Analysis of Fish Populations in Icicle Creek, Trout Creek, Jack Creek, Peshastin Creek, Ingalls Creek, and Negro Creek, Washington 1994 and 1995

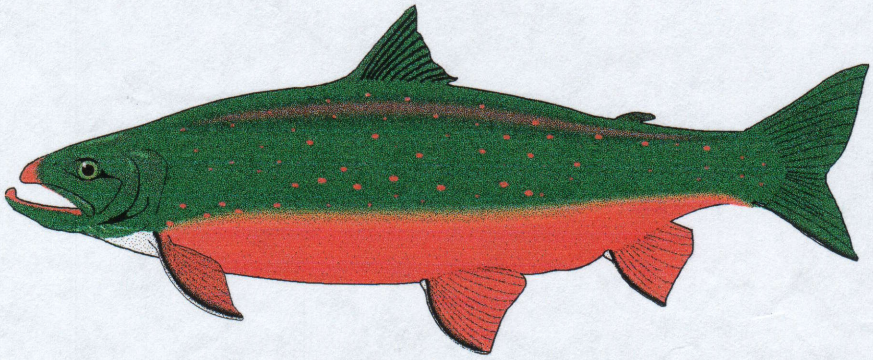

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Table of Contents

List of Tables

List of Figures

Abstract

In the summers of 1994 and 1995 streams in the Icicle Creek and Peshastin Creek watersheds were surveyed by snorkeling to assess fish populations. Study objectives were to determine fish species compositions and distributions. Streams were surveyed within public land boundaries from mouth to headwaters or just past the upper extent of the apparent fish distribution. Streams surveyed were: Icicle Creek, Trout Creek, Jack Creek, Trapper Creek, Peshastin Creek, Ingalls Creek, and Negro Creek. Most of the streams were entirely or partly in the Alpine Lakes Wilderness Area, Wenatchee National Forest. There is a fish barrier on Icicle Creek at the Leavenworth National Fish Hatchery (river km 4.5) which was constructed in 1940. In 1994 snorkel surveys were done in conjunction with aquatic habitat surveys. Selected pools, riffles, glides, and side-channels were snorkeled. In 1995 one randomly selected 100-m unit was snorkeled within every 500 m reach.

Rainbow trout *(Oncorhynchus mykiss)* were the dominant species in all streams, comprising close to 99% of the fish seen in most stream reaches surveyed. Native cutthroat trout *(Oncorhynchus clarki)* were found primarily in headwater areas. Small populations of cutthroat trout were found in the headwaters of Jack Creek and Negro Creek. Neither of these streams have been stocked with rainbow trout in their headwaters. It appeared that there was some degree of hybridization of cutthroat trout and rainbow trout in these populations. Degree of hybridization needs to be determined by genetic analysis. Icicle Creek, Trout Creek, Peshastin Creek, and Ingalls Creek all have lakes at their headwaters. These lakes have been stocked with rainbow trout. We observed cutthroat trout in Icicle and Trout creeks, however we did not find any cutthroat in any of the other streams. Native bull trout *(Salvelinus confluentus)* were not common in these watersheds. Bull trout were seen in dispersed locations in Icicle Creek and the lower end of Jack Creek. Their populations comprised less than 0.2% of the fish seen in these streams. In the Peshastin Creek watershed, bull trout were found only in Ingalls Creek. They comprised about 1% of the fish seen in the lower 11 km, and it appeared that they were resident bull trout. Brook trout *(Salvelinus fontinalis)*, a non-native species, have been planted in some lakes in the Icicle Creek drainage. There were some dispersed brook trout in the lower 41 km of Icicle Creek below Leland Creek. In the reach from Leland Creek to Trapper Creek brook trout were more common. Their populations comprised approximately 6% of the fish seen. In Trapper Creek, 2.4% of the fish seen were brook trout. Grass Lake, which is on Trapper Creek, was stocked with brook trout in 1961. The brook trout population could be impacting bull trout in Icicle Creek through competition or hybridization. Steelhead *(Oncorhynchus mykiss)* may have been present in the Peshastin drainage, but juvenile steelhead cannot be discerned from rainbow trout. The only other fish species seen while snorkeling were dace *(Rhinichthys* spp.*)* in Icicle Creek. Sculpins *(Cottus* spp.*)* may have been present in some areas but were not detected by snorkeling. We had expected to find mountain whitefish *(Prosopium williamsoni)* in both drainages. Their absence in Icicle Creek could be due to the fish barrier since they are present below it. Chinook salmon *(Oncorhynchus tshawytscha)* occasionally spawn in Peshastin Creek, but were not found during these surveys.

Species distributions in these watersheds have changed from their historical distributions. Native fish populations such as cutthroat trout and bull trout have declined. Hybridization and competition with rainbow trout and brook trout appear to be some of the greatest threats to the remaining cutthroat trout and bull trout populations. The fish barrier on Icicle Creek at the Leavenworth National Fish Hatchery (river km 4.5) blocks access of 34 km of historical anadromous salmon, steelhead *(Oncorhynchus mykiss)*, and bull trout spawning habitat, as well as disrupting movements of fish in the lower river. Several species such as fluvial bull trout, whitefish, and steelhead are present in Icicle Creek below the barrier but not above. Fish populations in Peshastin Creek have been affected by occasional dewatering of the lower 7.7 km, Highway 97 and associated channelization, culverts, and siltation, and small-scale placer mining. We recommend that native populations in these watersheds be protected and monitored. Efforts need to be taken to provide fish passage past the Leavenworth National Fish Hatchery fish barrier. In addition, water quality and quantity problems in Peshastin Creek need to be addressed.

Acknowledgments

I greatly appreciate the considerable time and effort spent snorkeling these streams by Dan Free, Vina Free, Jayson Ringel, Chuck Hamstreet, and David Carie. Thanks to Sandy Noble for her critical review and suggestions.

Introduction

In the summers of 1994 and 1995 the U.S. Fish and Wildlife Service (FWS) Mid-Columbia River Fishery Resource Office, in a cooperative effort with U.S. Forest Service (USFS), Wenatchee National Forest, conducted fish surveys by snorkeling in Icicle Creek and Peshastin Creek watersheds. Objectives were to determine what fish species are present, species composition, and species distributions. One focus of the surveys was to determine status of bull trout *(Salvelinus confluentus)* and westslope cutthroat trout *(Oncorhynchus clarki lewisi)* in these watersheds. Information from these stream surveys will be used by USFS for analysis of these watersheds within boundaries of the Northwest Forest Plan. Information from 1994 and 1995 surveys are incorporated in this report. Information from 1994 is also included in a report by Free (1995).

Study Area

Icicle Creek and Peshastin Creek are major tributaries of the Wenatchee River, which is a tributary of the Columbia River. The area is east of the Cascade mountain range, in Chelan County, Washington. In 1994 and 1995 the FWS surveyed seven streams in Icicle and Peshastin Creek drainages. Total distance surveyed was approximately 96 km: mainstem Icicle Creek (36 km), Trout Creek (6 km), Jack Creek (16 km), Trapper Creek (2 km), mainstem Peshastin Creek (8 km), Ingalls Creek (19 km), and Negro Creek (9 km). In 1994 surveys began on Icicle, Trout, and Jack creeks, but were not completed due to the forest fires in the area. In 1995 FWS completed surveying these three creeks and the four other streams.

Following are brief descriptions of the streams surveyed. Reach descriptions are in Appendix A and maps of the streams surveyed are in Appendix B. For more information about the habitat surveys, refer to the USFS stream survey reports (USFS 1990, 1992, 1994[a,b,c,d], 1995).

Icicle Creek

Icicle Creek is a fifth order stream that drains a 55,387 hectare watershed and contains approximately 48 km of mainstem fish bearing stream (USFS 1994[a]). The minimum discharge is 1,699 L/s (Mullan et al. 1992). In 1994 mean monthly flows were: June - 22,937 L/s, July - 10,336 L/s, August - 3,766 L/s, September - 2,520 L/s (USFS 1994[a]). The Leavenworth National Fish Hatchery (NFH) fish barrier at river km (rkm) 4.5 was constructed in 1940. This barrier blocks access to 34 km of historical anadromous salmon, steelhead, and bull trout spawning habitat. Eighty-seven percent of the Icicle watershed is publicly owned, and 74% is in the Alpine Lakes Wilderness, Wenatchee National Forest. Roughly 5% of the watershed has been impacted by logging, and roughly 12% of the watershed burned to varying degrees during the 1994 fires (USFS 1994[a]).

Jack Creek

Jack Creek is a fourth order stream and a tributary of Icicle Creek. It drains a 7,537 hectare watershed and contains approximately 17 km of mainstem fish bearing stream (USFS 1994[b]). Average stream gradient is 5%. Mean annual discharge is 2,322 L/s and minimum discharge is 396 L/s (Mullan et al. 1992). The majority of the watershed is in the Alpine Lakes Wilderness. Timber harvest in the watershed has been minimal. The Van Epps mine, at the headwaters of Van Epps Creek, was a copper ore mine around the turn of the century. Lightning fires in 1990 and 1994 on Blackjack Ridge burned within 6% of the watershed (USFS 1994[b]).

Trout Creek

Trout Creek, a tributary of Icicle Creek, originates at Trout Lake and is a third order stream. Average gradient is 6% and minimum discharge is 28 L/s (Mullan et al. 1992). Trout Creek drains a 2,168 hectare watershed and contains approximately 6 km of mainstem fish bearing stream (USFS 1994[c]). Upstream of rkm 4, Trout Creek is in the Alpine Lakes Wilderness. Outside of the wilderness, the stream has been adversely affected by timber harvest and roads. Riparian vegetation has been cut in the past. There are two debris slides originating at roads (USFS 1994[c]).

Trapper Creek

Trapper Creek is a third order stream that originates at Trap Lake. The entire 5 km of Trapper Creek is in the Alpine Lakes Wilderness area. It is a tributary to Icicle Creek at rkm 44.3. Stream flow measured on August 18, 1994, was 76 L/s (Resources Northwest 1996). Trapper Creek's basin encompasses 1,813 hectare. There are no trails that access the creek. Trapper Creek was surveyed up to Grass Lake (1.6 km). The gradient of this reach averages 3%. A 27-m high waterfall approximately 150 m downstream of Trap Lake is an upstream barrier (Resources Northwest 1996).

Peshastin Creek

Peshastin Creek is a fifth order stream that enters the Wenatchee River at rkm 29. Mean flow at the mouth is 3,313 L/s, and low flow is 0-142 L/s (Mullan et al. 1992). Average stream gradient is 6% in the reach surveyed (rkm 16.2-24.7). Peshastin Creek drainage is 31,882 hectare. Twenty percent of the drainage is privately owned (USFS 1992). Management activities within the watershed include agriculture, logging, and mining. Placer mining was extensive between the 1860's and approximately 1940. Small-scale placer mining still occurs (USFS 1992). Habitat in Peshastin Creek has been most adversely affected by irrigation diversion in the lower 7.7 km of the creek, which occasionally causes the stream to go dry (Hindes 1994). The 1994 fires burned within roughly 11% of the watershed (Dan Rife, pers. comm.). Peshastin Creek has been altered and channelized by construction of Highway 97 from the mouth to Scotty Creek. There were eleven culverts: ten 60 m long open bottom culverts and a 14 m long round pipe. It is doubtful that any of these culverts are fish barriers (USFS 1992). Flooding of Peshastin Creek in 1996 changed the stream morphology and several culverts and sections of the road have had to be rebuilt.

Ingalls Creek
Ingalls Creek originates at Ingalls Lake at 1,970 m elevation. It drains a 9,714 hectare watershed and is a third order tributary to Peshastin Creek. Mean gradient is 5%. Discharge was 21.4 L/s on September 6, 1995 (USFS 1995). Ingalls Creek is 26 km long. The lower 7.6 km are accessible to anadromous fish. All but the lower 1.5 km of Ingalls Creek are in the Alpine Lakes Wilderness. It is paralleled by a hiking trail up to Ingalls Lake.

Negro Creek
Negro Creek is a second order stream and a tributary to Peshastin Creek. Negro Creek is 12.5 km long. Its watershed area is 3,013 hectare. Forty percent of the drainage is privately owned and the rest is public land managed by the Forest Service (USFS 1990). Stream gradient averaged 5.5%. Discharge at the mouth measured in mid-July 1990 was 178 L/s (USFS 1990). There are numerous small mining operations in the drainage that have been active since the 1800's (USFS 1990).

Historical Distribution of Fish Species in the Icicle and Peshastin Watersheds

Oncorhynchus species
Westslope cutthroat trout are native in the Wenatchee River drainage. It is thought that populations existed in the upper and mid Columbia River basins by the mid Pleistocene and were spread by flood events from Glacial Lake Missoula (Behnke 1992). Cutthroat trout now found in the Wenatchee River basin are either indigenous populations or are from past stocking. Westslope cutthroat trout planted in this area are mostly from Twin Lake, Washington. The Twin Lake stock originally included some cutthroat trout from Lake Chelan (Proebstel et al. *in press*).

Interior redband rainbow trout *(Oncorhynchus mykiss gairdneri)* were also historically present in the Wenatchee River drainage. During the post-Pleistocene period, redband rainbow trout may have replaced cutthroat trout in most drainages, though "pure" westslope cutthroat trout populations remained above barriers and in some headwaters (Proebstel et al. *in press*). Rainbow trout have been extensively propagated and stocked in the mid-Columbia River basin. From 1949 to 1994, over 12 million rainbow trout from at least 15 different brood sources were stocked in the basin (Chapman et al. 1994). Because of genetic interactions with non-native steelhead, rainbow trout, and cutthroat trout few uncontaminated indigenous native rainbow trout populations remain (Proebstel et al. *in press*).

Historically, steelhead trout *(Oncorhynchus mykiss)* and chinook salmon (*O. tshawytscha)* spawned and reared in Icicle Creek and had access to 39 km of stream. Since the Leavenworth NFH barrier was constructed in 1940, anadromous fish have been restricted to the lower 4.5 km of Icicle Creek. The barrier was constructed to divert returning salmon into Leavenworth NFH, although in some years fish may be able to move past the barrier.

Steelhead were stocked in Icicle Creek below the hatchery in the years 1941-1945 and since 1978 (Carie 1995). Steelhead utilize Peshastin Creek and have occasionally been stocked there (Mullan et al. 1992, WDFW 1996).

Chinook salmon are native to the Wenatchee River drainage and have been extensively propagated and stocked. From 1939 to 1943 all adult chinook salmon (and some juveniles) in the Columbia River were collected at Rock Island Dam and relocated to the Wenatchee, Entiat, and Methow river drainages. Leavenworth NFH on Icicle Creek (rkm 4.5) has been rearing and releasing chinook salmon since 1940. There are several wild chinook salmon sub-populations in the Wenatchee River drainage. Small numbers of spring chinook salmon occasionally spawn in Peshastin Creek. In six years, from 1990 to 1995, a total of ten chinook redds were found. Although in six years between 1958 and 1989, an average of five redds were counted each year (Hays and Peven 1991 and 1992; Peven 1992 and 1994; Peven and Truscott 1995; Peven and Mosey 1996).

Coho salmon *(Oncorhynchus kisutch)* were historically present in the Wenatchee River basin. However, runs in the mid-Columbia were drastically reduced or destroyed prior to completion of Grand Coulee Dam in 1941. Despite extensive stocking of coho salmon at Leavenworth NFH from 1942 to 1975, self-sustaining populations were never reestablished (Mullan 1984).

Salvelinus species

Bull trout probably evolved in the Columbia River Basin and dispersed inland (Behnke 1980). Their distribution has declined and abundance has decreased in the eastern Cascades of Washington during the past 50 years (Brown 1992). Two life history patterns have been present in both the Icicle and Peshastin watersheds: fluvial and resident. Fluvial bull trout in Icicle Creek previously had access to 39 km for spawning and rearing, but are now restricted to the lower 4.5 km of stream due to the Leavenworth NFH barrier. Several large, fluvial bull trout have been observed in Icicle Creek just below the barrier in recent years (personal observation). It is suspected that fluvial bull trout utilize Peshastin Creek since they are present in the Wenatchee River, but we have no record of this.

Eastern brook trout *(Salvelinus fontinalis)* are not a native species west of the Continental Divide. They have been imported from the eastern United States and extensively cultured and stocked in the west. Brook trout have been stocked in Nada, Upper Snow, Lower Snow, and Grass lakes in the Icicle Creek drainage (WDFW 1996; Dan Rife, pers. comm.). There are no records of brook trout stocking in the Peshastin Creek drainage.

Other species

There are several other fish species native to the mid-Columbia Basin and some introduced species. Mountain whitefish *(Prosopium williamsoni)* are native in the Wenatchee River drainage. Native non-salmonids present in the Wenatchee River drainage include longnose dace *(Rhinichthys cataractae)*, speckled dace *(R. osculus)*, leopard dace *(R. falcatus)*, longnose sucker *(Catostomus macrocheilus)*, bridgelip sucker *(C. columbianus)*, northern squawfish *(Ptychocheilus oregonensis)*, redside shiner *(Richardsonius balteatus)*, peamouth chub

(Mylocheilus caurinus), chiselmouth *(Acrocheilus alutaceus)*, pacific lamprey *(Lampetra tridentata)*, western brook lamprey *(Lampetra richardsoni)*, and sculpins (*Cottus* spp.) (Mullan et al. 1986; Mullan et al. 1992; Scott and Crossman 1973). Several species of sculpins are present including: prickly sculpin *(Cottus asper)*, mottled sculpin *(C. bairdi)*, slimy sculpin *(C. cognatus)*, shorthead sculpin (*C. confusus*), and torrent sculpin (*C. rhotheus)* (Scott and Crossman 1973).

Methods

Fish were surveyed by direct observation while snorkeling, as described by Thurow (1994). All snorkeling was done during daylight hours. Typically, one or two snorkelers entered the water downstream of the unit to be snorkeled and carefully moved upstream to the lower end of the unit. Snorkelers continued upstream through the unit identifying all fish species seen, including non-salmonids, and counting fish by species. Streams were surveyed starting either at the mouth or on accessible Forest Service land. Surveys proceeded upstream to the end of the stream or until no more fish were seen and it appeared that the upper extent of fish distribution had been passed due to apparent barriers or limited fish habitat.

Survey methods varied slightly from 1994 to 1995. Methods used in 1994 for surveying fish populations in the lower parts of Icicle, Jack, and Trout creeks were based on a modification of Hankin and Reeves (1988) methodology and are more fully described by Free (1995). Snorkel surveys were done in conjunction with USFS modified Hankin and Reeves (1988) stream surveys, described in the USFS Stream Inventory Handbook (USFS 1994[d]). USFS divided the stream into reaches based on changes in stream and valley morphology. Reach descriptions from their habitat inventory reports are in Appendix A. Habitat units were classified as pools, riffles, and glides. The length of the unit had to exceed the width. A minimum of ten habitat units or 10% of each habitat type were randomly selected by USFS as "measured" habitat units within each reach. We snorkeled "measured" habitat units, counted fish by species, and categorized fish within three-inch size groups. Water temperatures were measured with a hand-held thermometer at the time a unit was snorkeled. Additional information such as water temperature and begin and end times were recorded. A sample data sheet from 1994 is in Appendix C. Methods used in 1994 allowed for estimations of fish populations (Hankin and Reeves 1988), and these are reported by Free (1995).

In 1995 a different survey method was used so that snorkeling did not have to be done in conjunction with habitat surveys. This method emphasized determining species presence, and allowed us to survey more stream distance given time limitations. We snorkeled one randomly selected 100-m unit of every 500 m of stream. Distances between surveyed units were estimated, and lengths of 100-m units were measured using a hip chain. Additionally, some non-randomly selected sites that looked like potential bull trout habitat, such as large pools or log jams, were snorkeled in Ingalls Creek. The lengths of these units were measured. Fish were counted by species in the 100-m units but fish lengths were not estimated. This method did not allow for expansion of fish numbers to estimate the population in the stream. Water temperatures were measured with a hand-held thermometer at the time a unit was snorkeled. Additional information recorded included: estimated lengths of bull trout; location descriptions; longitude

and latitude using a global positioning system (GPS); start and end snorkel times; weather; habitat description; and additional comments. Representative widths and maximum depths of surveyed units were either measured or estimated. The number of pools where the length exceeded the width were usually counted within the unit. A sample data sheet from 1995 is in Appendix C. Data collected in 1995 is in Appendix D.

Sampling intensity in 1995 was based on a modification of methods described in Hillman and Platts (1993) to detect the presence of bull trout. Hillman and Platts (1993) found 0.25 fish/100 m stream length to be the lowest density for bull trout reported in the literature. They recommend that this density be used as the value for degree of rareness in their Poisson-based formula. They also recommended using a probability of detection (power) of 0.95 to aid the FWS in determining the population status of bull trout. They calculated that for a 95% probability of detecting bull trout at a density of 0.25 fish/100 m, twelve randomly selected 100 m units must be surveyed. If the stream is longer than 10 km, twelve 100-m units must be sampled within each 10-km reach. In this report, we include the probability of detecting bull trout at 0.10 fish/100-m, because we detected bull trout densities closer to this lower density in several streams. We typically sampled twenty 100-m units within a 10-km reach. We selected sites using a stratified random sampling design and randomly selected one 100-m unit in every 500-m reach. For each stream sampled, we determined the probability of detecting bull trout at 0.10 and 0.25 fish/100 m using the statistical information in Hillman and Platts (1993). To verify absence of bull trout Hillman and Platts (1993) recommend electrofishing the sites. We did not electrofish to verify absence because of potential harmful effects to fish (McMichael 1993, Dalbey et al. 1996), and because electrofishing efficiency is typically low in these streams due to low water conductivity. The statistical table used to calculate detection probability is in Appendix E.

For this report, data for both years were summarized by stream reach. Numbers of fish and total lengths snorkeled within reaches were summed, and the average numbers of fish per 100-m were calculated. There were differences between reaches in stream widths and depths, the proportions of pools to riffles snorkeled, and snorkeling efficiency due to factors such as cover and water temperature. Because of these differences, average numbers of fish per 100-m are not directly comparable, but do provide a representation of species abundance.

Results

Icicle Creek and Trapper Creek

Icicle Creek was surveyed August 22 to September 27, 1994, from the Leavenworth NFH intake at rkm 6.4 up to the confluence of French Creek at rkm 32.3 (reaches 1-3). Water temperatures during these daytime surveys varied from 8°C to 18°C. Cold temperatures when snorkeling reaches 2 and 3 likely reduced the number of fish seen (Hillman et al. 1992; Free 1995). From July 12 to August 2, 1995, Icicle Creek was surveyed from French Creek (rkm 32.3) to the confluence with Trapper Creek (rkm 44.3) (reaches 4-5). Trapper Creek was surveyed up to Grass Lake (1.8 km). Water temperatures measured while snorkeling in 1995 varied from 8°C to 17°C.

Rainbow trout were the dominant species in all reaches, comprising 99% of all fish seen (Table 1). Only five cutthroat trout were seen in disperse locations. All five were positively identified by the red jaw slash and spotting pattern.

Seven bull trout were seen between Hoxsey Creek (rkm 23.8) and upstream to just below Leland Creek (rkm 41.1). Locations and estimated lengths of bull trout are in Table 2. Three fish near Leland Creek were only identified to genus *Salvelinus* because they quickly moved away. They could have been bull trout, brook trout, or *Salvelinus confluentus* x *S. fontinalis* hybrids. One fish was approximately 23 cm, had a light yellow wash, a large head, deep body, and appeared to be a bull trout.

A total of 34 brook trout were seen in all reaches of Icicle Creek and Trapper Creek. In reach 1 there were only three brook trout. One of these was observed upstream of the Snow Creek tributary (rkm 9). No more brook trout were seen until just downstream of the Leland Creek confluence. Upstream of Leland Creek brook trout were common. From Leland Creek to the Trapper Creek confluence 20 brook trout were observed in seven 100-m units (2.9 fish/100-m). In Trapper Creek ten brook trout were observed in five 100-m units (2.0 fish/100-m).

Bull trout were detected at very low densities in Icicle Creek. In reach 2, the average density of observed bull trout was 0.06 bull trout/100-m. In reach 4, there were 0.26 bull trout/100-m, and overall 0.06 bull trout/100-m were observed. We snorkeled 11,440 m of 36,600 m (31%) of Icicle Creek. Of the snorkeled units, twenty-six 100-m units were selected using the Hillman and Platts (1993) method. At this sampling frequency, the probability of detecting bull trout at a density of 0.10 fish/100-m was 92.5% and 99.8 % at 0.25 fish/100-m (Hillman and Platts 1993).

Five 100-m units of 1,600 m (31%) were snorkeled in Trapper Creek. No bull trout were seen, however there were brook trout present. The probability of detecting bull trout was 71.3% at 0.25 fish/100-m (Hillman and Platts 1993).

The only other fish species observed during these surveys appeared to be dace. They were seen in reaches 2 and 3 in slow edgewater of glides. We also saw cascade frogs *(Rana cascadae)* in reaches 3, 4, and 5, and tailed frogs *(Ascaphus truei)* in reach 5.

Table 1. Number of fish observed in reaches 1-5 of Icicle Creek and Trapper Creek, 1994-1995.

Reach # Survey dates Temp. range	# Units	Survey length -m (Reach length) -m % sampled	Species	Number	Percent species	Avg. # fish/ 100-M	Range # fish/ 100-M
Reach 1 8/22-9/2/94 12-18°C	49	3,630 (13,700) 26%	Rainbow	2,535	99.80	69.8	-
			Cutthroat	2	0.08	0.06	-
			Brook Trout	3	0.12	0.08	-
Reach 2 9/6-9/12/94 9-12°C	33	2,720 (5,900) 46%	Rainbow	127	98.45	4.7	-
			Bull Trout	2	0.55	0.07	-
Reach 3 9/13-9/27/94 8-12°C	38	2,490 (5,000) 50% rkm 32.3	Rainbow	8	100	0.32	-
Reach 4 7/12-8/1/95 9-14.5°C	19	1,900 (8,800) 41.1 22% rm 25.7	Rainbow	1,303	99.16	68.6	14-157
			Cutthroat	2	0.15	0.11	0-1
			Bull Trout	5	0.38	0.26	0-2
			Salvelinus [a]	3	0.23	0.16	0-2
			Brook Trout	1	0.08	0.05	0-1
Reach 5 8/1-8/2/95 11-14°C	7	700 (3,200) 22% rkm 44.3 rm 27.7	Rainbow	341	94.20	48.7	12-83
			Cutthroat	1	0.27	0.46	0-1
			Brook Trout	20	5.53	2.9	0-21
Trapper Cr. 8/2/95 14-17°C	5	500 (1,600) 31%	Rainbow	399	97.60	79.8	57-112
			Brook Trout	10	2.40	2.0	0-5
Total	151	11,940 (38,200) 31%	Rainbow	4,713	98.97	39.5	
			Cutthroat	5	0.11	0.04	
			Bull Trout	7	0.15	0.06	
			Salvelinus [a]	3	0.06	0.03	
			Brook Trout	34	0.71	0.28	
			Total	4,762		39.9	

[a] These fish were identified as *Salvelinus* species, but it was not known if they were bull trout, brook trout, or *Salvelinus confluentus* x *S. fontinalis* hybrids.

Table 2. Locations and sizes of bull trout observed while snorkeling in Icicle Creek, 1994-1995.

River KM	Reach	# Bull trout	Bull trout length (cm)	Habitat type	Comments
23.8	2	1	25	Pool	long, glide like, no woody debris
26.2	2	1	22-30	Pool	large log jam
33.6	4	2		Pool and Riffle	
36.7	4	1		Pool	high concentration of rainbows
37.9	4	2	35	Pool	
40.5	4	(1)[a]	22	Pool	found brook trout nearby
41.0	4	(2)[a]		Pool	found brook trout nearby

[a] These fish were *Salvelinus* species, but it is not certain if they were bull trout, brook trout, or *Salvelinus confluentus* x *S. fontinalis* hybrids.

Trout Creek

In 1994 the lower end of reach 1 of Trout Creek was surveyed from the mouth to the beginning of a large clear-cut at approximately rkm 2.1. In 1995 the survey continued up to Trout Lake (reaches 1-2). Daytime water temperatures while snorkeling were 11-14°C during 1994 surveys and 8-10.5°C in 1995.

Rainbow trout were the dominant species in Trout Creek, comprising 99.4% of all species seen (Table 3). Only four disperse cutthroat trout were observed. The cutthroat trout were identified by their spotting pattern, but the red jaw slashes were not seen.

We snorkeled 1,775 m of 6,400 m (28%) of Trout Creek. No bull trout were detected in the stream. Of the areas snorkeled, 12 were randomly selected 100-m units using the Hillman and Platts (1993) methodology. An additional 18 units with a total length of 575 m were selected using the Hankin and Reeves (1988) methodology. Probabilities of detecting bull trout when only considering the twelve 100-m units were 0.950% at 0.25 fish/100-m and 0.698% at 0.10 fish/100-m (Hillman and Platts 1993, Appendix B).

No other fish species were observed. We did find tailed frogs and cascade frogs in Trout Creek.

Table 3. Number of fish observed in reaches 1-5 of Trout Creek, 1994-1995.

Reach # Survey dates Temp. range	# Units	Survey length -m (Reach length) -m % sampled	Species	Number	Percent species	Avg. # fish/ 100-M	Range # fish/ 100-M
Reach 1 7/14-7/27/94 11-14°C	18	575 (2,200) 14%	Rainbow	255	99.2	44.3	-
			Cutthroat	2	0.8	0.35	-
Reach 1 7/21/95 9-10°C	4	400 (1,800) 22%	Rainbow	119	100	29.8	17-48
Reach 2 7/25/95 8-10.5°C	8	800 (2,400) 33%	Rainbow	354	99.4	44.3	18-120
			Cutthroat	2	0.6	0.25	0-2
Total	30	1,775 (6,400) 28%	Rainbow	728	99.4	41.0	
			Cutthroat	4	0.6	0.23	
			Total	732		41.2	

Jack Creek

Jack Creek was surveyed July 15-26, 1994, from its mouth at Icicle Creek up to Dunn Creek (reaches 1-2). Water temperatures while snorkeling varied from 10.5°C to 16°C. In 1995 surveys resumed at Dunn Creek and continued up to the headwaters area (approx. rkm 15.3), past what appeared to be the upper extent of the fish distribution (reaches 3-5). We surveyed July 28 to August 10, 1995. Water temperatures were 5-10°C.

Rainbow trout were the dominant species in Jack Creek up to Solomon Creek (reaches 1-3) (Table 4). In reaches 1-3, we counted 2,769 (99.8%) rainbow trout; one cutthroat trout; one fish that could have been a rainbow trout, cutthroat trout or *Oncorhynchus mykiss* x *O. clarki* hybrid; and four bull trout (Table 5). In reach 4 (rkm 10.3-14.3) there was a transition from rainbow trout to cutthroat trout (Figure 1). There is a 12 m high water fall at approximately rkm 11.4 in reach 4. We snorkeled one 100-m unit between this fall and Van Epps Creek at rkm 11.9. We observed five rainbow trout, twenty-three cutthroat trout and seven trout that were either rainbow trout, cutthroat trout, or *Oncorhynchus mykiss* x *O. clarki* hybrids. Above Van Epps Creek (rkm 11.9), we observed twenty-six cutthroat trout, but did not identify any rainbow trout. Four trout were not positively identified and could have been rainbow trout, cutthroat trout, or hybrids. The furthest upstream trout were found was near rkm 14.5, in a high mountain meadow area.

Bull trout were seen only in lower Jack Creek up to rkm 1.4. Locations and estimated lengths of bull trout are in Table 4. Bull trout densities observed by snorkeling in Jack Creek were 0.29 bull trout/100-m in reach 1 and 0.25 bull trout/100-m in reach 2. Overall density was 0.11 bull

trout/100-m. Bull trout were only found in reaches 1 and 2, where we snorkeled units that had been selected for habitat surveys. No bull trout were observed in reaches 3, 4 and 5. These sites were randomly selected. Twenty-two 100-m units were snorkeled. At this sampling frequency, the probabilities of detecting bull trout at 0.25 fish/100-m was 99.5% and at 0.10 fish/100-m was 88.9% (Hillman and Platts 1993).

No other species of fish were observed during these surveys. We did find cascade frogs and tailed frogs in Jack Creek.

Table 4. Number of fish observed in reaches 1-5 of Jack Creek, 1994-1995.

Reach # Survey dates Temp. range	# Units	Survey length -m (Reach length) -m % sampled	Species	Number	Percent species	Avg. # fish/ 100-M	Range # fish/ 100-M
Reach 1 7/15-7/20/94 10.5-14°C	17	688 (1,100) 61%	Rainbow	839	99.76	121.9	-
			Bull Trout	2	0.24	0.29	-
Reach 2 7/20-7/26/94 11-16°C	22	787 (2,900) 27%	Rainbow	1,278	99.84	162.4	-
			Bull Trout	2	0.16	0.25	-
Reach 3 7/28-8/10/95 6.5-10°C	10	1,000 (6,300) 16%	Rainbow	652	99.09	65.2	16-142
			Cutthroat	1	0.15	0.1	0-1
			Rb-Cut[a]	5	0.76	0.5	0-2
Reach 4 8/8-8/10/95 5-6.5°C	7	700 (4,000) 17%	Rainbow	52	46.85	7.4	0-31
			Cutthroat	45	40.54	6.4	0-23
			Rb-Cut[a]	14	12.61	2.0	0-7
Reach 5 8/9/95 6-6.5°C	5	500 (1,900) 26%	Cutthroat	6	100	1.2	0-6
Total	61	3,675 (16,200) 23%	Rainbow	2,821	97.41	76.8	
			Cutthroat	52	1.80	1.4	
			Rb-Cut[a]	19	0.65	0.52	
			Bull Trout	4	0.14	0.11	
			Total	2,896		15.3	

[a] Rb-Cut: rainbow trout, cutthroat trout, or *Oncorhynchus mykiss* x *O. clarki* hybrid.

Table 5. Locations and sizes of bull trout observed while snorkeling in Jack Creek, 1994.

River KM (NSO)	Reach	# Bull trout	Bull trout length (cm)	Habitat type	Comments
0.1 (2)	1	1	7-15	Pool (side-channel)	log complex at top of unit
0.4 (12)	1	1	30-37	Riffle	4 pieces LWD [a]
1.3 (27)	2	1	22-30	Pool	no LWD, max depth 1.5 m
1.4 (30)	2	1	22-30	Riffle	no LWD

[a] LWD = large woody debris, defined as diameter > 15 cm (6 in.), length > 6 m (20 ft.)

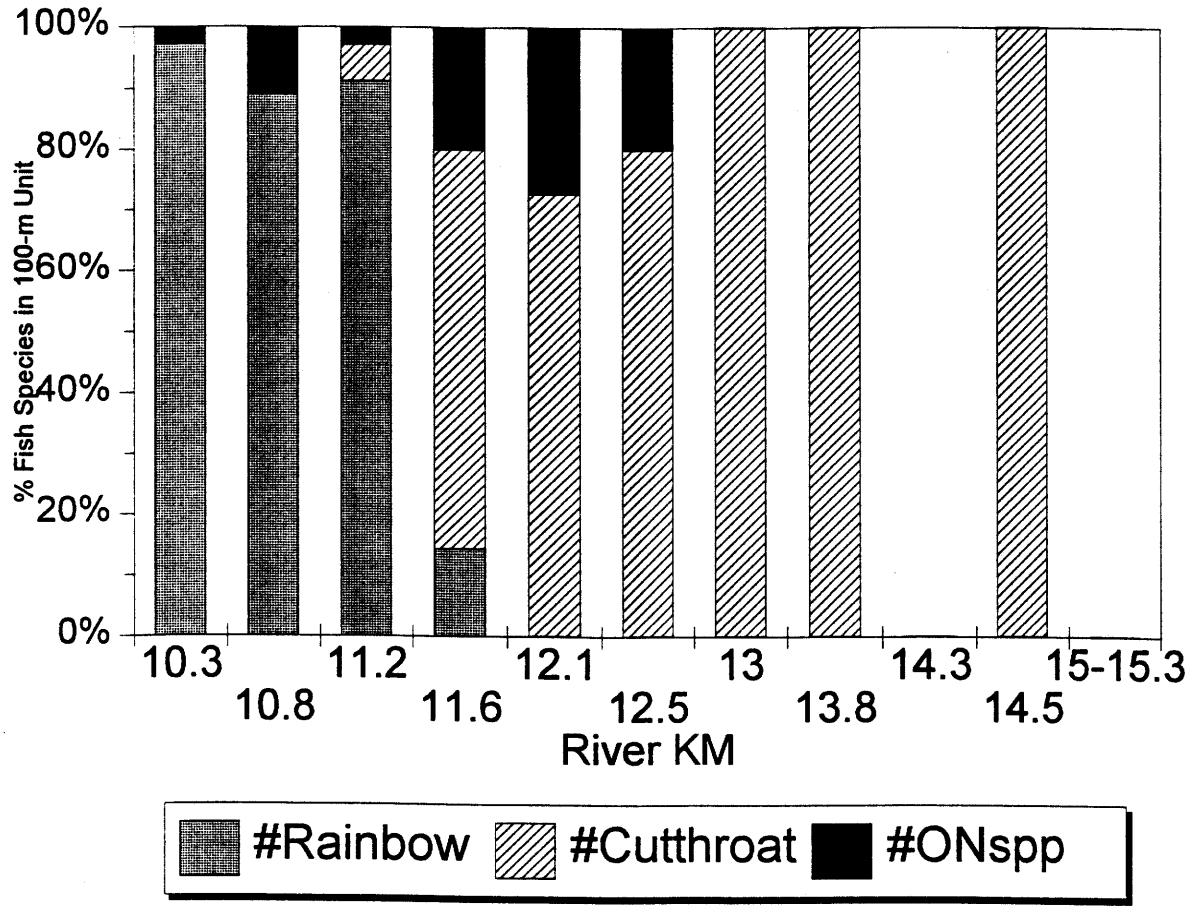

Figure 1. Composition of rainbow trout, cutthroat trout, and fish that were either rainbow trout, cutthroat trout or *Oncorhynchus mykiss* x *O. clarki* hybrids (ONspp) observed by snorkeling in Jack Creek in 100-m units from river km 10.3-14.3.

Peshastin Creek

Peshastin Creek was snorkeled September 6-8, 1995, from the confluence of Ruby Creek (rkm 16.2) to the confluence of Scotty Creek (rkm 24.7). The survey ended near Scotty Creek, because in this area flows were low, few fish were seen, and upstream the gradient increased. Access to Peshastin Creek was difficult so 100-m units spaced approximately 1 km apart were selected based on accessibility.

Steelhead may be present in Peshastin Creek, but juvenile steelhead and rainbow trout cannot be differentiated when snorkeling. In this report these *Oncorhynchus mykiss* fish will be referred to as rainbow/steelhead trout. Seven units or only 8.5% of this reach were surveyed, and 75 rainbow /steelhead trout were observed (Table 6). Numbers of rainbow/steelhead trout in each 100-m unit varied from 1 to 29, and four units had only one or two fish. Water temperatures while snorkeling were 10.5-11°C.

Rainbow/steelhead trout were present in low densities in Peshastin Creek. No adult steelhead were observed. Fish habitat was generally poor. Areas we snorkeled had maximum depths ranging from 0.3 m to 0.8 m. Water was slow moving, silt covered much of the stream bottom, there was little woody debris, and few invertebrates were observed. In the USFS (1992) stream habitat survey of Peshastin Creek poor habitat quality characteristics were also observed.

Because of our low sampling intensity for Peshastin Creek, we have little certainty of the presence of other fish species. We did not see any other fish species and did not note any amphibians. Habitat conditions looked unfavorable for bull trout and none were observed. There may have been bull trout present in areas not sampled, such as the lower 16.3 km of Peshastin Creek or upstream of Scotty Creek. They may be present at other times of the year if they are using the stream as a migration corridor. Our probabilities of detecting bull trout in Peshastin Creek were low, and actually could be lower, because of violations in random sampling selection. The probability of detecting bull trout at a density of 0.25 fish/100 m or greater was 82.6%, and at a density of 0.10 fish/100 m or greater was 50.3% (Hillman and Platts 1993).

Table 6. Number of fish observed in Peshastin Creek, 1995.

Survey dates Temp. range	# Units	Survey length -m (Reach length) -m % sampled	Species	Number	Percent species	Avg. # fish/ 100-M	Range # fish/ 100-M
9/6-9/8/95 10.5-11°C	7	700 (8,200) 8.5%	Rainbow/ Steelhead	75	100	10.7	1-29

Ingalls Creek

Ingalls Creek was surveyed August 10-24, 1995. Water temperatures during daytime surveys were 6.5-11°C. The survey began on USFS land at the Ingalls Creek trailhead (#1215) at rkm 1.0, and continued upstream to approximately rkm 19.9 just past Turnpike Creek Trail (#1391).

At approximately rkm 16.3 and rkm 18.9, there were falls with vertical drops of over 6 m high that are fish barriers. Steelhead may be present in Ingalls Creek up to the falls at rkm 16.3. No adult steelhead were observed in Ingalls Creek. We did observe 1,069 rainbow/steelhead trout, 19 rainbow trout (above rkm 16.3), and seven bull trout (Table 7). No other fish species were observed, however we did see cascade frogs. The furthest upstream we found bull trout was near rkm 10.5, which was well below the lower falls (Table 8). The furthest upstream that rainbow trout were observed was just downstream of the uppermost falls at rkm 18.6.

Rainbow trout could have accessed the area above the lower falls by moving down from Ingalls Lake, which was planted with rainbow trout in 1950, 1987, and 1991, and with cutthroat trout between 1965 and 1983. Between the two falls, five 100-m units and one 50-m unit that ended at the falls were snorkeled. Only 19 fish were seen, for an average of 3.5 fish / 100-m. Water flow was low in this upstream reach, and between the two falls, stream widths were approximately 5-7 m and maximum depths in the 100-m units snorkeled were 0.6-1.2 m. Turnpike Creek enters about 150 m below the upper falls, and contributes roughly one-third of the flow. We did not observe fish in two 100-m units above the upper falls. Fish are present above the falls in Ingalls Lake and undoubtedly inhabit the creek. There was very little flow just upstream of the upper falls. Stream widths were around 4 m, and maximum depths were less than 0.6 m. Gradient increased above here and fish habitat appeared limited in this area, especially for overwintering.

Table 7. Number of fish observed in reaches 1-3 of Ingalls Creek, 1995.

Reach # Survey dates Temp. range	# Units	Survey length -m (Reach length -m) % sampled	Species	Number	Percent species	Avg. # fish/ 100-M	Range # fish/ 100-M
Reach 1 8/10-8/16/95 10-11°C	14	1,245 (6,400) 19%	Rainbow/Stt	521	99.05	41.8	16-54
			Bull Trout	5	0.95	0.40	0-2
Reach 2 8/14-8/24/95 7-10.5°C	11	1,100 (6,300) 18%	Rainbow/Stt	325	99.08	29.5	11-65
			Bull Trout	3	0.92	0.27	0-2
Reach 3 8/15-8/16/95 6.5-8°C	15	1,370 (6,500) 21%	Rainbow/Stt[a]	242	100	17.7	0-61
Total	40	3,715 (19,200) 19%	Rainbow/Stt	1,088	99.27	29.3	
			Bull Trout	8	0.73	0.22	
			Total	1,095		15.3	

[a] Steelhead would not be able to access the stream above the falls at rkm 16.3, and 19 rainbow trout were found above these falls.

Eight bull trout were observed in Ingalls Creek, and average densities of observed bull trout were 0.40 bull trout/100 m in reach 1, 0.27 bull trout/100 m in reach 2; no bull trout were observed in reach 3 (Table 8). The average bull trout density (observed) for all reaches surveyed was 0.22 bull trout/100 m.

We snorkeled three "quality" habitat units in Icicle Creek for a total length of 65 m. In these units we saw a total of 53 rainbow trout and 2 bull trout. Because these were non-randomly selected units, we cannot include these in the statistical model used to determine the probability of bull trout presence. We randomly sampled thirty-six 100-m units and one 50-m unit in 19.2 km for an average of nineteen 100-m units/10 km. At this sampling frequency, the probabilities for detecting bull trout at densities greater than 0.25 fish/100-m was 99.1% and for densities greater than 0.10 fish/100-m were 85.0% (Hillman and Platts 1993, Appendix B).

Table 8. Locations and sizes of bull trout observed while snorkeling in Ingalls Creek, 1995.

River KM	Reach	# Bull trout	Bull trout length (cm)	Habitat type	Comments
2.2	1	2	45		
3.7	1	1	25-30	Plunge Pool	
5.0	1	2	25-30	Plunge Pool	quality habitat unit
9.2	2	1	15	Pool	pool small, 1.5-2 m deep
10.7	2	2	18	Pool	bulls in 2 pools, with many rb.

Negro Creek

Negro Creek was surveyed from its mouth up to near the beginning of Trail #1210, a distance of approximately 9.2 km. We surveyed August 25 to September 5, 1995. Temperatures during snorkel surveys were 6.5-8.5°C. There is a 2.1 m high waterfall at approximately rkm 4.9. USFS did not do habitat surveys past the falls, but we designated the reach from the large boulder waterfall up to where we ended our survey (rkm 9.2) as reach 3.

Below the waterfall (rkm 4.9), we observed 142 rainbow trout and 1 cutthroat trout. We counted 200 cutthroat trout and 13 fish that appeared to be *Oncorhynchus mykiss* x *O. clarki* hybrids above the falls in eight 100-m units . The furthest upstream that we saw trout was in a unit 400 m downstream of USFS Road #400 (the uppermost stream crossing). Water temperature at this point was 6.5°C. We did not observe any fish in two 100-m units within 1 km above the bridge. Maximum depth in these two units was 0.4 m, and temperatures were 6-6.5°C. Snorkeling efficiency is greatly reduced at water temperatures this low (Hillman et al. 1992). However, the presence of trout in units below the bridge when water temperatures were 6.5°C leads us to believe that there could be other reasons why trout were not seen in these units. These units were surveyed on August 30 and September 5. During our surveys we observed several aggregations of trout in pools. Other researchers have observed salmonids aggregating at the onset of winter (Cunjak and Power 1986; Hillman et al. 1987; Griffith and Smith 1993;

Riehle and Griffith 1993). Some pools containing fish were small and isolated. It was doubtful that trout could have survived the winter in these pools. It is possible that fish had moved from the upper areas to lower reaches to overwinter. It appeared that in the summer the upper distribution of trout could have been upstream of the bridge. However, the stream forks and stream gradient becomes considerably steeper about 1 km upstream of the bridge.

Thirteen fish in reach 3 were collected for potential future genetics analysis. Of the fish collected, eight were cutthroat trout and five appeared to be *Oncorhynchus mykiss* x *O. clarki* hybrids. Genetic testing and morphometric analysis of these fish is needed to determine species purity and degree of hybridization. Fish were collected above the falls near the furthest downstream crossing of Road # 400. Flows at the time we surveyed were very low, and fish were concentrated in a few pools. Several of the pools containing fish were small and isolated pools, and it is doubtful that these fish would have been able to survive the winter.

We did not observe any other species of fish in Negro Creek. We did note a tailed frog in reach 3. No bull trout were seen in Negro Creek. We sampled nineteen 100-m units within 9.1 km. At this sampling frequency, the probabilities of detecting bull trout at 0.25 fish/100 m were 99.1% and at 0.10 fish/100-m were 85.0% (Hillman and Platts 1993, Appendix B). This does not mean that there were no bull trout in the stream, but that we are 99.1% certain that bull trout did not occur at a density $\geq$ 0.25 fish/100 m and 85% certain at a density $\geq$ 0.10 fish/100 m.

Table 9. Number of fish observed in reaches 1-3 of Negro Creek, 1995.

Reach # Survey dates Temp. range	# Units	Survey length -m (Reach length) -m % sampled	Species	Number	Percent species	Avg. # fish/ 100-M	Range # fish/ 100-M
Reach 1 8/25/95 7-8°C	5	500 (2,400) 21%	Rainbow	73	98.6	14.6	7-20
			Cutthroat	1	1.4	0.2	0-1
Reach 2 8/25-8/29/95 6.5-8.5°C	6	600 (2,500) 24%	Rainbow	69	100	11.5	0-23
Reach 3 8/30-9/5/95 6.5-8°C	8	800 (4,200) 19%	Cutthroat	200	93.9	25.0	0-60
			Rb-Cut[a]	13	6.1	1.6	0-6
Total	19	1,900 (9,100) 21%	Rainbow	144	40.2	7.6	
			Cutthroat	201	56.1	10.6	
			Rb-Cut[a]	14	3.9	0.7	
			Total	358		18.8	

[a] Rb-Cut: rainbow trout, cutthroat trout, or *Oncorhynchus mykiss* x *O. clarki* hybrid.

Discussion

Oncorhynchus Species

Icicle Creek Watershed

Very few cutthroat trout compared to rainbow trout were observed in Icicle Creek (5 cutthroat trout and 4,713 rainbow trout) and in Trout Creek (4 cutthroat trout and 728 rainbow trout). The few cutthroat trout seen were highly dispersed. The cutthroat trout we observed in Icicle Creek could have drifted down from lakes in the drainage or from headwater populations, such as in Jack Creek.

Although we observed few cutthroat trout in Trout Creek, there may have been more in Trout Lake. Fish can move freely between the lake and creek. Cutthroat trout were planted in Trout Lake seven times between 1951 and 1972 (WDFW 1996). Rainbow trout were planted in Trout Lake in 1992, 1987, 1981, and several other years since 1936 (WDFW 1996). The cutthroat trout in Trout Creek were only identified by their spotting pattern and coloration; the red jaw slash was not seen, so there is some question if they were cutthroat trout.

There was a transition from rainbow trout in the lower reaches of Jack Creek to cutthroat trout in the headwaters. This was the only allopathic population of cutthroat trout we found in the Icicle Creek drainage. The cutthroat trout population might be persisting because the waterfalls and steep gradient could be impeding the upstream distribution of rainbow trout, and/or the steep gradient and elevation might confer a competitive advantage to the cutthroat trout. Cutthroat trout tend to occur farther upstream and at higher elevations and gradients than do rainbow/ steelhead trout (Proebstel et al. *in press,* Griffith 1988, Moyle 1975). This partitioning of the aquatic resource by cutthroat trout and redband rainbow trout could have occurred historically (Proebstel et al. *in press*). Headwater lakes are often planted with non-native species, which can then displace downstream native populations. There are no lakes in the upper drainage of Jack Creek. The furthest upstream in the Jack Creek drainage that fish have been stocked is Cradle Lake, which feeds into Jack Creek near rkm 7.4. Cradle Lake was planted with rainbow trout in 1942 and has been planted with cutthroat trout in five years between 1946 and 1983 (WDFW records). Jack Creek was planted near its mouth with rainbow trout and cutthroat trout several times between 1934 and 1947. Icicle Creek was planted annually with rainbow trout until 1993 and with cutthroat trout six times between 1935 and 1946 (WDFW 1996).

Peshastin Creek Watershed

Of the *Oncorhynchus* species, only rainbow trout/steelhead trout were seen in Peshastin and Ingalls Creeks. Genetic composition of these fish could be influenced by hatchery or wild steelhead and by hatchery rainbow trout or native redband rainbow trout. Steelhead have been planted in Peshastin Creek since 1981 and as recently as 1990 (WDFW 1996). Rainbow trout have been extensively stocked in the drainage (WDFW 1996). In 1993 trout were collected from Ingalls Creek near rkm 1 for genetic analysis using DNA and morphometric analysis. Fish collected were primarily interior redband rainbow trout with some influence from non-native coastal (hatchery) rainbows (Proebstel et al. *in press*) (Appendix D).

USFS reported seeing cutthroat trout in Peshastin Creek during their 1992 surveys (USFS 1992). We did not observe cutthroat trout during our surveys. Because Peshastin Creek is a lower elevation stream with poor water quality and dominated by rainbow trout, it is not optimal habitat for cutthroat trout.

We suspect that native cutthroat trout historically could have been in the headwaters of Ingalls Creek, as they are often distributed in the upper reaches of streams (Proebstel et al. *in press:* Griffith 1988: Moyle 1975). However, species distribution in the Ingalls Creek headwaters has likely been influenced by stocking in Ingalls Lake, which was planted with rainbow trout in 1950, 1987, and 1991; and with cutthroat trout in five years between 1965 and 1983 (WDFW 1996).

In Negro Creek below the falls at rkm 4.9, we saw predominantly rainbow trout. Above the falls there were cutthroat trout and possible *Oncorhynchus mykiss* x *O. clarki* hybrids. The presence of fish above the falls indicates that they can occasionally move up the 2.1 m high falls. There are some "steps" in the falls. It is also possible that private citizens placed fish above the falls, but access to this stream area is limited. There are no maintained trails and the USFS road accessing the area is gated. Persistence of this cutthroat trout population, like the Jack Creek population, is likely due to impediment of the upstream distribution of rainbow trout because of the waterfall; a competitive advantage of cutthroat trout in headwater areas; and no upstream stocking of rainbow trout. Proebstel et al. (*in press*) analyzed trout collected at rkm 1.1 in Negro Creek using mitochondrial DNA and morphometric techniques. They observed that some characteristics of the Negro Creek rainbow trout were typical for redband rainbow trout, but that it probably was not an indigenous "pure" native population (Appendix F). Rainbow trout were planted in Negro Creek from 1933 to 1947. Rainbow trout and steelhead have been planted in Peshastin Creek (WDFW records). Cutthroat trout and what appeared to be *Oncorhynchus mykiss* x *O. clarki* hybrids were collected in Negro Creek from above the falls in 1994, but they still need to be genetically tested to evaluate genetic purity.

Salvelinus Species

Icicle Creek Watershed

The Leavenworth NFH barrier has blocked access of fluvial bull trout from most of the Icicle Creek drainage. Several large, fluvial bull trout have been observed below the Leavenworth NFH barrier (personal observation). During the surveys we observed small numbers of resident bull trout above the barrier. Blockage of fluvial bull trout movement has likely reduced their numbers from historical levels and limited gene flow within the Icicle Creek drainage.

We only observed seven bull trout in Icicle Creek, four in lower Jack Creek, and none in Trout Creek. Our limited observations could be due to difficulty in observing bull trout because of their tendency to use underwater cover and their cryptic coloration. Several researchers suggest that daytime snorkel counts underestimate the true abundance of bull trout and are less accurate than nighttime counts (Bonneau et al. 1995; Fraley and Shepard 1989; and Sexauer 1994). However, Thurow and Schill (1996) found no significant differences between day and night snorkel counts of bull trout. They suggested that the discrepancy between their results and others could be explained by differences in stream temperature. Water temperatures were 9-13.5°C

during their surveys conducted in early August and they did not observe diel behavioral shifts of bull trout. At temperatures below 8-9°C salmonids have been observed seeking daytime concealment (Bustard and Narver 1975; Campbell and Neuner 1985; Hillman et al. 1987; Cunjak 1988; Griffith and Smith 1993; Riehle and Griffith 1993). Most of our surveys were done when water temperatures were at or above 8-9°C; however, some units were snorkeled when the water temperature was as low as 5°C. We did not snorkel at night because of difficult access, and because we were able to detect bull trout during daytime. Our snorkel counts represent a minimum number of bull trout. While the actual number of bull trout could be greater, this population still appears depressed. Bull trout populations have been declining throughout their historical range (Rieman and McIntyre 1993; Fraley and Shepard 1989). Mongillo (1993) considers the Wenatchee River bull trout population at moderate risk of extinction.

The six brook trout we saw in Icicle Creek below Leland Creek could be part of a small population, or they could have drifted down from lakes or upstream areas. In the Icicle Creek drainage, eastern brook trout have been stocked in Nada Lake, Upper Snow and Lower Snow lakes (years of stocking unknown), and Grass Lake, which was first stocked in 1961 (WDFW 1996, Dan Rife, pers. comm.). It is unfortunate that Grass Lake was stocked with brook trout, since it has been the source of the furthest upstream brook trout population in Icicle Creek. It is unknown why Grass Lake was stocked, since access for angling is difficult - at least one full day of hiking and off-trail scrambling up Trapper Creek. Brook trout in Icicle Creek above Leland Creek and in Trapper Creek were common, and it is not known if the brook trout are segregated to the upper part of the drainage or if their distribution is expanding downstream. Habitat below Leland Creek down to the confluence with Frosty Creek appeared suitable for brook trout with predominantly long, deep, slow-moving pool habitat. The brook trout could be impacting bull trout populations in Icicle Creek. Bull trout and brook trout are known to produce hybrids which are nearly sterile (Leary et al. 1983, 1991; Markle 1992). Because brook trout mature earlier than bull trout, hybridization can eliminate bull trout populations (Leary et al. 1991).

Peshastin Creek Watershed

Although only eight bull trout were observed in Ingalls Creek, densities were suspected to be higher than in the other five creeks surveyed. It is a significant creek to the watershed since it was the only stream in the Peshastin Creek watershed that we found bull trout. Presence of bull trout in Ingalls Creek suggests that bull trout may use Peshastin Creek. Our survey of Peshastin Creek started at rkm 16.2, and bull trout could have been in areas downstream of where we surveyed. Fluvial bull trout are highly migratory, and could have been in other areas when we were sampling and could have been in areas we snorkeled at other times of the year. Because of the sediment load, lack of woody debris, and warmer temperatures, it seems unlikely that bull trout would spawn in Peshastin Creek. It could, however, be an important connecting stream between the Wenatchee River and streams within the Peshastin Creek drainage with bull trout, such as Ingalls Creek. It is not known if bull trout historically used Negro Creek.

Other Species

Icicle Creek Watershed

Mountain whitefish were not observed above the barrier during the snorkel surveys. Considering the intensity of our sampling, whitefish were probably not present above the barrier. Mountain whitefish are common below the Leavenworth NFH barrier, and historically they may have been present in the Icicle Creek drainage above the barrier. Several researchers have observed seasonal migrations of stream-dwelling mountain whitefish (Pettit and Wallace 1975; Davies and Thompson 1976). Adults migrate to upper river areas or tributaries to spawn and may spend the summer before returning downstream. The fry rear upstream their first summer and migrate downstream to rear to sexual maturity. If mountain whitefish from the Wenatchee River migrated seasonally into Icicle Creek the barrier could have eliminated this population.

Several non-salmonid species have recently been found in Icicle Creek below the hatchery barrier including longnose dace, speckled dace, sculpins, longnose suckers, bridgelip suckers, and northern squawfish (Mullan et al. 1992). Only what appeared to be dace were seen in the snorkel surveys. Dace were seen in a few backwater areas, and we could not determine their distribution from this survey. Sculpins could be present above the hatchery barrier. They can be difficult to observe when snorkeling because of their cryptic coloration and close association with the substrate. Sampling by electrofishing or trapping would be helpful in determining the presence of small fish species and for collection for in-hand species determination. Suckers and squawfish are easily seen while snorkeling, but were not found above the barrier. Historically they may have used some areas above the barrier, at least seasonally.

Peshastin Creek Watershed

Non-salmonid species and whitefish were not seen in the Peshastin Creek drainage. Dace and sculpin have been found in Peshastin and Ingalls creeks (Mullan et al. 1992). Absence of non-salmonid fishes in the surveys does not mean they were not present. These species can be difficult to see, and they often occupy shallow waters that are difficult to snorkel. Determination of presence or absence of these species will require electrofishing and/or trapping.

Recommendations

Species distributions throughout the Icicle Creek and Peshastin Creek watersheds need to be determined by surveying additional streams where distributions are unknown. Other areas where there are native cutthroat trout and bull trout need to be identified. Non-salmonid fish should be more intensively sampled for by electrofishing and/or trapping to determine their distributions.

There are important cutthroat trout populations in the headwaters of Jack and Negro creeks. Hybridization and competition with rainbow trout may be the greatest threat to these populations. Degree of hybridization of cutthroat trout and rainbow trout in these streams needs to be determined by genetic analysis. These cutthroat trout populations should be protected and monitored.

The brook trout and bull trout in the Icicle Creek watershed, and especially in the area near Leland Creek, should be monitored for changes in distributions and abundance. Currently harvest of bull trout is not allowed in the Icicle Creek drainage, and this protection needs to continue. It would be helpful to identify areas where bull trout spawn so that spawning ground surveys could be conducted annually to monitor these populations. It is important to document their seasonal movements and habitat uses to determine the association among sub-populations in the Icicle and the remainder of the Wenatchee River system.

The Leavenworth NFH fish barrier on Icicle Creek has blocked access of the stream to many species and disrupted fish movements and migrations. Efforts need to be taken to provide fish passage past this barrier. This would restore access to 34 km of spawning and rearing habitat for fluvial bull trout, summer steelhead, chinook salmon, mountain whitefish, and other indigenous species.

In the Peshastin Creek drainage, we only found a small population of resident bull trout in Ingalls Creek. This bull trout population is a significant local population, but given its low numbers, it appears to be at risk. Currently no bull trout harvest is allowed in this drainage, and this protection needs to continue. This population should be monitored, and spawning areas should be identified.

Fish populations in Peshastin Creek have probably been affected by occasional dewatering of the lower 7.7 km, Highway 97 and associated channelization, culverts and siltation, and small-scale placer mining. These water quality and quantity problems in Peshastin Creek need to be addressed. There are many opportunities for stream restoration work in the mainstem and some of the tributaries.

A significant risk to the native trout populations in these watersheds is competition and hybridization from stocked fish species. It is important in the future that non-native fish not be stocked in areas where they have the potential to adversely affect native fish populations.

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Appendix A

Stream Reach Descriptions

Icicle Creek

Start of snorkel survey - rkm 6.4 (rm 4.0)
Leavenworth National Fish Hatchery water intake

Reach 1 - rkm 7.7 - 21.3 (rm 4.8 - 13.3)
from Forest Service boundary (T24N, R17E, Sec. 27) to Road 7605 bridge near Big Slide Creek (T24N, R16E, Sec. 3)

Reach 2 - rkm 21.3 - 27.3 (rm 13.3 - 17.0)
from bridge to Road 7699 bridge near Jack Creek (T24N, R15E, Sec.1)

Reach 3 - rkm 27.3 - 32.3 (rm 17.0 - 20.1)
from bridge to confluence with French Creek

Reach 4 - rkm 32.3 - 41.1 (rm 20.1 - 25.6)
from French Creek to confluence with Leland Creek

Reach 5 - rkm 41.1 - 44.3 (rm 25.6 - 27.6)
from Leland Creek to confluence with Trapper Creek

Reach 6 - rkm 44.3 - 48.3 (rm 27.6 - 30.1)
from Trapper Creek to Lake Josephine

Trapper Creek

Reach 1 - rkm 0 - 1.6 (rm 0 - 1.0)
from confluence with Icicle Creek to Grass Lake

Reach 2 and 3 - rkm 1.6 - 4.8 (rm 1.0 - 3.0)
from Grass Lake to Trap Lake, not surveyed

Trout Creek

Reach 1 - rkm 0 - 4.0 (rm 0 - 2.5)
from confluence with Icicle Creek to Alpine Lakes Wilderness boundary

Reach 2 - rkm 4.0 - 6.4 (rm 2.5 - 4.0)
from wilderness boundary to Trout Lake.

Appendix A (continued).

Jack Creek

Reach 1 - rkm 0 - 1.1 (rm 0 - 0.7)
from confluence with Icicle Creek up to trail No. 1558 foot bridge.

Reach 2 - rkm 1.1 - 4.0 (rm 0.7 - 2.5)
from trail No. 1558 foot bridge to confluence with Dunn Creek

Reach 3 - rkm 4.0 - 10.3 (rm 2.5 - 6.4)
from Dunn Creek to confluence with Solomon Creek

Reach 4 - rkm 10.3 - 14.3 (rm 6.4 - 8.9)
from Solomon Creek to a high mountain meadow

Reach 5 - rkm 14.3 - 16.2 (rm 8.9 - 10.1)
from high mountain meadow to the terminus of two headwater tributaries

Peshastin Creek

Reach 1 - rkm 0 - 14.4 (rm 0 - 9.0)
from confluence with Wenatchee River to confluence with Ingalls Creek, on private property and not surveyed

Reach 2 - rkm 14.4 - 24.7 (rm 9.0 - 15.4)
from Ingalls Creek to confluence with Scotty Creek

Ingalls Creek

Reach 1 - rkm 0 - 6.4 (rm 0 - 4.0)
from confluence with Peshastin Creek to confluence with T10, NSO 264 (valley form change)

Reach 2 - rkm 6.4 - 13.2 (rm 4.0 - 8.2)
from T10 NSO 264 to confluence with Cascade Creek (T22, NSO 264)

Reach 3 - rkm 13.2 - 20.0 (rm 8.2 - 12.4)
from Cascade Creek to 200 m upstream of Turnpike Creek Trail No. 1391

Negro Creek

Reach 1 - rkm 0 - 2.4 (rm 0 - 1.5)
from confluence with Peshastin Creek to 2.4 km upstream

Reach 2 - rkm 2.4 - 4.8 (rm 1.5 - 3.0)
from 2.4 km upstream to the large waterfall

Appendix B

Maps of Streams Surveyed

Index to Maps: **Page**

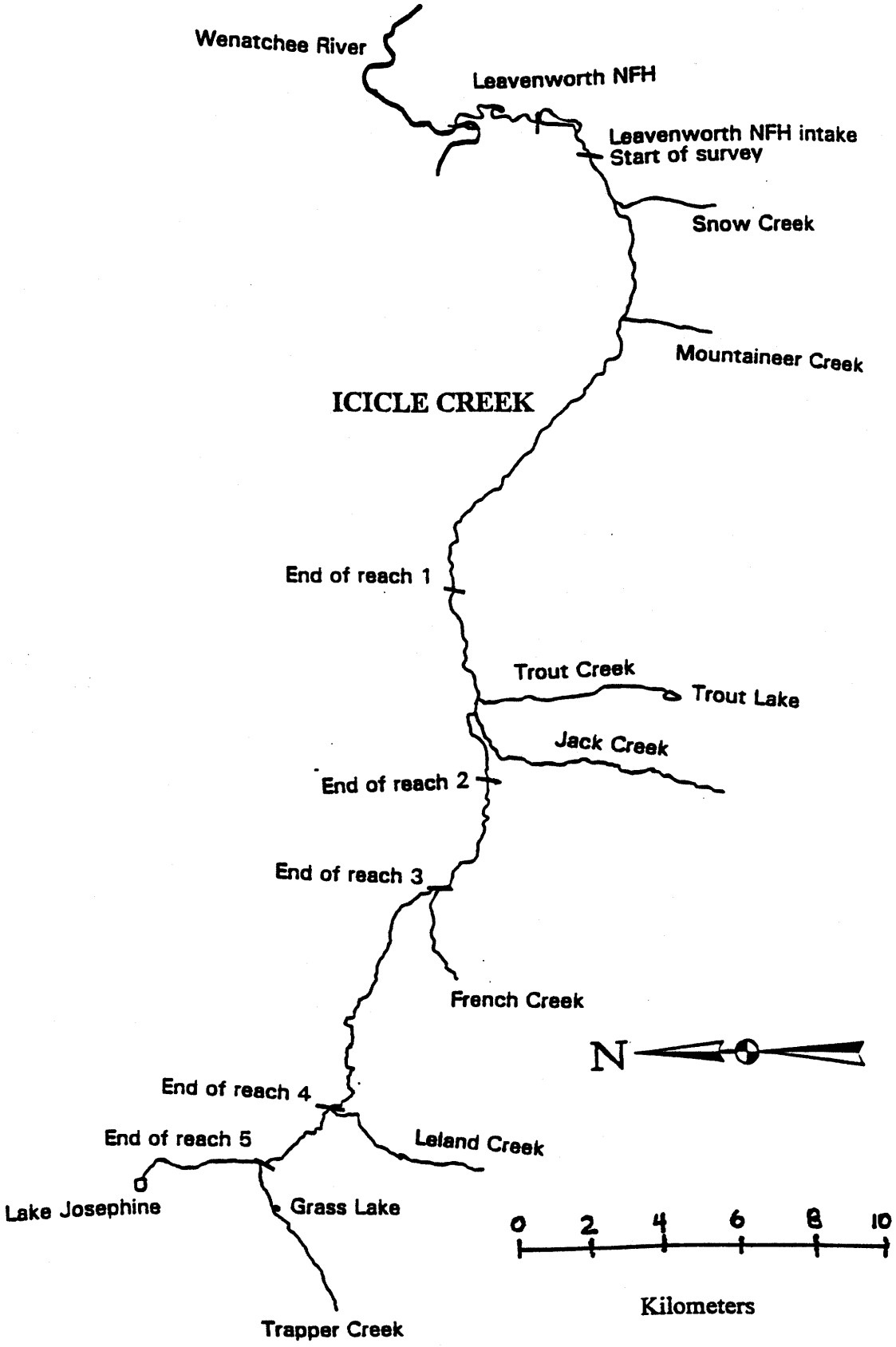

Figure 1. Map of Icicle Creek and tributaries.

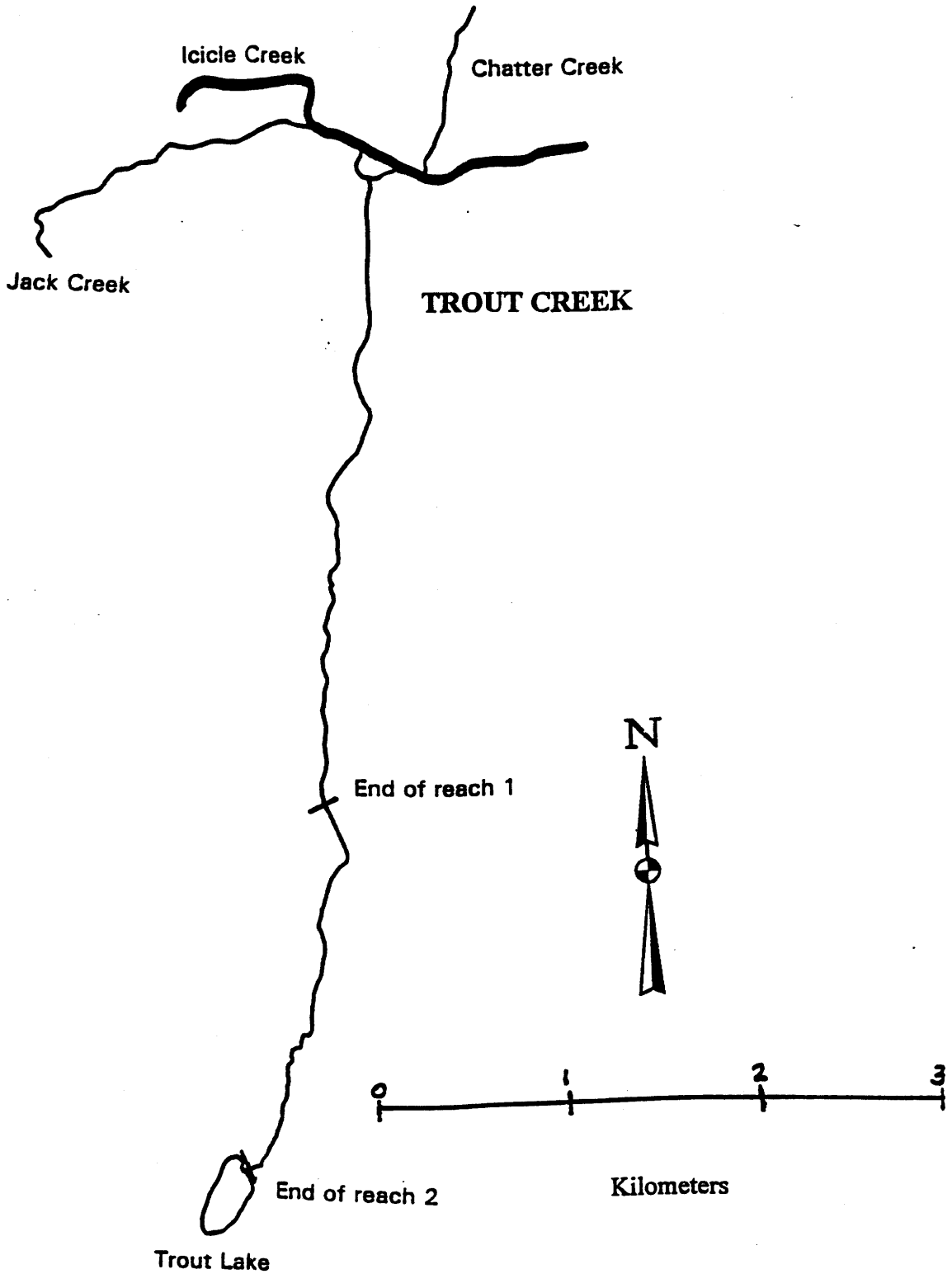

Figure 2. Map of Trout Creek

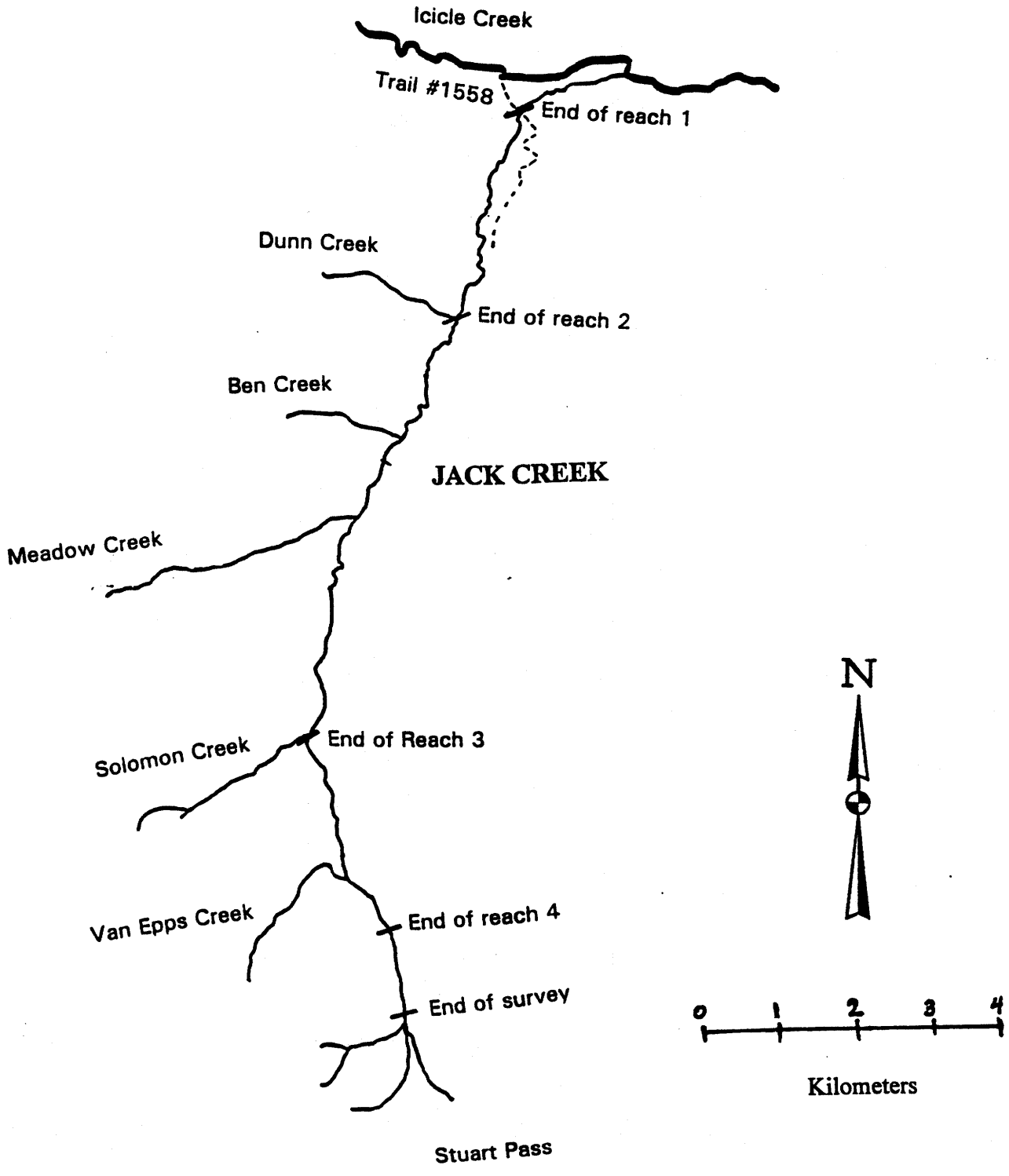

Figure 3. Map of Jack Creek

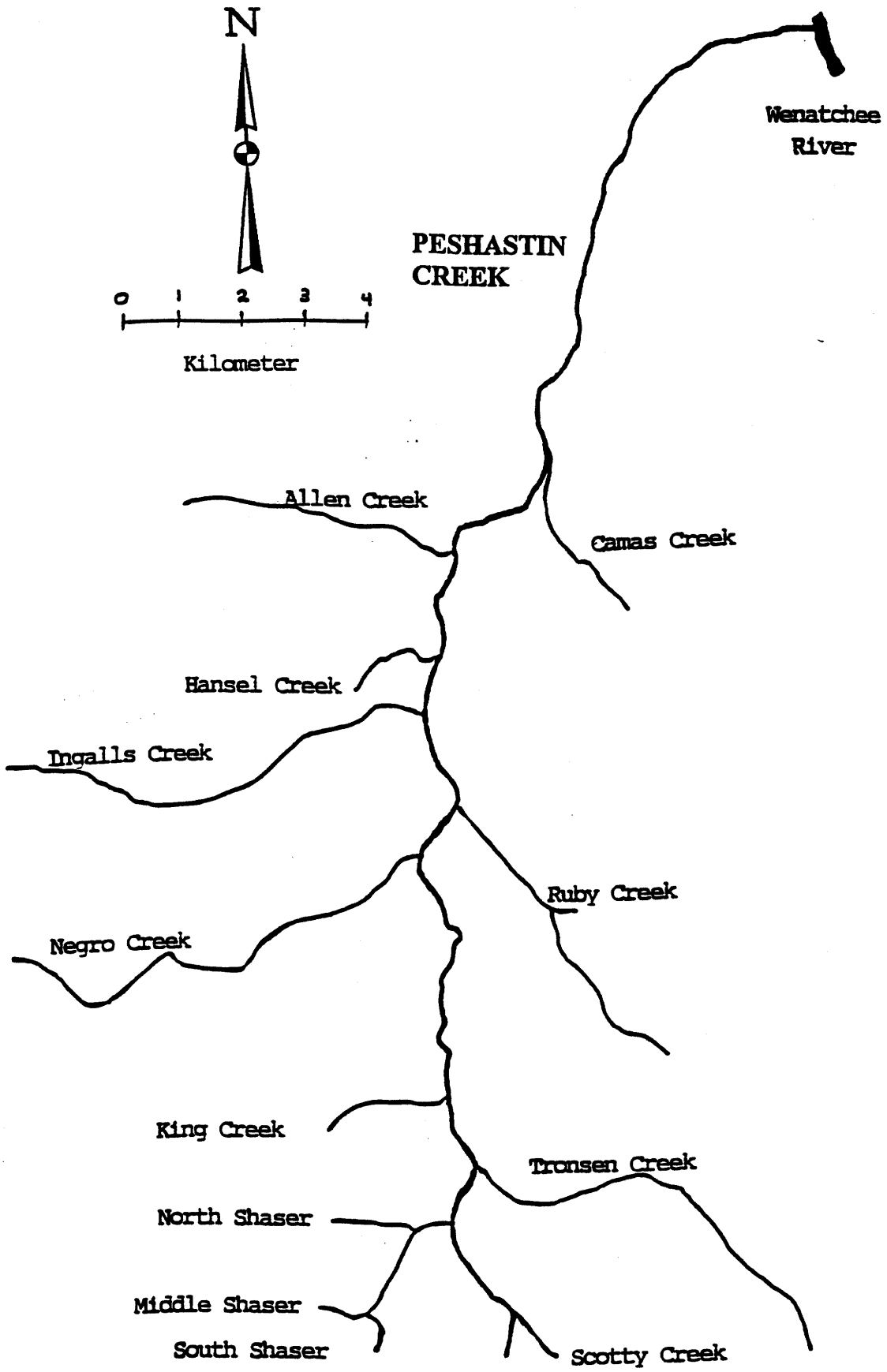

Figure 4. Map of Peshastin Creek and tributaries

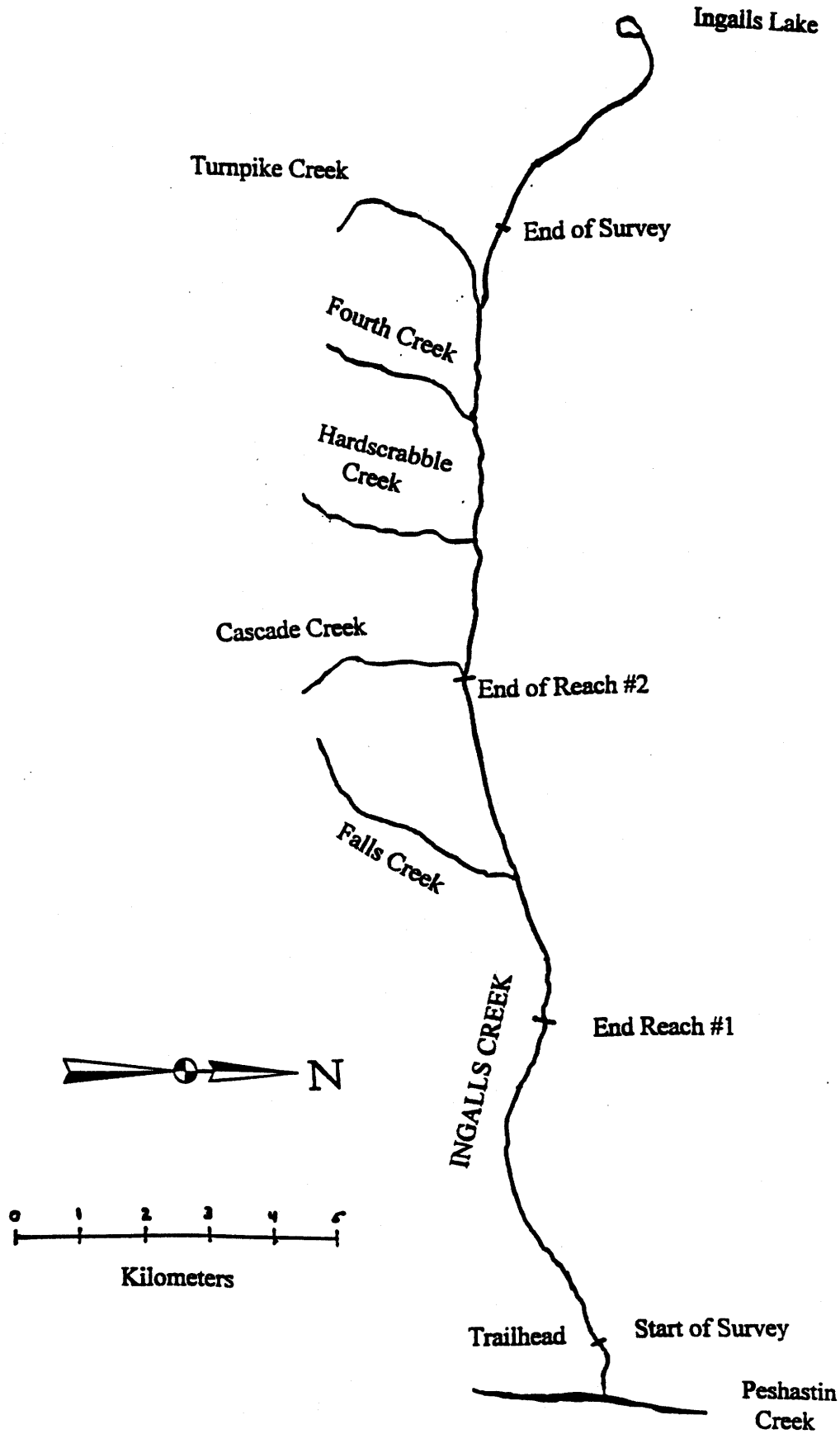

Figure 5. Map of Ingalls Creek

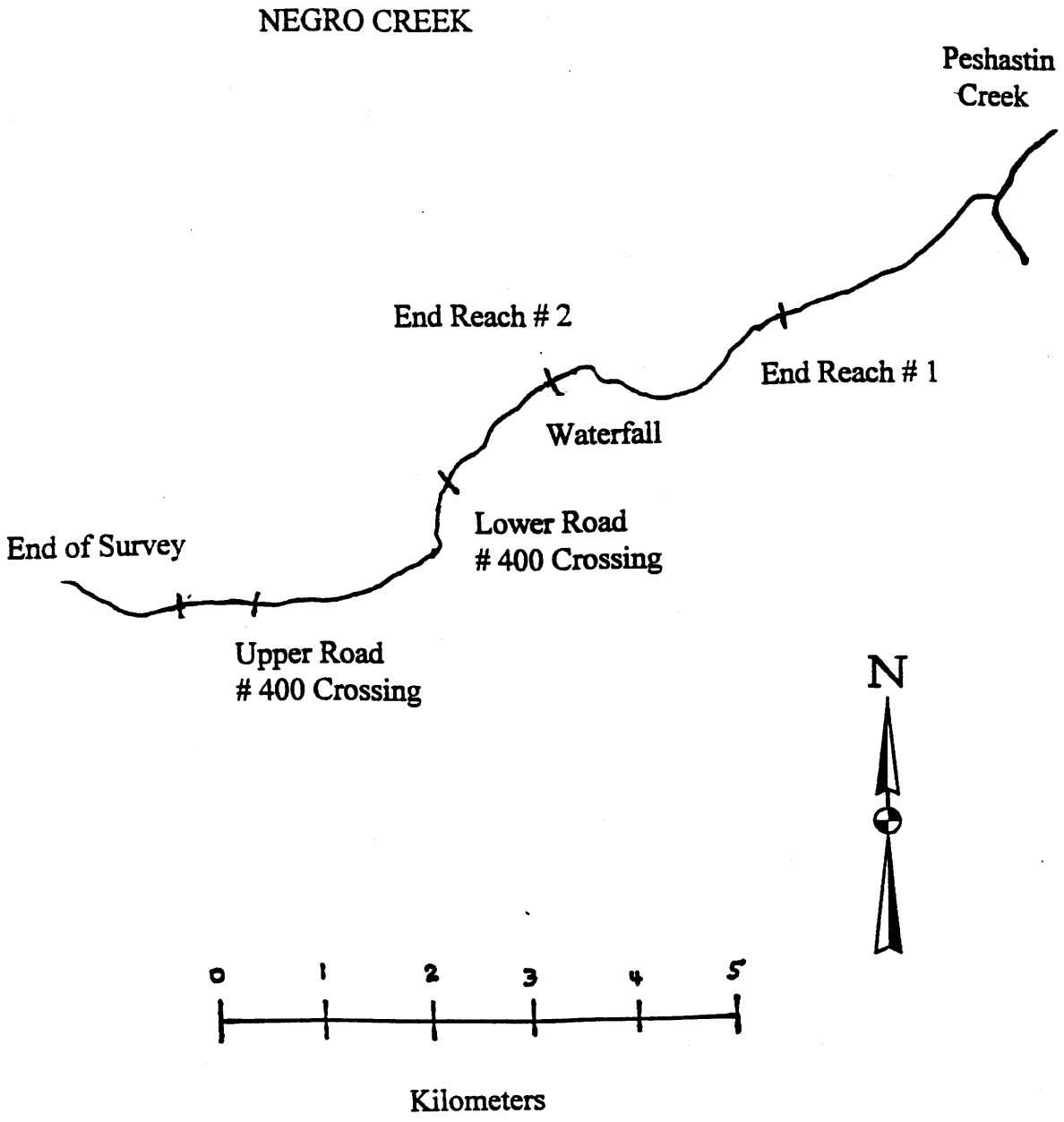

Figure 6. Map of Negro Creek

Appendix C

Snorkel Survey Data, 1995

Index to Data Tables: **Page**

ICICLE CREEK AND TRAPPER CREEK
Fish Species Composition Snorkle Survey, 1995
Survey Dates: 7/12/95 - 8/2/95
French Creek to Grass Lake on Trapper Cr.

UNIT #	APPROX. RKM	USFS REACH #	DATE	H20 TEM oC	LENGTH Meters	HABITAT DESC. # POOLS	WIDTH	MAX DEPTH Feet	1. SPECI	NUMBER	2. SPECI	NUMBER	TOTAL # FISH	AMPHIBS
0.2	32.5	4	12-Jul	9	100	0	18	4.2	onmy	14			14	
0.3	32.6	4	12-Jul	9	100	0	16	3.8	onmy	24			24	
1.3	33.6	4	14-Jul		100	1	18	8	onmy	94	saco	2	96	
1.8	34.1	4	14-Jul	11	100	1	18	5	onmy	55	oncl	1	56	
2	34.2	4	17-Jul	12	100	0	15	5.8	onmy	39			39	
2.6	34.8	4	17-Jul	14	100	0		5	onmy	73			73	
3.1	35.3	4	18-Jul	13	100	0	12	4.8	onmy	114			114	
3.9	36.1	4	18-Jul	13	100	0	12	5.4	onmy	81			81	2 cascfr
4.4	36.6	4	18-Jul	12.5	100	0	12	6.5	onmy	157	saco	1	158	2 cascfr
4.5	36.7	4	31-Jul	10.5	100	0	13.1	2.2	onmy	145			145	
5	37.2	4	31-Jul	10.5	100	0	13	2.1	onmy	42			42	
5.6	37.8	4	31-Jul	11	100	1	15	6	onmy	81	saco	2	83	
6.4	38.6	4	01-Aug	11	100	1	14.5	15	onmy	26			26	
6.8	39	4	01-Aug	11	100	1	13.8	10	onmy	49			49	
7.4	39.6	4	01-Aug	11	100	1	13.3	10	onmy	120			120	1 cascfr
7.8	40	4	01-Aug	12	100	1	14.7	10	onmy	47			47	#cascfr
8.2	40.4	4	01-Aug	13	100	1	16.1	10	onmy	56			56	#cascfr
8.5	40.7	4	01-Aug	13	100	1	13.4	10	onmy	25	saco	1	26	
9.2	41.1	4	01-Aug	14.5	100	1	11.3	8	onmy	61	saco	2	63	
									oncl	1	safo	1	2	
													0	
9.5	41.4	5	01-Aug	14	100		9.5	3	onmy	37	safo	12	49	
10	41.9	5	02-Aug	11	100	lots	5	2.5	onmy	52			52	
10.3	42.2	5	02-Aug	11	100	1	6	10	onmy	12	safo	1	14	
											on spp	1		
10.7	42.6	5	02-Aug	12	100	3	7	2.3	onmy	47			47	
11.2	43.1	5	02-Aug	12	100		4		onmy	56	safo	4	60	
11.5	43.4	5	02-Aug	13	100	3			onmy	54	safo	2	56	
12	43.9	5	02-Aug	14	100	3	3.5	7	onmy	83	safo	21	104	1 tailfr tad
Trapper Creek:														
12.5	0.2	1	02-Aug	14	100		3	3.5	onmy	112	safo	5	117	toad
12.8	0.5	1	02-Aug		100		3	3.8	onmy	64			64	
13	0.7	1	02-Aug	17	100		3	8	onmy	99	safo	4	103	
13.5	1.2	1	02-Aug	17	100		3	3.8	onmy	57	safo	1	58	
14	1.7	1	02-Aug		100		3	2.8	onmy	67			67	

Table 1. Snorkel survey data for Icicle Creek and Trapper Creek, 1995.

TROUT CREEK
Fish Species Composition Snorkle Survey, 1995
Survey Dates: 7/21/95 - 7/25/95
Beginning of clear cut to Trout Lake

UNIT #	APPROX. RKM	USFS REACH #	DATE	H2O TEM oC	LENGTH Meters	HABITAT DESC. # POOLS	WIDTH	MAX DEPTH Feet	1. SPECI	NUMBER	2. SPECI	NUMBER	TOTAL # FISH	AMPHIBS
0.1	2.2	1	21-Jul	9	100		10	2.8	onmy	35			35	2 cascfr
0.6	2.7	1	21-Jul	9	100		10	3.8	onmy	17			17	
1.2	3.3	1	21-Jul	9.5	100		9	3.1	onmy	19			19	
1.7	3.8	1	21-Jul	10	100		8	3.9	onmy	48			48	
2.3	4.1	2	25-Jul	8	100		6	2.8	onmy	18			18	6 tailfr
2.7	4.4	2	25-Jul	9	100			2.9	onmy	18			18	
3.2	4.8	2	25-Jul	9.5	100			3.1	onmy	23			23	1 cascfr
3.9	5.3	2	25-Jul	10.5	100		7	2.1	onmy	120			120	
4.2	5.5	2	25-Jul	10.5	100				onmy	50			50	
4.8	5.9	2	25-Jul	10	100		6	3.1	onmy	56	oncl	2	58	
5	6.1	2	25-Jul	9	100				onmy	33			33	
5.2	6.3	2	25-Jul	9.5	100			2.7	onmy	36			36	

Table 2. Snorkel survey data for Trout Creek, 1995.

JACK CREEK
Fish Species Composition Snorkle Survey, 1995
Survey Dates: 7/26/95 - 8/9/95
Dunn Creek to near headwaters in zone of no fish

UNIT #	APPROX. RKM	USFS REACH #	DATE	H20 TEM oC	LENGTH Meters	HABITAT DESC. # POOLS	WIDTH	MAX DEPTH Feet	1. SPECI	NUMBER	2. SPECI	NUMBER	TOTAL # FISH	AMPHIBS
0.2	4.3	3	26-Jul		100	0	11.8		onmy	58	on spp	2	60	
0.7	4.9	3	26-Jul	9.5	100	0	11.8		onmy	63	on spp	1	64	
1.3	5.6	3	26-Jul	9.5	100	0	11.8	3.2	onmy	90	on spp	1	91	
1.5	5.9	3	07-Aug		100	0		2	onmy	56			56	
2.0	6.4	3	07-Aug		100			2.2	onmy	142			142	
2.6	7.2	3	07-Aug		100	1	7	2.1	onmy	85			85	
3.3	8.1	3	07-Aug	7	100	2		2.8	onmy	76	oncl	1	77	
3.8	8.8	3	10-Aug	6.5	100			2	onmy	24			24	
4.2	9.4	3	10-Aug	6.5	100	4	10	3.5	onmy	25			25	
4.5	10.2	3	10-Aug	6.5	100			2.6	onmy	33	on spp	1	34	
5.0	10.8 11	4	10-Aug	6.5	100	2	7	2	onmy	16	on spp	2	18	
10.2	11.2	4	08-Aug	6	100	3	7	2.5	onmy	31	oncl	2	34	
	11.4										on spp	1		
10.6	11.6	4	08-Aug	6	100	2	8	2.5	onmy	5	oncl	23	35	
											on spp	7		
11.1	12.1	4	08-Aug	6	100	0	5	1.5	on spp	3	oncl	8	11	
11.5	12.5	4	08-Aug	6	100	0	7	1.5	on spp	1	oncl	4	5	
12.0	13	4	08-Aug	6	100	1	7	9			oncl	7	7	
12.8	13.8	4	09-Aug	5	100		4	1.8			oncl	1	1	
13.3	14.3	5	09-Aug	6	100		4	2				0	0	
13.5	14.5	5	09-Aug	6	100		4	2			oncl	6	6	
14.0-14.3	15-15.3	5	09-Aug	6.5	100	20	3	3				0	0	

Table 3. Snorkel survey data for Jack Creek, 1995.

PESHASTIN CREEK
Fish Species Composition Snorkle Survey, 1995
Survey Dates: 9/6/95 - 9/8/95
Ruby Creek to Kings Grave

UNIT #	APPROX. RKM	DATE	H20 TEM oC	LENGTH Meters	HABITAT DESC. # POOLS	WIDTH	MAX DEPTH Feet	1. SPECI	NUMBER	TOTAL # FISH	AMPHIBS
1	16.2	906	10.5	100	2	10	2.5	onmy	29	29	
2	17.9	906		100	2		2.5	onmy	23	23	
3	18.5	906		100	0	9	1	onmy	2	2	
4	19.5	906	11	100	2	8	2	onmy	18	18	
5	21.8	908	10.5	100	0		1.5	onmy	1	1	
6	22.8	908	10.5	100	0	8	2.5	onmy	1	1	
7	24.2	908	10.5	100	2	3	2	onmy	1	1	

Table 4. Snorkel survey data for Peshastin Creek, 1995.

INGALLS CREEK
Fish Species Composition Snorkle Survey, 1995
Survey Dates: 8/10/95 - 8/23/95
Trailhead Bridge to Turnpike Cr. trail

UNIT #	APPROX. RKM	USFS REACH #	DATE	H20 TEMP oC	LENGTH Meters	HABITAT DESC. # POOLS	WIDTH	MAX DEPTH Feet	1. SPECIE	NUMBER	2. SPECIE	NUMBER	TOTAL # FISH	AMPHIBS
0.5	1.4	1	10-Aug	11	100		7	5	onmy	25			25	
0.6	1.5	1	10-Aug		100		7	5	onmy	45			45	
Qual 0.7	1.6	1	10-Aug	11	25	2	11		onmy	22			22	
1.2	2.1	1	10-Aug	11	100		10	5	onmy	50	saco	2	52	
1.7	2.6	1	10-Aug	11	100		9	6	onmy	54			54	
2.4	3.3	1	11-Aug	10	100		7	7	onmy	45			45	
2.7	3.6	1	11-Aug	10	100	3	7	4.1	onmy	44	saco	1	45	
3.3	4.2	1	11-Aug		100		7	5	onmy	25			25	
3.5	4.4	1	11-Aug	10	100				onmy	54			54	
Qual		1	11-Aug		20	2	6		onmy	16	saco	2	18	
4.2	5.1	1	16-Aug	10	100		7	3.2	onmy	37			37	
4.8	5.7	1	16-Aug	10	100		7	3	onmy	35			35	
5.2	6.1	1	16-Aug	10	100		7	2.4	onmy	27			27	
5.5	6.4	1	16-Aug	10	100		7	3.7	onmy	42			42	
					1245									
7.5	8.4	2	24-Aug	8	100	1	7.6	3.4	onmy	26			26	
7.7	8.6	2	24-Aug	7	100	1			onmy	15			15	1 cascfr
8.2	9.1	2	24-Aug	7	100	2	9.7	5	onmy	39	saco	1	40	
8.7	9.5	2	14-Aug	9	100	2		4	onmy	38			38	
9.1	9.9	2	14-Aug	9	100	2	7	3.3	onmy	37			37	
9.7	10.5	2	14-Aug	9	100	3	9	5	onmy	65	saco	2	67	
10	10.8	2	14-Aug	9	100	2	7	2.8	onmy	21			21	
10.6	11.4	2	23-Aug	9.5	100	0	8	2.9	onmy	31			31	
11.1	11.9	2	23-Aug	10.5	100	2		3.3	onmy	19			19	

Table 5. Snorkel survey data for Ingalls Creek, 1995.

NEGRO CREEK
Fish Species Composition Snorkle Survey, 1995
Survey Dates: 8/25/95 - 9/5/95

UNIT #	APPROX. RKM	USFS REACH #	DATE	H20 TEM oC	LENGTH Meters	HABITAT DESC. # POOLS	WIDTH	MAX DEPTH Feet	1. SPECI	NUMBER	2. SPECI	NUMBER	TOTAL # FISH	AMPHIBS
0.3	0.3	1	825	7	100	5		5.2	onmy	7			7	
0.8	0.7	1	825	7	100	2	4.5	1.9	onmy	7			7	
1.1	1	1	825	7.5	100	4	4.5	3	onmy	20			20	
1.8	1.6	1	825	7.5	100	3		2.6	onmy	19	oncl	1	20	
2.1	1.9	1	825	8	100	1		3.5	onmy	20			20	
2.6	2.4	2	825	8.5	100	3		4	onmy	23			23	
3.3	3	2	829	7.5	100	5	5	2.5	onmy	19			19	
3.5	3.2	2	829	7.5	100	5	5	3.5	onmy	16			16	1 cascfr
4.4	4	2	829	8	100	3	5	3.8	onmy	10			10	
4.7	4.3	2	829	7.5	100	5		3.5	onmy	0			0	
5.2	4.7	2	829	6.5	100	3	4.5	4	onmy	1			1	
* in between these units is a high gradient canyon and 2.1 m falls that probably acts as at least a partial fish barrier														
5.7	5.2	3	831	6.5	100	3	4	1.5	oncl	8			8	
5.9	5.4	3	831	5.5	100	3	4	1.5	oncl	26	on spp	3	29	
6.4	6	3	830	7.5	100	4	4	1.5	oncl	10			10	
7.1	6.8	3	830	7.5	100	4	4.5	2	oncl	60	on spp	4	64	
7.7	7.4	3	830	7.5	100	5	4.5	2	oncl	52	on spp	6	58	tailed frog
8	8	3	830	6.5	100	2	4.5	2	oncl	44			44	
8.5	8.6	3	830	6	100	1	3.5	1.4	oncl	0			0	
9	9.2	3	905	6.5	100	1	3.5	1.4		0			0	

Table 6. Snorkel survey data for Negro Creek, 1995.

Appendix D

Fish Population Survey Data Sheets

Appendix D. Fish Population Survey Data Sheet, 1994.

Snorkeling Data

USFWS MCR-FRO Icicle Drainage

Date __/__/94 Page __of__

Stream: __________ Reach: __________ Diver 1: __________

Diver 2: __________

Location: ____________________ Diver 3: __________

Hab. Unit #: ___ Map Coordinate: ________ Diver 4: __________

Begin Time: _____ End Time: _____ Recorder: __________

H20 Temp.: ____ Air Temp.: ____ Underwater Visibility: __________

Weather: ____________________ Photo #: __________

Species	Size	Diver1	Diver2	Diver3	____
____	YOY	____	____	____	____
____	YOY	____	____	____	____
____	<2.9	____	____	____	____
	3-5.9	____	____	____	____
	6-8.9	____	____	____	____
	9-11.9	____	____	____	____
	12-14.9	____	____	____	____
	>15	____	____	____	____
____	<2.9	____	____	____	____
	3-5.9	____	____	____	____
	6-8.9	____	____	____	____
	9-11.9	____	____	____	____
	12-14.9	____	____	____	____
	>15	____	____	____	____
____	<2.9	____	____	____	____
	3-5.9	____	____	____	____
	6-8.9	____	____	____	____
	9-11.9	____	____	____	____
	12-14.9	____	____	____	____
	>15	____	____	____	____
Chin.	age 0	____	____	____	____
Chin.	age 1	____	____	____	____
____	____	____	____	____	____
____	____	____	____	____	____
____	____	____	____	____	____

Habitat

Type: ________

Length: ___._FT

Avwidth: ___._FT

Avdepth: ___._FT

Mxdepth: ___._FT

Amphib: ________

____

____

Comments:

Appendix D. Fish Population Survey Data Sheet, 1995.

Snorkeling Data
USFWS MCR-FRO Icicle Drainage

Date __/__/95 Page __of__

Stream: _____ Reach: _____ Diver 1: _____
GPS : _____N; _____W Diver 2: _____
Unit #: ___ Diver 3: _____
Location: _____ Diver 4: _____

100 meter?_____ Quality habitat?_____ Day?_____ Night?_____
Begin Time: _____ End Time: _____ Recorder: _____
H20 Temp.: _____ Air Temp.: _____
Weather: _____ Photo #:_____

Habitat Description:

Type	Number	Length(s)	Ave Width	Max Depth

Other Pools (plunge, pocket): _____

Snorkel Observations:

Species	Percent	Number	ID +?	Comments*

*habitat type if rare species, etc.

Comments:

Appendix E.

Probabilities of Detecting Bull Trout *from* Hillman and Platts (1993)

Appendix E. *From* Hillman and Platts (1993).

Table 1.–Probabilities of detecting bull trout in a site (power) given some target or mean density (fish/100 m) and number of 100-m long sample sites.

Number of 100-m long sample sites	Mean density (fish/100 m)						
	0.10	0.25	0.40	0.55	0.70	0.85	1.00
1	0.095	0.221	0.329	0.423	0.503	0.572	0.632
2	0.181	0.393	0.550	0.667	0.753	0.817	0.864
3	0.259	0.527	0.698	0.807	0.877	0.921	0.950
4	0.329	0.632	0.798	0.889	0.939	0.966	0.981
5	0.393	0.713	0.864	0.936	0.969	0.985	0.993
6	0.451	0.776	0.909	0.963	0.985	0.993	0.997
7	0.503	0.826	0.939	0.978	0.992	0.997	0.999
8	0.550	0.864	0.959	0.987	0.996	0.998	0.999
9	0.593	0.894	0.972	0.992	0.998	0.999	0.999
10	0.632	0.917	0.981	0.995	0.999	0.999	0.999
11	0.667	0.936	0.987	0.997	0.999	0.999	0.999
12	0.698	0.950	0.991	0.998	0.999	0.999	0.999
13	0.727	0.961	0.994	0.999	0.999	0.999	0.999
14	0.753	0.969	0.996	0.999	0.999	0.999	0.999
15	0.776	0.976	0.997	0.999	0.999	0.999	1.000
16	0.798	0.981	0.998	0.999	0.999	0.999	1.000
17	0.817	0.985	0.998	0.999	0.999	0.999	1.000
18	0.834	0.988	0.999	0.999	0.999	1.000	1.000
19	0.850	0.991	0.999	0.999	0.999	1.000	1.000
20	0.864	0.993	0.999	0.999	0.999	1.000	1.000

Appendix E (continued). *From* Hillman and Platts (1993).

Table 1.–Concluded.

Number of 100-m long sample sites	Mean density (fish/100 m)						
	0.10	0.25	0.40	0.55	0.70	0.85	1.00
21	0.877	0.994	0.999	0.999	1.000	1.000	1.000
22	0.889	0.995	0.999	0.999	1.000	1.000	1.000
23	0.899	0.996	0.999	0.999	1.000	1.000	1.000
24	0.909	0.997	0.999	0.999	1.000	1.000	1.000
25	0.917	0.998	0.999	0.999	1.000	1.000	1.000
26	0.925	0.998	0.999	0.999	1.000	1.000	1.000
27	0.932	0.998	0.999	1.000	1.000	1.000	1.000
28	0.939	0.999	0.999	1.000	1.000	1.000	1.000
29	0.944	0.999	0.999	1.000	1.000	1.000	1.000
30	0.950	0.999	0.999	1.000	1.000	1.000	1.000
31	0.954	0.999	0.999	1.000	1.000	1.000	1.000
32	0.959	0.999	0.999	1.000	1.000	1.000	1.000
33	0.963	0.999	0.999	1.000	1.000	1.000	1.000
34	0.966	0.999	0.999	1.000	1.000	1.000	1.000
35	0.969	0.999	0.999	1.000	1.000	1.000	1.000
36	0.972	0.999	0.999	1.000	1.000	1.000	1.000
37	0.975	0.999	1.000	1.000	1.000	1.000	1.000
38	0.977	0.999	1.000	1.000	1.000	1.000	1.000
39	0.979	0.999	1.000	1.000	1.000	1.000	1.000
40	0.981	0.999	1.000	1.000	1.000	1.000	1.000

Appendix F

Genetic Information Summaries for Ingalls Creek and Negro Creek *from* Proebstel et al. (*in press*)

Appendix F. Genetic information summaries for Ingalls Creek and Negro Creek from Proebstal et al. (*in press*).

Peshastin Creek Watershed:

Ingalls Creek Site 210, N=5, 119-148 mm.

Ingalls Creek was sampled just above its confluence with Peshastin Creek. Specimens collected are primarily interior redband rainbow trout, but there is some indication of a slight influence of coastal rainbow in the population. Scale counts and gill raker numbers are similar to other nearby Peshastin Creek tributaries (lateral series: 151-166, 159.8; above the lateral line: 29-33, 30.8; total gill rakers: 18-20, 18.8), but there is a greater range for pyloric caeca counts (28-55, 41.2). While the mean number of caeca is typical for redband rainbow, it is not expected to observe 55 caeca in an individual unless there has been some gene flow with non-native coastal (hatchery) rainbows. There is also a fair amount of variation within the sample in spotting patterns and secondary rows of primitive parr marks, which also imply different sources of rainbow trout in the population.

Negro Creek Site 206, N=6, 125-145 mm.

Negro Creek enters Peshastin Creek at river mile 10 and was sampled just above the confluence (river mile 0.7). Specimens collected are interior redband rainbow, very similar to rainbow trout collected about 5 miles upstream in North Schaser Creek. Lateral series counts are slightly high for redband rainbow (146-172, 162.8) and scales above the lateral line are 31-36 (33.7). Pyloric caeca numbers are quite typical for redband rainbow (33-48, 40.0), as are gill raker numbers (18-21, 19.2). One specimen has seven vestigial gill rakers on the posterior side of the first gill arch, which is rare in interior redband rainbow trout. None of the specimens have basibranchial teeth, and spotting patterns are variable within the sample (a range of spots on the head was observed, similar to Schaser Creek fish). There are two distance types of parr marks observed in the population, indicating that this is probably not an indigenous "pure" native population of rainbow trout. Mitochondrial DNA RFLP patterns of the cytochrome b and ND-1 genes are diagnostic for rainbow trout, but could not unambiguously identify interior redband from coastal rainbow trout.