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Wind River Watershed Restoration

U.S. Geological Survey
Annual Report

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Table of Contents

Executive Summary

During 2004, researchers from U.S. Geological Survey's Columbia River Research Laboratory (USGS-CRRL) collected temperature, flow, and habitat data to characterize physical habitat condition and variation within and among tributaries and mainstem sections in the Wind River subbasin. Juvenile salmonid population surveys were conducted within select study areas throughout the subbasin. We expanded our survey coverage of the mainstem Wind River to a reach in the vicinity of Carson National Fish Hatchery to assess effects of non-indigenous Chinook on native steelhead. These efforts add to a database of habitat and fish data collected in the Wind River since 1996. This research contributes to the Wind River Restoration Project, which includes active stream habitat restoration and monitoring of adult and juvenile steelhead populations.

We maintained a network of 32 thermographs in the Wind River subbasin during 2004. Additionally, Underwood Conservation District provided us with data from seven thermographs that they maintained during 2004. Thermograph data are identifying areas with chronic high water temperatures and stream sections where high rates of warming are occurring. During 2004, water temperatures at 26 thermograph sites exceeded the 16°C limit for surface waters set by the Washington Department of Ecology. Water temperatures exceeded 20°C at five sites in the Trout Creek watershed. Our thermograph dataset includes information from as early as 1996 at some sites and has become a valuable long-term dataset, which will be crucial in determining bioenergetic relationships with habitat and life-histories.

We have monitored salmonid populations throughout the Wind River subbasin by electrofishing and snorkeling. We electrofished four stream sections for population estimates during 2004. In these sections, and others where we simply collected fish without a population estimate, we tagged juvenile steelhead and Chinook salmon with Passive Integrated Transponder (PIT) tags to track growth and movement of individuals. We snorkeled nine stream sections during 2004. Juvenile steelhead populations have varied greatly between streams and between years. Numbers of age-0 steelhead have increased substantially since 2000 within the MINE reach (rkm 35.0 – 40.0) section of the upper Wind River. Because of potential negative

interactions with steelhead, naturally spawned populations of introduced juvenile Chinook salmon are of concern in the mainstem of the Wind River.

During 2004, we deployed over 3,000 PIT tags in the Wind River subbasin, primarily in juvenile steelhead, but also in juvenile Chinook. We are compiling a dataset of recapture information on these tagged fish as well as interrogation information from Bonneville Dam and other sites.

The habitat and fish data collected have been used in Ecosystem Diagnosis and Treatment modeling efforts, the Wind River Subbasin Plan, and the Total Maximum Daily Load report from Washington Department of Ecology. Continued monitoring of changes in habitat, combined with data on fish populations, will help guide planning efforts of land and fish managers. As long-term active and passive restoration actions are implemented in the Wind River and its tributaries, these data will provide the ability to measure change. Because the Wind River subbasin has no steelhead hatchery or supplementation, these data will be useful to compare population trends in subbasins with hatchery or supplementation management.

Report A: Temperature and Flow Monitoring in the Wind River Subbasin

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Table of Contents

List of Tables

List of Figures

List of Appendix Tables

Introduction

Sampling efforts and results covered by this report include temperature and stream flow. Since 1996, we have gathered temperature and flow data at key sites within the Wind River subbasin in southwest Washington. This report covers a portion of the work completed under Objective 2 in the Statement of Work submitted in April 2004 by the U.S. Geological Survey's Columbia River Research Laboratory (USGS-CRRL). Our goal was to collect water temperature, and flow data in areas of the subbasin used by steelhead *Oncorhynchus mykiss*. We desired to monitor temperature through the entire year and flow during the declining and base flow portion of the hydrograph. With these data and previously gathered data on stream geomorphic features, future analysis can investigate habitat variability and limiting factors acting on steelhead in the subbasin. This report presents a compilation of the data we have collected from 1996 through 2004. Funding from Bonneville Power Administration has supported these efforts since 1998.

In 2004, we continued flow monitoring and temperature profiling to characterize variation among and within most of the major tributaries and mainstem sections in the Wind River subbasin (Connolly and Jezorek 2006). These characterizations, in concert with companion efforts to estimate fish populations, condition, movement, and survival will allow assessment of rearing conditions for steelhead and other fish within the subbasin. Portions of these data were used extensively in an Ecological Diagnosis and Treatment (EDT) modeling effort, which was incorporated in the Wind River subbasin plan (NPCC 2004), and in the Wind River Watershed Temperature Total Maximum Daily Load report from Washington Department of Ecology (Howard and Pelletier 2002). It is our hope that this information will continue to help prioritize areas for restoration and help judge the success or failure of past and ongoing restoration activities.

Study Area

The Wind River subbasin covers 582 km^2 and supports a fifth-order stream system with the largest tributary watersheds being Trout Creek (88 km^2) and Panther Creek (107 km^2), which support fourth-order stream-systems (Figure 1). Elevations in the Wind River subbasin range

from 25 m at the mouth of the Wind River at the watershed's southern edge to 1,190 m at ridge tops near its northern edge (USFS 1996). The watershed is exposed to a temperate marine climate with most of the average annual precipitation of 280 cm occurring between November and April. The watershed is largely forested with little agriculture and low population density. Precipitation in the winter is largely delivered as rain in the lower elevations of the watershed and as snow in the higher elevations.

Methods

Temperature

Personnel from CRRL maintained a network of 9 to 32 thermographs throughout the Wind River subbasin from December 1996 through October 2004 (Table 1; Figures 2 - 5). All thermograph units deployed and maintained by CRRL personnel were Optic StowAway thermographs from Onset Computer Corporation (OCC). Prior to deployment, the units were tested at our lab for accuracy and adequacy of response time to change in temperature as per instructions from OCC's operating manual.

We maintained 32 thermographs during 2004. The location of fish sampling efforts has influenced some changes in thermograph placement throughout the years. Periodically, data are lost from sites due to equipment failure or displacement by high water, or exposure to air because of low water (Appendix Table 1). In mainstem Wind River and Trout Creek, we have attempted to distribute thermographs throughout the stream to capture areas of thermal change.

Thermographs deployed by USGS were intended to be left in the stream all year and were set to record temperature every two hours. Thermographs were downloaded twice a year (spring and fall). Downloads occurred in the field with use of an OCC optic shuttle to minimize time out of water and missed readings. We calculated the daily mean temperature as the mean of the twelve daily readings. We also report the daily minimum and maximum temperatures at each site (Appendix Table 2).

Underwood Conservation District (UCD) personnel maintained six to nine thermographs in the Wind River subbasin between mid June and early October of each year from 1999 to 2004 (Table 2; Figures 2 - 4). The units deployed by UCD were OCC Hobo thermographs. These units took 20 readings per day. Personnel from CRRL derived daily maximum, minimum, and mean temperatures from these 20 readings.

Flow

Personnel from CRRL have established 23 flow-monitoring sites in the Wind River subbasin (Table 3; Figures 6 and 7). During 2004, we monitored flow at six sites. In the upper Wind River watershed, flow was taken in Paradise Creek, in mainstem Wind River just above Paradise Creek (rkm 40.6), and in mainstem Wind River below Trapper Creek (rkm 30.3). We have seven years of data from the Paradise Creek site and five years each for the two mainstem Wind River sites. In the Trout Creek watershed, flow was taken in Trout Creek at the Forest Road 33 Bridge (rkm 14.0), at the Forest Road 43 Bridge (rkm 11.0), and in Trout Creek above Hemlock Lake (rkm 3.0). Sites were visited about every three weeks from early June – October. Flow measurements were taken with a Marsh-McBirney flow meter (calibrated by the manufacturer once per year) following the protocol of Gallagher and Stevenson (1999). Flow sites were selected where the stream cross section had a relatively smooth bottom profile and even, laminar flow across the channel. A tape was stretched across the steam and the transect was divided into at least 10 cells. Depth and velocity were measured between cells and the values averaged to calculate flow in each cell. Flow from all cells was summed to determine total flow.

Results

Temperature

The Wind River restoration project has a database of stream temperatures dating from December 1996. We have complete annual thermograph coverage for many sites in the Trout and Panther creek watersheds from 1997 to 2004 (Tables 4 and 5). We expanded our thermograph network to the upper portions of the mainstem Wind River during 2000 and 2001

and have maintained those sites through 2004 (Table 1). We recorded temperature throughout the entire year, but limited our analyses to July through September for this report.

A 16°C seven-day average of daily maximum temperature limit for surface water has been set by the Washington Department of Ecology for core summer salmonid habitat as an indicator of stream health (Washington Department of Ecology 2006). We recorded water temperatures that met or exceeded 16°C at 26 of 39 sites in 2004 (Table 4). Water temperature met or exceeded 20°C at five sites in 2004. This extensive thermograph coverage points to several sites that consistently experience high temperatures or rapid rates of warming.

The mainstem of the Wind River reached temperatures in excess of 16°C for up to 63 days per year (at Stabler Bridge, 2003) depending on location. All thermographs in the mainstem Wind River downstream of the Pacific Crest Trail Bridge (rkm 22.0) have recorded days equal to or greater than 16°C. Our thermograph in the mainstem Wind River below the mine reach (BMIN; rkm 35.5; Figure 2) has recorded days equal to or greater than 16°C during all three years of operation. We have never recorded a temperature of 20°C or higher within the mainstem Wind River or its tributaries other than Trout Creek (Tables 4 and 5; Figure 8).

The upper tributaries of the Wind River (above rkm 30.0) maintain relatively cool temperatures, but with occasional days equal to or greater than 16°C. During 2004, we have data from four tributaries to the Wind River above rkm 30.0 (Trapper, Dry, Ninemile, and Paradise creeks). There were only three days equal to or greater than 16°C between these tributaries in 2004 (Table 4).

Bear Creek and Little Wind River are tributaries of the lower mainstem Wind River (Bear Creek elevation of thermograph = 97 m, Little Wind River elevation of thermograph = 85 m). They regularly have many days where water temperature is equal to or greater than 16°C (Table 4).

The Wind River warms rapidly in the section between Beaver Campground (WBVR; rkm 26.0) and the site at the Pacific Crest Trail Bridge (WPCT; rkm 22.0), but otherwise has a

relatively flat temperature profile. The addition of water from Panther Creek (Figures 9 and 10) helps to cool the Wind River below its confluence at rkm 7.0. The apparent high degree of warming between the lower Mine Reach (LMIN; rkm 36.5) and Mine Reach (BMIN; rkm 35.4) sites is a result of the LMIN thermograph placement at a point of groundwater input at the downstream end of a long alluvial reach, a pattern similarly described by Stanford and Ward (1993) and Baxter et al. (1999) in other systems. This apparent high rate of warming probably does not accurately reflect the true rate of warming between these two closely spaced sites, but indicates a small pocket of cool water upwelling at the LMIN site. The decrease in water temperature between the site below Trapper Creek (UWIN; rkm 30.0) and the WBVR site is due largely to cold water input from Tyee Springs, a large spring creek that provides water for Carson National Fish Hatchery at rkm 28.0.

Diel temperature variation, represented on the year's hottest day (measured at the WIBF site; rkm 33.5), can be greater than 6°C in the Wind River at the Pacific Trail Bridge site (WPCT; rkm 22.0) and at the site at Stabler (MWIN; rkm 18.5; Figures 11a and 11b). Diel variation is lower at sites above the WPCT site with mean diel range on the year's hottest day falling between 2.4°C and 3.8°C. Diel variation moderates to 2.6°C at the lower Wind River site (BWIN; rkm 1.5).

The portion of Trout Creek below Forest Road 43 routinely experiences high water temperatures (Tables 4 and 5). During 2004, our thermograph site in Trout Creek below Hemlock Dam (HEML; rkm 2.0; Figure 12) recorded 61 days when maximum temperature met or exceeded 16°C, a decrease from 2003 when this site had 100 days that met or exceeded 16°C. The highest water temperature we have recorded in the Wind River subbasin was 25.9°C in 2003 at the HEML site, exceeding the lethal limit, for steelhead, of 23.9°C reported by Bell (1986). High water temperatures occur regularly in Trout Creek at our site above Hemlock Lake (LTRO; rkm 3.0). In 2004, maximum water temperature recorded there was 21.8°C and the site met or exceeded 16°C on 23 days (Tables 4 and 5) Upstream of the site at Forest Road 43 (MS43; rkm 11.0) , temperatures in mainstem Trout Creek are moderate with only the MS43 site meeting or exceeding 16°C.

All tributaries of Trout Creek, except Compass Creek, routinely meet or exceed 16°C (Tables 4 and 5; Appendix Table 2). Mean water temperatures for each tributary for the month of August during each year are shown in Figure 13. Collectively, these tributaries have the potential to strongly influence temperatures in mainstem Trout Creek. Percentage of combined surface water contributed to Trout Creek (total flow measured at rkm 3.0) by the tributaries varies from 64.4 to 32.1 percent (Jezorek et al. 2005).

In all years of sampling Trout Creek with our full thermograph network (1998 – 2004), a high rate of warming, measured by difference in mean August temperature, has occurred in the section between the lower old growth site (LOLG; rkm 11.6) and the Forest Road 43 Bridge site (MS43; rkm 11.0; mean value for 6 years of data = 2.1°C per km; Figures 13 and 14) and between the site above Hemlock Lake (LTRO; rkm 3.0) and below Hemlock Lake (HEML; rkm 2.0; Figure 14; mean value for 6 years of data = 2.1°C per km). From the HEML site to the site at the mouth of Trout Creek (BTRO; rkm 0.2), water temperatures remain steady or slightly decrease.

Diel temperature variation, represented on the year's hottest day (recorded at the MS43 site; rkm 11.0), has been higher than 6°C at several locations in Trout Creek (Figures 15a and 15b). The greatest diel variation has occurred at the MS43 site (mean for 8 years of data = 5.7°C). Though the sites downstream of MS43 experience higher maximum temperatures, diel variation actually decreases relative to sites upstream. This corresponds with a change from a reach with much solar exposure to a more confined and shaded canyon reach with a larger volume of water.

Mainstem Panther Creek warms little between our upper Panther thermograph (UPAN; rkm 12.0) and the lower Panther thermograph (LPAN; rkm 2.0;Table 5). During 2004, the maximum temperature at UPAN was 10.0°C, while maximum temperature at LPAN was 15.1°C. Eightmile Creek (rkm 11.0) contributes a small amount of warm water (< 2.0 cfs August flow, visual estimation) to Panther Creek. The lower 500 m of Eightmile Creek experienced a large debris flow in February 1996, which removed much of the riparian vegetation and greatly increased solar input. Maximum temperature in Eightmile Creek in 2004 was 18.3°C. We have

never recorded a temperature that met or exceeded 20°C in the Panther Creek watershed and have never recorded a temperature that met or exceeded 16°C in the mainstem of Panther Creek.

Flow

Flow during July, August, and early September of 2004 was in the middle range of levels we have seen at our sites through the years (Figures 16 - 18). Over the five years of data collection, mid-August flow at the Wind River below Trapper Creek site has ranged from 11.6 – 31.1 cfs, during 2004, flow was 17.8 cfs. Over the four years of data collection, mid-August flow at the Trout Creek above Hemlock Lake site have ranged from 1.5 – 9.9 cfs, during 2004, flow was 5.8 cfs.

In mid-September, a week of heavy rain elevated flow to much higher levels than the normal base flow at that time. The mean mid-September flow at Paradise Creek (four years of data) is 1.13 cfs; Paradise Creek flow on 17 September 2004, was 16.3 cfs. The mean late-September flow for Trout Creek at the 43 Road Bridge (three years of data) is 5.6 cfs; Trout Creek flow at the 43 Road Bridge on 18 September 2004, was 110.0 cfs. During some years, flow had continued to drop into October or November. During 2004, flow remained high after the rain in September, and no further measurements were taken.

Discussion

Our long-term water temperature and summer-flow data provide a basis for comparisons within and between watersheds in the Wind River subbasin. We expect our habitat data to be used in concert with fish data to assess limiting factors, density-habitat relationships, and influences on life-history expressions. These data have already proven useful to restoration planning and prioritization in the Wind River subbasin as demonstrated by extensive use in recent EDT modeling efforts (Rawding et al. 2004) and in the Wind River Subbasin Plan (NPCC 2004). Our temperature data have contributed to a Total Maximum Daily Load analysis by Washington State Department of Ecology (Howard and Pelletier 2002). These efforts will help guide land managers with restoration actions. Our habitat monitoring will help track response to both active and passive restoration measures through time.

The mainstem Wind River maintains a relatively flat temperature profile. The Wind River benefits from input of cool water from several tributaries and spring sources (Falls Creek, Tyee Springs, and Panther Creek). Although temperatures do not vary much between the upper portion of the Wind and the lower Wind, there is a high rate of warming between our sites WBVR (rkm 24.0) and WPCT (rkm 22.0), and a corresponding increase in the diel fluctuation below WBVR. Diel fluctuations can be detrimental to fish if lethal temperatures are reached, however, if maximums persist for a short time and minimums reach into optimal levels, fish can maintain normal growth (Bjorn 1978). Overall, the mainstem Wind River maintains temperatures that are well below those considered stressful or lethal to steelhead (Wydoski and Whitney 2003).

Unlike the mainstem Wind River, water temperatures in Trout Creek increase greatly between the upper and lower portions of the creek. At sites in Trout Creek, water temperatures regularly exceed 20°C despite cold, spring-fed headwaters. At the thermograph site in the headwater section (Trout Creek – upper; rkm 15.2), we have never recorded a water temperature in excess of 9°C. During base-flow periods, upper Trout Creek (above Crater Creek confluence) can contribute up to 67% of the surface flow as measured at the Lower Trout site (rkm 3.0; Jezorek et al. 2005). Restoration actions have already targeted portions of the Trout Creek watershed (Bair et al. 2002) and further actions are planned, including the removal of Hemlock Dam. Our data will help determine if removal of the dam decreases the rate of warming in the section between our thermograph sites LTRO (rkm 3.0) and HEML (rkm 2.0). Trout Creek has several tributaries between our sites at UTRO (rkm 15.2) and MS43 (rkm 11.0) that contribute warm water (Crater Creek, E. Fork Trout Creek, and Layout Creek). Some restoration actions have already been implemented on these tributaries and passive restoration will slowly influence these streams.

Panther Creek maintains lower temperatures than either Trout Creek or the Wind River. Cool water from Panther Creek most likely helps to keep the lower portion of the Wind River moderated during the summer when adult salmonids hold there. Eightmile Creek does experience warming in the lower 500 m, a section that was scoured by a debris flow in 1996.

Though Eightmile Creek contributes a minor amount of water to Panther Creek, we will continue to monitor temperatures there as the lower section revegetates.

Base flow levels influence available habitat and water temperatures during the warmest portion of the summer, potentially limiting populations or influencing steelhead parr migrations in summer. Low flows may be a factor in the distribution of non-indigenous Chinook between years. Access to upstream areas for spawning adults may be limited during low flow years. We are currently investigating distribution and densities of wild-spawned Chinook in the Wind River, the relationship between flow and Chinook distribution, and potential Chinook affects on steelhead.

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References

Bair, B., A. Olegario, P. Powers, D. Doede, E. Plimmer, and J. Deshong. 2002. Wind River Watershed Restoration Project, Segment II. Project No. 1998-019000, (BPA Report DOEBP-00000407-1)

Baxter, C. V., C. A. Frissell, and F. R. Hauer. 1999. Geomorphology, logging roads, and the distribution of bull trout spawning in a forested river basin: implications for management and conservation. Transactions of the American Fisheries Society 128:854-867.

Bell, M. C. 1986. Fisheries handbook of engineering requirements and biological criteria. U.S. Army, Corps of Engineers, Office of the Chief of Engineers, Fish Passage Development and Evaluation Program, Portland, Oregon.

Bjornn, T. C. 1978. Survival, production, and yield of trout and chinook salmon in the Lemhi River, Idaho. University of Idaho. College of Forestry, Wildlife, and Range Sciences Bulletin 27, Moscow.

Connolly, P. J., and I. G. Jezorek, editors. 2006. Wind River watershed restoration. Annual Report for April 2003 – March 2004. Project number 1998-0190-00. Prepared for: Bonneville Power Administration, Portland, OR.

Gallagher, A. S., and N. J. Stevenson. 1999. Streamflow. Pages 149-155 *in* M. B. Bain and N. J. Stevenson, editors. Aquatic habitat assessment: common methods. American Fisheries Society, Bethesda, Maryland.

Howard, D., and G. Pelletier. 2002. Wind River watershed temperature total maximum daily load. Washington State Department of Ecology, Publication No. 02-10-029, Olympia, WA.

Jezorek, I. G., P. J. Connolly, and K. M. Martens. 2005. Wind River Watershed Project: Flow, Temperature, and Habitat Conditions. 2002 Annual Report. Project number 1998-019-00. Prepared for: Bonneville Power Administration, Portland OR.

NPCC (Northwest Power and Conservation Council). 2004. Wind River subbasin plan. Portland, OR.

Rawding, D., B. Glaser, S. VanderPloeg, and N. Pittman. 2004. Documentation used in the Ecosystem Diagnosis and Treatment Model (EDT) for the Wind River Subbasin. Washington Department of Fish and Wildlife. Vancouver, WA.

Stanford, J. A., and J. V. Ward. 1993. An ecosystem perspective of alluvial rivers: connectivity and the hyporheic corridor. Journal of the North American Benthological Society. 12(1):48-60.

USFS (U.S. Forest Service). 1996. Wind River basin watershed analysis. Gifford Pinchot National Forest, Wind River Ranger District. Carson, WA.

Washington Department of Ecology, 2006, Chapter 173-201A, Water Quality Standards for the Surface Waters of the State of Washington. Olympia, WA.

Wydoski, R. S., and R. L. Whitney. 2003. Inland Fishes of Washington. 2nd Edition. University of Washington Press, Seattle, WA.

Table 1. Locations of thermographs that have been maintained by U.S. Geological Survey's Columbia River Research Laboratory. Sites are listed from upstream to downstream within a watershed. Coordinates were obtained from a hand-held Global Positioning System using North American Datum 1927. The word "present" indicates that the thermograph was recording data as of November 2004. See Appendix Table 1 for dates when units were lost or malfunctioned.

Watershed Subwatershed Subdrainage	Coordinates North	 West	Elevation (ft)	Distance upstream from mouth (km)	Date start (mm/yy)	Date end (mm/yy)
Trout Creek						
Trout Cr. – upper	45º 50.798'	122º 01.962'	1,920	15.2	12/96	present
Crater Cr.	45º 50.769'	122º 01.997'	1,920	0.1	12/96	present
Trout Cr. – 33 bridge	45º 50.727'	122º 01.987'	1,900	14.4	12/96	present
Compass Cr.	45º 50.427'	122º 02.051'	1,900	0.2	12/96	present
East Fork Trout Cr.	RNO[a]		1,860	0.2	05/99	present
Trout Cr. – upper OG[b]	45º 49.867'	122º 01.428'	1,835	12.2	11/97	present
Layout Cr. - upper	RNO		1,930	2.9	05/99	present
Layout Cr.[c]	45º 49.776'	122º 01.525'	1,830	0.1/0.7[c]	11/97	present
Layout Cr. (BLAY)[c]	RNO		1,810	0.1	07/04	present
Trout Cr. – lower OG	45º 49.656'	122º 01.278'	1,810	11.6	11/97	present
Trout Cr. – 43 bridge	45º 49.320'	122º 00.894'	1,805	11.0	08/97	present
Planting Cr.	45º 48.972'	121º 59.436'	1,730	0.2	07/97	present
Trout Cr. – ab. Hemlock	RNO		1,120	3.0	11/97	present
Trout Cr. – bl. Hemlock	45º 48.126'	121º 55.810'	1,080	2.0	10/98	present
Martha Cr. -CMCW	RNO		1,150	2.0	07/04	present
Martha Cr.- upper	RNO		1,130	1.8	05/99	present
Martha Cr.- lower	45º 47.737'	121º 55.342'	1,080	1.0	10/97	present

Continued.

Table 1. Continued.

Watershed Subwatershed Subdrainage	Coordinates North	 West	Elevation (ft)	Distance upstream from mouth (km)	Date start (mm/yy)	Date end (mm/yy)
Upper Wind River						
Wind R. – ab. Paradise Cr.	45º 57.047'	121º 55.815'	1,560	40.9	07/00	present
Paradise Cr.	45º 57.149'	121º 56.400'	1,550	1.0	10/98	present
Wind R – lower mining	45º 54.793'	121º 56.926'	1,360	36.5	07/00	present
Wind R. – bl. mining			1,350	35.5	07/02	present
Falls Cr.	45º 54.486'	121º 56.844'	1,340	0.1	07/00	present
Ninemile Cr.	45º 53.651'	121º 56.752'	1,300	0.2	06/00	present
Dry Cr. – 1	45º 54.127'	121º 57.874'	1,190	1.5	05/99	06/00
Dry Cr. – 2	RNO		1.250	3.3	06/00	present
Trapper Cr.	45º 53.431'	122º 00.593'	1,360	1.5	10/98	present
Wind R. – bl. Trapper Cr.	45º 52.501'	121º 58.629'	1,090	30.0	10/98	present
Panther Creek						
Panther Cr. – upper	45º 50.573'	121º 51.567'	1,070	12.0	10/98	present
Eightmile Cr. – upper	RNO		1,090	0.6	07/97	present
Eightmile Cr. – lower	45º 50.393'	121º 52.069'	1,030	0.2	07/97	present
Cedar Cr. - upper	RNO		1,140	2.3	06/04	present
Cedar Cr. – lower	45º 48.176'	121º 51.404'	940	1.2	05/97	present
Panther Cr. – lower	RNO		730	4.0	07/97	present

[a] RNO = Reading not obtainable.

[b] OG = Restored old-growth channel.

[c] During winter 02-03 Trout Creek reconnected with the old-growth channel at the mouth of Layout Creek. This caused the bottom of Layout Creek to extend approximately 600 m further downstream. A new thermograph was installed (BLAY) 150m above new confluence.

Table 2. Locations of thermographs deployed and maintained by Underwood Conservation District within the Wind River subbasin during summer 1999-2004. Sites are listed from upstream to downstream within a subbasin. No GPS readings are available at the time of writing.

Watershed Subwatershed Subdrainage	Elevation (ft)	Distance upstream from mouth (km)	Date start (mm/yy)	Date end (mm/yy)
Upper Wind River				
Wind R. – blw. Falls Cr.	1,250	33.5	6/99	10/99
			6/00	11/00
			6/01	11/01
			5/02	9/02
			5/03	11/03
			5/04	10/04
Trapper Cr. at mouth[a, b]	1,135	0.3	6/99	10/99
			6/00	11/00
			6/01	11/01
			5/02	9/02
			5/03	10/03
Middle Wind River				
Wind R. – at Beaver Cr. Camp Gr.	1,030	26.0	7/02	9/02
			5/03	8/03
			5/04	11/04
Wind R. – at Pacific Crest Trail	910	22.0	7/02	9/02
			5/03	8/03
			5/04	10/04
Wind R. – at Stabler Bridge	890	18.5	6/99	10/99
			6/00	11/00
			6/01	11/01
			5/02	9/02
			5/03	11/03
			6/04	10/04
Trout Creek				
Trout Cr. – blw. Martha Cr.	865	0.2	6/99	10/99
			6/00	11/00
			6/01	11/01
			5/02	9/02
			6/04	10/04

Continued.

Table 2. Continued.

Watershed Subwatershed Subdrainage	Elevation (ft)	Distance upstream from mouth (km)	Date start (mm/yy)	Date end (mm/yy)
Lower Wind River				
Bear Cr.	317	2.4	6/99	10/99
			6/00	11/00
			6/01	11/01
			5/02	9/02
			5/02	12/03
			5/04	10/04
Little Wind River [b]	85	0.2	6/99	10/99
			6/00	11/00
			6/01	11/01
			5/02	9/02
			5/03	11/03
Wind River near mouth	80	1.5	6/99	10/99
			6/00	11/00
			6/01	11/01
			5/02	9/02
			5/03	11/03
			5/04	11/04

[a] No data from 07/06/02 – 07/30/02 because of air exposure of thermograph.
[b] No data in 2004 due to loss of thermograph.

Table 3. Flow measurement locations within the Wind River subbasin, 1996-2004. Coordinates are from a hand-held Global Positioning System (GPS) using North American Datum 1927. Sites are listed from upstream to downstream within a subbasin.

Watershed / Subwatershed	GPS reading North	GPS reading West	Elevation (ft)	Distance upstream of mouth (km)	Year sampled[a] 1996	1997	1998	1999	2000	2001	2002	2003	2004
Upper Wind River[b]													
Wind R. – ab. Paradise Cr.	45º 57.047'	121º 55.815'	1,560	40.6	No	No	No	No	Yes	Yes	Yes	Yes	Yes
Paradise Cr.	45º 56.951'	121º 56.957'	1,550	0.5	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Falls Cr.	45º 54.534'	121º 56.772'	1,340	0.1	No	No	No	No	Yes	Yes	Yes	No	No
Ninemile Cr.	45º 53.651'	121º 56.752'	1,300	0.2	No	No	No	No	Yes	Yes	Yes	No	No
Dry Cr. – upper	RNO[c]		1,190	1.5	No	No	No	Yes	Yes	Yes	Yes	No	No
Dry Cr. – lower	45º 54.127'	121º 57.874'	1,120	0.1	No	No	No	Yes	Yes	Yes	Yes	No	No
Trapper Cr.	45º 52.761'	121º 58.849'	1,120	0.1	No	No	Yes	Yes	Yes	Yes	Yes	No	No
Wind R. – bl. Trapper Cr.	45º 52.581'	121º 58.682'	1,090	30.3	No	No	No	No	Yes	Yes	Yes	Yes	Yes
Trout Creek[d]													
Trout Cr. – upper	45º 50.794'	122º 01.961'	1,920	15.2	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No
Crater Cr.	45º 50.779'	122º 01.036'	1,920	0.1	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No
Trout Cr. – 33 bridge	RNT[e]		1,920	14.0	No	No	No	No	No	No	Yes	Yes	Yes
Compass Cr.	45º 50.427'	122º 02.051'	1,900	0.2	No	No	No	No	No	Yes	No	No	No
East Fork Trout Cr.	RNO		1,860	0.2	No	No	No	No	No	Yes	No	No	No
Layout Cr. – upper	RNO		1,940	2.5	No	No	Yes	Yes	No	Yes	No	No	No
Layout Cr. – lower	45º 49.776'	122º 01.525'	1,830	0.1	No	No	No	Yes	Yes	Yes	No	No	No
Trout Cr. – 43 bridge	45º 49.434'	122º 00.978'	1,805	11.3	No	No	No	No	Yes	Yes	Yes	Yes	Yes
Planting Cr.	45º 48.972'	121º 59.436'	1,730	0.1	No	Yes	Yes	No	No	Yes	No	No	No
Trout Cr. – lower	RNO		1,120	3.0	No	No	No	No	No	Yes	Yes	Yes	Yes
Martha Cr.	45º 47.767'	121º 55.255'	1,070	1.0	No	Yes	Yes	Yes	No	No	No	No	No
Panther Creek													
Mouse Cr.	RNO		1,080	0.1	Yes	No	No	No	No	No	No	No	No
Eightmile Cr. – lower	45º 50.393'	121º 52.069'	1,020	0.1	No	Yes	Yes	No	No	No	No	No	No
Cedar Cr.	45º 48.176'	121º 51.404'	940	1.2	Yes	Yes	No	No	No	No	No	No	No
Panther Cr. – lower	RNO		1,010	4.0	Yes	No	No	No	No	No	No	No	No

[a] Flows generally taken at regular intervals of time, about every two weeks, from June through October.
[b] In addition, a flow reading was taken on the mainstem Wind River above Paradise Cr. and below Trapper Cr. on 10/6/99.
[c] RNO = Reading not obtainable by GPS because of topography of basin.
[d] Trout Cr. flows in 2000 were measured once, on 10/13/00.
[e] RNT = Reading not taken.

Table 4. Annual number of days when maximum water temperature exceeded 16°C and 20° C at sites in the Wind River subbasin, 1997-2004. Data are from Onset Corporation's StowAway thermographs, which recorded temperature every two hours. Sites are listed from upstream to downstream within a subbasin. See Appendix Table 1 for notes on missing thermograph data.

Watershed Subwatershed Subdrainage	No. days ≥16°C								No. days ≥20°C							
	1997	1998	1999	2000	2001	2002	2003	2004	1997	1998	1999	2000	2001	2002	2003	2004
Trout Creek																
Trout Cr. – upper	0	0	---	---	0	0	0	0	0	0	---	---	0	0	0	0
Crater Cr. – site 2	23	44	15	22	11	8	53	33	0	1	0	0	0	0	0	0
Trout Cr. – 33 bridge	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Compass Cr.	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
East Fork Trout Cr.	---	---	42	34	37	39	54	49	---	---	0	0	0	0	0	0
Trout Cr. – upper OG[b]	---	0	0	0	0	0	0	---	---	0	0	0	0	0	0	---
Layout Cr. - upper	---	---	0	0	0	0	10	2	---	---	0	0	0	0	0	0
Layout Cr.	---	56	23	---	31	---	67	36	---	0	0	---	0	---	0	0
Layout Cr. (BLAY)[c]	---	---	---	---	---	---	---	42	---	---	---	---	---	---	---	13
Trout Cr. – lower OG	---	---	1	0	0	0	0	0	---	---	0	0	0	0	0	0
Trout Cr. – 43 bridge	13	37	0	9	17	1	22	23	0	0	0	0	0	0	0	0
Planting Cr.	16	33	---	---	6	4	21	22	0	0	---	---	0	0	0	0
Trout Cr. – ab. Hemlock	---	74	---	48	56	47	77	44	---	23	---	11	9	1	33	23
Trout Cr. – blw. Hemlock	---	---	44	65	69	59	100	61	---	---	6	16	22	7	44	37
Martha Cr. - CMCW	---	---	---	---	---	---	---	43	---	---	---	---	---	---	---	11
Martha Cr .- upper	---	---	22	11	11	35	56	13	---	---	0	0	0	0	0	0
Martha Cr. - lower	---	62	45	45	62	49	56	28	---	5	0	0	0	1	2	0
Trout Cr. – at mouth	---	---	37	55	75	50	---	59	---	---	0	11	20	3	---	34

Continued.

Table 4. Continued.

Watershed Subwatershed Subdrainage	No. days ≥16°C								No. days ≥20°C							
	1997	1998	1999	2000	2001	2002	2003	2004	1997	1998	1999	2000	2001	2002	2003	2004
Upper Wind River																
Wind R. – ab. Paradise Cr.	---	---	---	3	---	7	13	23	---	---	---	0	---	0	0	0
Paradise Cr.	---	---	---	0	0	---	---	0	---	---	---	0	0	---	---	0
Wind R. – L. Mine Reach	---	---	---	0	0	0	0	8	---	---	---	0	0	0	0	0
Wind R. – Blw. Mine Reach	---	---	---	---	---	27	29	37	---	---	---	---	---	0	0	0
Falls Cr.	---	---	---	0	1	0	0	1	---	---	---	0	0	0	0	0
Wind R. – blw. Falls Cr	---	---	0	0	6	0	1	4	---	---	0	0	0	0	0	0
Ninemile Cr.	---	---	---	0	0	0	0	0	---	---	---	0	0	0	0	0
Dry Cr.	---	---	---	0	1	0	28	2	---	---	---	0	0	0	0	0
Trapper Cr.	---	---	---	0	0	0	---	0	---	---	0	0	0	0	---	0
Trapper Cr. -lower	---	---	---	0	4	0	12	---	---	---	0	0	0	0	0	---
Wind R. – blw. Trapper Cr.	---	---	---	1	18	0	---	20	---	---	---	0	0	0	---	0
Middle Wind River																
Wind R. – at Beaver Cr.CG	---	---	---	---	---	0	0	0	---	---	---	---	---	0	0	0
Wind R. – at Pacific Crest Tr.	---	---	---	---	---	8	29	37	---	---	---	---	---	0	0	0
Wind R. – at Stabler Bridge	---	---	6	19	40	30	63	44	---	---	0	0	0	0	0	0
Lower Wind River																
Bear Cr.	---	---	25	20	31	31	---	41	---	---	0	0	0	0	---	0
Little Wind River	---	---	---	51	58	57	78	---	---	---	---	0	0	0	0	---
Lower Wind River site 1	---	---	---	18	44	20	46	43	---	---	---	0	0	0	0	0
Lower Wind River site 2	---	---	---	17	38	20	46	43	---	---	---	0	0	0	0	0

Continued.

Table 4. Continued.

Watershed Subwatershed Subdrainage	No. days ≥16°C								No. days ≥20°C							
	1997	1998	1999	2000	2001	2002	2003	2004	1997	1998	1999	2000	2001	2002	2003	2004
Panther Creek																
Panther Cr. – upper	---	---	0	0	0	0	0	0	---	---	0	0	0	0	0	0
Eightmile Cr. – upper	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eightmile Cr. – lower	29	39	32	31	37	42	53	20	0	0	0	0	0	0	0	0
Cedar Cr. - upper	---	---	---	---	---	---	---	0	---	---	---	---	---	---	---	0
Cedar Cr. - lower	0	10	0	---	---	---	7	0	0	0	0	---	---	---	0	0
Panther Cr. – lower	---	---	0	0	0	0	0	0	---	---	0	0	0	0	0	0

[a] --- = Thermograph not in place or not operating properly during period of maximum temperatures.
[b] OG = Restored old-growth channel.
[c] Thermograph installed 150 m above new confluence of Layout Creek on 7/6/04.

Table 5. Maximum water temperature recorded at sites in the Wind River subbasin, 1997-2004. Data are from Onset Corporation's StowAway thermographs, which recorded temperature every two hours. Sites are listed from upstream to downstream within a subbasin.

Watershed Subwatershed Subdrainage	Maximum (°C)							
	1997	1998	1999	2000	2001	2002	2003	2004
Trout Creek								
Trout Cr. – upper	8.3	8.5	---[a]	---	7.8	7.3	7.9	8.7
Crater Cr. Site 1	18.3	20.0	17.4	---	---	---	---	---
Crater Cr. Site 2	---	---	---	18.4	17.8	17.0	19.2	18.4
Trout Cr. – 33 bridge	10.1	10.7	9.0	10.6	8.9	9.4	9.4	11.5
Compass Cr.	14.9	16.3	14.0	14.9	14.8	14.1	15.1	15.4
East Fork Trout Cr.	---	---	19.0	19.2	19.9	19.7	19.9	20.0
Trout Cr. – upper OG	---	15.9	13.5	14.4	15.2	13.9	15.8	---
Layout Cr. - upper	---	---	14.0	14.6	15.4	14.6	16.8	16.5
Layout Cr.	---	19.6	17.4	---	18.5	---	19.6	18.4
Layout Cr. (BLAY) [b]	---	---	---	---	---	---	---	20.7
Trout Cr. – lower OG	---	---	16.1	15.8	15.9	14.8	15.6	15.1
Trout Cr. – 43 bridge	17.8	18.6	15.7	16.7	17.6	16.0	17.5	16.8
Planting Cr.	18.7	19.2	---	---	17.3	16.6	17.9	17.6
Trout Cr. – ab. Hemlock	---	23.2	---	21.3	21.8	20.0	23.3	21.8
Trout Cr. – blw. Hemlock	---	---	20.3	22.6	22.8	21.3	25.9	23.5
Martha Cr. - (CMCW) [c]	---	---	---	---	---	---	---	16.9
Martha Cr. - upper	---	---	17.0	16.7	17.3	17.9	18.4	18.2
Martha Cr. - lower	---	21.2	18.7	19.8	19.7	20.2	20.4	20.4
Trout Cr. – at mouth	---	---	18.7	21.0	22.9	20.2	---	23.3

Continued.

Table 5. Continued.

Watershed Subwatershed Subdrainage	Maximum (°C)							
	1997	1998	1999	2000	2001	2002	2003	2004
Upper Wind River								
Wind R. – ab. Paradise Cr.	---	---	---	16.8	---	15.5	17.1	17.2
Paradise Cr.	---	---	---	15.7	15.7	---	---	15.1
Wind R. – lower Mine Reach	---	---	---	12.7	12.9	15.8	12.7	17.7
Wind R. – blw. Mine Reach	---	---	---	---	---	17.7	17.0	17.5
Falls Cr.	---	---	---	14.3	16.3	14.3	15.6	16.1
Wind R. – blw. Falls Cr.	---	---	14.1	15.6	17.1	14.1	16.0	16.4
Ninemile Cr.	---	---	---	13.7	14.6	13.8	14.0	14.0
Dry Cr.	---	---	---	15.2	16.1	15.5	16.9	19.8
Trapper Cr.-upper	---	---	13.8	14.5	15.2	14.9	---	15.4
Trapper Cr.-lower	---	---	14.5	15.6	16.0	15.6	16.4	---
Wind R. – blw. Trapper Cr.	---	---	---	16.3	18.5	15.9	---	---
Middle Wind River								
Wind R. – at Beaver Cr. CG	---	---	---	---	---	14.4	14.7	14.7
Wind R. – at Pacific Crest Tr.	---	---	---	---	---	17.4	18.4	17.9
Wind R. – at Stabler Bridge	---	---	16.4	17.5	18.3	17.9	18.7	18.3
Lower Wind River								
Bear Cr.	---	---	16.8	17.9	17.5	17.9	---	18.7
Little Wind River	---	---	---	19.4	19.0	19.4	19.8	---
Lower Wind River site 1	---	---	---	17.5	19.4	17.5	18.3	17.9
Lower Wind River site 2	---	---	---	17.1	17.9	17.5	18.3	17.9

Continued.

Table 5. Continued.

Watershed Subwatershed Subdrainage	Maximum (°C)							
	1997	1998	1999	2000	2001	2002	2003	2004
Panther Creek								
Panther Cr. – upper	---	---	9.3	9.3	10.2	9.6	9.8	10.0
Eightmile Cr. – upper	15.3	16.1	14.9	15.3	14.7	15.4	15.4	15.8
Eightmile Cr. – lower	18.4	18.6	18.7	18.4	18.1	18.6	18.4	18.3
Cedar Cr. – upper [d]	---	---	---	---	---	---	---	14.4
Cedar Cr. – lower	15.8	16.9	15.6	---	---	---	16.3	15.8
Panther Cr. – lower	---	---	13.5	14.3	15.7	14.3	14.9	15.1

[a] --- = Thermograph not in place or not operating properly during period of maximum temperatures.
[b] Thermograph installed 150m above new confluence of Layout Creek on 7/6/04.
[c] Thermograph installed in upper Martha Creek on 7/4/04.
[d] Thermograph installed in upper Cedar Creek on 7/29/04.
See Appendix Table 1 for dates that thermographs were lost or malfunctioned.

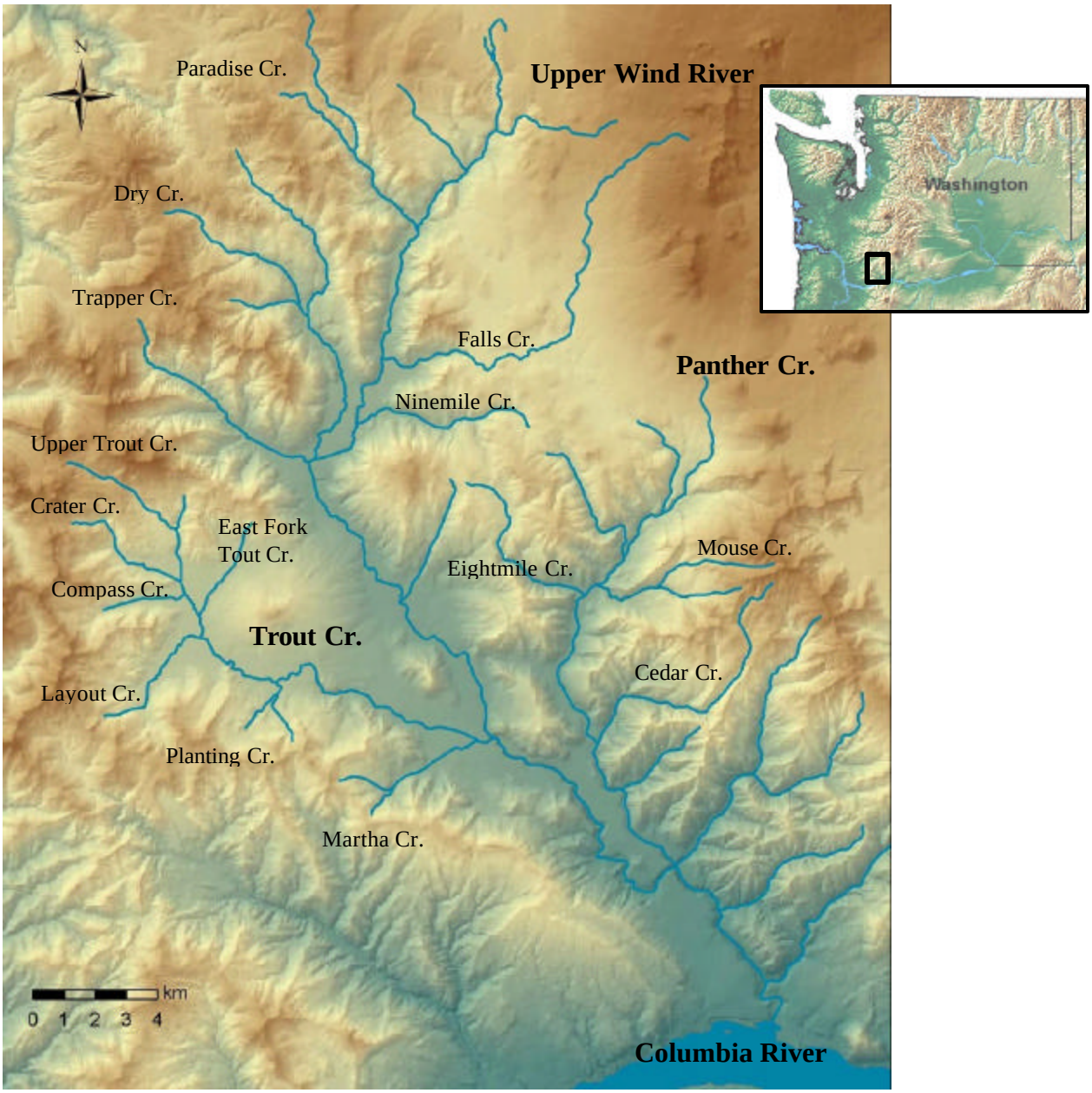


Figure 1. Map of the Wind River subbasin.

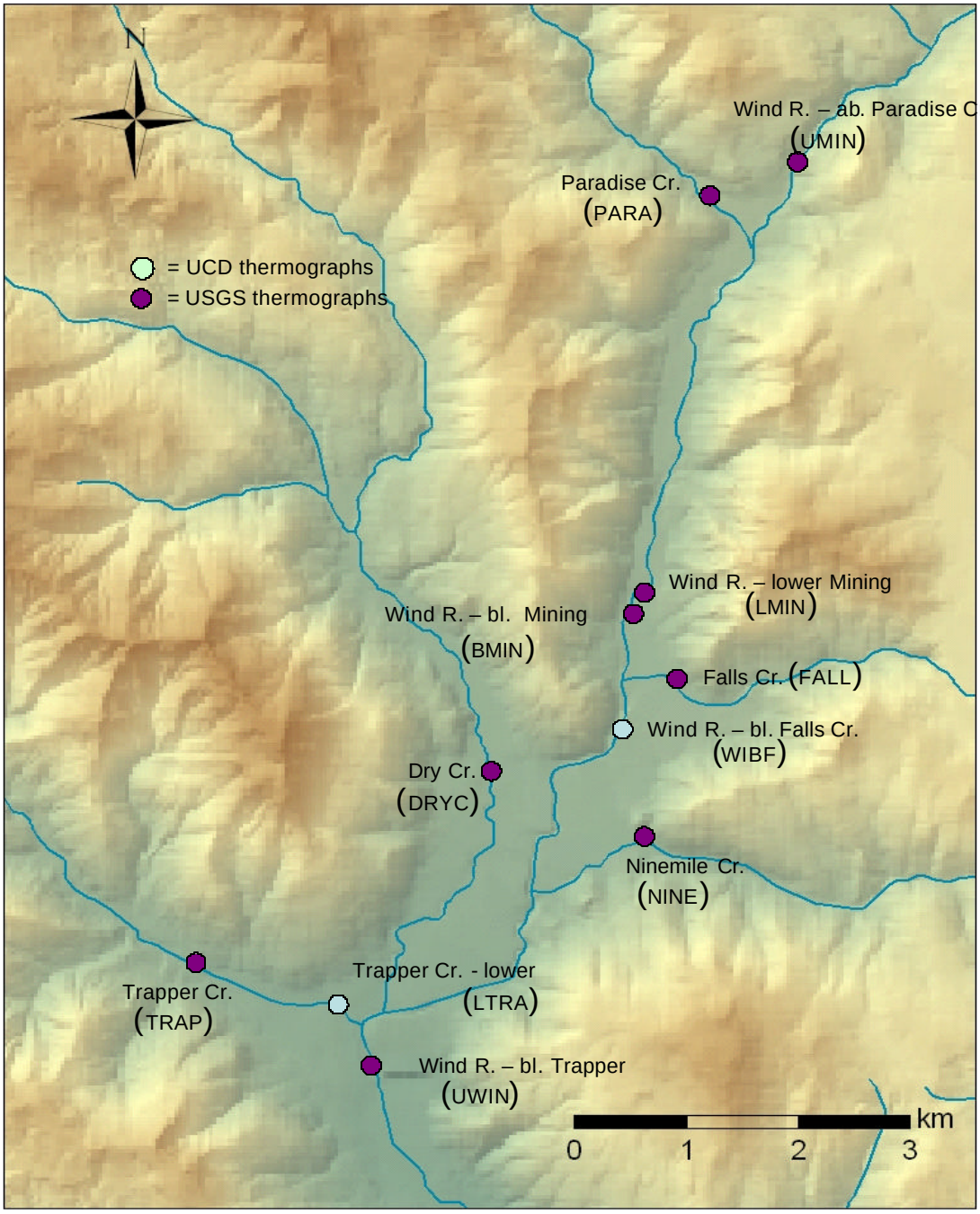


Figure 2. Location of thermographs maintained by USGS and Underwood Conservation District within the upper Wind River watershed, 2004. Thermograph sites are geo-referenced in Tables 1 and 2 of this report. (ab. = above, bl. = below)

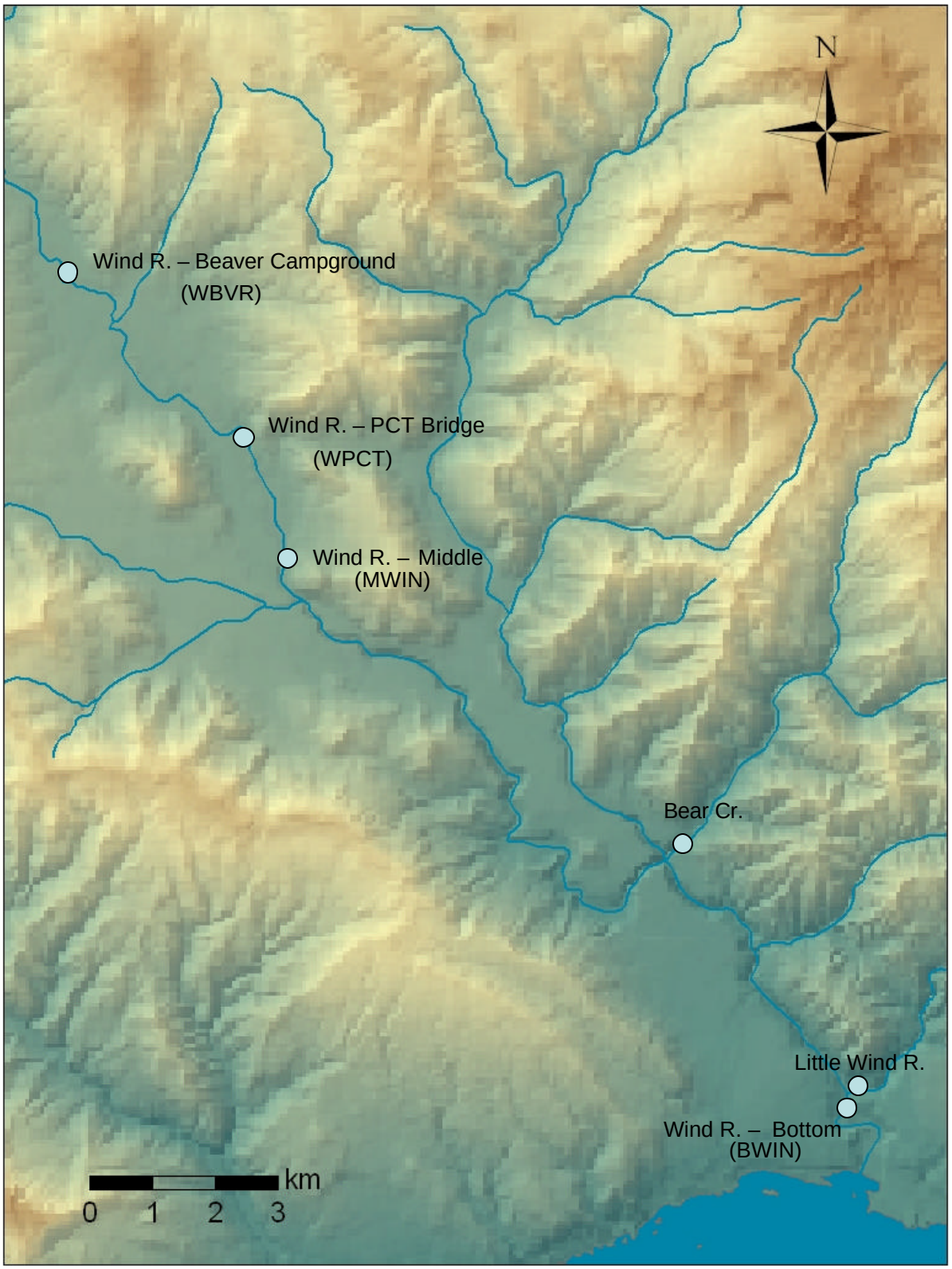


Figure 3. Location of thermographs maintained by Underwood Conservation District within the lower Wind River watershed, 2004. Thermograph sites are geo-referenced in Table 2 of this report.

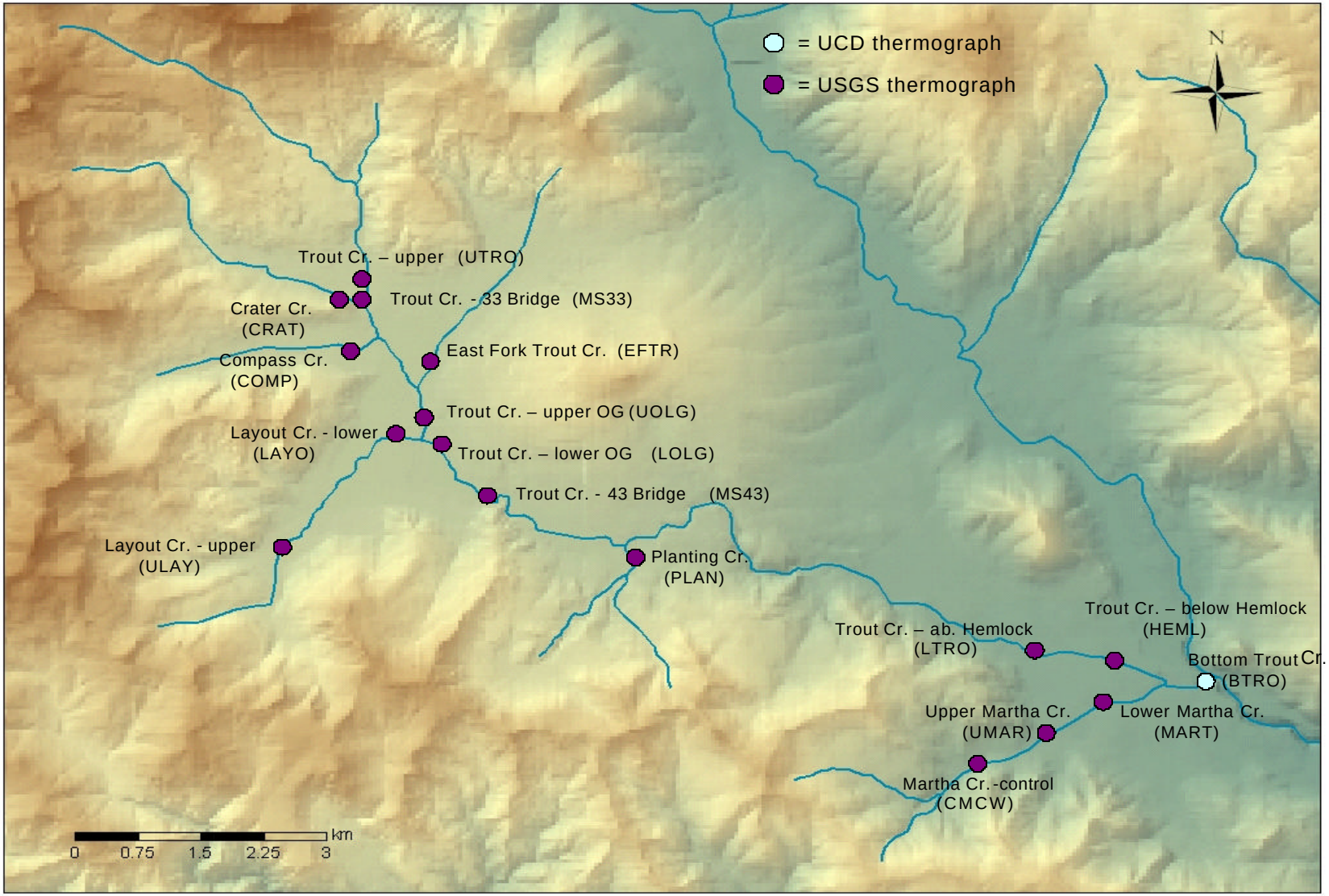


Figure 4. Location of thermographs maintained by USGS and Underwood Conservation District within the upper Trout Creek watershed, 2004. Thermograph sites are geo-referenced in Tables 1 and 2 of this report. (ab. = above, bl. = below)

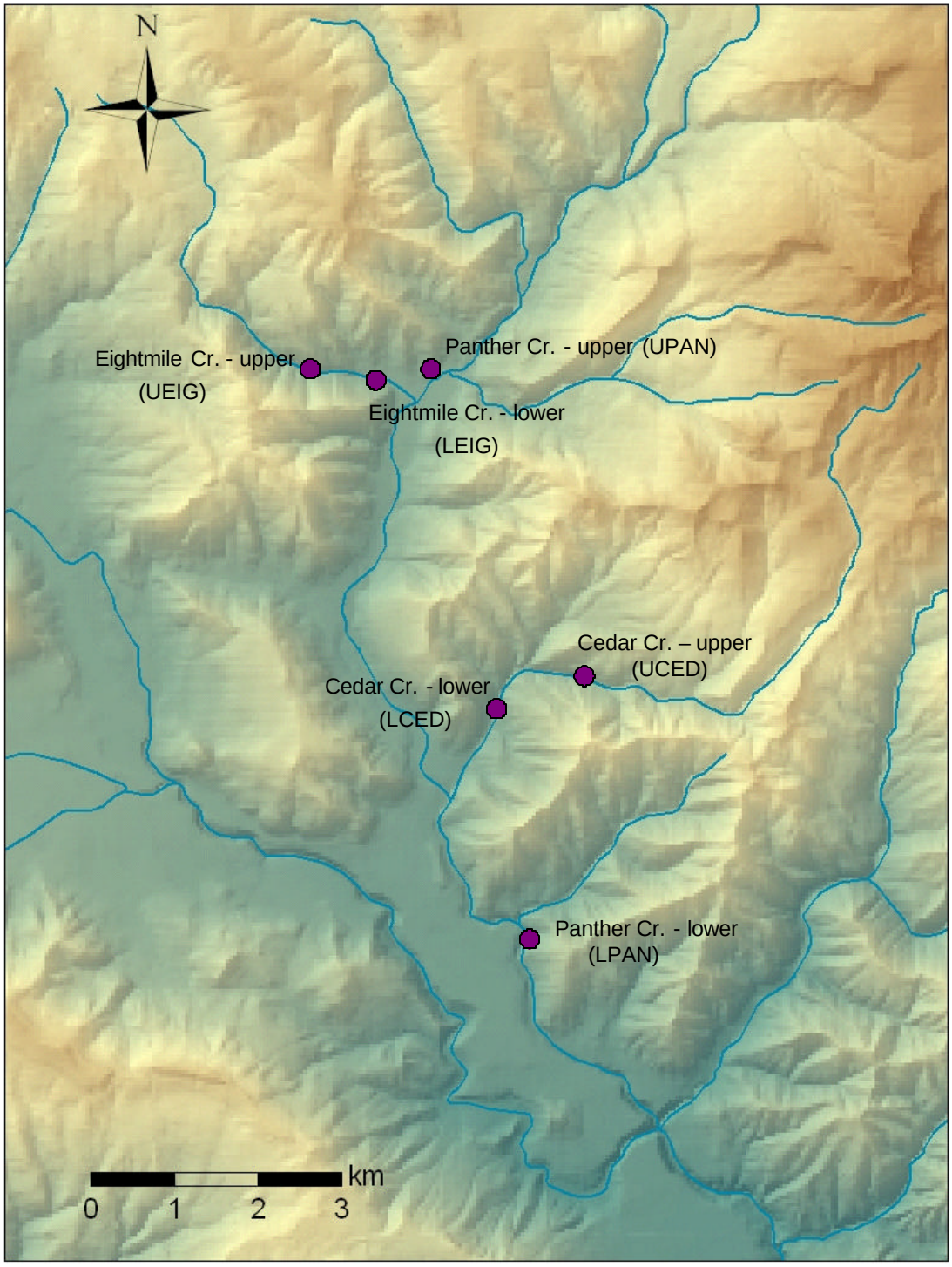


Figure 5. Location of thermographs maintained by USGS within the Panther Creek watershed, 2004. Thermograph sites are geo-referenced in Table 1 of this report.

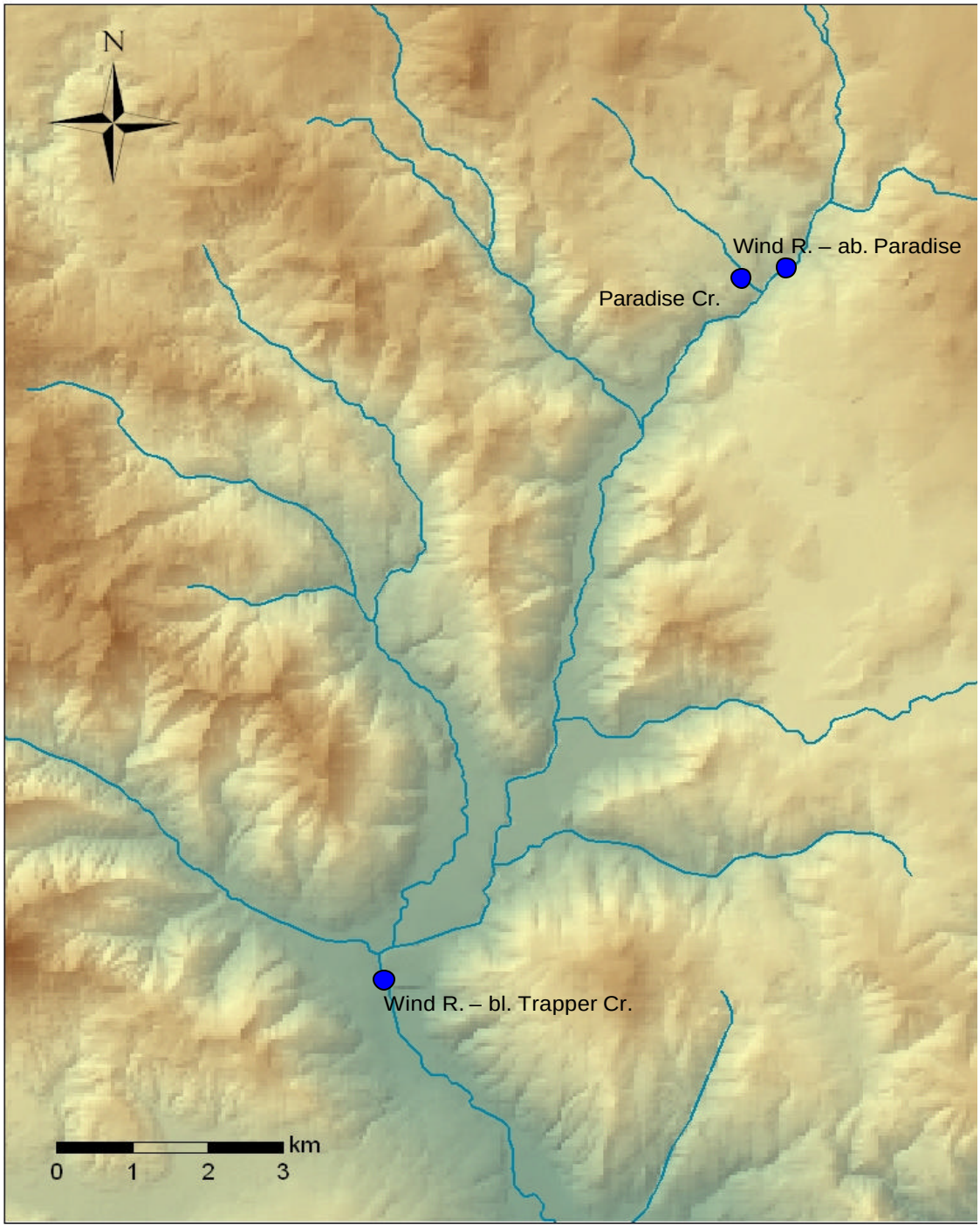


Figure 6. Location of flow sites in the upper Wind River watershed, 2004. Flow sites are geo-referenced in Table 3 of this report. (ab. = above, bl. = below)

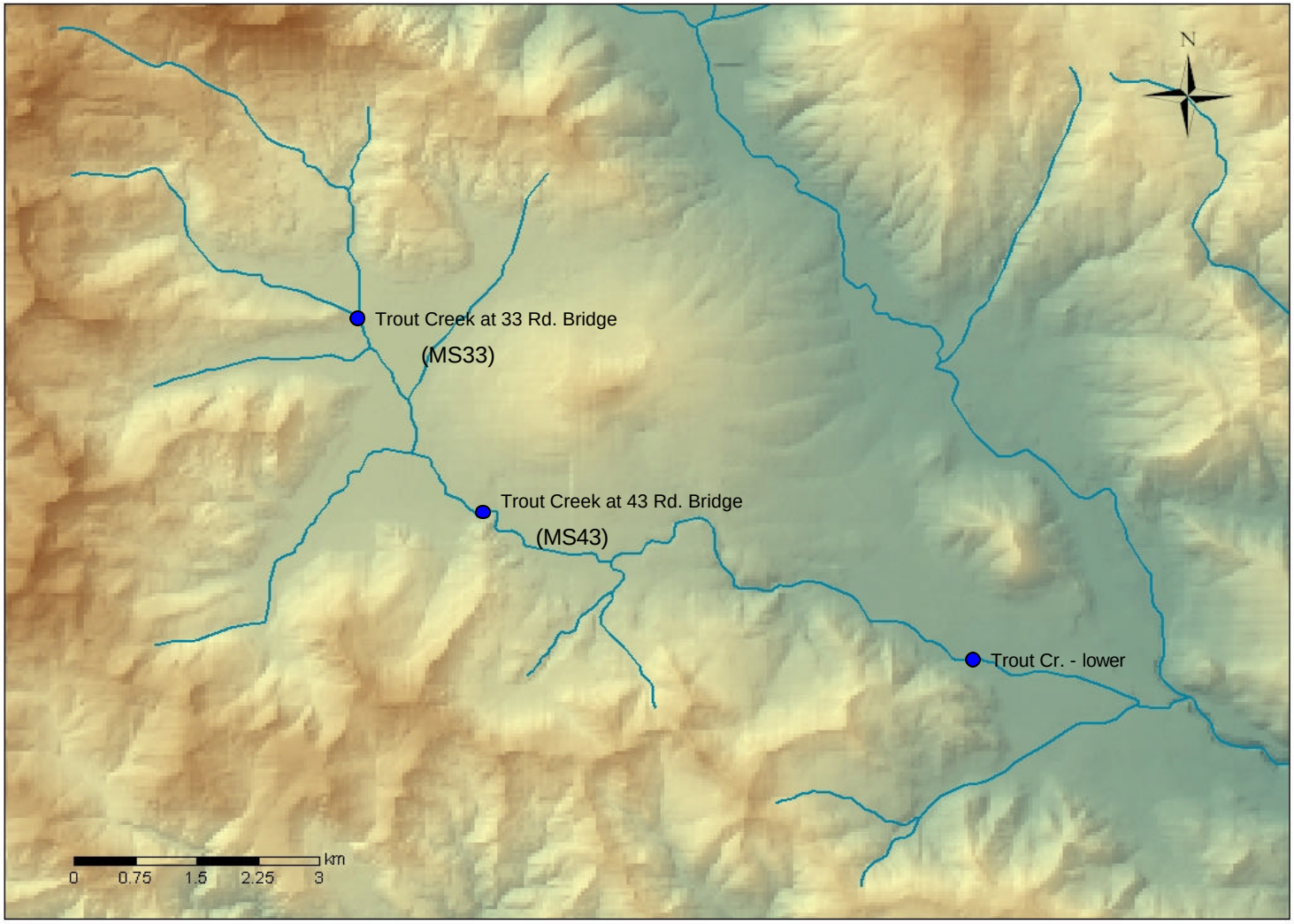


Figure 7. Location of flow sites in the Trout Creek watershed, 2004. Flow sites are geo-referenced in Table 3 of this report.

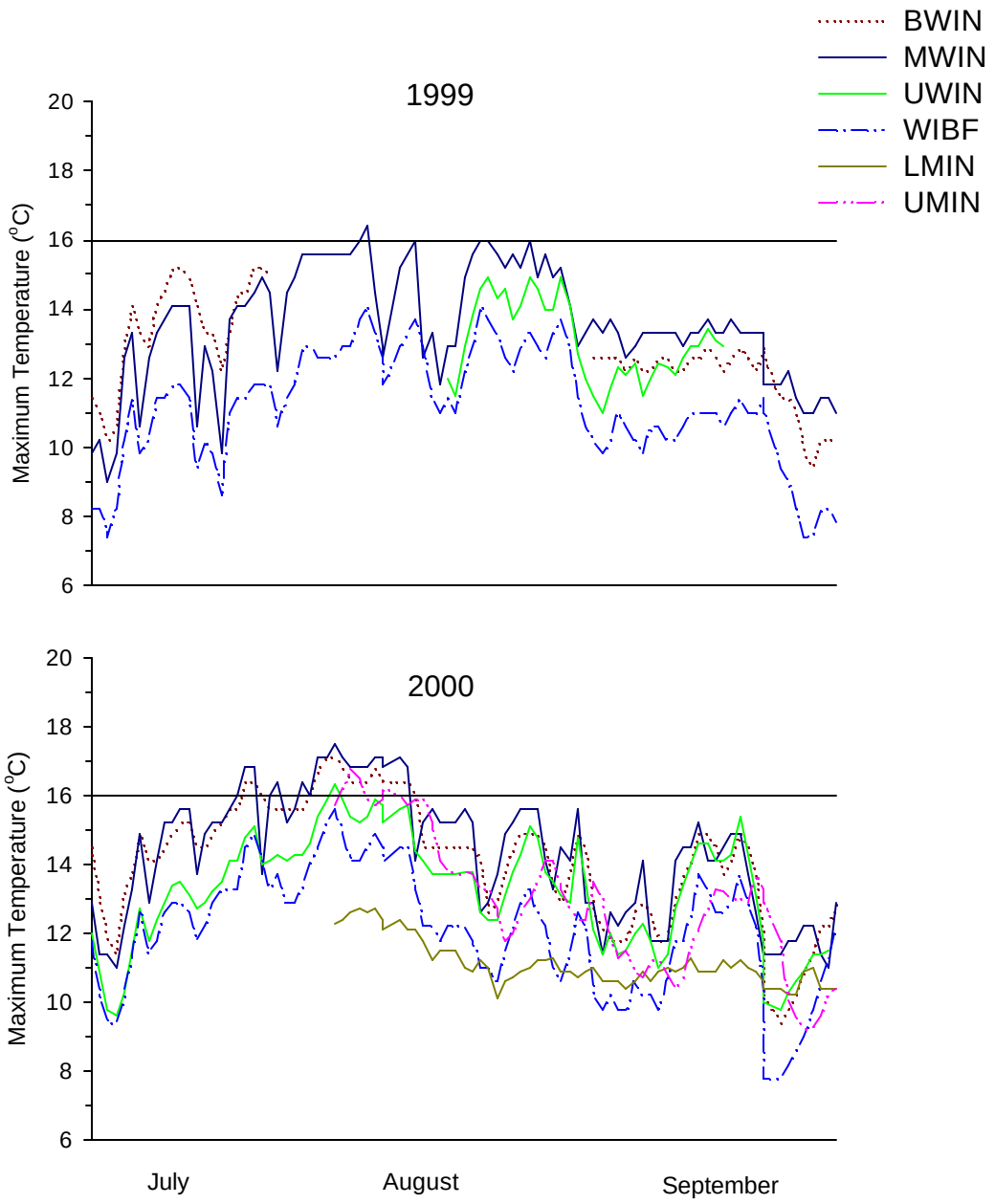


Figure 8. Daily maximum temperature at six sites in the mainstem Wind River for 1 July to 1 October, from 1999 through 2004. Sites from downstream to upstream are, lower Wind at rkm 1.5 (BWIN), Stabler Bridge at rkm 18.5 (MWIN), 3065 Rd. Bridge at rkm 30.0 (UWIN), downstream of Falls Creek at rkm 33.5 (WIBF), lower mine reach at rkm 36.5 (LMIN), and upper mine reach at rkm 40.9 UMIN). The line at 16°C marks the maximum surface water temperature standard set by the Washington Department of Ecology (Chapter 173-201A, Nov. 18 1997, Water Quality Standards for the Surface Waters of the State of Washington). Continued.

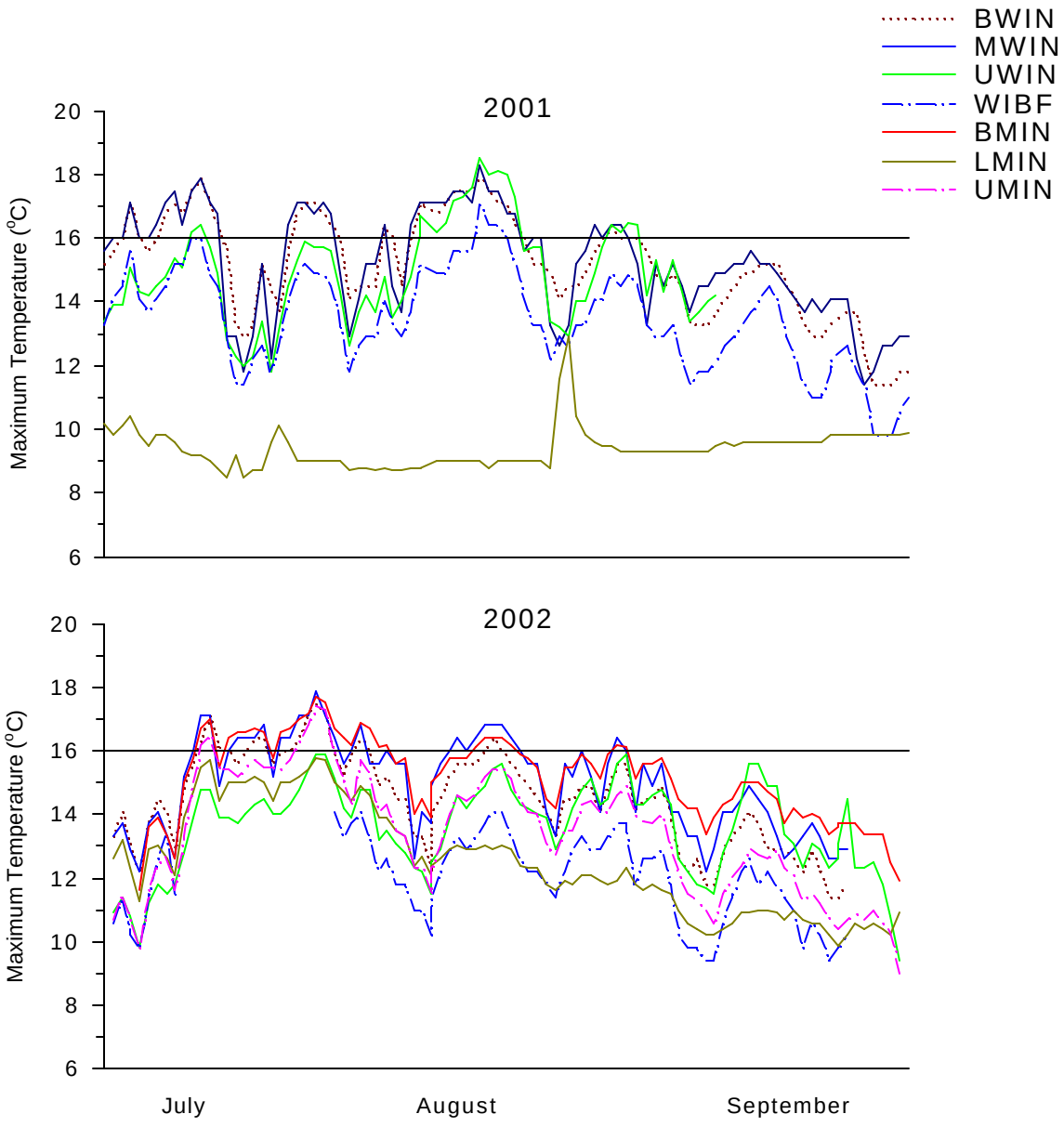


Figure 8. Continued.

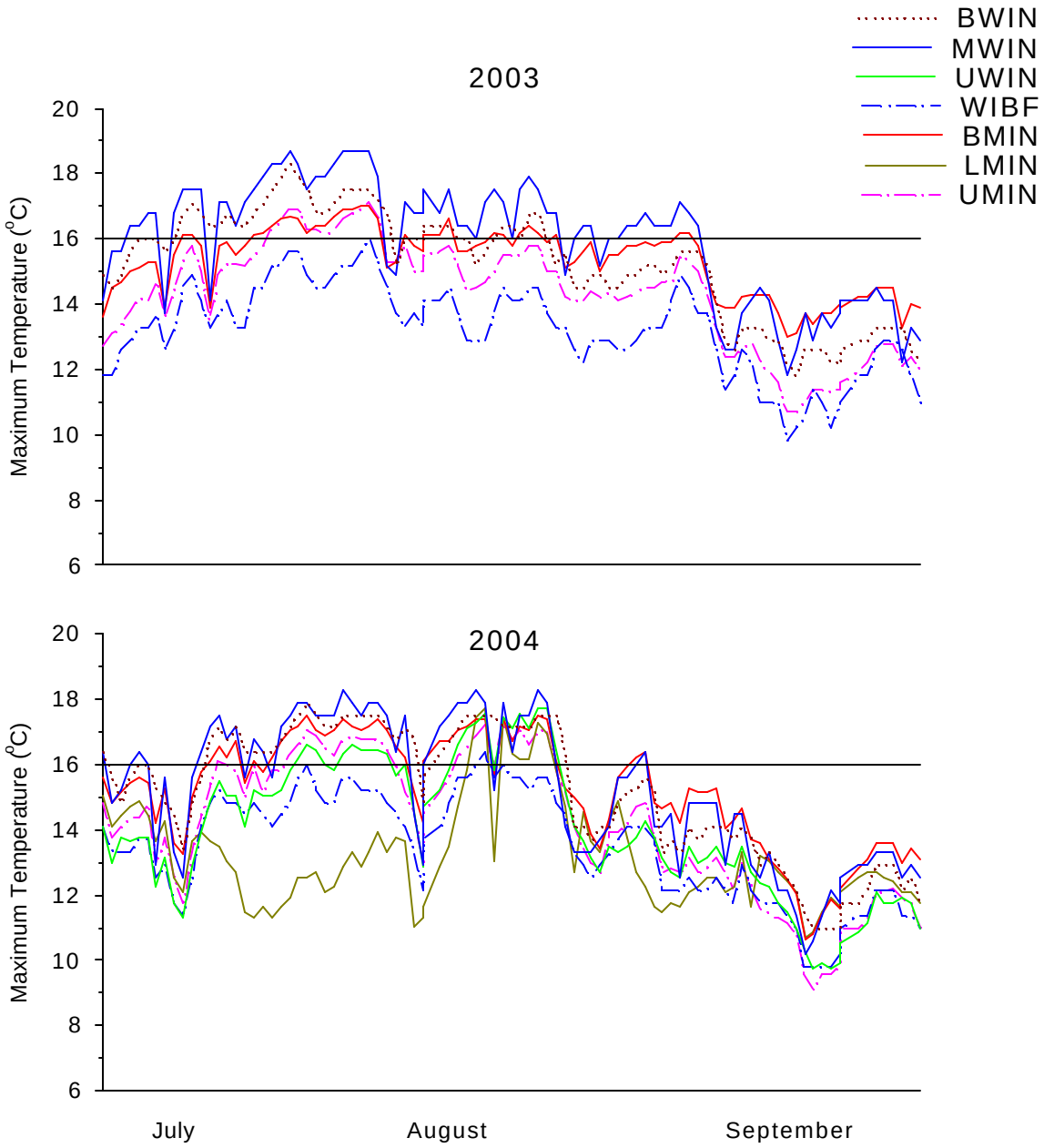


Figure 8. Continued.

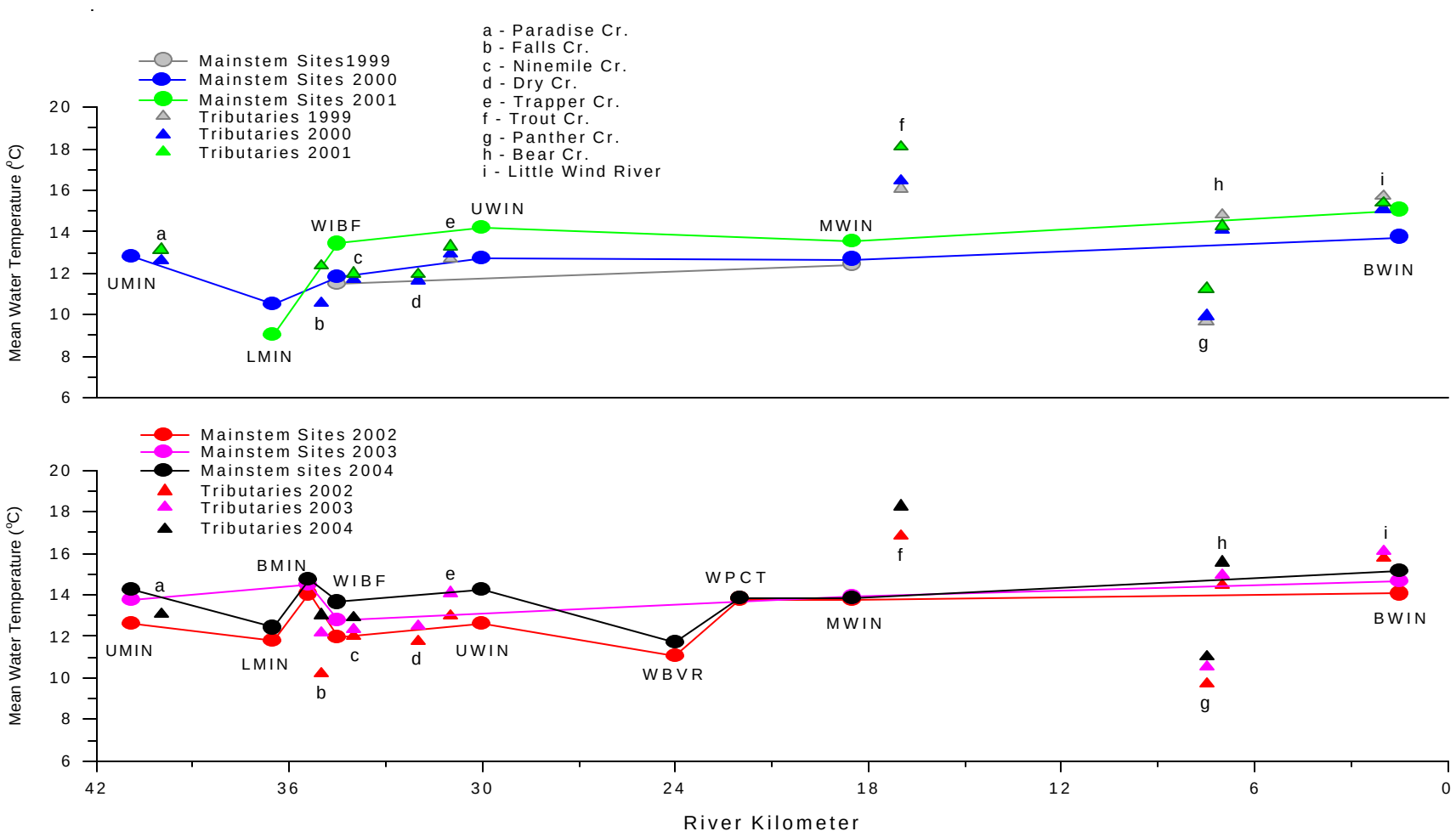


Figure 9. Mean Temperature for the month of August 1999-2004 in mainstem Wind River. Sites, from left to right, are shown from upstream to downstream. River kilometer zero is the mouth of the Wind River. Mainstem sites are: upper mine reach above Paradise Creek at rkm 40.9 (UMIN), lower mine reach at rkm 36.5 (LMIN), below mine reach at rkm 35.4 (BMIN), below Falls Cr. At rkm 33.5 (WIBF), 3065 Road Bridge below Trapper Creek at rkm 30.0 (UWIN), Beaver campground at rkm 24.0 (WBVR), Pacific Crest Trail Bride at rkm 22 (WPCT), Stabler Bridge at rkm 18.5 (MWIN), below Little Wind River at rkm 1.5 (BWIN).

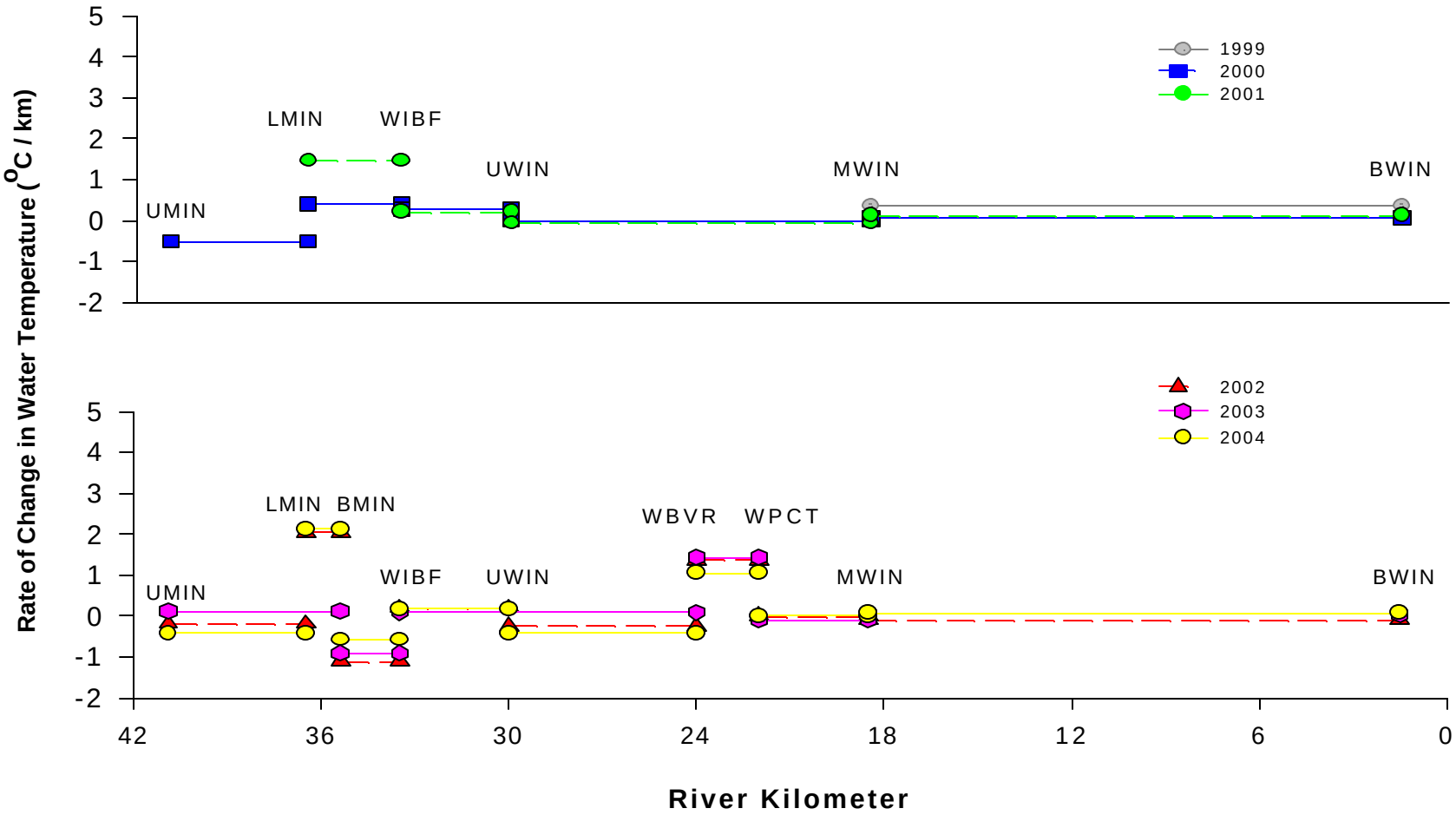


Figure 10. Rate of change (°C/km) of mean temperature for sections of the Wind River for the month of August 1999 - 2004. River kilometer zero is the mouth of the Wind River. Mainstem sites are: upper mine reach at rkm 40.9 (UMIN), lower mine reach at rkm 36.5 (LMIN), Wind River below mine reach at rkm 35.4 (BMIN), Wind River below Falls Cr. at rkm 33.5 (WIBF), 3065 Rd. Bridge at rkm 30.0 (UWIN), Wind River at Beaver campground at rkm 24.0 (WBVR), Wind River at Pacific coast Trail bridge at rkm 22 (WPCT), Stabler Bridge at rkm 18.5 (MWIN), lower Wind River at rkm 1.5 (BWIN).

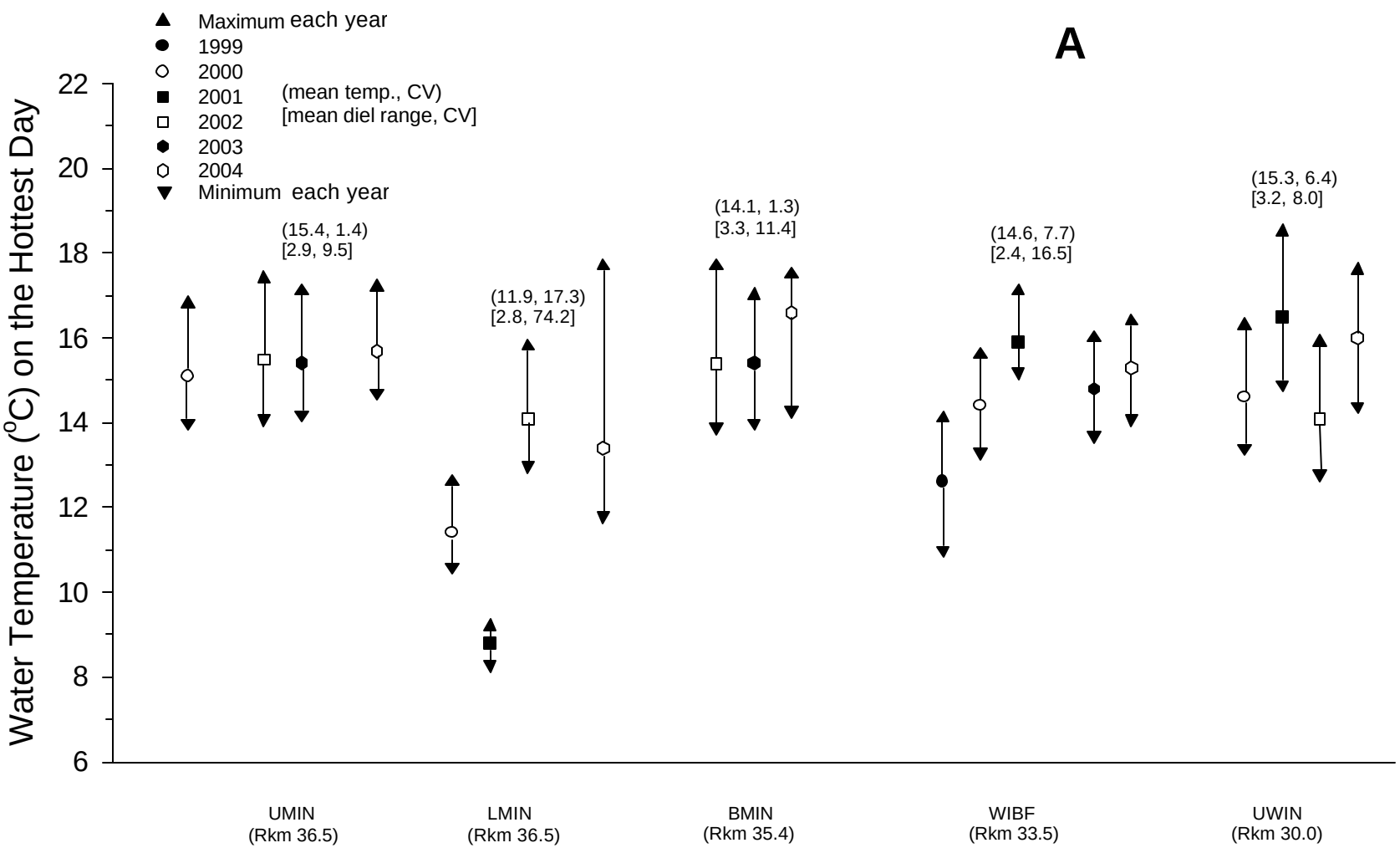


Figure 11. Mean and diel water temperature range for the year's hottest day at nine sites in mainstem Wind River. Sites from left to right are ordered in an upstream to downstream direction. Sites in graph A are: Wind River above Paradise Cr. at rkm 40.9 (UMIN), Wind River mining reach at rkm 36.5 (LMIN), Wind River below mine reach at rkm 35.4 (BMIN), below Falls Creek at rkm 33.5 (WIBF), 3065 Rd. Bridge at rkm 30.0 (UWIN). Dates chosen had the warmest single day water temperature at the WIBF site in the years 1999(August 4), 2000 (July 31), 2001 (August 13), 2002 (July 24), 2003 (July 31), 2004 (August 13). Continued.

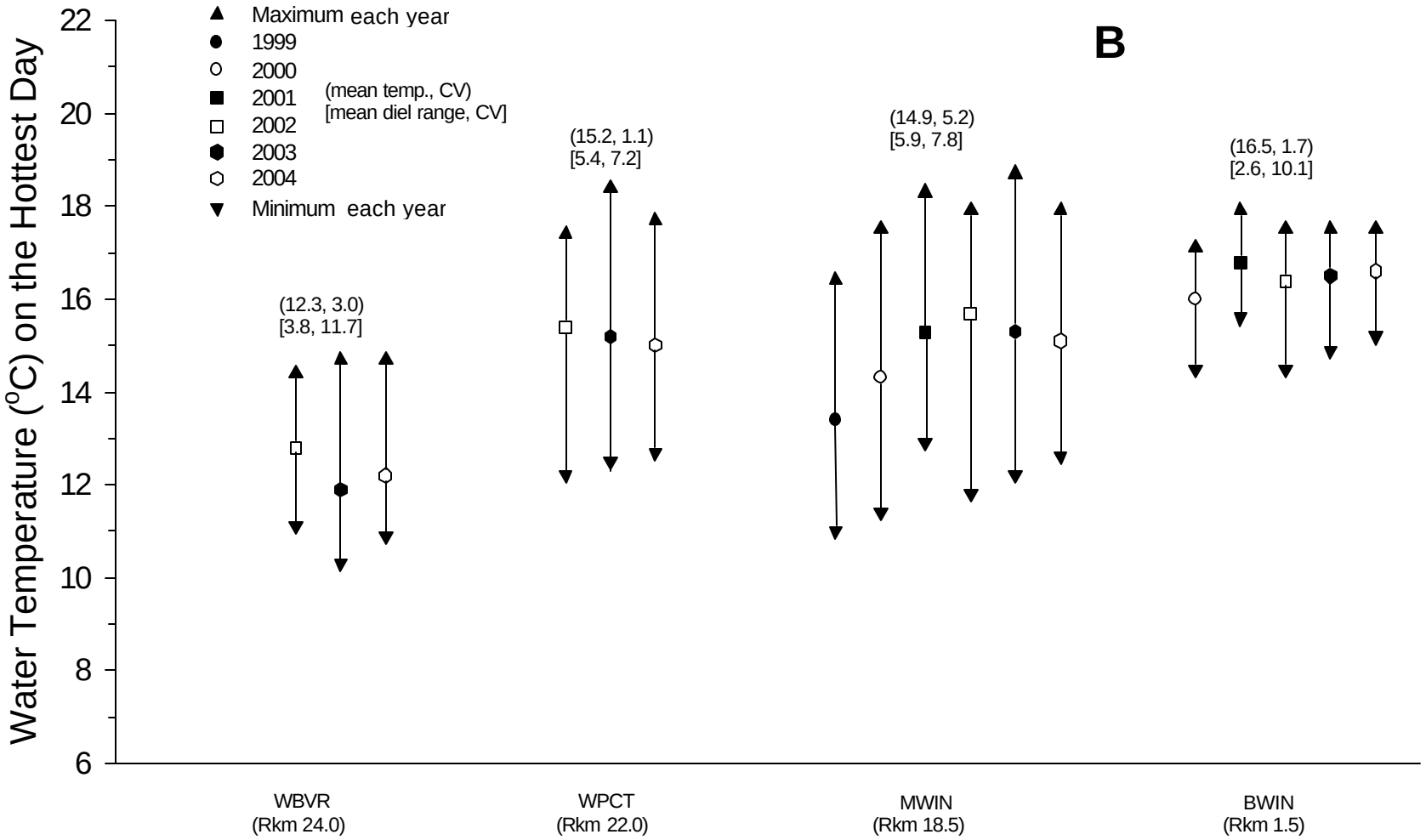


Figure 11. Continued. Sites in graph B are: Wind River at Beaver campground at rkm 24.0 (WBVR), Wind River at Pacific Coast Trail bridge at rkm 22.0 (WPCT), Stabler Bridge at rkm 18.5 (MWIN), lower Wind River at rkm 1.5 (BWIN).

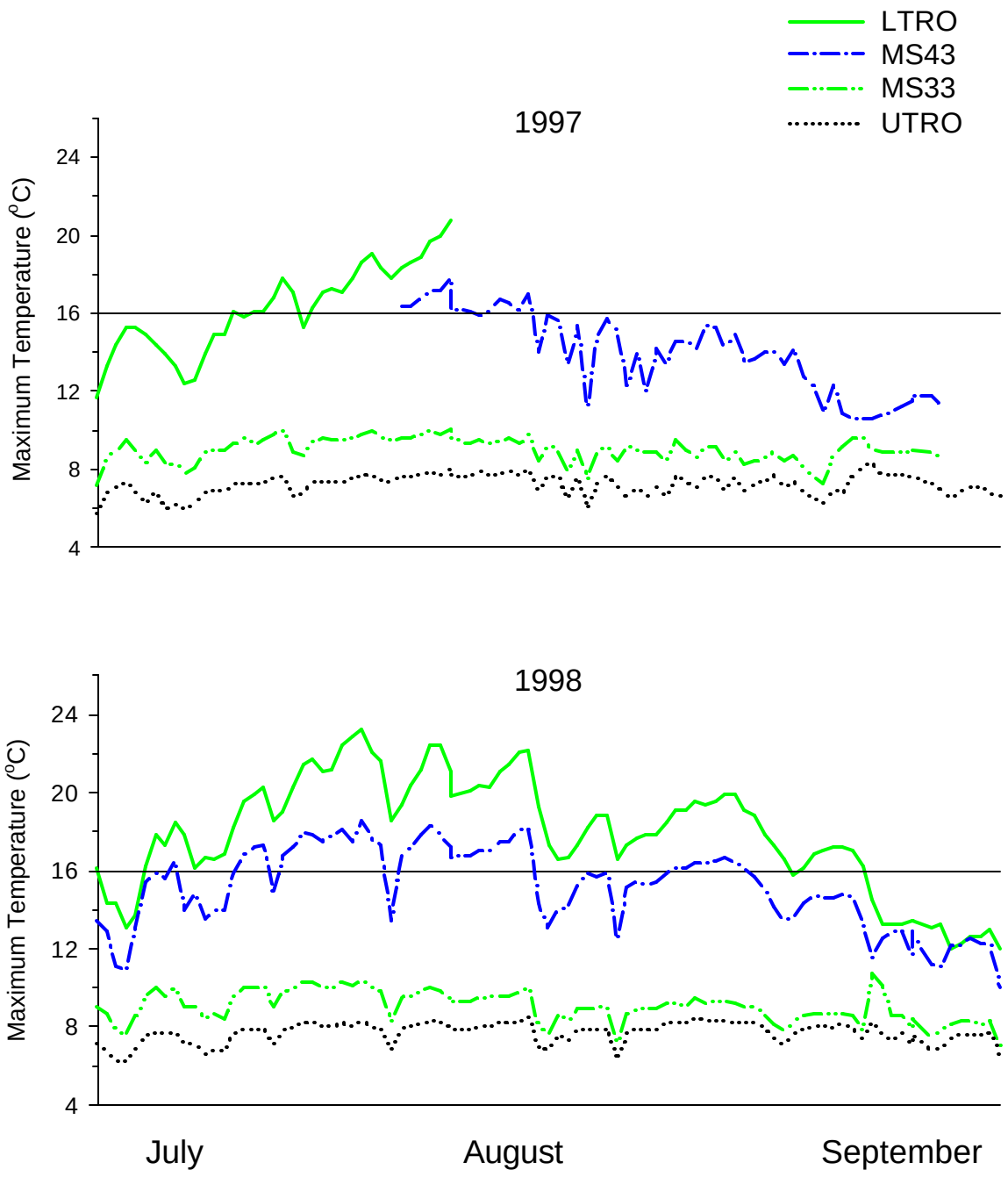


Figure 12. Daily maximum temperatures at seven sites in mainstem Trout Creek for 1 July to 1 October 1 1997-2004. Sites from downstream to upstream are: the mouth of Trout Cr. at rkm 0.2 (BTRT), below Hemlock Dam at rkm 2.0 (HEML), lower Trout Cr. at rkm 3.0 (LTRO), 43 Bridge at rkm 11.0 (MS43), upper old-growth channel at rkm 12.2 (UOLG), 33 Bridge at rkm 14.4 (MS33), and upper Trout Cr. at rkm 15.2 (UTRO). The line at 16°C marks the maximum surface water temperature standard set by the Washington Department of Ecology (Chapter 173-201A, Nov. 18 1997, Water Quality Standards for the Surface Waters of the State of Washington). Continued.

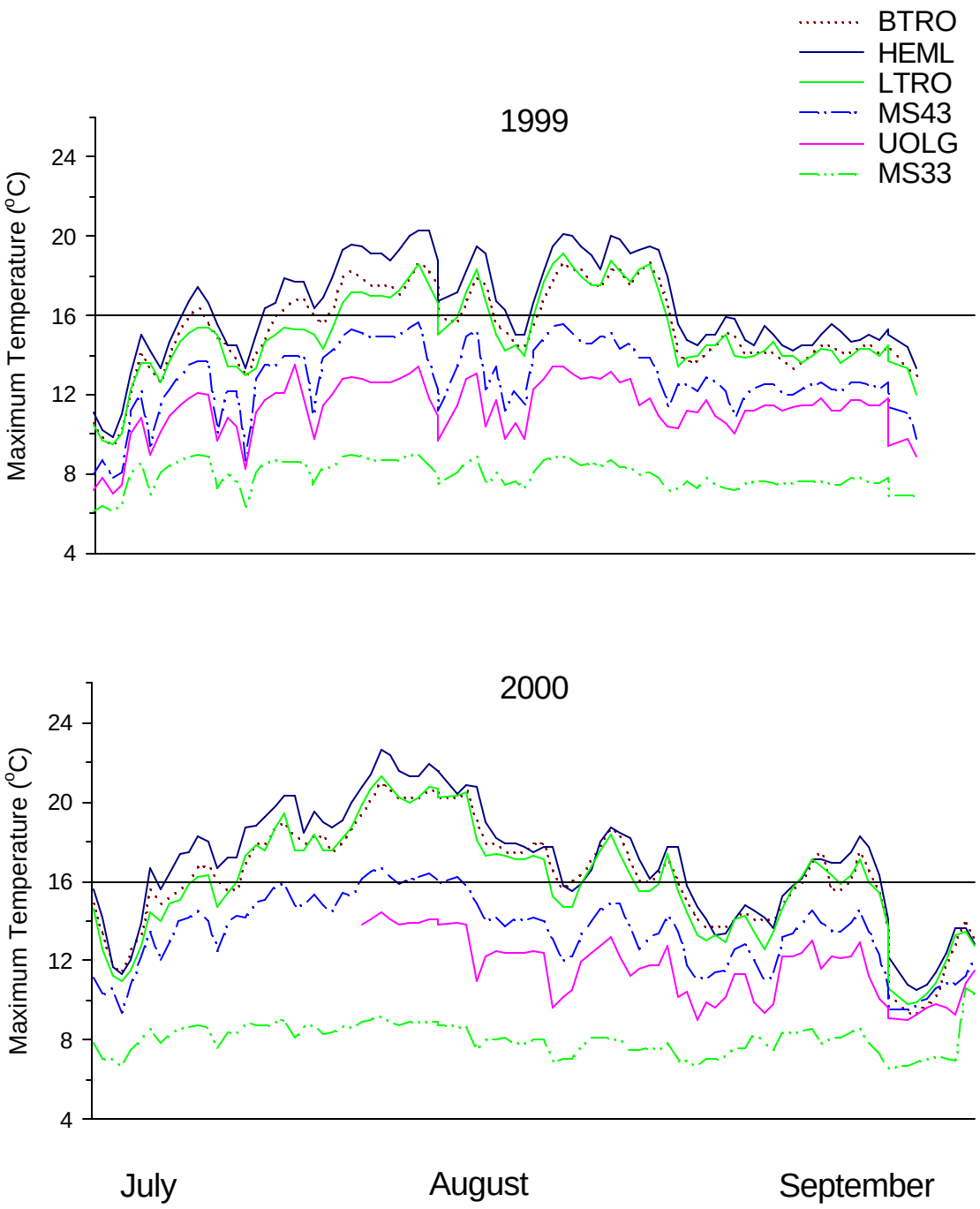


Figure 12. Continued.

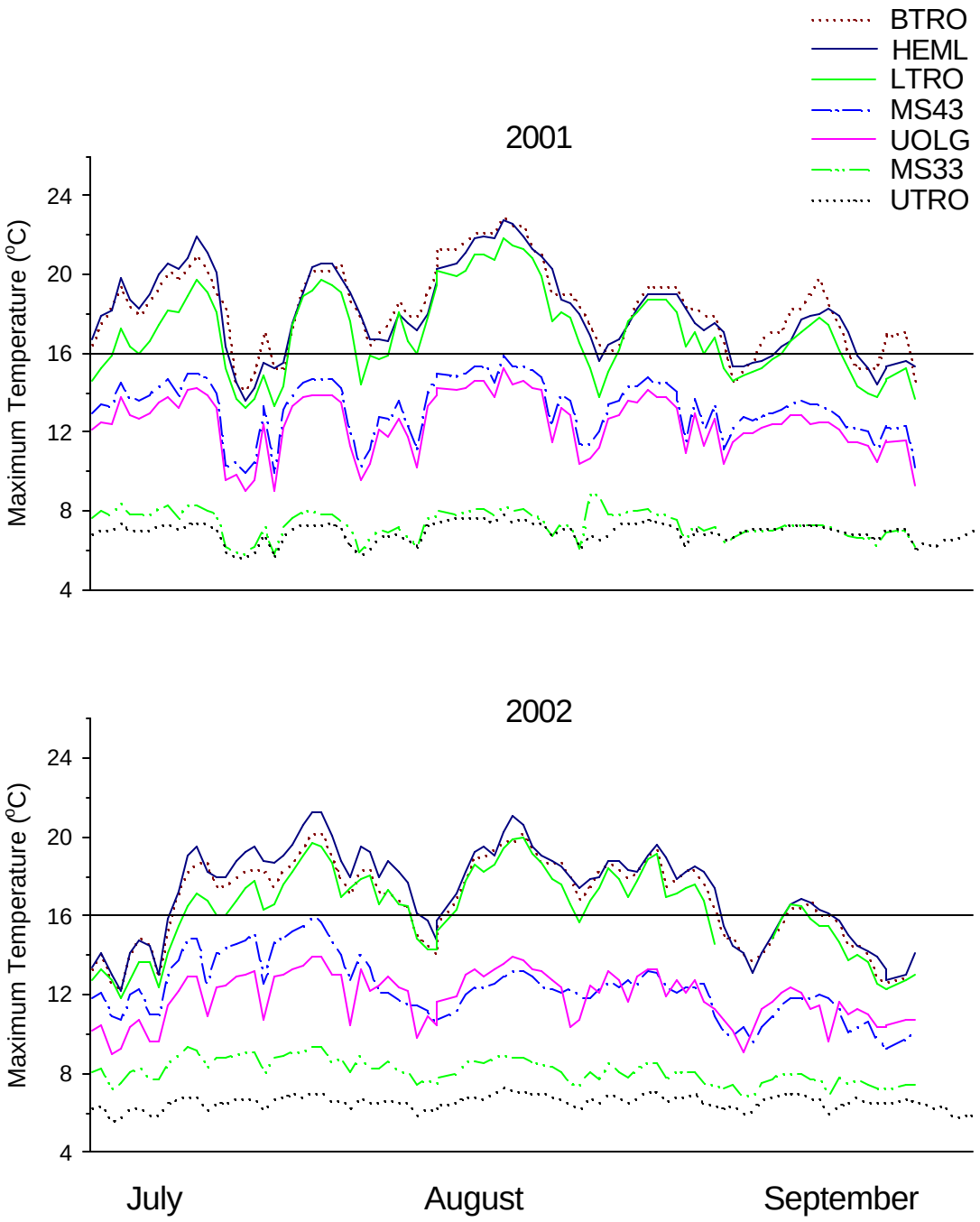
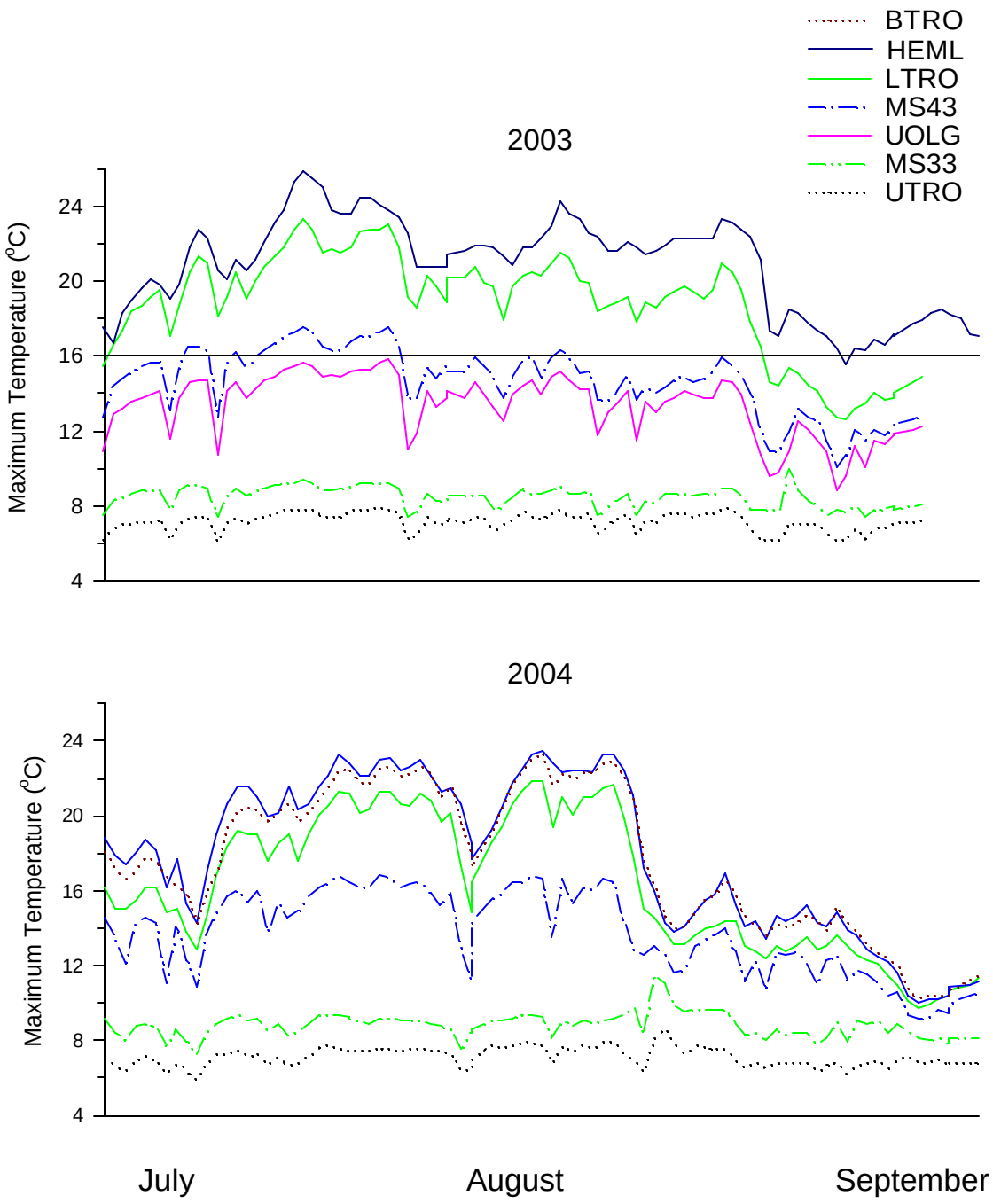


Figure 12. Continued.



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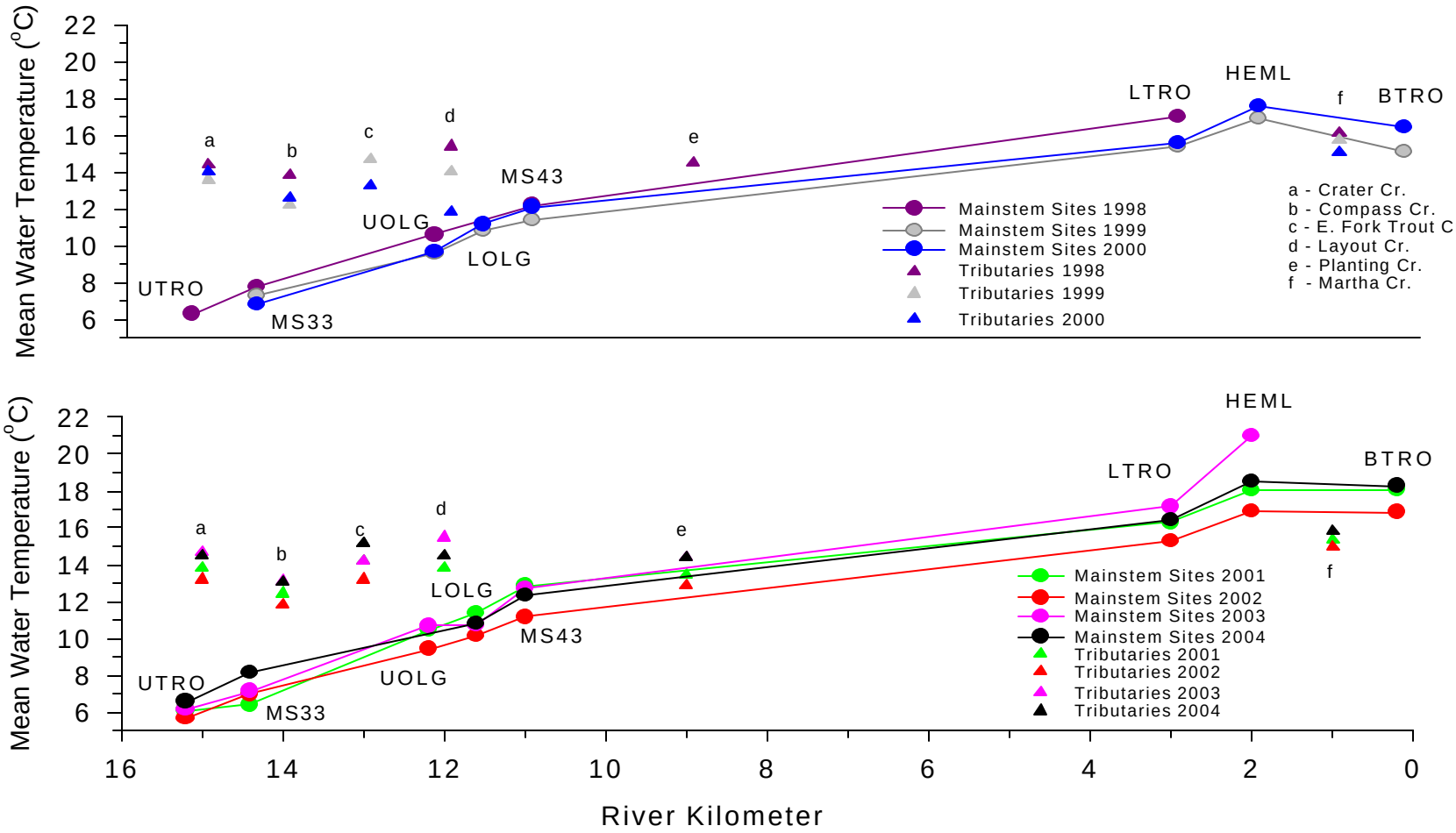

Figure 13. Mean water temperature for the month of August 1998-2004 in mainstem Trout Creek and its tributaries. Sites, from left to right, are shown from upstream to downstream. River kilometer zero is the mouth of Trout Creek. Mainstem sites are: upper Trout Cr. at rkm 15.2 (UTRO), 33 Rd. Bridge at rkm 14.4 (MS33), upper old-growth channel at rkm 12.2 (UOLG), lower old-growth channel at rkm 11.6 (LOLG), 43 Rd. Bridge at rkm 11.0 (MS43), above Hemlock Lake at rkm 3.0 (LTRO), below Hemlock Dam at rkm 2.0 (HEML), and the mouth of Trout Creek at rkm 0.2 (BTRO).

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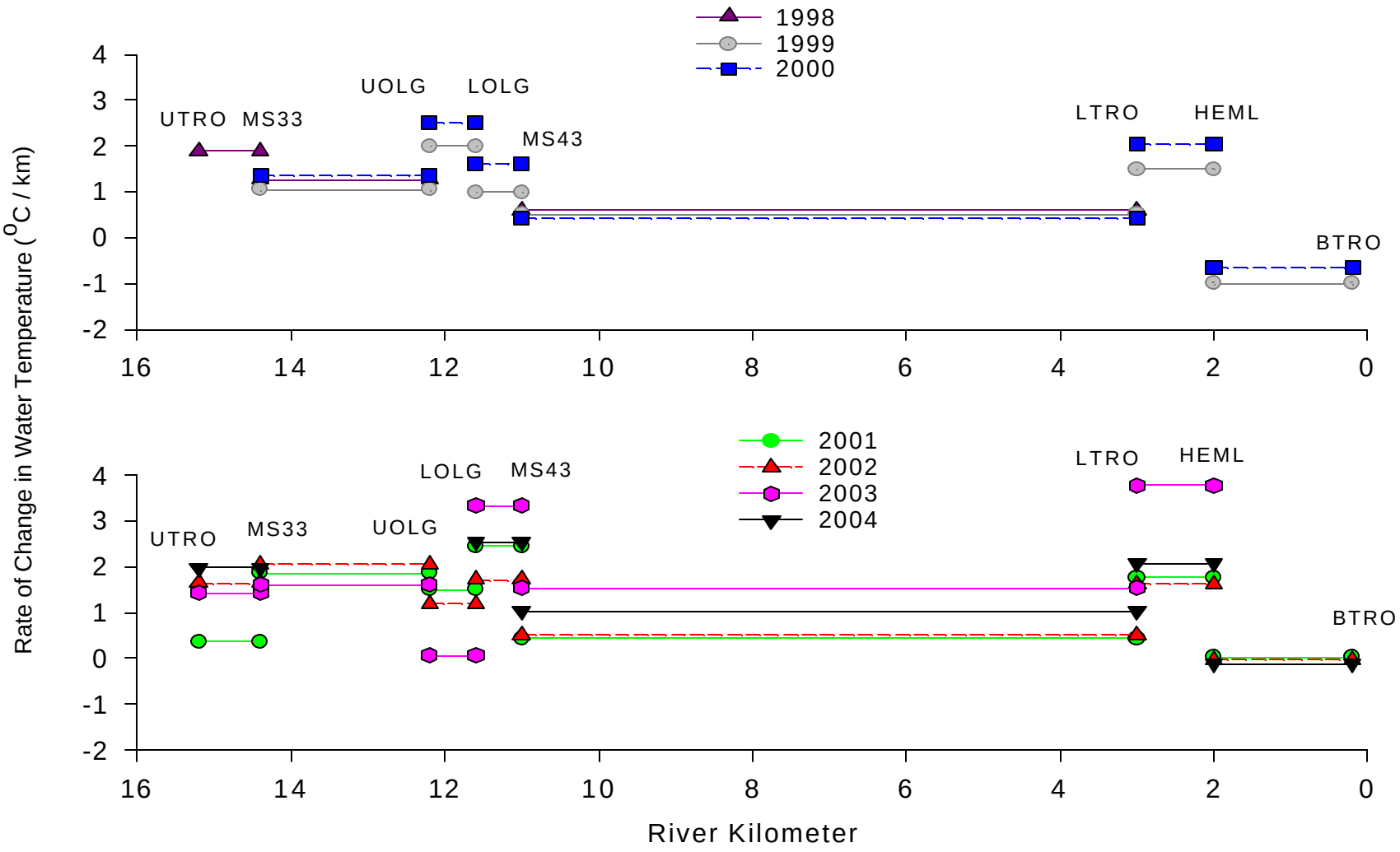

Figure 14. Rate of change (°C/km) of mean temperature for sections of Trout Creek for the month of August 1998-2004. River kilometer (rkm) zero is the mouth of Trout Creek. Thermograph locations at the ends of each section are shown from upstream to downstream. Sites are: upper Trout Cr. at rkm 15.2 (UTRO), 33 Rd. Bridge at rkm 14.4 (MS33), upper old-growth channel at rkm 12.2 (UOLG), lower old-growth channel at rkm 11.6 (LOLG), 43 Rd. Bridge at rkm 11.0 (MS43), lower Trout at rkm 3.0 (LTRO), below Hemlock Dam at rkm 2.0 (HEML), and the mouth of Trout Cr. at rkm 0.2 (BTRO).

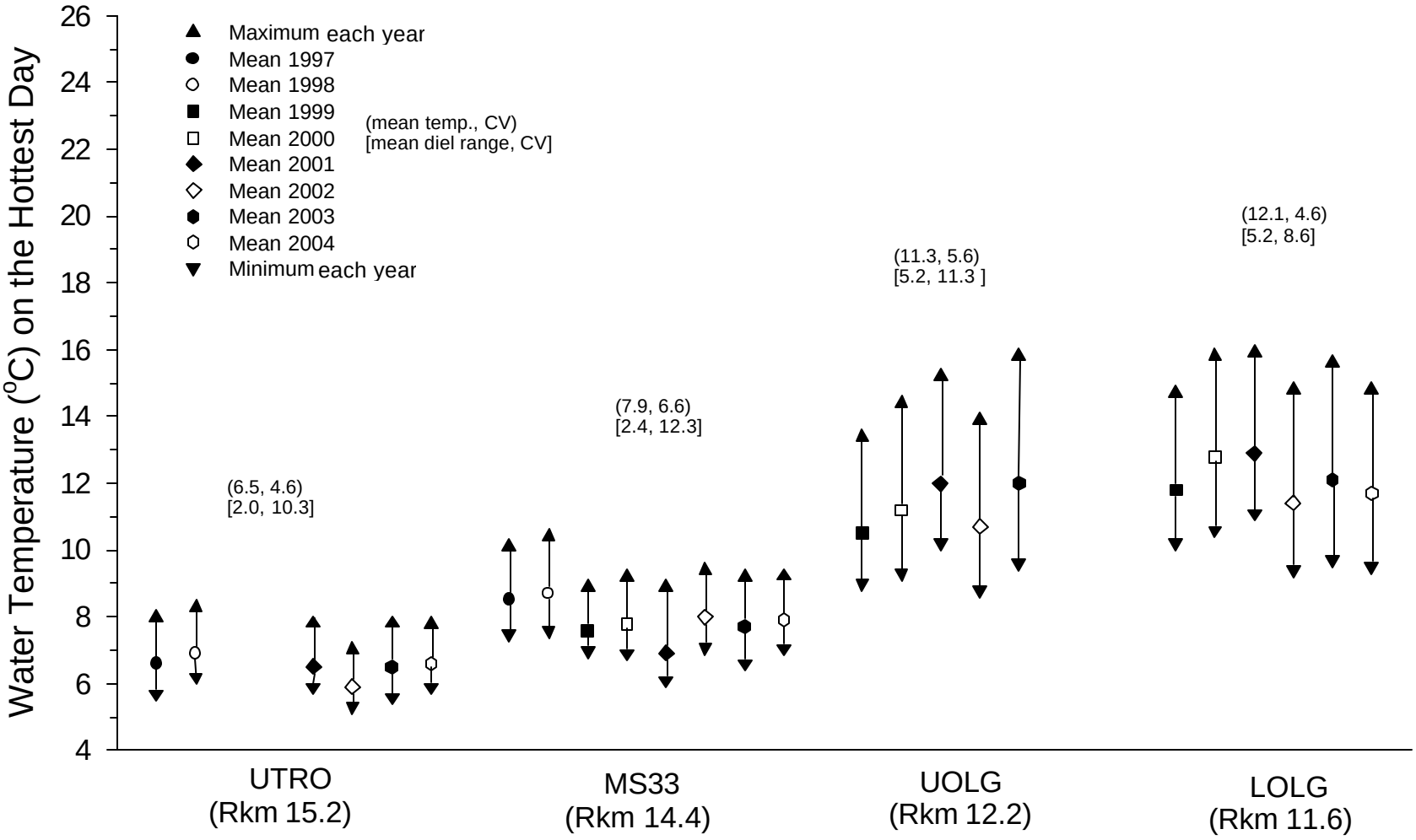

Figure 15a. Mean and diel water temperature range for the year's hottest day at eight sites in mainstem Trout Creek. Sites from left to right are ordered in an upstream to downstream direction. Sites are: upper Trout Cr. at rkm 15.2 (UTRO); 33 Rd. Bridge at rkm 14.4 (MS33); upper old-growth channel at rkm 12.2 (UOLG), lower old-growth channel at rkm 11.6 (LOLG). Dates chosen had the warmest single day water temperature at the MS43 site within the years 1997 (August 6), 1998 (July 28), 1999 (August 19), 2000 (July 31), 2001 (August 13), 2002 (July 24), 2003 (July 31), 2004 (August 13).

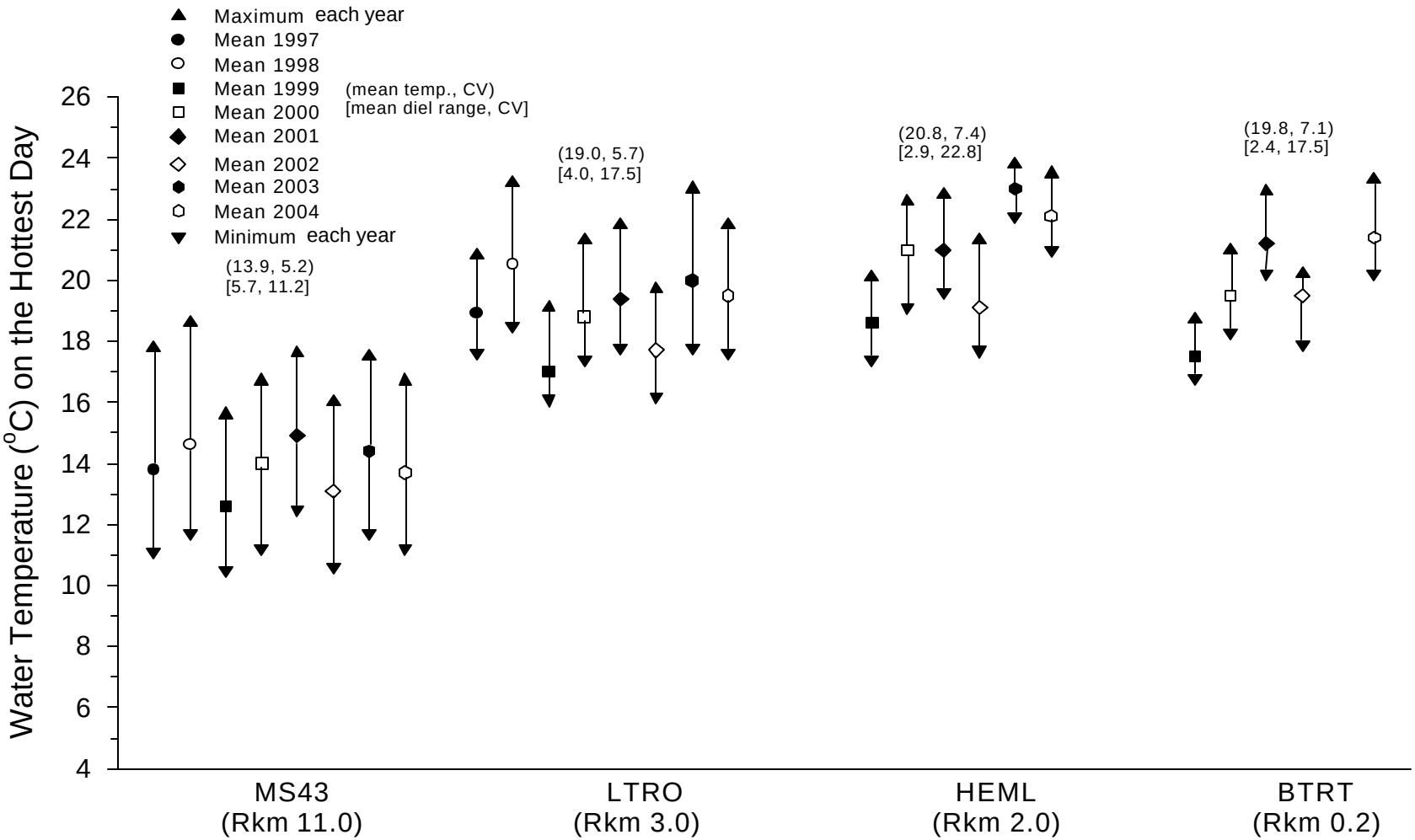

Figure 15b. Mean and diel water temperature range for the year's hottest day at eight sites in mainstem Trout Creek. Sites from left to right are ordered in an upstream to downstream direction. Sites are: 43 Rd. Bridge at rkm 11.0 (MS43); lower Trout Creek at rkm 6.0 (LTRO); below Hemlock Dam at rkm 4.9 (HEML), and the mouth of Trout Cr. at rkm 0.2 (BTRT). Dates chosen had the warmest single day water temperature at the MS43 site within the years 1997 (August 6), 1998 (July 28), 1999 (August 19), 2000 (July 31), 2001 (August 13), 2002 (July 24), 2003 (July 31), 2004 (August 13).

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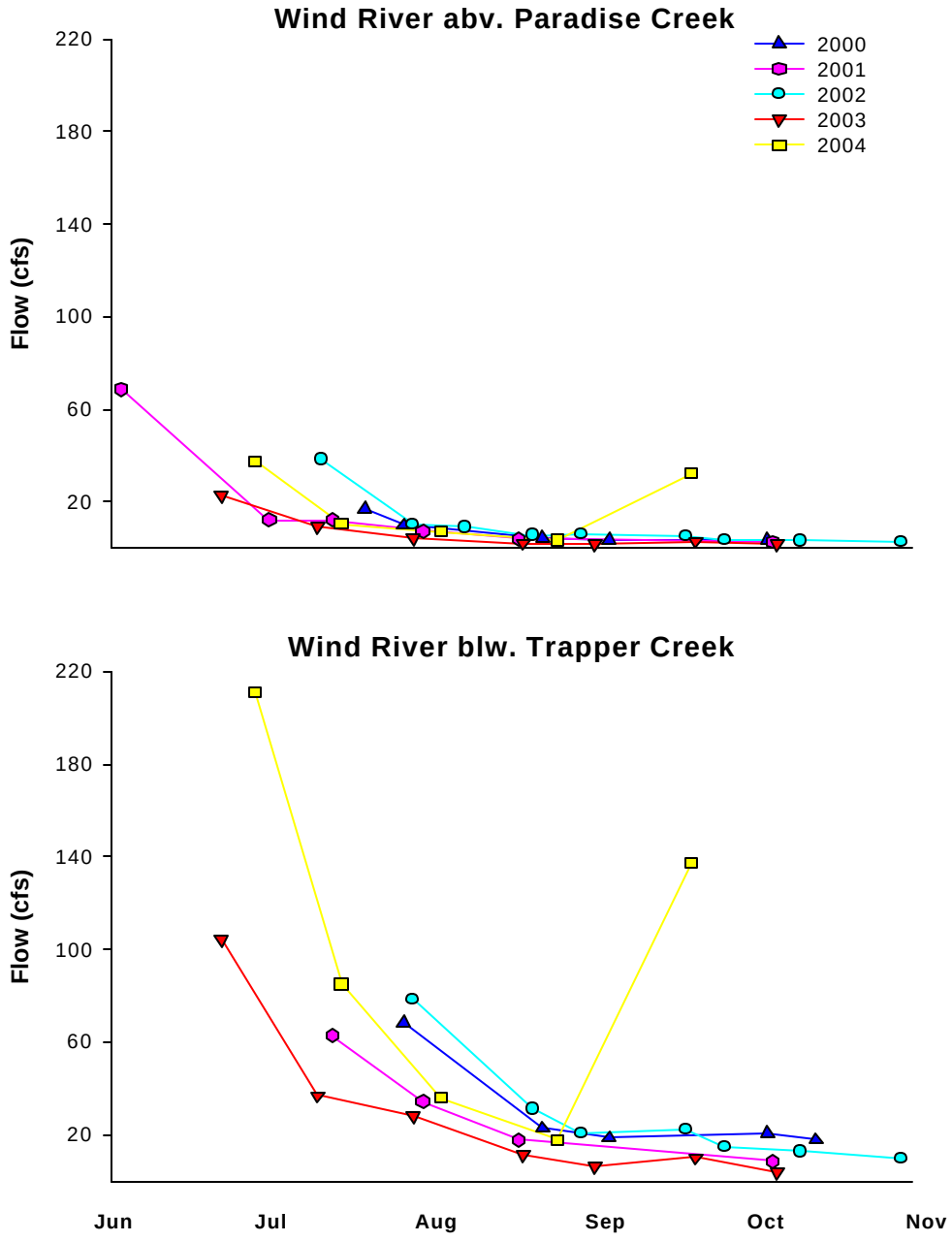

Figure 16. Flow for two sites on the Wind River, 2000-2004. For locations of measurement sites, see Table 3 of this report.

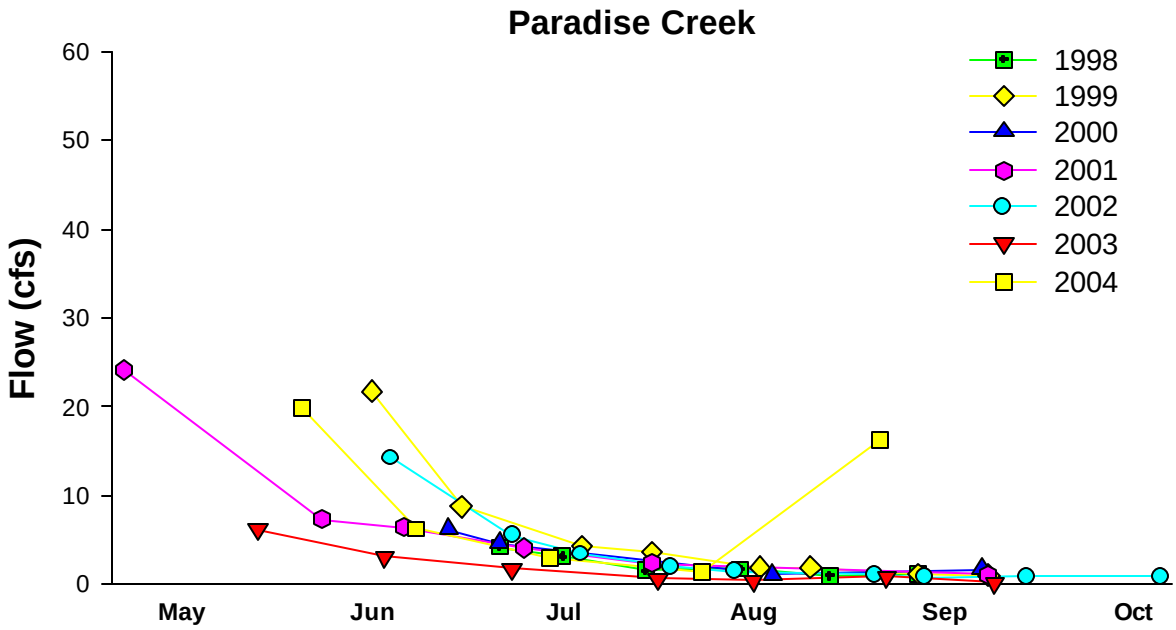

Figure 17. Flow for Paradise Creek in the Upper Wind River watershed, 1998-2004. For locations of measurement sites, see Table 3 of this report.

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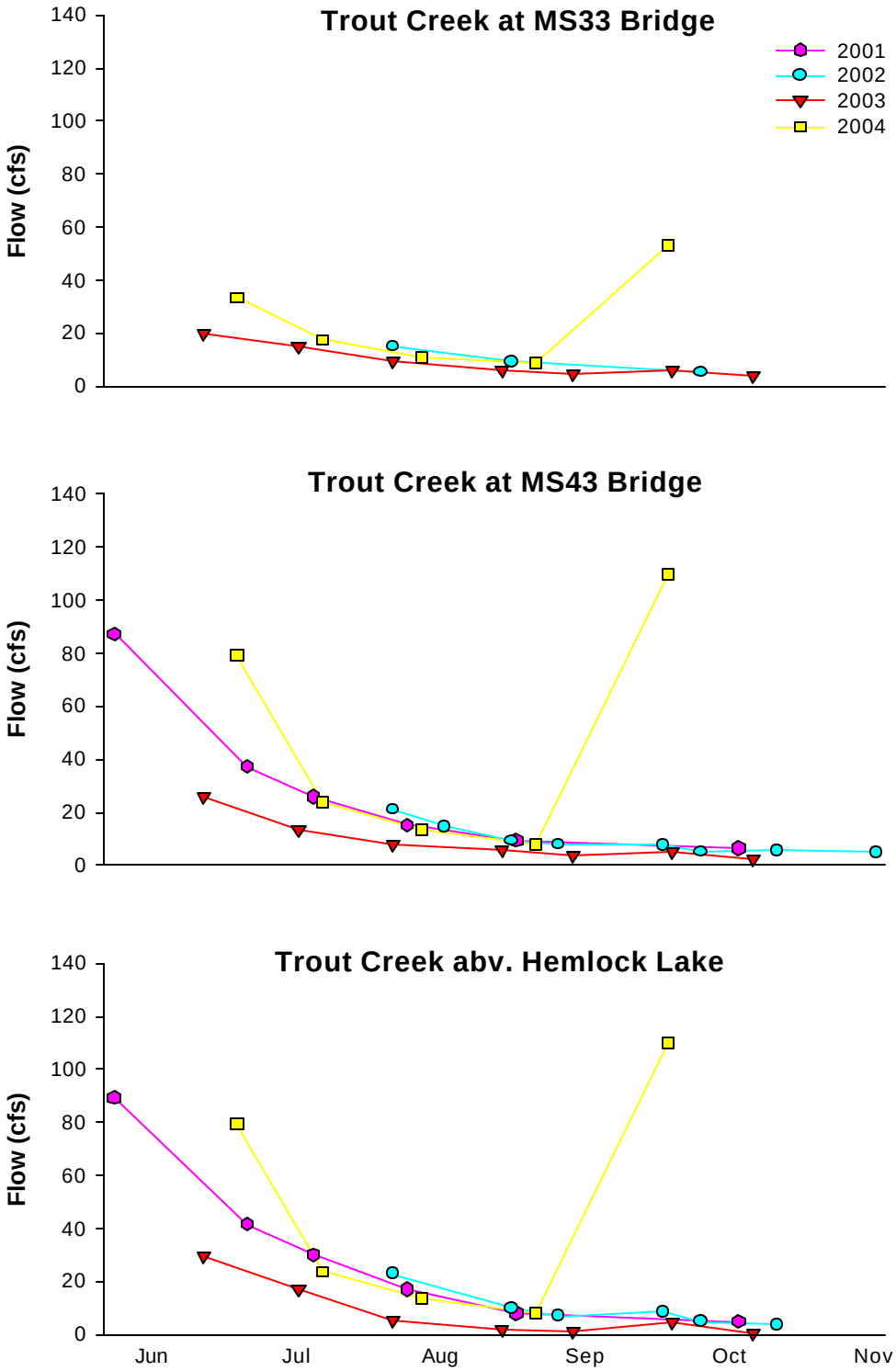

Figure 18. Flow for two sites on Trout Creek, 2001-2004. For locations of measurement sites, see Table 3 of this report.

Appendix Table 1. Dates through November 2004, when thermographs were not functioning due to loss or malfunction. (ab. = above, bl. = below)

Watershed Subwatershed Subdrainage	Problem dates	Comments
Trout Creek		
Trout Cr. – upper	10/7/98-6/6/01	Thermograph lost
Crater Cr.	10/4/99-6/15/00	Thermograph lost
Trout Cr. – 33 bridge	10/7/98-6/17/99	Thermograph failure
Compass Cr.	None	
East Fork Trout Cr.	None	
Trout Cr. – upper OG	10/18/99-10/27/99 6/15/00-7/28/00	Broken mount Thermograph failure
Layout Cr. - upper	None	
Layout Cr.	10/4/99-7/28/00 6/20/02-10/07/02 10/20/03-5/19/04	Thermograph lost Thermograph failure Thermograph failure
Layout Cr. (BLAY)	None	
Trout Cr. – lower OG	4/22/98-10/19/98 10/07/02-07/03/03	Thermograph failure Thermograph lost
Trout Cr. – 43 bridge	Sept-Oct 1999 Aug-Oct 2002 10/29/04-11/19/04	Exposed to air during low water Exposed to air during low water Data Transfer failure
Planting Cr.	Sept-Oct 1999 10/21/99-6/7/01	Exposed to air during low water Thermograph lost

Continued.

Appendix Table 1. Continued.

Watershed Subwatershed Subdrainage	Problem dates	Comments
Trout Creek		
Trout Cr. – ab. Hemlock	11/96-5/97	Data available from the Forest Service
	Sept-Oct 1999	Exposed to air during low water
	10/18/99-6/16/00	Thermograph failure
Trout Cr. – bl. Hemlock	None	
Martha Cr. - CMCW	None	
Martha Cr. - upper	10/29/04-11/19/04	Data transfer failure
Martha Cr. - lower	Sept-Oct 1999	Exposed to air during low water
Upper Wind River		
Wind R. – ab. Paradise Cr.	5/30/01-10/25/01	Thermograph failure
	10/11/02-06/12/03	Thermograph lost
Paradise Cr.	Sept-Oct 1999	Exposed to air during low water
	06/17/02-10/06/03	Thermograph failure
Wind R – lower mining	6/30/03-10/16/03	Thermograph failure
Wind R. – bl. mining	2/4/03-6/30/03	Thermograph failure
Falls Cr.	2/01/03-07/03/03	Thermograph lost
Ninemile Cr.	6/01/01-6/06/01	Thermograph failure
	Aug-Oct 2002	Exposed to air during low water
	4/18/03-6/30/03	Thermograph failure
Dry Cr. – 1	Sept-Oct 1999	Exposed to air during low water
Dry Cr. – 2	None	
Trapper Cr.	2/99-8/13/99	Thermograph failure
	5/10/03-10/20/03	Thermograph failure

Continued.

Appendix Table 1. Continued.

Watershed Subwatershed Subdrainage	Problem dates	Comments
Upper Wind River		
Wind R. – bl. Trapper Cr.	2/1/99-8/13/99	Thermograph failure
	Sept-Oct 1999	Exposed to air during low water
	10/25/00-3/26/01	Thermograph failure
	10/17/02-10/16/03	Thermograph lost
Panther Creek		
Panther Cr. – upper	10/25/02-07/07/03	Thermograph lost
Eightmile Cr. – upper	None	
Eightmile Cr. – lower	Sept-Oct 1999	Exposed to air during low water
	10/16/03-07/20/03	Thermograph lost
Cedar Cr. - upper	10/29/04-11/19/04	Data transfer failure
Cedar Cr. - lower	1/03/00-7/02/03	Thermograph failure
	10/29/04-11/19/04	Data transfer failure
Panther Cr. – lower	9/27/97-10/7/98	Thermograph lost
	11/01/01-7/12/02	Thermograph failure
	10/29/04-11/19/04	Data transfer failure

Appendix Table 2. Mean, minimum, and maximum water temperature recorded at sites within the Wind River subbasin during summer 2004. Data are from Onset Corporation's StowAway Thermographs, which recorded water temperature every two hours. Sites are listed from upstream to downstream within a subbasin. (ab. = above, bl. = below)

Watershed Subwatershed Subdrainage	Minimum (°C)			Mean (°C)			Maximum (°C)		
	July	Aug.	Sept.	July	Aug.	Sept.	July	Aug.	Sept.
Trout Creek									
Trout Cr. – upper	5.0	5.4	5.3	6.1	6.6	6.2	7.8	8.7	7.1
Crater Cr.	9.5	9.3	7.5	14.0	14.5	10.0	18.1	18.4	12.6
Trout Cr. – Road 33 Bridge	6.0	6.4	6.4	7.7	8.2	7.8	9.4	11.5	9.1
Compass Cr	9.0	9.8	7.3	12.0	13.1	9.5	14.6	15.4	11.3
East Fork Trout Cr.	9.9	11.4	8.2	15.4	15.2	11.4	20.0	18.8	14.7
Trout Cr. – upper OG[a]	---	---	---	---	---	---	---	---	---
Layout Cr. - upper	7.9	9.4	7.9	11.0	12.0	9.7	15.3	16.5	12.4
Layout Cr.	9.3	10.7	7.9	13.5	14.5	10.8	18.1	18.4	14.1
Layout Cr. – (BLAY)	---	10.1	7.2	---	15.3	10.6	---	20.7	14.9
Trout Cr. – lower OG	6.9	8.1	7.0	10.4	10.8	8.9	15.0	15.1	11.7
Trout Cr. – Road 43 Bridge	7.6	9.3	7.5	11.8	12.4	9.7	16.8	16.8	12.7
Planting Cr.	9.3	11.0	8.1	13.3	14.4	10.7	17.1	17.6	13.2
Trout Cr. – ab. Hemlock	10.7	10.9	8.1	16.0	16.4	11.2	21.3	21.8	14.4
Trout Cr. – bl. Hemlock	11.3	11.6	8.2	18.0	18.5	11.9	23.3	23.5	15.2
Martha Cr. - CMCW	---	10.9	8.8	---	13.8	11.1	---	16.9	13.1
Martha Cr. - upper	10.4	11.5	9.3	13.7	14.8	11.9	16.9	18.2	13.9
Martha Cr. - lower	10.3	11.5	9.2	14.7	15.8	12.0	20.4	20.4	15.4
Trout Cr. – at mouth[b]	11.5	12.1	8.4	17.9	18.3	12.1	12.6	23.3	15.8

Continued.

Appendix Table 2. Continued.

Watershed Subwatershed Subdrainage	Minimum (°C)			Mean (°C)			Maximum (°C)		
	July	Aug.	Sept.	July	Aug.	Sept.	July	Aug.	Sept.
Upper Wind River									
Wind R. – ab. Paradise Cr.	9.6	11.4	7.7	13.5	14.3	11.0	17.1	17.2	13.8
Paradise Cr.	9.8	11.3	8.7	12.5	13.1	11.0	15.1	14.9	12.7
Wind R. – Lower Mine Reach	9.5	9.8	9.5	11.3	12.4	11.3	15.0	17.7	13.3
Wind R – Below Mine Reach	10.8	12.3	9.2	13.9	14.7	12.2	17.5	17.5	15.3
Wind R. – bl. Falls Cr.[b]	9.0	11.0	7.8	12.9	13.6	10.9	16.0	16.4	13.7
Falls Cr.	8.2	10.2	6.5	12.4	13.0	9.9	15.5	16.1	13.1
Ninemile Cr.	9.9	11.6	9.6	11.9	12.9	11.2	13.5	14.0	12.7
Dry Cr.	---	---	8.5	---	---	11.6	---	---	16.8
Trapper Cr.	9.8	10.6	7.8	12.3	13.2	10.2	14.9	15.4	12.3
Trapper Cr. at mouth[b, c]	---	---	---	---	---	---	---	---	---
Wind R. – bl. Trapper Cr.	9.4	11.2	8.4	13.1	14.3	11.2	16.6	17.7	13.8
Middle Wind River									
Wind R. – at Beaver Cr. CG.[b]	8.5	10.1	8.2	11.2	11.7	10.1	14.4	14.7	12.7
Wind R. – at Pacific Crest Tr.[b]	9.3	11.0	8.8	13.4	13.8	11.6	17.9	17.9	15.0
Wind R. – at Stabler Bridge[b]	9.0	10.6	8.2	13.4	13.8	11.4	18.3	18.3	14.9
Panther Creek									
Panther Cr. – upper	6.4	6.9	6.3	8.0	8.1	7.4	10.0	9.7	8.4
Eightmile Cr. – upper	11.6	13.0	9.9	13.7	14.5	12.1	15.7	15.8	13.8
Eightmile Cr. – lower	---	13.1	9.6	---	15.2	12.5	---	18.3	15.2
Cedar Cr. - upper	---	10.8	9.1	---	12.5	10.7	---	14.4	12.3
Cedar Cr. - lower	9.8	11.5	9.3	12.6	13.2	11.2	15.8	15.8	13.1
Panther Cr. – lower	7.8	8.7	7.5	11.1	11.1	9.4	15.1	14.9	12.1
Lower Wind River									
Bear Cr.[b]	11.6	12.8	9.6	14.9	15.6	12.5	18.7	18.5	15.0
Little Wind River[c]	---	---	---	---	---	---	---	---	---
Lower Wind River site 1[b]	11.0	12.2	9.4	15.2	15.2	12.2	17.9	17.5	15.2

[a] OG = Restored old-growth channel.
[b] Thermographs deployed and maintained by Underwood Conservation District during summer 2004.
[c] No data during 2004 due to thermograph loss.

Report B: Juvenile Steelhead and Other Fish Rearing in the Wind River Subbasin

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Portland, OR 97208

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Table of Contents

List of Tables

List of Figures

List of Appendix Tables

Introduction

This report presents fish assemblage and juvenile salmonid population and life-history data collected through 2004. Sampling efforts and data covered by this report are the result of work by personnel from U.S. Geological Survey's Columbia River Research Laboratory (USGS-CRRL) with assistance from U.S. Fish and Wildlife Service's Lower Columbia River Fish Health Center (USFS-LCRFHC), and Washington Department of Fish and Wildlife (WDFW). Personnel from USGS-CRRL have been sampling areas of the Wind River since 1997 (Table 1). This report covers work completed under Objective 2 outlined in the FY2004 Statement of Work submitted to Bonneville Power Administration. Our goals were to collect information on populations of juvenile salmonids in select streams and reaches in the subbasin, including index sites with long-term records. Some of this data will include areas where steelhead *Oncorhynchus mykiss* coexist with introduced fish. We also wanted to continue to gather information on life histories used by steelhead within the subbasin. These data on populations and life histories will allow future exploration of limiting factors, potential interactions with introduced species, and habitat use and success of various life histories.

Personnel from USGS-CRRL conducted field sampling in 2004 to derive population estimates for steelhead/rainbow trout and Chinook salmon *O. tshawytscha* in selected stream sections of the Wind River subbasin. Fish sampling was done by electrofishing and snorkeling. Steelhead are the only anadromous salmonid native to the Wind River above Shipherd Falls at rkm 4.0. Chinook salmon were introduced to the Wind River above Shipherd Falls through production at Carson National Fish Hatchery. Shipherd Falls was laddered in 1956 and gave Chinook access to the subbasin (USFS 1996). Each year, a portion of these Chinook adults do not enter the hatchery, but stay in the river and spawn. Fish population sampling efforts took place in the upper Wind River watershed (above rkm 25.0), index sites in mainstem Trout Creek, and two streams, Martha and Cedar creeks, where fellow USGS-CRRL researchers are investigating the effects of nutrient addition.

In addition to determining juvenile salmonid populations, we are investigating life-history strategies of steelhead/rainbow trout in the Wind River subbasin. We have been tagging fish with Passive Integrated Transponder (PIT) tags, which uniquely mark individuals, allowing

identification upon subsequent recapture, or detection at Bonneville Dam as smolts or adults. We began PIT tagging juvenile steelhead in 1999 and have expanded our efforts since. In 2004 we also began PIT tagging wild-spawned juvenile Chinook in the mainstem Wind River. We PIT tagged over 3,000 fish during 2004.

During 2004, we conducted a study on bioenergetics and potential impacts to juvenile steelhead of Hemlock Lake, which is located on Trout Creek. We collected fish above, below, and in the lake, and ran a weir above the lake for a portion of the summer. We also placed PIT tag detection equipment in the Hemlock Dam fish ladder to track movements of juvenile and adult steelhead. Results from this study will be the subject of a separate paper in a Technical Report format.

Study Area

The Wind River subbasin covers 582 km^2 and supports a fifth-order stream system with the largest tributary watersheds being Trout Creek (88 km^2) and Panther Creek (107 km^2), which support forth-order stream-systems (Figure 1). Elevations in the Wind River subbasin range from 25 m at the mouth of the Wind River at the watershed's southern edge to 1,190 m at ridge tops near its northern edge. The watershed is exposed to a temperate marine climate with most of the average annual precipitation of 280 cm occurring between November and April. Precipitation in the winter is largely delivered as rain in the lower elevations of the watershed and as snow in the higher elevations.

Concentrated fish-sampling efforts occurred in the mainstem Wind River above rkm 26.0, at index sites in Trout Creek, and in Martha and Cedar creeks (Table 2). The mainstem Wind River above rkm 25.0 flows in an alluvial, low gradient valley, upstream past Trapper Creek to its confluence with Dry Creek at rkm 30.5. Carson National Fish Hatchery is located at rkm 28.0. Base flow at rkm 30.3 is generally about 10 cfs. Above Dry Creek, the Wind River is in a higher gradient bedrock controlled canyon section. Ninemile and Falls creeks are tributaries that enter in this section. At rkm 35.4, the valley widens and the gradient lessens with the channel again flowing over alluvial valley bottom. Paradise Creek enters the Wind River at rkm 40.0.

Above Paradise, the valley becomes more confined, with remnant old growth riparian forest. Our five index sampling sites on Trout Creek cover the length of the mainstem from rkm 3.2 to 11.0 (Table 2). At the lower and upper ends, Trout Creek is in a moderately confined channel with cobble and gravel substrate. The middle sections of Trout Creek are confined channel with boulder, large cobble, and bedrock substrates. Base flow in Trout Creek at rkm 3.0 is generally about 4 cfs. Martha Creek is a tributary of Trout Creek at rkm 0.5. Cedar Creek is a tributary of Panther Creek at rkm 6.0. Base flow in Martha Creek in generally less than 1 cfs, with portions going subterranean in many years. Base flow in Cedar Creek is generally about 1.5 cfs. More detailed reach-scale habitat data can be found in Connolly (2003) and expanded information on flow and temperature is the subject of Report A of this document.

Methods

We determined fish assemblage and density estimates by electrofishing and snorkeling select stream sections. Electrofishing allowed us to handle fish in order to measure length and weight, to inspect for disease, to PIT tag fish, and to assess growth of recaptured PIT-tagged fish. Snorkeling allowed us to sample long sections of stream rapidly with minimal impacts to individual fish, and to sample stream sections too large to effectively electrofish. Though many of our fish-sampling sites are sampled on a rotating basis, we have maintained a number of index sample sites throughout the subbasin that have been sampled every year or nearly so since 1997 (Tables 1 and 2).

Electrofishing

All electrofishing efforts conducted to estimate fish population and density were preceded by a habitat-unit survey. Survey sections were 500 m long. We divided habitat units into strata (e.g., pools, glides, riffles, and side channels) and shocked a systematic sample of units. Habitat units chosen for electrofishing were block netted to insure no immigration or emigration of fish. We used a backpack electrofisher to conduct two or more passes under removal-depletion methodology (Zippin 1956; Bohlin et al. 1982; White et al. 1982). The field guides of Connolly (1996) were used to determine the number of passes necessary to insure that a controlled level of precision in the population estimate (CV < 25% for age-0 steelhead and CV < 12.5% for age-1 or

older juvenile steelhead) was achieved within each sampling unit for each salmonid species (steelhead/rainbow trout, brook trout, Chinook salmon) and age group (age-0 and age-1 or older). These methods were chosen to minimize the number of units sampled and the number of passes per unit. This approach lessens the chance that individual fish will be exposed to the effects of electrofishing while insuring a high degree of precision in our estimates.

In a number of streams and stream sections, we electofished to collect fish for PIT tagging. No habitat surveys were conducted with this effort. Collection of fish and recapture of previously tagged fish to investigate growth was the purpose.

Fish captured by electrofishing were anesthetized with the lightest possible dose of MS-222 before handling. All fish captured were measured for fork length to the nearest mm, weighed to the nearest 0.1 g, and inspected for external signs of disease. When possible, fish that died during sampling were sent to USFWS-LCRFHC for disease analysis (see below). We PIT tagged juvenile steelhead that were 72-mm fork length or greater and Chinook that were 65-mm fork length or greater to track movements, growth, and survival. After work up, fish were held in fresh ambient-temperature stream water, allowed to recover and regain equilibrium, and released at or near their point of capture.

PIT Tagging

All PIT tagging followed the procedures and guidelines outlined by Columbia Basin Fish and Wildlife Authority (1999). The PIT tags we used during 2004 were 134.2 kHz and 12-mm long. Because PIT tags have an effective life of over 10 years (Prentice et al. 1990), PIT-tagged fish provide opportunities for data collection throughout their lifespan. We captured fish for tagging by electrofishing, at smolts traps run by WDFW, and at the Trout Creek weir. We recaptured tagged fish by electrofishing, at smolt traps, at the Trout Creek weir, and by trapping as returning adults. Juvenile and adult PIT-tagged fish were also interrogated by automated detectors at Bonneville Dam on the Columbia River. We submitted all PIT-tag and recapture data to the PTAGIS database administered by Pacific States Marine Fisheries Commission (PSMFC).

Snorkeling

Our snorkel surveys followed the first stage sampling methodology of Hankin and Reeves (1988), utilizing a stratified-systematic survey technique to sample and estimate fish populations. We performed a habitat-unit survey from downstream to upstream and snorkeled every other pool, every third glide, every fourth riffle, and every fifth side channel. The start number for each unit type was randomly determined prior to the survey. Generally, one snorkeler was in the water for each unit. Riffles and side channels longer than 20 m were sub-sampled. Snorkelers counted all salmonids seen and classified them by estimated age (age-0, age-1 or older, and adult). In the past, we have collected snorkeler calibration data for age-0 and age-1 or older *O. mykiss* in a sub-sample of pool units (Jezorek and Connolly 2003), following guidelines outlined in Dolloff et al. (1993). We also snorkeled five 100-m sections in Trout Creek in which all habitat units were sampled. These sampled sections serve as an index of salmonid numbers between years and between reaches in Trout Creek.

Trout Creek Weir and Hemlock Ladder PIT-tag Interrogators

As part of a companion study on bioenergetics of *O. mykiss*, we operated a weir on Trout Creek at rkm 3.2 (immediately upstream of Hemlock Lake) from 20 July 2004 to 24 August 2004 when high water forced us to stop operation. The weir had traps for both upstream and downstream moving fish. We checked the traps daily and released fish in the direction they were traveling.

We installed PIT-tag detectors in the ladder at Hemlock Dam. Two readers were installed on 5 August 2004, one near the upstream end of the ladder, the other near the downstream end.

Fish Health

Fish provided to the USFWS-LCRFHC (Susan Gutenberger, Project Leader) were given a rigorous lab inspection for disease. Diseases screened at the Center by testing or microscopic observations included bacterial (bacterial kidney disease, coldwater disease, columnaris, emphysematous putrefactive disease, furunculosis, enteric redmouth), viral (infectious pancreatic necrosis, infectious hematopoietic necrosis, viral hemorrhagic septicemia), and parasitic

(whirling disease, *Certomyxa*, digenetic trematodes, *Myxobous kisutchi*, *Myxidium minteri*, *Hexamita*, *Gyrodactulus*, *Scyphidia*, *Heteropolaria*) agents. The budgeting for this effort was 100% supported by in-kind contributions from the USFWS.

Results

We found a total of five fish species in our sampling areas in 2004: steelhead/rainbow trout (hereafter referred to as steelhead), shorthead sculpin *Cottus confusus*, brook trout *Salvelinus fontinalis*, Chinook salmon, and mountain whitefish *Prosopium williamsoni* (Table 3). Juvenile steelhead were present in all areas sampled. Shorthead sculpin, brook trout, Chinook salmon, and mountain whitefish were much more limited in their distribution than steelhead.

Sculpin were present throughout mainstem Wind River, Panther Creek, and their tributaries, but were present only in the lower portion of Trout Creek. We have not determined the exact extent of sculpin distribution in Trout Creek. We have encountered sculpin at the head of Hemlock Lake (rkm 2.8), but never in mainstem Trout Creek or its tributaries upstream of the Pacific Crest Trail Bridge (rkm 6.0).

Brook trout were present in both the Trout Creek and upper Wind River watersheds. Brook trout are prevalent in the mainstem and tributaries of Trout Creek above Planting Creek (rkm 9.0), but their densities are low in the portion of Trout Creek between Hemlock Lake and Planting Creek (rkm 2.9-9.0). Though we saw no brook trout in the upper Wind River during 2004, in the past we have recorded a few individuals in the mainstem and tributaries above rkm 30.0.

We found juvenile Chinook salmon throughout the mainstem Wind River. Juvenile Chinook were present in the mainstem Wind River up to rkm 30.0. In the past, we have found juvenile Chinook in the Wind River tributaries of Trapper, Falls, and Paradise creeks, and up to rkm 42.0 of the mainstem (Connolly 2003). We did not sample Trapper or Falls creeks in 2004. A one day sampling effort was made in Paradise Creek, but no Chinook were found. We have never found juvenile Chinook in Trout Creek, Panther Creek, or their tributaries.

Mountain whitefish are present in the mainstem Wind River up to rkm 30.0. Mountain whitefish have been frequently observed in large schools in pools downstream of rkm 30.0 by project personnel.

Electrofishing

During 2004, we electrofished four stream sections with the removal method to generate population estimates (Table 2; Figure 2). There were two population sections in Martha Creek and two population sections in Cedar Creek (Figure 3; Appendix Table 1). These samples were done in concert with fellow CRRL researchers studying the potential effects of nutrient enhancement; the upstream section in each creek is a control and the downstream section is a treatment section. The intensive sampling of Martha and Cedar creeks gave us the opportunity to deploy many PIT tags (699 in Martha; 667 in Cedar), which will allow us to track growth and life histories of fish from these streams. We also electrofished many stream sections to deploy new PIT tags and recapture previously PIT-tagged fish (Table 5), including several efforts in the mainstem Wind River to capture and tag co-occurring steelhead and Chinook juveniles.

PIT Tagging

We PIT tagged juvenile steelhead and Chinook during 2004. Fish were collected and tagged at four smolt traps run by WDFW and through instream electrofishing efforts. Smolt trapping occurred during April through early July with 1,589 steelhead parr tagged (Table 4). Electrofishing occurred from April through October in numerous streams throughout the subbasin. We PIT tagged 2,661 juvenile steelhead through electrofishing efforts during 2004 (Table 5). We also tagged 170 juvenile Chinook in the Wind River between rkm 26.0 and 30.0.

During our sampling, we recaptured previously PIT-tagged fish, allowing us to determine growth and movement of individuals. Tagged fish were also recaptured at smolt traps. Additionally, PIT-tagged fish could be interrogated by remote antennas while passing Bonneville Dam as juveniles or adults, and recaptured at adult traps run by WDFW at Shipherd Falls and Hemlock Ladder. Our database of instream recapture events of PIT-tagged fish continues to expand. During 2004, we recaptured 677 PIT-tagged steelhead through electrofishing, or at our

weir in Trout Creek. An additional 79 steelhead were recaptured at the four smolt traps in the Wind River. Details of locations of tagging, recaptures, and interrogations of fish are summarized in Tables 6 - 13.

Snorkeling

During 2004, we snorkeled extensively throughout the upper Wind River watershed (above rkm 26.0). We snorkel surveyed 8.6 km of stream in four reaches (MWBT, rkm 26.0 – 30.0; UWTF, rkm 30.0 – 35.0; MINE, rkm 35.4 – 40.0; UMIN 40.0 – 44.0) of the mainstem Wind River between rkm 26.0 and 41.0 (Table 2; Figure 4; Appendix Table 3). We found juvenile steelhead in all reaches. We found juvenile Chinook only in the MWBT reach during 2004, though we have found juvenile Chinook far upstream as rkm 42.0 in past surveys. Previous snorkeler calibration correlations (r) by electrofishing in pool units were 0.80 for age-0 steelhead and 0.78 for age-1 and older steelhead. The calibration ration ($\hat{R}$) was 1.3 for age-0 steelhead and 1.1 for age-1 and older steelhead. Correlations for juvenile Chinook have not been calculated as of this writing. Population estimates of age-0 steelhead were highest in the MINE (283 fish/100 m) and UMIN sections (266 fish/100 m; Figure 5; Appendix Table 2). Age-0 steelhead population estimates were low in the MWBT and UWTF sections (less than 20 fish/100 m). Population estimates of age-1 and older steelhead followed the same pattern, with the greatest populations in the MINE (45 fish/100 m) and UMIN sections (73 fish/100 m) and fewer individuals in the MWBT (6 fish/100 m) and UWTF (4 fish/100 m) sections. The population estimate of juvenile Chinook in the MWBT section was 26 fish/100 m (Figure 5; Appendix Table 4), which was nearly double that of juvenile steelhead (14 fish/100 m) in that section.

We have snorkeled the MINE reach (rkm 35.0 – 40.0) since 2000 and numbers of age-0 steelhead have increased in that time (Figure 6). In 2000, the age-0 steelhead population estimate was 16 fish/100 m, in 2004 it was 283 fish/100 m. Age 1-or older steelhead population estimates have also increased in the MINE reach, though not to the same extent as age-0 steelhead. In 2000, the age-1 or older steelhead population estimate was 36 fish/100 m, in 2004, it was 45 fish/100 m. Juvenile Chinook have been rare or not present in the MINE reach during

many years (Figure 6), however, in 2000 the population estimate of age-0 Chinook was over half that of age-0 steelhead. During 2004, no juvenile Chinook were seen in the MINE reach.

We snorkeled five 100-m sections of Trout Creek in which all habitat units were snorkeled. The 100-m sections were between the upper end of Hemlock Lake (rkm 3) and the Forest Road 43 Bridge (rkm 11; Figures 4 and 7). Four of these sections have been snorkeled each year since 1998; a fifth section, at rkm 7.0 was added in 1999. Age-0 steelhead counts have varied wildly by year both within and between sections. In 2004, age-1 or older steelhead were most abundant (178 fish/100 m) in the section located in the Canyon at rkm 7.0. Age-1 or older steelhead counts were low in the two downstream sections at rkm 3.0 (3 fish/100 m) and 5.0 (1 fish/100m), but were at about average levels from the past seven years for the locations at rkm 9.0 (36 fish/100 m) and rkm 11.0 (41 fish/100 m; Figure 7).

Trout Creek Weir and Hemlock Ladder PIT-tag Interrogators

Operation of the weir for a companion study (bioengergetics of O. mykiss) provided us many fish for PIT tagging. A total of 426 juvenile steelhead were PIT tagged at the weir.

A total of 85 individual steelhead juveniles were detected by the PIT-tag interrogators in the ladder through 30 March 2005. Some of these juveniles were moving downstream, some took refuge in the lower portion of the ladder during high water, and some were moving upstream.

One fish that may have been an adult steelhead was detected at the upstream antenna in the ladder on 27 August 2004. This fish had originally been tagged in Layout Creek in 2000 (110 mm). Though old enough to be an adult steelhead, no detections of this fish were made at Bonneville Dam. No steelhead matching its PIT-tag code was scanned by personnel working the trap at the top of the ladder. The water was high at this time and the fish could have bypassed the lower antenna and exited the ladder downstream.

Fish Health

No viral disease agents were found in salmonids in the Wind River subbasin during 1996-2004. Bacterial Kidney Disease *Renibacterium salmoninarum* was found in steelhead and brook trout in the upper Trout Creek watershed and in Chinook salmon in the upper Wind River watershed (Tables 14-16). Bacterial Coldwater Disease was found in steelhead in the Trout Creek watershed. A number of parasitic disease agents were found in salmonids in the Wind River watershed (Tables 17-19). Throughout the basin, steelhead were infected, some heavily, with the ciliated protozoan *Heteropolaria* (formerly *Epistylis*). Brook trout were found to have *Heteropolaria* in the upper reach of mainstem Trout Creek and Compass Creek. No Whirling Disease *Myxobolus cerebralis* has been found in the Wind River watershed as of this writing.

Discussion

We continue to compile life-history data from PIT-tagged steelhead. We PIT tagged more fish during 2004 (than any year since beginning tagging in 1999. We had the most instream and smolt trap recaptures during 2004 since beginning PIT tagging in 1999. A long-term database of information from PIT-tagged fish from various streams and watersheds in the subbasin will provide clues to what habitats and life-history strategies are most favorable to steelhead in the Wind River subbasin. The inclusion of juvenile Chinook in our PIT-tagging efforts will help to evaluate the potential effects of non-indigenous wild spawned Chinook on juvenile steelhead. We continue to compile interrogation data from both juvenile and adult passage at Bonneville Dam.

The sampling efforts in Martha and Cedar creeks will greatly add to our database of growth data. The intense sampling frequency (4-5 times per year) will allow us to not only PIT tag many fish over several years, but will allow very close monitoring of growth with and without the addition of nutrients. These fish will contribute to evaluating the success of two apparent life-histories of steelhead in the Wind, those that remain in headwater areas and those that migrate downstream as parr and rear in lower river areas.

The dramatic increases in population estimates of age-0 steelhead in the MINE reach (rkm 35.0 – 40.0) of the Wind River since 2000 corresponds to increasing numbers of adult steelhead returning to the Wind River (Rawding and Cochran 2005). The less apparent increase in age-1 or older steelhead in the MINE reach may indicate that the reach is at carrying capacity or that many age-1 parr are outmigrating, perhaps a higher proportion with increased seeding. The number of parr outmigrating from the upper Wind River (pers. comm. Charlie Cochran, WDFW) appears to correlate strongly with trends in our population estimates of age-0 steelhead in the MINE reach. These parr may be contributing significantly to the overall smolt population from the Wind River. Continued monitoring will help detect if these increases result in increases of age-1 or older steelhead and smolts in following years. Future efforts in this area should include an increase in PIT tagging of juvenile steelhead in the MINE reach and deployment of an instream detection system operating year round, in concert with WDFW smolt trapping efforts. These actions will help to answer questions about the migration of parr from the upper reaches of the Wind River.

Because our five index-snorkel sites in Trout Creek are relatively short (100-m), the counts of age-0 steelhead there can be highly influenced by redd locations between years. This may explain some of the variability seen at these sites since adult counts have increased since 2000. The low numbers of age-1 or older steelhead at the two downstream sites, despite high numbers of age-0 fish during 2003 may be a result of downstream parr migration similar to the upper mainstem Wind River. This could be a density dependent function of a result of fish seeking refuge (either upstream or downstream) from high water temperatures.

In both Trout Creek and the upper Wind River watersheds, future work should include investigations of relationships between adult steelhead returns, parr densities, and habitat conditions to identify potential limiting factors. Additional PIT tagging and monitoring should be done to explore the downstream parr emigration life history strategy and the forces driving this behavior. Additional PIT-tagging efforts will help categorize life-history strategies. Due to the long lifespan of steelhead and the need for multiple years of data, this work will require future data collection and monitoring of detections of steelhead already PIT-tagged to maximize our knowledge of this system. Additional synthesis of steelhead parr population data with

habitat and adult population data is a goal, but will require additional research for full exploration.

Extensive analysis of the data described above are being conducted. These analyses will be the subject of several chapters in a Technical Report currently under preparation.

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References

Bohlin, T. 1982. The validity of the removal method for small populations – consequences for electrofishing practice. Institute of Freshwater Research Drottingholm Report 60:15-18.

Cochran, P. 1995. 1995 Level-2 Stream Survey, Trout Creek Stream Narrative. Prepared for U.S. Forest Service, Wind River Ranger District.

Columbia Basin Fish and Wildlife Authority, PIT Tag Steering Committee. 1999. PIT Tag Marking Procedures Manual

Connolly, P. J. 1996. Resident cutthroat trout in the central Coast Range of Oregon: logging effects, habitat associations, and sampling protocols. Doctoral dissertation. Oregon State University, Corvallis.

Connolly, P. J., editor. 2003. Wind River Watershed Restoration 2000 – 2001 Annual Report. Project No. 1998-019-01. Prepared for Bonneville Power Administration, Portland, Oregon.

Crawford, B. A., R. Pettit, and R. Claflin. 1985. Study of juvenile steelhead densities and biomass in the Wind and E. F. Lewis rivers. Washington Department of Game, Olympia

Dolloff, C. A., D. G. Hankin, and G. H. Reeves. 1993. Basinwide Estimation of Habitat and Fish Populations in Streams. Gen. Tech. Rep. SE-83. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station.

Hankin, D. G., and G. H. Reeves. 1988. Estimating total fish abundance and total habitat area in small streams based on visual estimation methods. Canadian Journal of Fisheries and Aquatic Sciences 45:834-844.

Jezorek, I. G., and P. J. Connolly. 2003. Juvenile Steelhead and Other Fish Rearing in the Wind River Watershed. Report B *in* P.J. Connolly, editor, Wind River Watershed Project. 2000 - 2001 Annual Report, Project number 1998-019-01, Prepared for: Bonneville Power Administration, Portland, Oregon.

Prentice, E. F., T. A. Flagg, and C. S. McCutcheon. 1990. Feasibility of using implantable passive integrated transponder (PIT) tags in salmonids. American Fisheries Society Symposium 7:317-322.

Rawding D., and P. C. Cochran. 2005. Wind River Winter and Summer Steelhead Adult and Smolt Population Estimates from Trapping Data, 2000 – 2004. Project No. 199801900. Prepared for Bonneville Power Administration, Portland, OR.

USFS (U.S. Forest Service). 1996. Wind River basin watershed analysis. Gifford Pinchot National Forest, Wind River Ranger District. Carson, Washington.

White, G. C., D. R. Anderson, K. P. Burnham, and D. L. Otis. 1982. Capture-recapture and removal methods for sampling closed populations. No. LA-8787-NERP, UC-11. Los Alamos National Laboratory, Los Alamos, New Mexico.

Zippin, C. 1956. An evaluation of the removal method of estimating animal populations. Biometrics 12:163-189.

Table 1. Surveys conducted from 1997-2000 by the USGS-CRRL using snorkeling or the removal method with electrofishing within the Wind River subbasin. Sites are listed from upstream to downstream within a watershed relative to the mainstem.

Watershed Subwatershed Subdrainage	Start point distance from mouth (km)	Length of reach (km)	Year electrofished (Yes/No)				Year snorkeled (Yes/No)			
			1997	1998	1999	2000	1997	1998	1999	2000
Upper Wind										
Wind R. – ab. Paradise Cr.	40.0	3.8	N	N	N	Y	N	N	N	Y
Paradise Cr. – lower[a]	0 (at mouth)	0.5	N	N	Y	Y	N	Y	N	N
Paradise Cr. – middle	1.3	0.8	N	N	N	N	N	N	N	Y
Paradise Cr. – upper	2.6	0.7	N	N	N	N	N	N	N	Y
Wind R – mining reach	35.4	4.6	N	N	N	N	N	N	N	Y
Falls Cr. – lower	0 (at mouth)	0.8	N	N	N	N	N	N	N	Y
Falls Cr. – upper	1.6	0.5	N	N	N	N	N	N	N	Y
Ninemile Cr.	1.5	0.8	N	N	N	N	N	N	N	Y
Dry Cr. – lower	3.4	0.5	N	N	N	Y	N	N	N	N
Dry Cr. – middle	4.5	0.7	N	N	N	N	N	N	N	Y
Dry Cr. – upper	5.9	0.6	N	N	N	N	N	N	N	Y
Big Hollow Cr.[a]	0 (at mouth)	0.5	N	Y	N	N	N	N	N	N
Trapper Cr. – lower	0 (at mouth)	1.0	N	N	N	N	N	Y	N	Y
Trapper Cr. – middle1	2.9	0.6	N	N	N	Y	N	N	N	N
Trapper Cr. – middle2	3.7	0.8	N	N	N	N	N	N	N	Y
Trapper Cr. – upper	4.8	0.6	N	N	N	N	N	N	N	Y
Wind R – (Trapper-Falls Cr.)	30.0	5.4	N	N	N	N	N	N	N	Y

Continued.

Table 1. Continued.

Watershed Subwatershed Subdrainage	Start point distance from mouth (km)	Length of reach (km)	Year electrofished[a] (Yes/No)				Year snorkeled (Yes/No)			
			1997	1998	1999	2000	1997	1998	1999	2000
Trout Creek										
Trout Cr. – upper	0 (at mouth)	0.5	Y	N	N	N	N	N	N	N
Trout Cr. – Reach 7	14.0	1.0	N	N	N	N	N	N	N	N
Crater Cr. – middle	0.5	0.5	N	N	N	N	N	N	N	N
Crater Cr.[b]	0 (at mouth)	0.5	Y	Y	Y	Y	N	N	N	Y
Trout Cr. – Reach 6	12.5	2.9	N	N	N	N	N	N	Y	N
Trout Cr. – 33 bridge[a]	14.0	0.1	Y	Y	Y	Y	N	N	N	N
Compass Cr. [b]	0 (at mouth)	0.5	N	N	N	N	N	N	N	N
East Fork Trout Cr.	0 (at mouth)	0.4	N	N	N	N	N	N	N	N
Layout Cr. – upper	2.3	0.5	N	N	N	N	N	N	N	N
Layout Cr.	0 (at mouth)	1.0	N	N	Y	N	N	N	N	Y
Trout Cr. – 43 bridge	11.0	0.1	N	Y	N	Y	N	N	N	Y
Trout Cr. – Reach 5	9.4	3.5	N	N	N	N	N	N	N	N
Planting Cr.[a]	0 (at mouth)	0.5	Y	N	N	N	N	N	N	N
Trout Cr. – at Planting Cr.	9.7	0.1	N	N	N	N	N	Y	Y	Y
Trout Cr. – Reach 4	7.3	2.8	N	N	N	N	N	N	N	N
Trout Cr. – Canyon	9.0	0.1	N	N	N	N	N	N	Y	Y
Trout Cr. – PCT Bridge	8.0	0.1	N	N	N	N	N	Y	Y	Y
Trout Cr. – Reach 3	6.7	0.6	N	N	N	N	N	N	N	N
Trout Cr. – Reach 2	5.7	1.0	N	N	N	N	N	N	N	N
Trout Cr. – bl. Smolt Trap	6.0	0.1	N	N	N	N	N	Y	Y	Y
Trout Cr. – All Reaches	5.7	12.1	N	N	N	N	N	N	N	N
Martha Cr.[a]	0.9	0.4	Y	Y	N	N	N	N	N	N

Continued.

Table 1. Continued.

Watershed Subwatershed Subdrainage	Start point distance from mouth (km)	Length of reach (km)	Year electrofished[a] (Yes/No)				Year snorkeled (Yes/No)			
			1997	1998	1999	2000	1997	1998	1999	2000
Panther Creek										
Mouse Cr.[a]	0 (at mouth)	0.5	N	N	N	N	N	N	N	N
Eightmile Cr. – upper	0.7	0.5	N	Y	N	N	N	N	N	N
Eightmile Cr. – lower	0 (at mouth)	0.6	Y	Y	N	N	N	N	N	N
Cedar Cr.	1.0	0.6	N	N	N	N	N	N	N	N

[a] Locations sampled in 1984 by Crawford et al. (1985).

Table 2. Surveys conducted from 2001-2004 by the USGS-CRRL using snorkeling or the removal method with electrofishing within the Wind River subbasin. Sites are listed from upstream to downstream within a watershed relative to the mainstem.

Watershed Subwatershed Subdrainage	Start point distance from mouth (km)	Length of reach (km)	Year electrofished[a] (Yes/No)				Year snorkeled (Yes/No)			
			2001	2002	2003	2004	2001	2002	2003	2004
Upper Wind										
Wind R. – ab. Paradise Cr.	40.0	3.8	N	Y	N	N	N	N	N	Y
Paradise Cr. – lower[b]	0 (at mouth)	0.5	N	Y	Y	N	N	Y	N	N
Paradise Cr. – middle	1.3	0.8	N	N	N	N	N	Y	N	N
Paradise Cr. – upper	2.6	0.7	N	N	N	N	N	Y	N	N
Wind R – mining reach	35.4	4.6	N	N	N	N	Y	Y	Y	Y
Falls Cr. – lower	0 (at mouth)	0.8	N	N	N	N	N	Y	N	N
Falls Cr. – upper	1.6	0.5	N	N	N	N	N	Y	N	N
Ninemile Cr.	1.5	0.8	N	Y	N	N	N	N	N	N
Dry Cr. – lower	3.4	0.5	Y	Y	Y	N	N	N	N	N
Dry Cr. – middle	4.5	0.7	N	N	N	N	Y	Y	N	N
Dry Cr. – upper	5.9	0.6	N	N	N	N	N	Y	N	N
Big Hollow Cr.[b]	0 (at mouth)	0.5	N	N	N	N	N	N	N	N
Trapper Cr. – lower	0 (at mouth)	1.0	N	N	N	N	N	Y	N	N
Trapper Cr. – middle1	2.9	0.6	N	Y	N	N	N	N	N	N
Trapper Cr. – middle2	3.7	0.8	N	N	N	N	N	N	N	N
Trapper Cr. – upper	4.8	0.6	N	N	N	N	N	N	N	N
Wind R – (Trapper-Falls Cr.)	30.0	5.4	N	N	N	N	N	Y	N	Y
Wind River – bl. smolt trap	28.0	2.0	N	N	N	N	N	N	N	Y
Wind River – ab. Beaver camp	26.0	2.0	N	N	N	N	N	N	N	Y
Wind River – bl. Beaver camp	25.0	1.0	N	N	N	N	N	N	N	Y

Continued.

Table 2. Continued.

Watershed Subwatershed Subdrainage	Start point distance from mouth (km)	Length of reach (km)	Year electrofished[a] (Yes/No)				Year snorkeled (Yes/No)			
			2001	2002	2003	2004	2001	2002	2003	2004
Trout Creek										
Trout Cr. – upper	0 (at mouth)	0.5	Y	N	N	N	N	N	N	N
Trout Cr. – Reach 7	14.0	1.0	N	N	N	N	Y	N	N	N
Crater Cr. – middle	0.5	0.5	N	N	N	N	Y	N	N	N
Crater Cr.[b]	0 (at mouth)	0.5	Y	Y	Y	N	N	N	N	N
Trout Cr. – Reach 6	12.5	2.9	N	N	N	N	Y	Y	N	N
Trout Cr. – MS33 bridge[b]	14.0	0.1	Y	Y	Y	N	N	N	N	N
Compass Cr.[b]	0 (at mouth)	0.5	Y	N	N	N	N	N	N	N
East Fork Trout Cr.	0 (at mouth)	0.4	Y	N	N	N	N	N	N	N
Layout Cr. – upper	2.3	0.5	Y	N	N	N	N	N	N	N
Layout Cr.	0 (at mouth)	1.0	Y	Y	N	N	N	N	N	N
Trout Cr. – MS43 bridge	11.0	0.1	Y	Y	Y	N	Y	Y	N	Y
Trout Cr. – Reach 5	9.4	3.5	N	N	N	N	Y	N	N	N
Planting Cr.[b]	0 (at mouth)	0.5	Y	Y	N	N	N	N	N	N
Trout Cr. – at Planting Cr.	9.7	0.1	N	N	N	N	Y	Y	Y	Y
Trout Cr. – Reach 4	7.3	2.8	N	N	N	N	Y	N	N	N
Trout Cr. – Canyon	9.0	0.1	N	N	N	N	Y	Y	Y	Y
Trout Cr. – PCT Bridge	8.0	0.1	N	N	N	N	Y	Y	Y	Y
Trout Cr. – Reach 3	6.7	0.6	N	N	N	N	Y	N	N	N
Trout Cr. – Reach 2	2.7	1.0	N	N	N	N	Y	N	N	N
Trout Cr. – bl. Smolt Trap	3.0	0.1	N	N	N	N	Y	Y	Y	Y
Trout Cr. – All Reaches	2.7	12.1	N	N	N	N	Y	N	N	N
Martha Cr. – upper	2.0	0.5	N	N	N	Y	N	N	N	N
Martha Cr.[b] - lower	0.9	0.5	N	N	N	Y	N	N	N	N

Continued.

Table 2. Continued.

Watershed Subwatershed Subdrainage	Start point distance from mouth (km)	Length of reach (km)	Year electrofished[a] (Yes/No)				Year snorkeled (Yes/No)			
			2001	2002	2003	2004	2001	2002	2003	2004
Panther Creek										
Mouse Cr.[b]	0 (at mouth)	0.5	N	N	N	N	N	N	N	N
Eightmile Cr. – upper	0.7	0.5	N	N	N	N	N	N	N	N
Eightmile Cr. – lower	0 (at mouth)	0.6	N	N	N	N	N	N	N	N
Cedar Cr. – upper	2.0	0.5	N	N	N	Y	N	N	N	N
Cedar Cr. – lower	1.0	0.5	N	N	N	Y	N	N	N	N

[a] Electrofishing sampling conducted during August through mid-October – except Dry Creek in 2001, which was sampled on 12 July.
[b] Locations sampled in 1984 by Crawford et al. (1985).

Table 3. Assemblages of fish species observed in streams of the Wind River subbasin during electrofishing and snorkeling surveys, 1996-2004. Watersheds and streams are listed fromupstream to downstream. P = present, A = absent.

Watershed Subwatershed Stream	Stream code	Steelhead/ rainbow trout	Brook trout[a]	Chinook salmon[a]	Shorthead sculpin	Mountain whitefish
Upper Wind River						
Wind R – ab. Para. Cr.	UMIN	P	P	P	P	A
Paradise Cr. – upper	UPAR	P	A	A	A	A
Paradise Cr. – middle	MPAR	P	A	A	A	A
Paradise Cr. – lower[b]	PARA	P	P	P	P	A
Wind R – mine reach	MINE	P	P	P	P	A
Wind R. – (Falls – mine)	UWFM	P	P	P	P	A
Falls Cr. – upper	UFAL	P	P	P	A	A
Falls Cr. – lower	LFAL	P	P	P	A	A
Ninemile Cr.	NINE	P	A	A	P	A
Dry Cr. – upper	UDRY	P	A	A	P	A
Dry Cr. – middle	MDRY	P	A	A	P	A
Dry Cr. – lower	DRYC	P	A	A	P	A
Big Hollow Cr.[b]	BIGH	P	A	A	P	A
Trapper Cr. – upper	UTRA	P	A	A	P	A
Trapper Cr. – middle 1	TRAP	P	P	P	P	A
Trapper Cr. – midlle 2	MTRA	P	A	A	P	A
Trapper Cr. – lower	LTRA	P	A	P	P	A
Wind R. – (Trapper – Falls)	UWTF	P	P	P	P	A
Wind R. –(Beaver – Trap.)	MWBT	P	P	P	P	P
Panther Creek						
Mouse Cr.[b]	MOUS	P	A	A	A	A
Eightmile Cr. – upper	UEIG	P	A	A	P	A
Eightmile Cr. – lower	LEIG	P	A	A	P	A
Cedar Cr. – upper	UCED	P	A	A	P	A
Cedar Cr. - lower	CEDA	P	A	A	P	A

Continued.

Table 3. Continued.

Watershed Subwatershed Stream	Stream code	Steelhead/ rainbow trout	Brook trout[a]	Chinook salmon[a]	Shorthead sculpin	Mountain whitefish
Trout Creek						
Trout Cr. – upper	UTRO	P	P	A	A	A
Trout Cr. – Reach 7[c]	MTR7	P	P	A	A	A
Crater Cr. – middle	MCRA	P	P	A	A	A
Crater Cr.[b]	CRAT	P	P	A	A	A
Trout Cr. – Reach 6[c]	MTR6	P	P	A	A	A
Trout Cr. – 33 bridge[b]	MS33	P	P	A	A	A
Compass Cr.[b]	COMP	P	P	A	A	A
East Fork Trout Cr.	EFTR	P	P	A	A	A
Layout Cr. – upper	ULAY	P	P	A	A	A
Layout Cr.	LAYO	P	P	A	A	A
Trout Cr. – 43 bridge	MS43	P	P	A	A	A
Trout Cr. – Reach 5[c]	MTR5	P	P	A	A	A
Planting Cr.[b]	PLAN	P	P	A	A	A
Trout Cr. – at Planting Cr	MTPL	P	P	A	A	A
Trout Cr. – Reach 4[c]	MTR4	P	P	A	A	A
Trout Cr. – Canyon	TCAN	P	P	A	P	A
Trout Cr. – PCT Bridge	PCTB	P	P	A	A	A
Trout Cr. – Reach 3[c]	MTR3	P	P	A	A	A
Trout Cr. – Reach 2[c]	MTR2	P	P	A	A	A
Trout Cr. – Smolt Trap	LTRT	P	P	A	P	A
Martha Creek – upper	UMAR	P	P	A	P	A
Martha Creek[b] - lower	MART	P	A	A	A	A

[a] These species are considered nonnative to the Wind River subbasin above Shipherd Falls.
[b] Locations sampled in 1984 by Crawford et al (1985) as well as by USGS-CRRL during 1996-2004.
[c] Reaches were defined by P. Cochran (1995) who used the U.S. Forest Service Level II Stream Survey method.

Table 4. Number of steelhead/rainbow trout parr PIT tagged at each of four smolt traps within the Wind River subbasin during April through July 2000 - 2004. Readings are from a hand-held Global Positioning System (GPS) using North American Datum 1927. Steelhead parr were tagged three days each week throughout the period listed.

Smolt Trap	GPS Reading		2004 Tagging dates; (Number of tagging days)	Number of 134.2 kHz PIT tags deployed				
	North	West		2000	2001	2002	2003	2004
Upper Wind	45º 52.501'	121º 58.629'	6 Apr 2004 – 9 June 2004 (25)	547	290	316	626	569
Trout Creek	45º 48.241'	121º 56.330'	6 Apr 2004 – 24 June 2004 (32)	125	19	317	210	498
Panther Creek	RNO[a]		6 Apr 2004 – 9 July 2004 (24)	92	26	312	322	515
Lower Wind	RNT[b]		6 Apr 2004 – 19 May 2004 (4)	0	0	0	50	7
Total				**764**	**335**	**945**	**1,208**	**1,589**

[a] RNO = Reading not obtainable by GPS because of basin topography.
[b] RNT = Reading not taken.

Table 5. Total number of juvenile steelhead/rainbow trout that were captured and PIT tagged in the Wind River subbasin 1999-2004. Watersheds and streams are from upstream to downstream within a watershed.

Watershed / Stream reach or section	Number of PIT tags deployed[a]					
	1999	2000	2001	2002	2003	2004
Upper Wind River						
Wind River – ab. Paradise Cr.	0	36	15	119	43	0
Paradise Creek	68	85	17	49	129	15
Wind River - mining reach	59	61	36	0	115	0
Dry Creek - lower	44	115	142	220	170	7
Trapper Creek	0	101	30	132	0	0
Ninemile	0	0	0	123	0	0
Subtotal	**171**	**398**	**240**	**644**	**457**	**22**
Trout Creek						
Trout Creek - upper	0	0	14	0	0	0
Crater Creek - lower	27	24	49	88	135	3
Trout Creek – 33 bridge	18	26	18	50	52	0
Compass Creek - lower	0	0	71	4	99	15
East Fork Trout Creek - lower	0	0	7	0	0	0
Layout Creek - upper	0	0	127	5	133	25
Layout Creek - lower	69	89	36	126	67	0
Trout Creek – 43 bridge	0	46	116	49	132	0
Trout Creek mainstem – ab, PCT	---	---	---	---	---	21
Trout Creek mainstem – bl. PCT	---	---	---	---	---	18
Trout Creek mainstem – ab. Hemlock lake	---	---	---	---	---	137
Trout Creek mainstem – fish weir[b]	---	---	---	---	---	426
Trout Creek mainstem – in Hemlock lake[c]	---	---	---	---	---	75
Trout Creek mainstem – bl. Hemlock lake	---	---	---	---	---	80
Planting Creek - lower	0	0	90	4	58	3
Martha Creek– upper	---	---	---	---	---	310
Martha Creek – lower	0	114	0	88	121	389
Subtotal	**114**	**299**	**528**	**420**	**797**	**1,502**

Continued.

Table 5. Continued.

Watershed / Stream reach or section	Number of PIT tags deployed[a] 1999	2000	2001	2002	2003	2004
Wind River						
Wind River - canyon	0	0	12	0	0	0
Wind River – ab. Smolt trap	---	---	---	---	---	28
Wind River – bl. Smolt trap	---	---	---	---	---	5
Wind River – ab. Beaver campground	---	---	---	---	---	393
Wind River – bl. Beaver campground	---	---	---	---	---	17
Subtotal	**0**	**0**	**12**	**0**	**0**	**443**
Panther Creek						
Mouse Creek	0	0	0	0	74	0
Upper Panther	0	0	0	0	1	0
Eightmile Creek - upper	0	0	23	2	0	0
Eightmile Creek - lower	0	0	20	6	84	27
Cedar Creek – upper	--	--	--	--	--	340
Cedar Creek – lower	0	0	0	0	111	327
Subtotal	**0**	**0**	**43**	**8**	**271**	**694**
Total	**285**	**697**	**823**	**1,072**	**1,525**	**2,661**

[a] 400 kHz tags used 1999. 134.2 kHz tags used in all other years.
[b] Fish weir operated in lower Trout Creek, just above Hemlock from 7/20/04-8/24/04.
[c] These fish were captured by hook and line.

Table 6. The number and detection history of PIT-tagged juvenile steelhead/rainbow trout in the upper Wind River subwatershed, 1999-2004. Sites are listed from upstream to downstream within a watershed relative to the mainstem.

Subwatershed / Year tagged	PIT tags deployed[a]	Instream recaptures						Smolt trap recaptures											
								U. Wind					L. Wind						
		99	00	01	02	03	04	00	01	02	03	04	00	01	02	03	04		
Wind R. – ab. Paradise Cr.																			
2000	36	--	0	0	0	0	--	0	0	0	0	0	0	0	0	0	0		
2001	15	--	--	0	0	0	--	--	0	0	0	0	--	0	0	0	0		
2002	119	--	--	--	2	0	--	--	--	0	0	0	--	--	0	0	0		
2003	43	--	--	--	--	0	--	--	--	--	0	1	--	--	--	0	1		
Paradise Cr.																			
1999	68	0	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0		
2000	85	--	0	5	2	0	0	0	1	0	0	0	0	0	0	0	0		
2001	17	--	--	0	0	0	0	--	0	0	0	0	--	0	0	0	0		
2002	49	--	--	--	4	5	0	--	--	0	1	0	--	--	0	0	0		
2003	128	--	--	--	--	24	0	--	--	--	0	4	--	--	--	0	1		
2004	15	--	--	--	--	--	0	--	--	--	--	0	--	--	--	--	0		
Wind R. – mining reach																			
1999	59	0	3	0	0	0	--	0	0	0	0	0	0	0	0	0	0		
2000	61	--	0	1	0	0	--	0	1	0	0	0	0	2	0	0	0		
2001	36	--	--	0	0	0	--	--	0	1	0	0	--	0	0	0	0		
2003	115	--	--	--	--	0	--	--	--	--	0	7	--	--	--	0	0		
Ninemile Cr.																			
2002	123	--	--	--	0	--	--	--	--	0	0	2	--	--	0	0	1		
Dry Cr.																			
1999	44	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
2000	115	--	1	4	0	0	0	0	0	0	0	0	0	0	0	0	0		
2001	142	--	--	0	3	0	0	--	0	0	0	0	--	0	0	0	0		
2002	220	--	--	--	0	14	0	--	--	0	0	0	--	--	0	0	0		
2003	170	--	--	--	--	14	0	--	--	--	0	0	--	--	--	0	0		
2004	7	--	--	--	--	--	3	--	--	--	--	0	--	--	--	--	0		

Continued.

Table 6. Continued.

Subwatershed Year tagged	PIT tags deployed[a]	Instream recaptures						Smolt trap recaptures									
								U. Wind					L. Wind				
		99	00	01	02	03	04	00	01	02	03	04	00	01	02	03	04
Trapper Cr.																	
2000	101	--	0	3	3	--	--	0	0	0	0	0	0	0	0	0	0
2001	30	--	--	0	0	--	--	--	0	0	0	0	--	0	0	0	0
2002	132	--	--	--	4	--	--	--	--	0	2	0	--	--	0	2	0
Wind R. – ab. Smolt trap																	
2004	66	--	--	--	--	--	0	--	--	--	--	0	--	--	--	--	0
U. Wind R. – smolt trap																	
2000	547	--	--	--	--	--	--	0	0	0	0	0	0	2	1	0	0
2001	289	--	--	--	--	--	--	--	0	1	0	0	--	0	1	0	0
2002	316	--	--	--	--	--	--	--	--	0	1	0	--	--	0	3	0
2003	625	--	--	--	--	--	--	--	--	--	0	3	--	--	--	0	3
2004	570	--	--	--	--	--	1[b]	--	--	--	--	1	--	--	--	--	1
Wind R. – bl. Smolt trap																	
2004	5	--	--	--	--	--	0	--	--	--	--	0	--	--	--	--	0
Wind R. – ab. Beaver camp.																	
2004	179	--	--	--	--	--	6	--	--	--	--	0	--	--	--	--	0
Wind R. – bl. Beaver camp.																	
2004	28	--	--	--	--	--	0	--	--	--	--	0	--	--	--	--	0

[a] All fish tagged in 1999 were tagged with a 400 khz PIT tag, all fish tagged after 1999 were tagged with a 134.2 khz PIT tag.
[b] Fish was recatptured in the Wind River below the smolt trap.

Table 7. The number and detection history of PIT-tagged juvenile steelhead/rainbow trout in the Trout Creek subwatershed, 1999-2004. Sites are listed from upstream to downstream within a watershed relative to the mainstem.

Subwatershed / Year tagged	PIT tags deployed[a]	Instream recaptures						Smolt trap recaptures: Trout Creek					Smolt trap recaptures: L. Wind				
		99	00	01	02	03	04	00	01	02	03	04	00	01	02	03	04
Trout Cr. – upper																	
2001	14	--	--	1[b]	--	--	--	--	0	0	0	0	--	0	0	0	0
Crater Cr.																	
1999	27	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2000	24	--	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	49	--	--	3	4	1	0	--	0	0	0	0	--	0	0	0	0
2002	86	--	--	--	0	15	0	--	--	0	0	0	--	--	0	0	0
2003	135	--	--	--	--	27	0	--	--	--	0	0	--	--	--	0	0
2004	3	--	--	--	--	--	4	--	--	--	--	2	--	--	--	--	0
Trout Cr. – MS33																	
1999	18	0	2	0	0	0	--	0	0	0	0	0	0	0	0	0	0
2000	26	--	0	2	1	0	--	0	0	1	0	0	0	0	0	0	0
2001	18	--	--	0	0	0	--	--	0	0	0	0	--	0	0	0	0
2002	50	--	--	--	0	3	--	--	--	0	4	0	--	--	0	0	0
2003	52	--	--	--	--	0	--	--	--	--	0	1	--	--	--	0	1
Compass Cr.																	
2001	71	--	--	6	3	4	0	--	0	0	0	0	--	0	0	0	0
2002	4	--	--	--	0	0	0	--	--	0	0	0	--	--	0	0	0
2003	99	--	--	--	--	15	2	--	--	--	0	5[c]	--	--	--	0	0
2004	15	--	--	--	--	--	0	--	--	--	--	0	--	--	--	--	0
East Fork Trout Cr.																	
2001	7	--	--	0	--	--	--	--	0	0	0	0	--	0	0	0	0
Layout Cr. – upper																	
2001	127	--	--	0	0	2	0	--	0	1	1	0	--	0	0	0	0
2002	5	--	--	--	0	1	0	--	--	0	0	0	--	--	0	0	0
2003	133	--	--	--	--	13	2	--	--	--	0	0	--	--	--	0	0
2004	25	--	--	--	--	--	0	--	--	--	--	0	--	--	--	--	0

Continued.

Table 7. Continued.

Subwatershed Year tagged	PIT tags deployed[a]	Instream recaptures						Smolt trap recaptures										
								Trout Creek					L. Wind					
		99	00	01	02	03	04	00	01	02	03	04	00	01	02	03	04	
Layout Cr. – lower																		
1999	69	0	0	0	0	0	--	0	0	0	0	0	0	0	0	0	0	
2000	89	--	0	1	0	0	--	0	2	0	0	0	0	2	0	0	0	
2001	36	--	--	0	4	0	--	--	0	0	0	0	--	0	0	0	0	
2002	126	--	--	--	1	2	--	--	--	0	4	0	--	--	0	0	0	
2003	67	--	--	--	--	3	--	--	--	--	0	4	--	--	--	0	1	
Trout Cr. – MS43																		
2000	46	--	0	2	0	0	--	0	1	0	0	--	0	0	0	0	0	
2001	116	--	--	0	5	0	--	--	0	1	1	--		--	0	0	0	
2002	49	--	--	--	0	0	--	--	--	0	3	--	--	--	0	1	0	
2003	132	--	--	--	--	0	--	--	--	--	0	3	--	--	--	0	0	
Planting Cr.																		
2001	90	--	--	21	1	6	0	--	0	0	0	0	--	0	0	0	0	
2002	4	--	--	--	0	0	0	--	--	0	0	0	--	--	0	0	0	
2003	58	--	--	--	--	10	0	--	--	--	0	1	--	--	--	0	0	
2004	3	--	--	--	--	--	0	--	--	--	--	0	--	--	--	--	0	
Trout Cr. – near PCT trail																		
2004	50	--	--	--	--	--	0	--	--	--	--	0	--	--	--	--	0	
Trout Cr. – smolt trap																		
2000	125	--	--	--	--	--	--	0	2	0	0	0	0	0	0	0	0	
2001	19	--	--	--	--	--	1[d]	--	0	0	0	0	--	0	0	3	0	
2002	317	--	--	--	--	--	--	--	--	0	0	0	--	--	0	0	1	
2003	209	--	--	--	--	--	8[e]	--	--	--	1	3	--	--	--	0	4	
2004	498	--	--	--	--	--	17[f]	--	--	--	--	1	--	--	--	--	1	
Trout Cr. – near smolt trap																		
2004	106	--	--	--	--	--	11[g]	--	--	--	--	0	--	--	--	--	0	
Trout Cr. – upstream weir																		
2004	400	--	--	--	--	--	34[h]	--	--	--	--	0	--	--	--	--	0	

Continued.

Table 7. Continued.

Subwatershed Year tagged	PIT tags deployed[a]	Instream recaptures						Smolt trap recaptures: Trout Creek					Smolt trap recaptures: L. Wind				
		99	00	01	02	03	04	00	01	02	03	04	00	01	02	03	04
Hemlock Dam																	
2004	47	0	0	0	0	2[i]	2[i]	0	0	0	1	0	0	0	0	0	0
Hemlock Lake																	
2004	71	0	0	0	0	0	10[j]	0	0	0	0	0	0	0	0	0	0
Trout Cr. – bl. Hemlock dam																	
2004	80	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0
Martha Cr. – upper																	
2004	309	0	0	0	0	0	101	--	--	--	--	--	0	0	0	0	0
Martha Cr. – lower																	
2000	114	--	0	--	3	0	0	--	--	--	--	--	0	1	0	0	0
2002	88	--	--	--	0	15	0	--	--	--	--	--	--	--	0	0	1
2003	121	--	--	--	--	10	15	--	--	--	--	--	--	--	--	0	0
2004	389	--	--	--	--	--	162	--	--	--	--	--	--	--	--	--	0

[a] All fish tagged in 1999 were tagged with a 400 khz PIT tag, all fish tagged after 1999 were tagged with a 134.2 khz PIT tag.
[b] Fish was recaptured in Crater Creek
[c] One of these fish was recaptured in Hemlock Lake.
[d] Fish was recaptured near Trout Creek smolt trap.
[e] Six of these fish were recaptured at the Hemlock dam as juveniles, 2 were recaptured in Hemlock Lake.
[f] Three of these fish were recaptured in Hemlock Lake, 3 at the Trout Creek downstream weir, 8 at the Trout Creek upstream weir, and 3 below Hemlock Lake.
[g] One fish was recaptured as a juvenile at the Hemlock Dam trap.
[h] Three fish were recaptured in Hemlock Lake, Eight in the Trout Creek downstream weir, and 1 below Hemlock Lake.
[i] One of these fish was recaptured in Hemlock Lake
[j] One of these fish was recaptured in the Trout Creek downstream weir and 7 fish in the upstream Trout Creek weir.

Table 8. The number and detection history of PIT-tagged juvenile steelhead/rainbow trout in the Panther Creek subwatershed, 1999-2004. Sites are listed from upstream to downstream within a watershed relative to the mainstem.

Subwatershed Year tagged	PIT tags deployed[a]	Instream recaptures						Smolt trap recaptures									
								Panther Creek					L. Wind				
		99	00	01	02	03	04	00	01	02	03	04	00	01	02	03	04
Mouse Cr.																	
2003	74	--	--	--	--	18	--	--	--	--	0	0	--	--	--	0	0
Eightmile Cr. – upper																	
2001	23	--	--	0	1	--	--	--	0	1	0	0	--	0	0	0	0
2002	2	--	--	--	0	--	--	--	--	0	0	0	--	--	0	0	0
Eightmile Cr. – lower																	
2001	20	--	--	0	0	0	--	--	0	1	0	0	--	0	0	0	0
2002	6	--	--	--	0	0	--	--	--	0	0	0	--	--	0	0	0
2003	84	--	--	--	--	20	--	--	--	--	0	6	--	--	--	0	1
Cedar Cr. – upper																	
2004	339	--	--	--	--	--	121	0	0	0	0	0	0	0	0	0	0
Cedar Cr. – lower																	
2003	111	--	--	--	--	22	74	--	--	--	0	8	--	--	--	0	0
2004	327	--	--	--	--	--	87	--	--	--	--	1	--	--	--	0	0
Panther Cr. – smolt trap																	
2000	92	--	--	--	--	--	--	0	1	0	0	0	0	0	0	0	0
2001	26	--	--	--	--	--	--	--	0	0	0	0	--	0	0	0	0
2002	312	--	--	--	--	--	--	--	--	0	3	5	--	--	0	0	0
2003	327	--	--	--	--	1[b]	--	--	--	--	0	2	--	--	--	0	0
2004	515	--	--	--	--	--	--	--	--	--	--	0	--	--	--	--	2

[a] All fish tagged in 1999 were tagged with a 400 khz PIT tag, all fish tagged after 1999 were tagged with a 134.2 khz PIT tag.
[b] One fish tagged at Panther Creek smolt trap was recaptured up Cedar Creek.

Table 9. The number and detection history of PIT-tagged steelhead/rainbow trout with PIT tags in the upper Wind River subwatershed, 1999-2004. Sites are listed from upstream to downstream within a watershed relative to the mainstem.

		Juvenile interrogations												Adult interrogations and recaptures											
		Bonn. Dam						Estuary trawl						Bonn. Dam						Shipherd Falls					
Subwatershed Year tagged	PIT tags deployed[a]	99	00	01	02	03	04	99	00	01	02	03	04	99	00	01	02	03	04	99	00	01	02	03	04
Wind R. – ab. Paradise Cr.																									
2000	36	--	0	2	0	0	0	--	0	0	0	0	0	--	--	--	0	0	0	--	--	--	0	0	0
2001	15	--	--	0	1	0	0	--	--	0	0	0	0	--	--	--	--	0	1	--	--	--	--	0	0
2002	119	--	--	--	0	2	1	--	--	--	0	1	0	--	--	--	--	--	0	--	--	--	--	--	0
2003	43	--	--	--	--	0	0	--	--	--	--	0	0	--	--	--	--	--	--	--	--	--	--	--	--
Paradise Cr.																									
1999	68	0	0	0	0	0	0	0	0	0	0	0	0	--	--	0	0	0	0	--	--	0	0	0	0
2000	85	--	0	1	1	0	0	--	0	1	0	0	0	--	--	--	0	0	0	--	--	--	0	0	0
2001	17	--	--	0	1	0	0	--	--	0	0	0	0	--	--	--	--	0	0	--	--	--	--	0	0
2002	49	--	--	--	0	0	0	--	--	--	0	0	0	--	--	--	--	--	0	--	--	--	--	--	0
2003	128	--	--	--	--	0	0	--	--	--	--	0	0	--	--	--	--	--	--	--	--	--	--	--	--
2004	15	--	--	--	--	--	0	--	--	--	--	--	0	--	--	--	--	--	--	--	--	--	--	--	--
Wind R – mining reach																									
1999	59	0	0	0	0	0	0	0	0	0	0	0	0	--	--	0	0	0	0	--	--	0	0	0	0
2000	61	--	0	4	0	0	0	--	0	0	0	0	0	--	--	--	0	0	0	--	--	--	0	0	0
2001	36	--	--	0	1	0	0	--	--	0	0	0	0	--	--	--	--	0	0	--	--	--	--	0	0
2003	115	--	--	--	--	0	0	--	--	--	--	0	0	--	--	--	--	--	--	--	--	--	--	--	--
Ninemile Cr.																									
2002	123	--	--	--	0	1	1	--	--	--	0	0	0	--	--	--	--	--	0	--	--	--	--	--	0
Dry Cr.																									
1999	44	0	0	0	0	0	0	0	0	0	0	0	0	--	--	0	0	0	0	--	--	0	0	0	0
2000	115	--	0	0	0	0	0	--	0	0	0	0	0	--	--	--	0	0	0	--	--	--	0	0	0
2001	142	--	--	--	0	0	0	--	--	--	0	0	0	--	--	--	--	0	0	--	--	--	--	0	0
2002	220	--	--	--	--	1	0	--	--	--	--	0	0	--	--	--	--	--	0	--	--	--	--	--	0
2003	170	--	--	--	--	0	0	--	--	--	--	--	0	--	--	--	--	--	--	--	--	--	--	--	--
Trapper Cr.																									
2000	101	--	0	1	0	0	0	--	0	0	0	0	0	--	--	--	0	0	0	--	--	--	0	0	0
2001	30	--	--	0	0	0	0	--	--	0	0	0	0	--	--	--	--	0	0	--	--	--	--	0	0
2002	132	--	--	--	0	1	0	--	--	--	0	0	0	--	--	--	--	--	0	--	--	--	--	--	0

Continued.

Table 9. Continued.

Subwatershed / Year tagged	PIT tags deployed[a]	Juvenile interrogations: Bonn. Dam 99	00	01	02	03	04	Juvenile interrogations: Estuary trawl 99	00	01	02	03	04	Adult interrogations and recaptures: Bonn. Dam 99	00	01	02	03	04	Adult interrogations and recaptures: Shipherd Falls 99	00	01	02	03	04
Wind R. – ab. Smolt trap																									
2004	66	--	--	--	--	--	0	--	--	--	--	--	0	--	--	--	--	--	--	--	--	--	--	--	--
U. Wind R. – smolt trap																									
2000	547	--	0	50	2	0	0	--	0	3	0	0	0	--	--	--	0	8	1	--	--	--	0	1	0
2001	289	--	--	0	4	1	0	--	--	0	0	0	0	--	--	--	--	0	1	--	--	--	--	0	0
2002	316	--	--	--	0	12	0	--	--	--	0	3	0	--	--	--	--	--	0	--	--	--	--	--	0
2003	625	--	--	--	--	0	5	--	--	--	--	0	2	--	---	--	--	--	--	--	--	--	--	--	--
2004	570	--	--	--	--	--	0	--	--	--	--	--	0	--	--	--	--	--	--	--	--	--	--	--	--
Wind R. – bl. Smolt trap																									
2004	5	--	--	--	--	--	0	--	--	--	--	--	0	--	--	--	--	--	--	--	--	--	--	--	--
Wind R. – ab. Beaver camp.																									
2004	179	--	--	--	--	--	0	--	--	--	--	--	0	--	--	--	--	--	--	--	--	--	--	--	--
Wind R. – bl. Beaver camp.																									
2004	28	--	--	--	--	--	0	--	--	--	--	--	0	--	--	--	--	--	--	--	--	--	--	--	--

[a] All fish tagged in 1999 were tagged with a 400 khz PIT tag, all fish tagged after 1999 were tagged with a 134.2 khz PIT tag.

Table 10. The number and detection history of PIT-tagged steelhead/rainbow trout in the Trout Creek subwatershed, 1999-2004. Sites are listed from upstream to downstream within a watershed relative to the mainstem.

Subwatershed / Year tagged	PIT tags deployed[a]	Juvenile interrogations: Bonn. Dam 99	00	01	02	03	04	Juvenile interrogations: Estuary trawl 99	00	01	02	03	04	Adult interrogations and recaptures: Bonn. Dam 99	00	01	02	03	04	Adult interrogations and recaptures: Hemlock Dam 99	00	01	02	03	04
Trout Cr. – upper																									
2001	14	--	--	0	0	0	0	--	--	0	0	0	0	--	--	--	--	0	0	--	--	--	--	0	0
Crater Cr.																									
1999	27	0	0	0	0	0	0	0	0	0	0	0	0	--	--	0	0	0	0	--	--	0	0	0	0
2000	24	--	0	0	0	0	0	--	0	0	0	0	0	--	--	--	0	0	0	--	--	--	0	0	0
2001	49	--	--	0	0	0	0	--	--	0	0	0	0	--	--	--	--	0	0	--	--	--	--	0	0
2002	86	--	--	--	0	0	0	--	--	--	0	0	0	--	--	--	--	--	0	--	--	--	--	--	0
2003	135	--	--	--	--	0	0	--	--	--	--	0	0	--	--	--	--	--	--	--	--	--	--	--	--
2004	3	--	--	--	--	--	0	--	--	--	--	--	0	--	--	--	--	--	--	--	--	--	--	--	--
Trout Cr. – MS33																									
1999	18	0	0	0	0	0	0	0	0	0	0	0	0	--	--	0	0	0	0	--	--	0	0	0	0
2000	26	--	0	0	0	0	0	--	0	0	0	0	0	--	--	--	0	0	0	--	--	--	0	0	0
2001	18	--	--	0	0	0	0	--	--	0	0	0	0	--	--	--	--	0	0	--	--	--	--	0	0
2002	50	--	--	--	0	0	0	--	--	--	0	0	0	--	--	--	--	--	0	--	--	--	--	--	0
2003	52	--	--	--	--	0	0	--	--	--	--	0	0	--	--	--	--	--	--	--	--	--	--	--	--
Compass Cr.																									
2001	71	--	--	0	0	0	0	--	--	0	0	0	0	--	--	--	--	0	0	--	--	--	--	0	0
2002	4	--	--	--	0	0	0	--	--	--	0	0	0	--	--	--	--	--	0	--	--	--	--	--	0
2003	99	--	--	--	--	0	1	--	--	--	--	0	0	--	--	--	--	--	--	--	--	--	--	--	--
2004	15	--	--	--	--	--	0	--	--	--	--	--	0	--	--	--	--	--	--	--	--	--	--	--	--
East Fork Trout Cr.																									
2001	7	--	--	0	0	0	0	--	--	0	0	0	0	--	--	--	--	0	0	--	--	--	--	0	0
Layout Cr. – upper																									
2001	127	--	--	0	0	1	0	--	--	0	0	0	0	--	--	--	--	0	0	--	--	--	--	0	0
2002	5	--	--	--	0	0	0	--	--	--	0	0	0	--	--	--	--	--	0	--	--	--	--	--	0
2003	133	--	--	--	--	0	2	--	--	--	--	0	0	--	--	--	--	--	--	--	--	--	--	--	--
2004	25	--	--	--	--	--	0	--	--	--	--	--	0	--	--	--	--	--	--	--	--	--	--	--	--

Continued.

Table 10. Continued.

Subwatershed / Year tagged	PIT tags deployed[a]	Juvenile interrogations: Bonn. Dam 99	00	01	02	03	04	Juvenile interrogations: Estuary trawl 99	00	01	02	03	04	Adult interrogations and recaptures: Bonn. Dam 99	00	01	02	03	04	Adult interrogations and recaptures: Hemlock Dam 99	00	01	02	03	04
Layout Cr. – lower																									
1999	69	0	0	0	0	0	0	0	0	0	0	0	0	--	--	0	0	0	0	--	--	0	0	0	0
2000	89	--	0	5	0	0	0	--	0	0	0	0	0	--	--	--	0	0	0	--	--	--	0	0	1
2001	36	--	--	0	0	0	0	--	--	0	0	0	0	--	--	--	--	0	0	--	--	--	--	0	0
2002	126	--	--	--	0	5	0	--	--	--	0	0	0	--	--	--	--	--	0	--	--	--	--	--	0
2003	67	--	--	--	--	0	0	--	--	--	--	0	0	--	--	--	--	--	--	--	--	--	--	--	--
Trout Cr. – MS43																									
2000	46	--	0	3	1	0	0	--	0	0	0	0	0	--	--	--	0	0	0	--	--	--	0	0	0
2001	116	--	--	0	1	1	0	--	--	0	0	0	0	--	--	--	--	0	0	--	--	--	--	0	0
2002	49	--	--	--	0	0	0	--	--	--	0	0	0	--	--	--	--	--	0	--	--	--	--	--	0
2003	132	--	--	--	--	0	0	--	--	--	--	0	0	--	--	--	--	--	--	--	--	--	--	--	--
Planting Cr.																									
2001	90	--	--	0	0	0	0	--	--	0	0	0	0	--	--	--	--	0	0	--	--	--	--	0	0
2002	4	--	--	--	0	0	0	--	--	--	0	0	0	--	--	--	--	--	0	--	--	--	--	--	0
2003	58	--	--	--	--	0	0	--	--	--	--	0	0	--	--	--	--	--	--	--	--	--	--	--	--
2004	3	--	--	--	--	--	0	--	--	--	--	--	0	--	--	--	--	--	--	--	--	--	--	--	--
Trout Cr. – smolt trap																									
2000	125	--	1	9	1	0	0	--	0	0	0	0	0	--	--	--	1	1	0	--	--	--	0	0	0
2001	19	--	--	0	1	0	0	--	--	0	0	0	0	--	--	--	--	0	0	--	--	--	--	0	0
2002	317	--	--	--	0	8	0	--	--	--	0	0	0	--	--	--	--	--	0	--	--	--	--	--	0
2003	209	--	--	--	--	0	2	--	--	--	--	0	0	--	--	--	--	--	--	--	--	--	--	--	--
2004	498	--	--	--	--	--	0	--	--	--	--	--	0	--	--	--	--	--	--	--	--	--	--	--	--

Continued.

Table 10. Continued.

Subwatershed / Year tagged	PIT tags deployed[a]	Juvenile interrogations: Bonn. Dam 99	00	01	02	03	04	Juvenile interrogations: Estuary trawl 99	00	01	02	03	04	Adult interrogations and recaptures: Bonn. Dam 99	00	01	02	03	04	Adult interrogations and recaptures: Hemlock Dam 99	00	01	02	03	04
Martha Cr. – upper																									
2004	309	--	--	--	--	--	0	--	--	--	--	--	0	--	--	--	--	--	--	--	--	--	--	--	--
Martha Cr. – lower																									
2000	114	--	0	3	1	0	0	--	0	0	1	0	0	--	--	--	0	0	0	--	--	--	0	0	0
2002	88	--	--	--	0	1	0	--	--	--	0	0	0	--	--	--	--	--	0	--	--	--	--	--	0
2003	121	--	--	--	--	0	0	--	--	--	--	0	0	--	--	--	--	--	--	--	--	--	--	--	--
2004	389	--	--	--	--	--	0	--	--	--	--	--	0	--	--	--	--	--	--	--	--	--	--	--	--

[a] All fish tagged in 1999 were tagged with a 400 khz PIT tag, all fish tagged after 1999 were tagged with a 134.2 khz PIT tag.

Table 11. The number and detection history of PIT-tagged juvenile steelhead/rainbow trout in the Panther Creek subwatershed, 1999-2004. Sites are listed from upstream to downstream within a watershed relative to the mainstem.

		Juvenile interrogations												Adult interrogations and recaptures											
		Bonn. Dam						Estuary trawl						Bonn. Dam						Shipherd Falls					
Subwatershed Year tagged	PIT tags deployed[a]	99	00	01	02	03	04	99	00	01	02	03	04	99	00	01	02	03	04	99	00	01	02	03	04
Mouse Cr																									
2003	74	--	--	--	--	0	0	--	--	--	--	0	0	--	--	--	--	--	--	--	--	--	--	--	--
Eightmile Cr. – upper																									
2001	23	--	--	0	0	1	0	--	--	0	0	0	0	--	--	--	--	0	0	--	--	--	--	0	0
2002	2	--	--	--	0	0	0	--	--	--	0	0	0	--	--	--	--	--	0	--	--	--	--	--	0
Eightmile Cr. – lower																									
2001	20	--	--	0	0	0	0	--	--	0	0	0	0	--	--	--	--	0	0	--	--	--	--	0	0
2002	6	--	--	--	0	0	0	--	--	--	0	1	0	--	--	--	--	--	0	--	--	--	--	--	0
2003	84	--	--	--	--	0	0	--	--	--	--	0	1	--	--	--	--	--	--	--	--	--	--	--	--
Cedar Cr. – upper																									
2004	339	--	--	--	--	--	0	--	--	--	--	--	0	--	--	--	--	--	--	--	--	--	--	--	--
Cedar Cr. – lower																									
2003	111	--	--	--	--	0	0	--	--	--	--	0	0	--	--	--	--	--	--	--	--	--	--	--	--
2004	327	--	--	--	--	--	0	--	--	--	--	--	0	--	--	--	--	--	--	--	--	--	--	--	--
Panther Cr. – smolt trap																									
2000	92	--	0	4	0	0	0	--	0	1	0	0	0	--	--	--	0	0	0	--	--	--	0	0	0
2001	26	--	--	1	1	0	0	--	--	0	0	0	0	--	--	--	--	0	0	--	--	--	--	0	0
2002	312	--	--	--	1	7	0	--	--	--	0	1	0	--	--	--	--	--	0	--	--	--	--	--	0
2003	327	--	--	--	--	0	2	--	--	--	--	0	0	--	--	--	--	--	--	--	--	--	--	--	--
2004	515	--	--	--	--	--	1	--	--	--	--	--	0	--	--	--	--	--	--	--	--	--	--	--	--

[a] All fish tagged in 1999 were tagged with a 400 khz PIT tag, all fish tagged after 1999 were tagged with a 134.2 khz PIT tag.

Table 12. Total number of PIT-tagged juvenile steelhead/rainbow trout and the number of tag detections from fish originating in the Wind River subbasin from 1999 to 2004. Columbia River interrogations updated through 5 December 04. All other data updated through 3 February 05.

Watershed Subwatershed Subdrainage	PIT tags deployed 1999-2004[a]	Instream recapatures	Smolt trap recaptures[b]				Columbia River interrogations		Adult interrogations			
			Trout	UW	PAN	LW	Bonn. Dam	Estuary trawl	Bonn. Dam	Shipherd Falls	Heml. Dam	Other
Upper Wind												
Wind R. – ab. Paradise Cr.	213	2	--	1	--	1	6	1	1	0	0	0
Paradise Cr. – lower	362	43	--	6	--	1	3	1	0	0	0	0
Wind R. – mining reach	271	4	--	9	--	2	5	0	0	0	0	0
Ninemile Cr.	123	0	--	0	--	0	1	0	0	0	0	0
Dry Cr. – lower	698	41	--	0	--	0	1	0	0	0	0	0
Trapper Cr.	263	10	--	2	--	2	2	0	0	0	0	0
Wind R. – ab. smolt trap	66	0	--	0	--	0	0	0	0	0	0	0
Wind R. – upper smolt trap	2,347	--	--	6	--	11	74	8	10	1	0	1[c]
Wind R. – bl. smolt trap	5	0	--	0	--	0	0	0	0	0	0	0
Wind R. – ab. Beaver camp.	179	6	--	0	--	0	0	0	0	0	0	0
Wind R. – bl. Beaver camp.	28	0	--	0	--	0	0	0	0	0	0	0
Wind River												
Wind R. – canyon	12	0	--	--	--	0	1	0	0	0	0	0
Wind R. – lower smolt trap	57	--	--	--	--	0	2	0	0	0	0	0
Trout Creek												
Trout Cr. – upper	14	0	0	--	--	0	0	0	0	0	0	1[d]
Crater Cr.	324	57	2	--	--	0	0	0	0	0	0	0
Trout Cr. – 33 bridge	164	8	6	--	--	1	0	0	0	0	0	0
Compass Cr.	189	30	4	--	--	0	1	0	0	0	0	0
East Fork Trout Cr.	7	0	0	--	--	0	0	0	0	0	0	0
Layout Cr. – upper	290	18	2	--	--	0	3	0	0	0	0	0
Layout Cr. – lower	387	11	7	--	--	3	10	0	0	0	0	0
Trout Cr. – 43 bridge	343	7	9	--	--	1	6	0	0	0	0	0
Planting Cr.	155	38	1	--	--	0	0	0	0	0	0	0
Trout Cr. – near PCT trail	50	0	0	--	--	0	0	0	0	0	0	0
Trout Cr. – smolt trap	1,168	--	6	--	--	9	22	0	2	1	0	0
Trout Cr. –-near smolt trap	106	10	0	--	--	0	0	0	0	0	0	0

Continued.

Table 12. Continued.

Watershed Subwatershed Subdrainage	PIT tags deployed 1999-2004[a]	Instream recapatures	Smolt trap recaptures[b]				Columbia River interrogations		Adult interrogations			
			Trout	UW	PAN	LW	Bonn. Dam	Estuary trawl	Bonn. Dam	Shipherd Falls	Heml. Dam	Other
Trout Creek												
Trout Cr. – upstrm weir[e]	400	1	8	--	--	1	1	0	0	0	0	0
Trout Cr. – dwnstrm weir[e]	16	2	0	--	--	0	0	0	0	0	0	0
Hemlock Dam	118	0	1	--	--	0	0	0	0	0	0	0
Hemlock Lake	71	2	0	--	--	0	0	0	0	0	0	0
Trout Cr. – bl Hemlock dam	80	1	0	--	--	0	0	0	0	0	0	0
Martha Cr. – upper	309	101	--	--	--	0	0	0	0	0	0	0
Martha Cr. – lower	712	205	--	--	--	2	5	1	0	0	0	0
Panther Creek												
Mouse Cr.	74	18	--	--	0	0	0	0	0	0	0	0
Panther Cr. – upper	1	0	--	--	0	0	0	0	0	0	0	0
Eightmile Cr. – upper	25	1	--	--	1	0	1	0	0	0	0	0
Eightmile Cr. – lower	110	20	--	--	7	1	0	2	0	0	0	0
Cedar Cr. – upper	339	119	--	--	0	0	0	0	0	0	0	0
Cedar Cr. – lower	438	183	--	--	10	0	0	0	0	0	0	0
Panther Cr. – smolt trap	1,272	--	--	--	11	2	16	2	0	0	0	0
Total	**11,715**	**933**	**46**	**26**	**29**	**38**	**160**	**15**	**13**	**2**	**0**	**2**

[a] In 1999 all fish were tagged with a 400 khz PIT tag. After 1999 all fish were tagged with a 134.2 khz PIT tag.
[b] UW = upper Wind River smolt trap site. PAN = Panther Creek smolt trap site. LW = lower Wind River smolt trap site.
[c] A rainbow trout/juvenile steelhead (113 mm) was recaptured in the Upper Wind River below the smolt trap after initially being tagged (86 mm) at the smolt trap.
[d] A rainbow trout/juvenile steelheaed (166 mm) was recaptured in Crater Cr. after being initially tagged (169 mm) in upper Trout Creek.
[e] Fish weir operated just below Trout Creek smolt trap site 7/20/04-8/24/04.

Table 13. Total number of PIT-tagged Chinook and the number of tag detections from fish originating in the Wind River subbasin in 2003 and 2004. Columbia River interrogations updated through 5 December 04. All other data updated through 3 February 05.

Watershed Subwatershed Subdrainage	PIT tags deployed	Instream recapatures	Smolt trap recaptures[a]				Columbia River interrogations		Adult interrogations			
			Trout	UW	PAN	LW	Bonn. Dam	Estuary trawl	Bonn. Dam	Shipherd Falls	Heml. Dam	Other
Upper Wind												
Wind R. – mining reach	1	0	--	0	--	0	0	0	0	0	0	0
Wind R. – ab. smolt trap	18	0	--	0	--	0	0	0	0	0	0	0
Wind R. – upper smolt trap	3	--	--	0	--	0	0	0	0	0	0	0
Wind R. – bl, smolt trap	1	0	--	0	--	0	0	0	0	0	0	0
Wind R. – ab. Beaver camp.	129	0	--	0	--	0	0	0	0	0	0	0
Wind R. – bl. Beaver camp.	19	0	--	0	--	0	0	0	0	0	0	0
Wind River												
Wind R. – lower smolt trap	7	--	--	--	--	0	1	0	0	0	0	0
Total	**178**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**

[a] UW = upper Wind River smolt trap site. PAN = Panther Creek smolt trap site. LW = lower Wind River smolt trap site.

Table 14. Detected bacterial and viral disease agents in wild juvenile steelhead/rainbow trout from three focus watersheds in the Wind River subbasin, 1996-2004. Results are from laboratory examinations by the U.S. Fish and Wildlife Service's Lower Columbia River Fish Health Center (LCRFHC; Underwood, WA). YES = detected; S = suspected; nd = not detected; -- = not sampled. Streams not listed did not have fish analyzed by LCRFHC.

Watershed Stream or reach	Number of fish examined by LCRFHC	Disease agent[a]							
		IHNV	IPNV	VHS	RS	BCD	AS	YR	CD
Upper Wind River									
Paradise Creek	48	nd	nd	nd	YES	nd	nd	nd	nd
Wind River (mining reach)	20	nd	nd	nd	YES	nd	nd	nd	nd
Ninemile Creek	4	nd	nd	nd	nd	nd	nd	nd	nd
Dry Creek	7	nd	nd	nd	S	nd	nd	nd	nd
Big Hollow Creek	8	nd	nd	nd	nd	nd	nd	nd	nd
Trapper Creek	9	nd	nd	nd	YES	nd	nd	nd	nd
Middle Wind River									
Wind River (Beav. Camp to Trapper Cr.)	20	nd	nd	nd	nd	nd	nd	nd	nd
Trout Creek									
Trout Creek - upper	7	nd	nd	nd	S	YES	nd	nd	nd
Crater Creek	10	nd	nd	nd	YES	nd	nd	nd	nd
Trout Creek - A (33 bridge)	28	nd	nd	nd	YES	nd	nd	nd	nd
Compass Creek	15	nd	nd	nd	YES	nd	nd	nd	nd
Layout Creek	71	nd	nd	nd	YES	nd	nd	nd	nd
Trout Creek - B (43 bridge)	22	nd	nd	nd	S	nd	nd	nd	nd
Planting Creek	21	nd	nd	nd	nd	YES	nd	nd	nd
Hemlock Lake	7	nd	nd	nd	S	nd	nd	nd	nd
Martha Creek	12	nd	nd	nd	nd	nd	nd	nd	nd
Panther Creek									
Mouse	3	nd	nd	nd	--	nd	nd	nd	nd
Eightmile Creek	15	nd	nd	nd	nd	nd	nd	nd	nd
Cedar Creek	29	nd	nd	nd	S	nd	nd	nd	nd
Panther Creek (smolt trap)	1	nd	nd	nd	S	nd	nd	nd	nd

[a] Viral: IHNV = Infectious Hematopoietic Necrosis Virus, IPNV = Infectious Pancreatic Necrosis Virus, VHS = Viral Hemorrhagic Septicemia Virus; Bacterial: RS = *Renibacterium salmoninarum* (Bacterial Kidney Disease), BCD = *Flavobacterium psychrophilum* (Bacterial Coldwater Disease), AS = *Aeromonas salmonicida* (Furunculosis), YR = *Yersinia ruckeri* (Enteric Redmouth), CD = *Flavobacterium columnaris* (Columnaris).

Table 15. Detected bacterial and viral disease agents in wild brook trout from the Trout Creek watershed in the Wind River subbasin, 1996-2004. Results are from laboratory examinations by the U.S. Fish and Wildlife Service's Lower Columbia River Fish Health Center (LCRFHC; Underwood, WA). YES = detected; S = suspected; nd = not detected. Streams not listed did not have fish analyzed by LCRFHC.

Watershed Stream or reach	Number of fish examined by LCRFHC	Disease agent[a]							
		IHNV	IPNV	VHS	RS	BCD	AS	YR	CD
Upper Wind River									
Falls Creek	24	nd	nd	nd	S	nd	nd	nd	nd
Trout Creek									
Trout Creek - upper	10	nd	nd	nd	S	nd	nd	nd	nd
Crater Creek	51	nd	nd	nd	YES	nd	nd	nd	nd
Trout Creek - A (33 bridge)	38	nd	nd	nd	YES	nd	nd	nd	nd
Compass Creek	13	nd	nd	nd	S	nd	nd	nd	nd
East Fork Trout Creek	5	nd	nd	nd	nd	nd	nd	nd	nd
Layout Creek	127	nd	nd	nd	YES	nd	nd	nd	nd
Trout Creek - B (43 bridge)	6	nd	nd	nd	YES	nd	nd	nd	nd

[a] Viral: IHNV = Infectious Hematopoietic Necrosis Virus, IPNV = Infectious Pancreatic Necrosis Virus, VHS = Viral Hemorrhagic Septicemia Virus; Bacterial: RS = *Renibacterium salmoninarum* (Bacterial Kidney Disease), BCD = *Flavobacterium psychrophilum* (Bacterial Coldwater Disease), AS = *Aeromonas salmonicida* (Furunculosis), YR = *Yersinia ruckeri* (Enteric Redmouth), CD = *Flavobacterium columnaris* (Columnaris).

Table 16. Detected bacterial and viral disease agents in wild juvenile spring Chinook in the upper Wind River watershed, 2000-2004. Results are from laboratory examinations by the U.S. Fish and Wildlife Service's Lower Columbia River Fish Health Center (LCRFHC; Underwood, WA). YES = detected; S = suspected; nd = not detected. Streams not listed did not have fish analyzed by LCRFHC.

Watershed Stream or reach	Number of fish examined by LCRFHC	Disease agent[a]							
		IHNV	IPNV	VHS	RS	BCD	AS	YR	CD
Upper Wind River									
Paradise Creek	2	nd	nd	nd	YES	nd	nd	nd	nd
Wind River (mining reach)	105	nd	nd	nd	YES	nd	nd	nd	nd
Trapper Creek	1	nd	nd	nd	nd	nd	nd	nd	nd
Middle Wind River									
Wind River (Beaver camp to Trap.)	161	nd	nd	nd	nd	--	--	--	--

[a] Viral: IHNV = Infectious Hematopoietic Necrosis Virus, IPNV = Infectious Pancreatic Necrosis Virus, VHS = Viral Hemorrhagic Septicemia Virus; Bacterial: RS = *Renibacterium salmoninarum* (Bacterial Kidney Disease), BCD = *Flavobacterium psychrophilum* (Bacterial Coldwater Disease), AS = *Aeromonas salmonicida* (Furunculosis), YR = *Yersinia ruckeri* (Enteric Redmouth), CD = *Flavobacterium columnaris* (Columnaris).

Table 17. Detected parasitic disease agents in wild juvenile steelhead from three focus watersheds in the Wind River subbasin, 1996-2004. Results are from laboratory examinations by the U.S. Fish and Wildlife Service's Lower Columbia River Fish Health Center (LCRFHC; Underwood, WA) unless noted with an "*", which indicates the disease factor was identified by USGS personnel in the field. YES = detected; S = suspected; nd = not detected; -- = not sampled. Streams not listed did not have fish analyzed by LCRFHC.

Watershed Stream or reach	Number of fish examined by LCRFHC	Disease agent[a]									
		WD	CS	MK	MM	HEX	GYR	TRE	SCY	EPI	CO
Upper Wind River											
Paradise Creek	48	nd	nd	nd	nd	nd	nd	nd	YES	YES*	nd
Wind River (mining reach)	20	nd	nd	nd	nd	YES	YES	nd	YES	YES*	nd
Ninemile Creek	4	nd	nd	nd	nd	nd	YES	YES	nd	YES	nd
Dry Creek	7	nd	nd	nd	nd	nd	nd	nd	YES	YES	nd
Big Hollow Creek	8	nd	nd	nd	nd	nd	nd	nd	YES	YES	nd
Trapper Creek	9	nd	nd	nd	nd	nd	nd	nd	nd	YES	nd
Middle Wind River											
Wind River (Beaver camp to Trapper Cr.)	20	nd	--	--	--	--	--	--	YES	YES*	YES
Trout Creek											
Trout Creek - upper	7	nd	nd	nd	nd	nd	nd	YES	YES	YES	nd
Crater Creek	10	nd	nd	nd	YES	nd	YES	nd	YES	YES	nd
Trout Creek - A (33 bridge)	22	nd	nd	nd	nd	nd	YES	nd	nd	YES	YES
Compass Creek	15	nd	nd	nd	YES	YES	YES	nd	nd	YES	nd
Layout Creek	30	nd	nd	nd	nd	nd	nd	YES	YES	YES	nd
Trout Creek - B (43 bridge)	14	nd	nd	nd	nd	nd	nd	nd	nd	YES	nd
Planting Creek	15	nd	nd	nd	nd	nd	nd	nd	YES	YES	nd
Martha Creek	9	nd	nd	nd	nd	nd	YES	nd	nd	YES*	nd
Panther Creek											
Mouse Creek	3	nd	nd	--	--	--	--	--	--	--	--
Eightmile Creek	15	nd	nd	YES	nd	nd	nd	YES	YES	YES	nd
Cedar Creek	5	nd	nd	nd	nd	nd	YES	YES	nd	nd	nd

[a] Parasites: WD = *Myxobolus cerebralis* (Whirling Disease), CS = *Ceratomyxa Shasta* (Salmonid Ceratomyxosis), MK = *Myxobolus kisutchi*, MM = *Myxidium minteri*, HEX = *Hexamita*, GYR = *Gyrodactylus*, TRE = digenetic trematodes, SCY = *Scyphidia*, EPI = *Epistylis* (newer name: *Heteropolaria*), CO = *Costia*.

Table 18. Detected parasitic disease agents in wild brook trout from the Trout Creek watershed in the Wind River subbasin, 1996-2004. Results are from laboratory examinations by the U.S. Fish and Wildlife Service's Lower Columbia River Fish Health Center (LCRFHC; Underwood, WA) unless noted with an "*", which indicates the disease factor was identified by USGS personnel in the field. YES = detected; S = suspected; nd = not detected; -- = not sampled. Streams not listed did not have fish analyzed by LCRFHC.

Watershed Stream or reach	Number of fish examined by LCRFHC	Disease agent[a]									
		WD	CS	MK	MM	HEX	GYR	TRE	SCY	EPI	CO
Upper Wind River											
Falls Creek	24	nd	--	--	--	--	--	--	--	--	--
Trout Creek											
Trout Creek - upper	10	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Crater Creek	16	nd	nd	nd	YES	nd	nd	nd	YES	nd	nd
Trout Creek - A (33 bridge)	20	nd	nd	nd	nd	nd	YES	nd	YES	YES	nd
Compass Creek	2	nd	nd	nd	nd	nd	nd	nd	nd	YES	nd
East Fork Trout Creek	5	nd	nd	nd	nd	nd	nd	nd	YES	nd	nd
Layout Creek	66	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Trout Creek - B (43 bridge)	4	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd

[a] Parasites: WD = *Myxobolus cerebralis* (Whirling Disease), CS = *Ceratomyxa Shasta* (Salmonid Ceratomyxosis), MK = *Myxobolus kisutchi*, MM = *Myxidium minteri*, HEX = *Hexamita*, GYR = *Gyrodactylus*, TRE = digenetic trematodes, SCY = *Scyphidia*, EPI = *Epistylis* (newer name: *Heteropolaria*), CO = *Costia*.

Table 19. Detected parasitic disease agents in wild juvenile spring Chinook from the upper Wind River watershed, 2000-2004. Results are from laboratory examinations by the U.S. Fish and Wildlife Service's Lower Columbia River Fish Health Center (LCRFHC; Underwood, WA) unless noted with an "*", which indicates the disease factor was identified by USGS personnel in the field. YES = detected; S = suspected; nd = not detected; -- = not sampled. Streams not listed did not have fish analyzed by LCRFHC.

Watershed Stream or reach	Number of fish examined by LCRFHC	Disease agent[a]									
		WD	CS	MK	MM	HEX	GYR	TRE	SCY	EPI	CO
Upper Wind River											
Paradise Creek	2	nd	nd	nd	nd	YES	nd	nd	nd	nd	nd
Wind River (mining reach)	105	nd	nd	nd	nd	YES	nd	nd	nd	nd	nd
Trapper Creek	1	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Middle Wind River											
Wind River (Beaver camp to Trap.)	161	nd	--	--	--	--	--	--	--	--	S

[a] Parasites: WD = *Myxobolus cerebralis* (Whirling Disease), CS = *Ceratomyxa Shasta* (Salmonid Ceratomyxosis), MK = *Myxobolus kisutchi*, MM = *Myxidium minteri*, HEX = *Hexamita*, GYR = *Gyrodactylus*, TRE = digenetic trematodes, SCY = *Scyphidia*, EPI = *Epistylis* (newer name: *Heteropolaria*), CO = *Costia*.

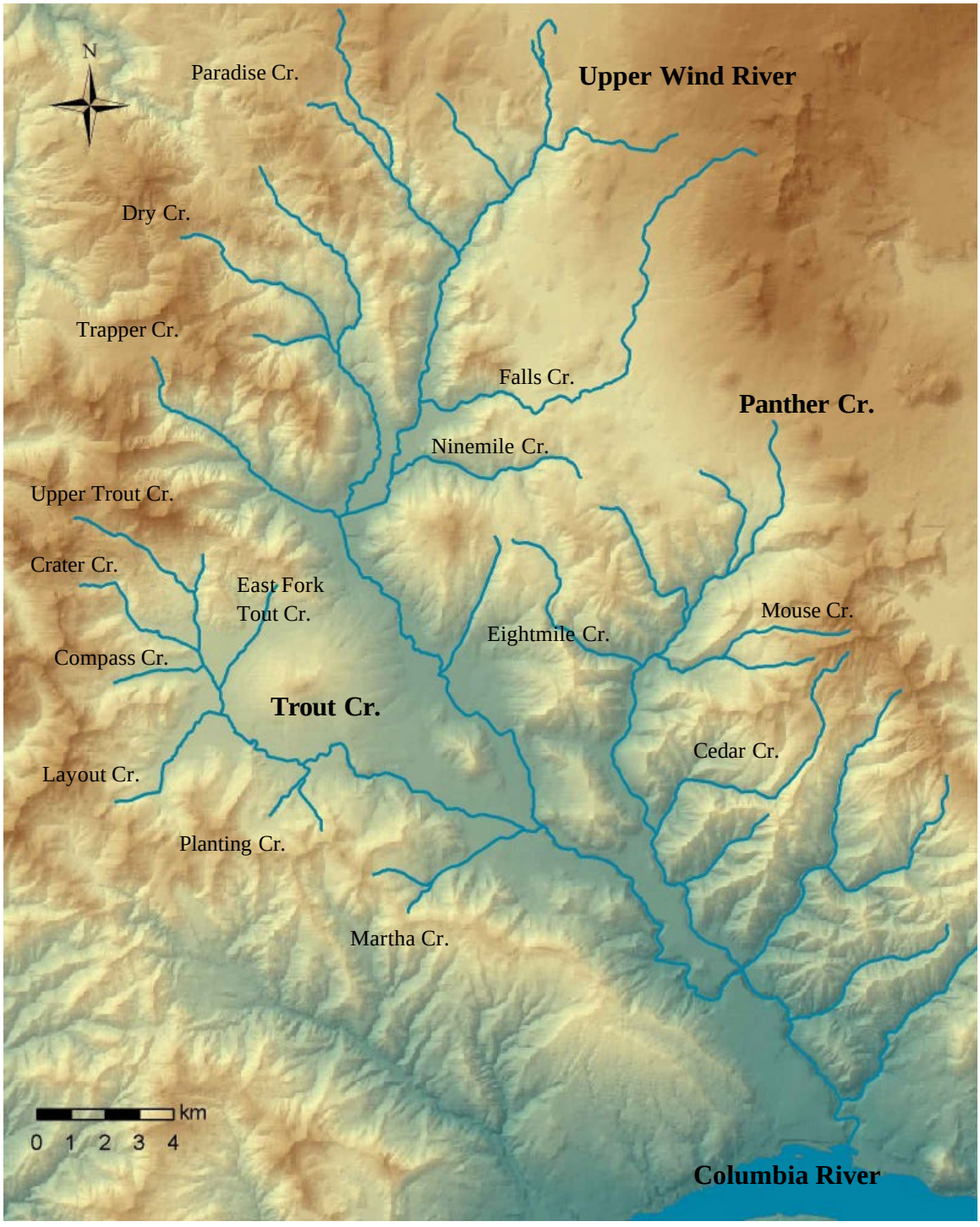

Figure 1. Map of the Wind River subbasin.

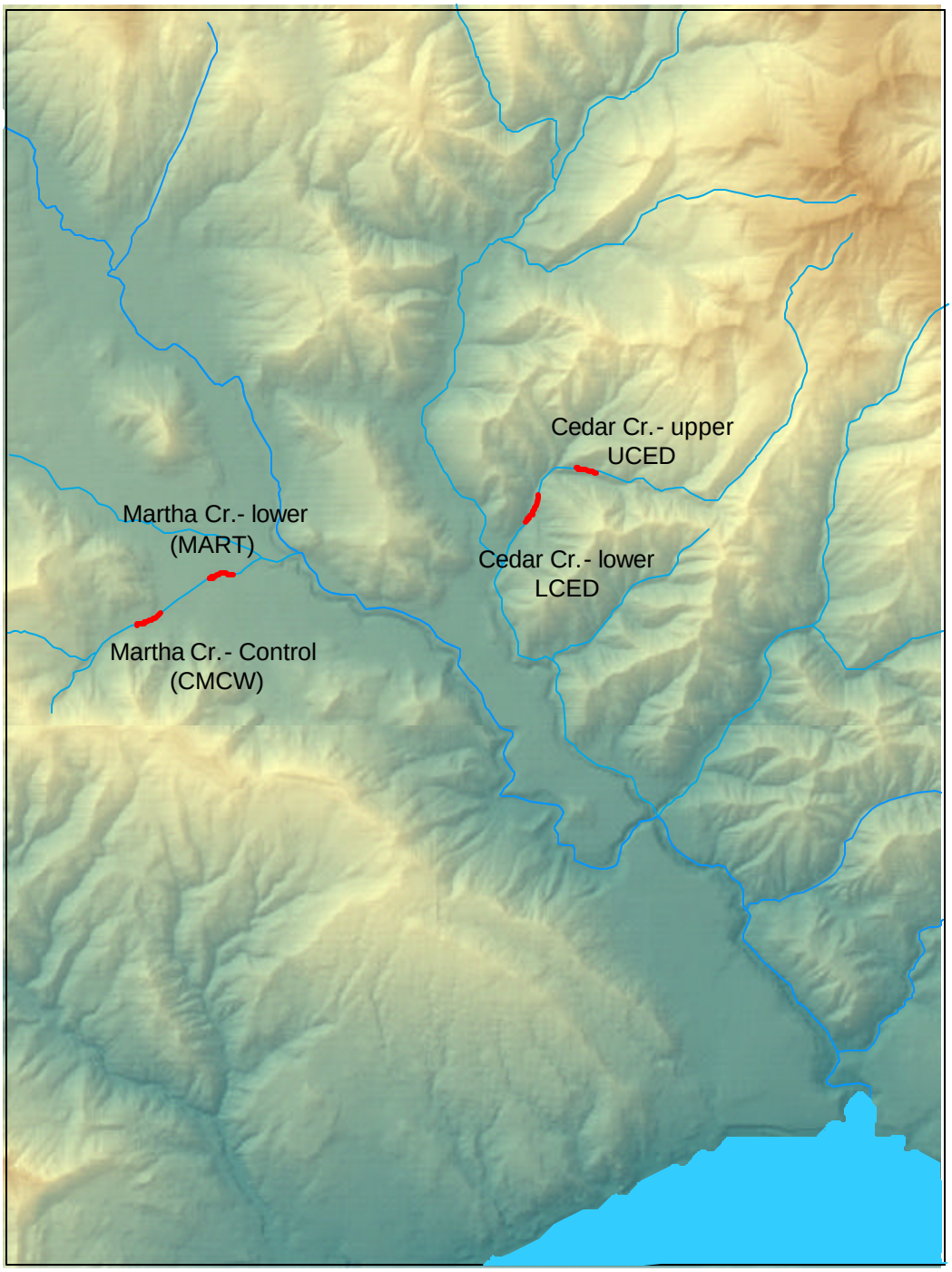

Figure 2. Locations of population surveys conducted with multiple pass-removal electrofishing in the Wind River subbasin, 2004.

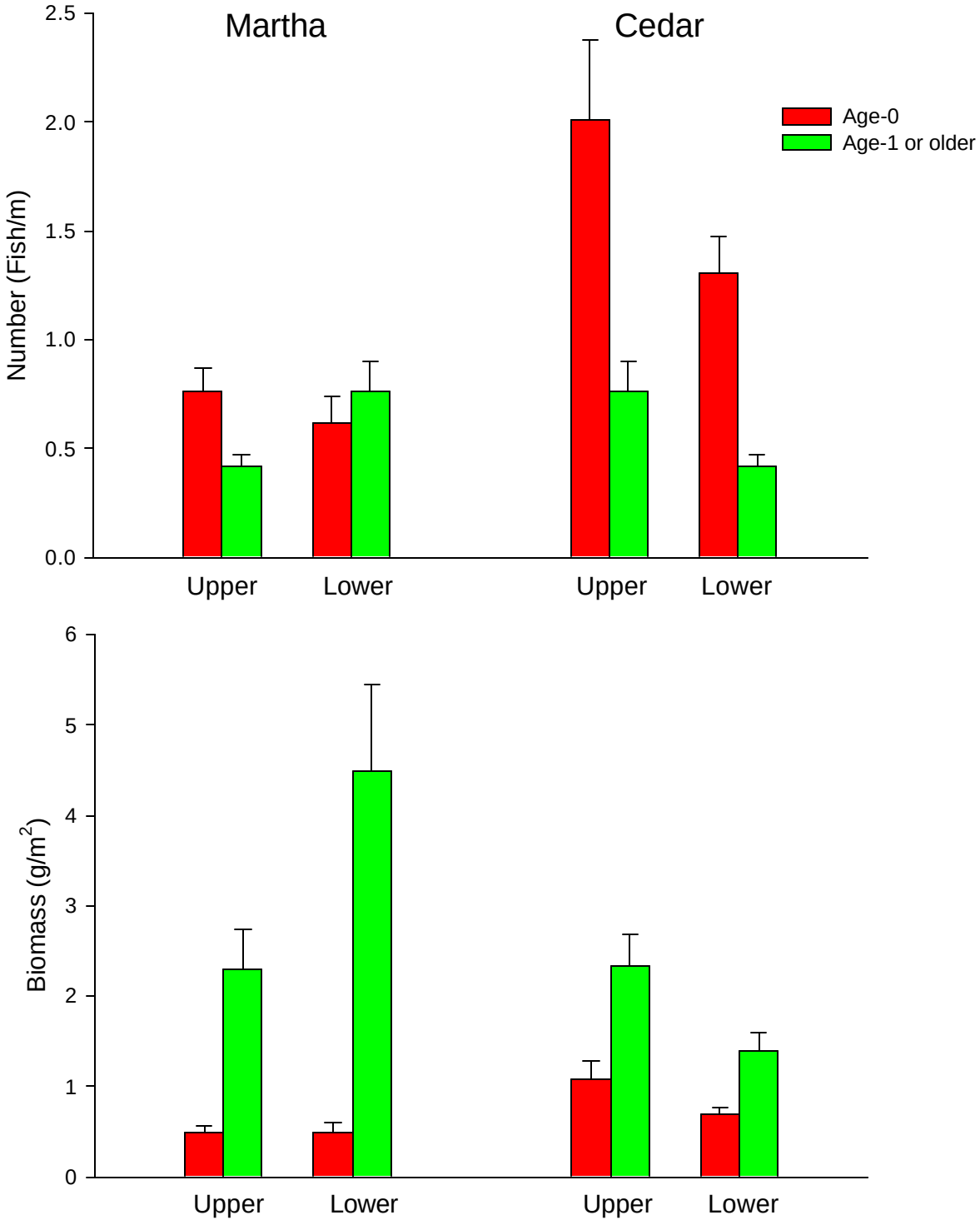

Figure 3. Electrofishing population and biomass estimates (with + 1 SE) of age-0 and age-1 or older rainbow trout/juvenile steelhead in two sections of Martha and Cedar creeks, 2004.

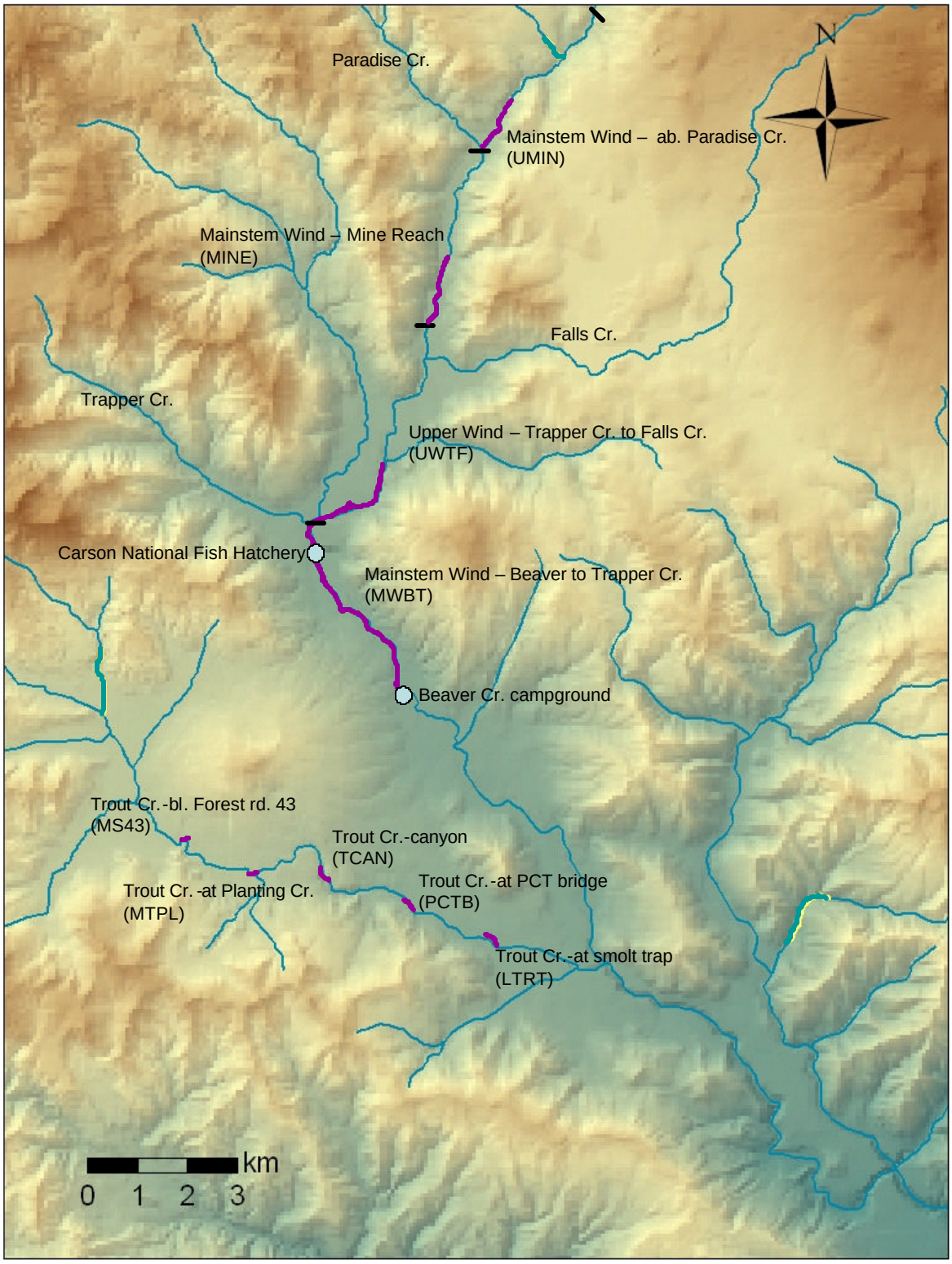

Figure 4. Locations of population surveys conducted by snorkeling within the Wind River subbasin, 2004. (ab. = above, bl. = below)

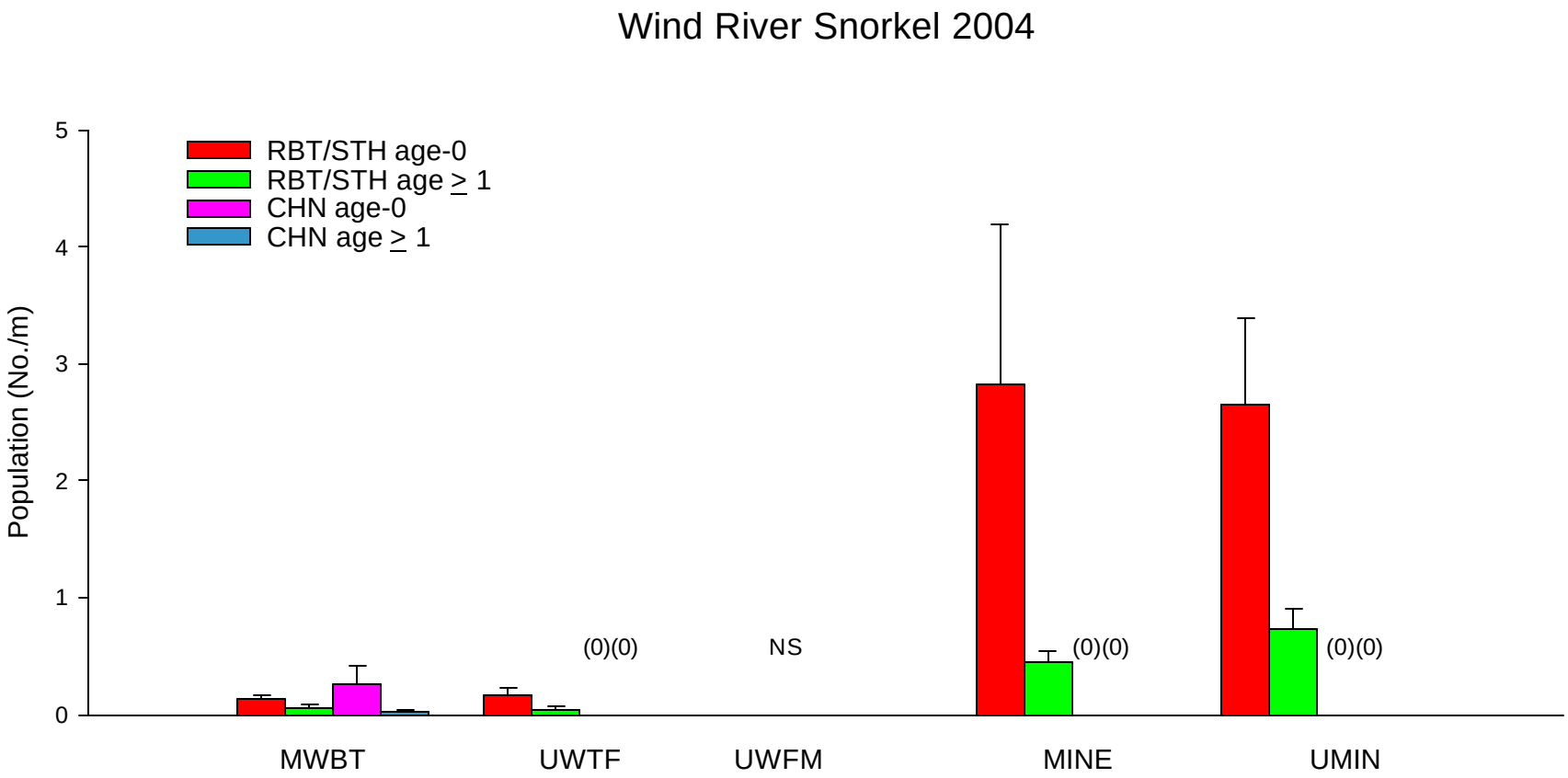

Figure 5. Population estimates (with +1 SE bars), by expanded direct snorkeler counts, of age-1 or older salmonids in stream sections of the Wind River Subbasin, 2004. MWBT= Beaver campground – Trapper Creek (rkm 26.0 - 30.0), UWTF= Trapper Creek – Falls Creek (rkm 30.0 - 32.0), Falls Creek – Mine reach (rkm 35.0 - 35.4), MINE = below Paradise Creek, (rkm 35.4 - 37.0), UMIN = above Paradise Creek (rkm = 40.0 - 41.0). UWFM was not sampled in 2004.

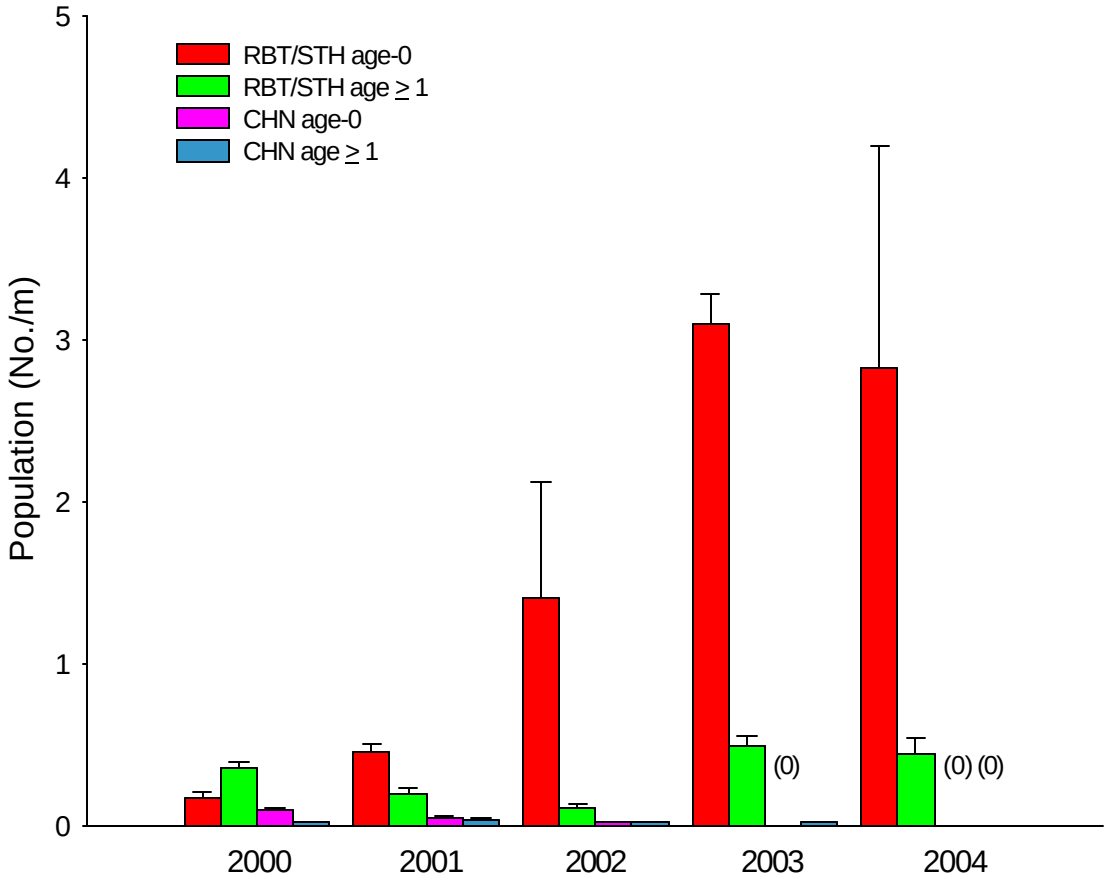

Figure 6. Fish-per-meter (with + 1 SE bars) by expanded direct-snorkeler counts of two age classes of juvenile steelhead (RBT/STH) and Chinook salmon (CHN) in the mine reach of the Wind River (rkm 35.4-40.0), during the years 2000-2004.

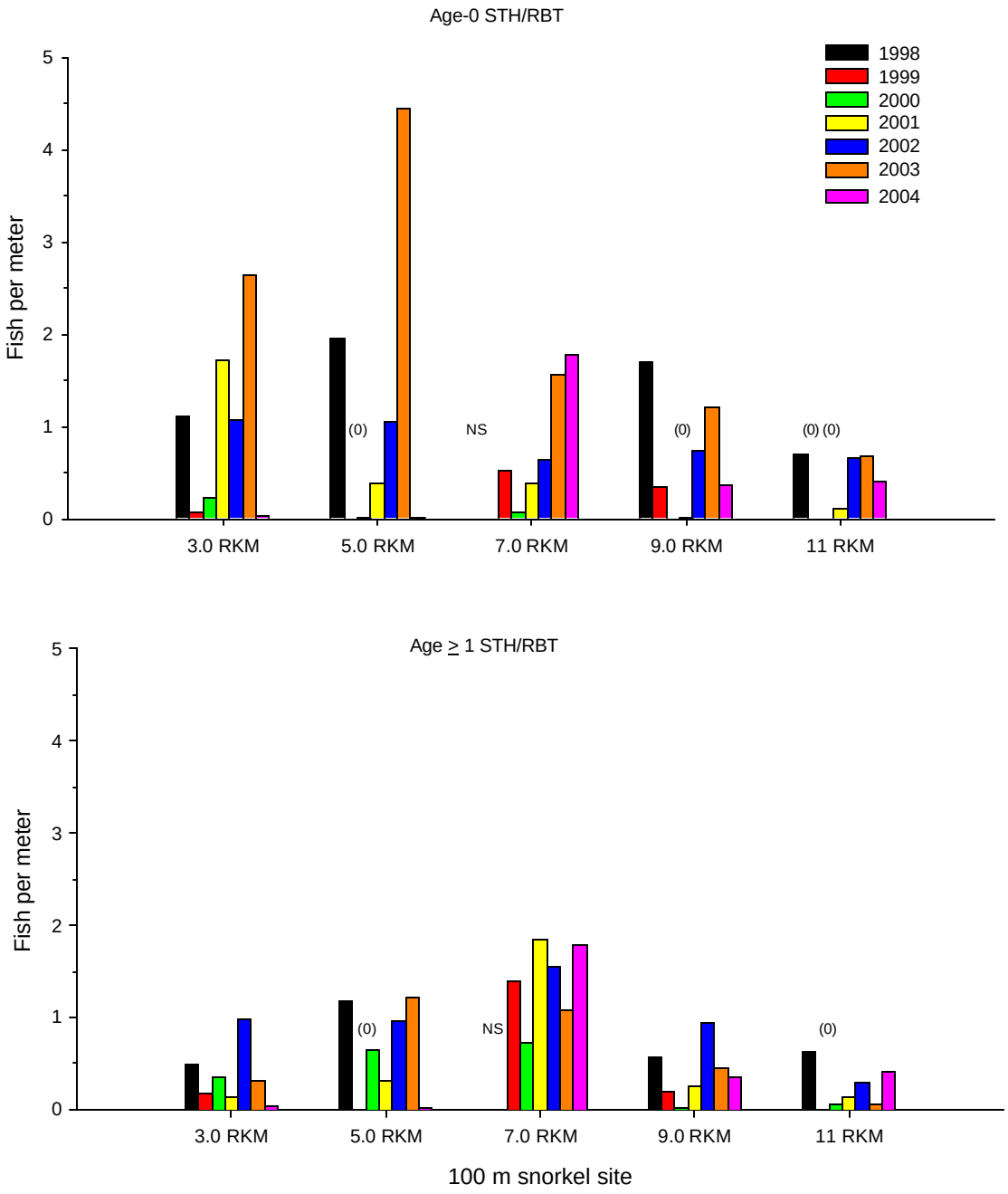

Figure 7. Fish-per-meter for two age classes of rainbow trout/juvenile steelhead (STH/RBT), by direct snorkeler count, in five 100-m sections of mainstem Trout Creek, 1998-2004. Sites read from left to right go downstream to upstream. The most downstream site is located 0.3 km above the head of Hemlock Lake and 3.0 rkm from the mouth of Trout Creek; the most upstream site is located just below Forest Road 43 Bridge.

Appendix Table 1. Estimates of populations from electrofishing surveys for two age classes of juvenile steelhead/rainbow trout (STH/RBT) in two streams in the Wind River subbasin, summer 2004. Sites are listed from upstream to downstream.

Subwatershed / Stream	Site Code	River kilometers Start	River kilometers End	Age-0 STH/RBT Total	Age-0 SE[a]	Age-0 CV[b]	Age-0 no./m	Age-0 no./m^2	Age-0 no./m^3	Age-1 or older STH/RBT Total	Age-1 or older SE	Age-1 or older CV	Age-1 or older no./m	Age-1 or older no./m^2	Age-1 or older no./m^3
Trout Cr.															
Martha Cr. - upper	UMAR	2.0	2.5	378	54.3	14.4	0.7616	0.2219	1.4231	207	28.8	13.9	0.4180	0.1278	0.7810
Martha Cr. - lower	LMAR	1.0	1.5	317	64.9	20.5	0.6162	0.1784	0.9475	394	67.8	17.2	0.7669	0.2220	1.1792
Panther Cr.															
Cedar Cr. - upper	UCED	2.2	2.7	1,005	183.1	18.2	2.0118	0.5234	2.0440	381	68.2	17.9	0.7625	0.1984	0.7747
Cedar Cr. - lower	LCED	1.2	1.7	655	83.0	12.7	1.3082	0.3212	1.6730	209	29.4	14.1	0.4163	0.1022	0.5323

[a] SE = standard error.
[b] CV = coefficient of variation = (SE/total fish)*100.

Appendix Table 2. Estimates of biomass from electrofishing surveys for two age classes of juvenile steelhead/rainbow trout (STH/RBT) in two streams in the Wind River subbasin, summer 2004. Sites are listed from upstream to downstream.

Subwatershed / Stream	Site Code	River kilometers Start	River kilometers End	Age-0 STH/RBT Total	Age-0 STH/RBT SE[a]	Age-0 STH/RBT CV[b]	Age-0 STH/RBT g/m	Age-0 STH/RBT g/m^2	Age-0 STH/RBT g/m^3	Age-1 or older STH/RBT Total	Age-1 or older STH/RBT SE	Age-1 or older STH/RBT CV	Age-1 or older STH/RBT g/m	Age-1 or older STH/RBT g/m^2	Age-1 or older STH/RBT g/m^3
Trout Cr.															
Martha Cr. - upper	UMAR	2.0	2.5	848	121	14.3	1.71	0.50	3.19	3,926	743	18.9	7.90	2.30	14.77
Martha Cr. - lower	LMAR	1.0	1.5	880	192	21.8	1.71	0.49	2.63	7,977	1719	21.5	15.50	4.49	23.83
Panther Cr.															
Cedar Cr. - upper	UCED	2.2	2.7	2,058	404	19.6	4.12	1.07	4.19	4,466	698	15.6	8.94	2.33	9.09
Cedar Cr. - lower	LCED	1.2	1.7	1,402	178	12.7	2.80	0.69	3.58	2,859	398	13.9	5.71	1.40	7.30

[a] SE = standard error.
[b] CV = coefficient of variation = (SE/total fish weight)*100.

Appendix Table 3. Estimates from expanded and direct snorkeler counts of two age classes of juvenile steelhead (STH)/rainbow trout (RBT) in the upper mainstem Wind River, summer 2004. Sites are listed from upstream to downstream.

Subwatershed Site (rkm)	Code	River kilometers snorkeled Start	End	Age-0 STH/RBT Total	SE[a]	CV[b]	no./m	no./m^2	Age-1 or older STH/RBT Total	SE	CV	no./m	no./m^2
Upper Wind River[c]													
Upper Mine (40.0-44.0)	UMIN	40.0	41.0	3,040	828.1	27.2	2.6595	0.2227	839	192.3	22.9	0.7344	0.0615
Mine reach (35.4-40.0)	MINE	35.4	37.0	2,834	1369.7	48.3	2.8303	0.2346	448	92.9	20.7	0.4479	0.0371
Trapper Cr. – Falls Cr. (30.0-35.0)	UWTF	30.0	32.0	314	141.0	44.9	0.1636	0.0131	81	46.1	57.3	0.0420	0.0034
Beaver Cm. – Trap. Cr. (26.0-30.0)	MWBT	26.0	30.0	606	138.9	22.9	0.1381	0.0076	272	139.2	51.0	0.0621	0.0034

Appendix Table 4. Estimates from expanded direct snorkeler counts of two age classes of juvenile Chinook salmon in the upper mainstem Wind River, summer 2004. Sites are listed from upstream to downstream.

Subwatershed / Site (rkm)	Code	River kilometers snorkeled Start	End	Age-0 Chinook Total	SE[a]	CV[b]	no./m	no./m^2	Age-1 or older Chinook Total	SE	CV	no./m	no./m^2
Upper Wind River													
Upper Mine (40.0-44.0)	UMIN	40.0	41.0	0	---	---	0.0000	0.0000	0	---	---	0.0000	0.0000
Mine reach (35.4-40.0)	MINE	35.4	37.0	0	---	---	0.0000	0.0000	0	---	---	0.0000	0.0000
Trapper Cr. – Falls Cr. (30.0-35.0)	MWTF	30.0	32.0	0	---	---	0.0000	0.0000	0	---	---	0.0000	0.0000
Beaver Cmp. – Trap. Cr. (26.0-30.0)	MWBT	26.0	30.0	1,131	716.1	63.3	0.2575	0.0141	67	26.3	39.1	0.0154	0.0008

[a] SE = standard error.
[b] CV = coefficient of variation = (SE/total fish)*100.

Appendix Table 5. Estimates from direct snorkel counts of two age classes of juvenile steelhead/rainbow trout (STH/RBT) in five 100-m sites in mainstem Trout Creek, summer 2004. Site are listed from upstream to downstream.

Subwatershed / Site (rkm)	Code	River kilometers snorkeled Start	End	Age-0 STH/RBT Total	SE[a]	CV[b]	no./m	no./m^2	Age-1 or older STH/RBT Total	SE	CV	no./m	no./m^2
Trout Creek[d]													
43 Bridge (11.0-11.1)	MS43	11.0	11.1	8	--	--	0.0800	0.0100	43	--	--	0.4100	0.0400
Planting Creek (9.0-9.1)	PLAN	9.0	9.1	93	--	--	0.8700	0.0900	39	--	--	0.3600	0.0400
Canyon (7.0-7.1)	TCAN	7.0	7.1	217	--	--	2.2300	0.2000	174	--	--	1.7800	0.1600
PCT Bridge (5.0-5.1)	PCTB	5.0	5.1	0	--	--	0.0000	0.0000	1	--	--	0.0100	0.0000
Smolt Trap (3.0-3.1)	LTRT	3.0	3.1	17	--	--	0.0900	0.0100	5	--	--	0.0300	0.0000

[a] SE = standard error.
[b] CV = coefficient of variation = (SE/total fish)*100.
[c] Expanded snorkeler count
[d] Direct snorkeler count