species, channel, code

Day	Month	Year	Freq	Chan	Code	Km	Species	Comment
28	1	93	149.700	20	26	1153.3	ARGR	
28	1	93	149.071	4	8	1244.9	BLTR	railroad bridge
28	1	93	149.680	19	20	1249.1	BLTR	
28	1	93	149.680	19	25	1220.0	BLTR	
28	1	93	149.700	20	44	1264.5	BLTR	
28	1	93	148.850	1	2	1249.9	BURB	
28	1	93	148.850	1	7	1237.1	BURB	
28	1	93	149.251	5	15	1262.0	LKWH	
28	1	93	149.680	19	27	1224.5	MNWH	
28	1	93	149.680	19	33	1189.0	MNWH	
28	1	93	149.700	20	12	1179.2	MNWH	

Species Recorded:	No.	Total	%
Arctic grayling (ARGR)	1	1	100
Bull trout (BLTR)	4	8	50
Burbot (BURB)	2	5	40
Lake Whitefish (LKWH)	1	1	100
Mountain Whitefish (MNWH)	3	17	18
Rainbow Trout (RNTR)	0	2	0
Total	11	34	32

Appendix C, Table 22. Summary of radio telemetry flight on 22 February 1993.

Day	Month	Year	Freq	Chan	Code	Km	Species	Comment
22	2	93	148.850	1	2	1267.5	BURB	
22	2	93	148.850	1	7	1241.9	BURB	
22	2	93	149.071	4	8	1245.5	BLTR	railroad bridge
22	2	93	149.251	5	15	1261.8	LKWH	
22	2	93	149.680	19	20	1246.7	BLTR	
22	2	93	149.680	19	25	1220.8	BLTR	
22	2	93	149.680	19	27	1224.0	MNWH	
22	2	93	149.700	20	12	1179.9	MNWH	
22	2	93	149.700	20	26	1153.3	ARGR	
22	2	93	149.700	20	44	1264.5	BLTR	

Total Fish Tracked = 10

sort by species, channel, code

Day	Month	Year	Freq	Chan	Code	Km	Species	Comment
22	2	93	149.700	20	26	1153.3	ARGR	
22	2	93	149.071	4	8	1245.5	BLTR	railroad bridge
22	2	93	149.680	19	20	1246.7	BLTR	
22	2	93	149.680	19	25	1220.8	BLTR	
22	2	93	149.700	20	44	1264.5	BLTR	
22	2	93	148.850	1	2	1267.5	BURB	
22	2	93	148.850	1	7	1241.9	BURB	
22	2	93	149.251	5	15	1261.8	LKWH	
22	2	93	149.680	19	27	1224.0	MNWH	
22	2	93	149.700	20	12	1179.9	MNWH	

Species Recorded:	No.	Total	%
Arctic grayling (ARGR)	1	1	100
Bull trout (BLTR)	4	8	50
Burbot (BURB)	2	5	40
Lake Whitefish (LKWH)	1	1	100
Mountain Whitefish (MNWH)	2	17	12
Rainbow Trout (RNTR)	0	2	0
Total	10	34	29

Appendix C, Table 23. Summary of radio telemetry flight on 1 March 1993.

Day	Month	Year	Freq	Chan	Code	Km	Species
1	3	93	148.850	1	2	1267.6	BURB
1	3	93	148.850	1	7	1243.1	BURB
1	3	93	149.251	5	15	1261.8	LKWH
1	3	93	149.680	19	20	1246.7	BLTR
1	3	93	149.680	19	25	1219.7	BLTR
1	3	93	149.680	19	27	1224.9	MNWH
1	3	93	149.700	20	12	1179.8	MNWH
1	3	93	149.700	20	26	1153.0	ARGR
1	3	93	149.700	20	44	1264.8	BLTR

Total Fish Tracked = 9

sort by species, channel, code

Day	Month	Year	Freq	Chan	Code	Km	Species
1	3	93	149.700	20	26	1153.0	ARGR
1	3	93	149.680	19	20	1246.7	BLTR
1	3	93	149.680	19	25	1219.7	BLTR
1	3	93	149.700	20	44	1264.8	BLTR
1	3	93	148.850	1	2	1267.6	BURB
1	3	93	148.850	1	7	1243.1	BURB
1	3	93	149.251	5	15	1261.8	LKWH
1	3	93	149.680	19	27	1224.9	MNWH
1	3	93	149.700	20	12	1179.8	MNWH

Species Recorded:	No.	Total	%
Arctic grayling (ARGR)	1	1	100
Bull trout (BLTR)	3	8	38
Burbot (BURB)	2	5	40
Lake Whitefish (LKWH)	1	1	100
Mountain Whitefish (MNWH)	2	17	12
Rainbow Trout (RNTR)	0	2	0
Total	9	34	26

Appendix C, Table 24. Summary of radio telemetry flight on 30 March 1993.

Day	Month	Year	Freq	Chan	Code	Km	Species
30	3	93	148.850	1	2	1258.0	BURB
30	3	93	148.850	1	7	1241.8	BURB
30	3	93	149.251	5	15	1261.9	LKWH
30	3	93	149.680	19	27	1224.6	MNWH
30	3	93	149.700	20	26	1153.2	ARGR
30	3	93	149.700	20	44	1264.6	BLTR

Total Fish Tracked = 6

sort by species, channel, code

Day	Month	Year	Freq	Chan	Code	Km	Species
30	3	93	149.700	20	26	1153.2	ARGR
30	3	93	149.700	20	44	1264.6	BLTR
30	3	93	148.850	1	2	1258.0	BURB
30	3	93	148.850	1	7	1241.8	BURB
30	3	93	149.251	5	15	1261.9	LKWH
30	3	93	149.680	19	27	1224.6	MNWH

Species Recorded:	No.	Total	%
Arctic grayling (ARGR)	1	1	100
Bull trout (BLTR)	1	8	13
Burbot (BURB)	2	5	40
Lake Whitefish (LKWH)	1	1	100
Mountain Whitefish (MNWH)	1	17	6
Rainbow Trout (RNTR)	0	2	0
Total	6	34	18