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Trudel Creek: Spring Low Flow Fisheries Assessment Data Report

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1. INTRODUCTION

1. Introduction

1.1 Background

The Taltson Hydro Project is located on the Taltson River, 56 km northeast of Fort Smith, Northwest Territories (NWT). The 18 mega-watt (MW) hydro project was originally developed in 1965 to supply power to the Pine Point mine. Since that time, the project has received two major upgrades. Closure of the Pine Point mine in 1986 enabled the expansion of power supply to the communities of Hay River and Fort Fitzgerald, NWT.

The Northwest Territories Energy Corporation's (NTEC) proposed Taltson Expansion Project will alter the flow regime of Trudel Creek, which currently receives excess water not used for power generation in the Taltson River system. The Expansion Project will maximize the use of this excess flow, thereby significantly reducing water flow through the South Valley Spillway and into Trudel Creek. NTEC therefore requires recommendations on a minimum flow threshold into Trudel Creek to avoid significant negative effects on fish and fish habitat, and to meet DFO's *Policy for the Management of Fish Habitat*.

Previous studies focused on identifying the fish community and habitat in Trudel Creek with the objective of developing a minimum flow threshold for the spillway. Data collected in September 2006 helped to identify which species use the Trudel Creek system; however, information on habitat use during key life stages was limited by the timing of the sampling. As a result of this sampling, northern pike (*Esox lucius*) and lake whitefish (*Coregonus clupeaformis*) were identified as species of interest. Lake whitefish was chosen due to its abundance in the Trudel Creek system, and due to its importance to local user groups. Northern pike was also selected because it has specific habitat requirements that overlap with other species in the system (*i.e.*, walleye (*Sander vitreus*)).

1.2 Objectives

In order to develop low-flow thresholds that are sensitive to the habitat needs of fish in Trudel Creek, data must be collected on habitat use. One of the key requirements of any fish species is the availability of suitable spawning habitat. Northern pike rely on shallow, weedy bays and channels for spawning and rearing in the early spring. Walleye also rely on complex, weedy habitat for feeding, while juvenile lake whitefish inhabit near-shore areas during rearing. These areas are most likely to be affected by any alterations to the flow of Trudel Creek; therefore, it is important to know where this habitat occurs in the Trudel Creek system, and whether or not fish are using it. Thus, the objectives of the spring sampling program were:

- To identify potential spawning and rearing areas for the species of interest in the Trudel Creek system; and,
- To determine if the species of interest are currently using those areas for spawning and rearing.

2. METHODS

2. Methods

2.1 Fish Habitat

Fish habitat was assessed and described at six river sites and three lakes along Trudel Creek in 2006 (Rescan, 2006). These sites were re-assessed between May 11 and May 19, 2007 during the spring low-flow period. In addition, one site immediately downstream of the confluence of Trudel Creek and the Taltson River was surveyed so that the impacts of potential flow ramping on the local fish population may be assessed.

Prior to on-the-ground surveys, Trudel Creek was surveyed by air so that areas of potential northern pike spawning and rearing habitat could be identified and documented at each survey location. Rather than describe the habitat of the entire site (which measured up to 500 m long and 200 m wide), habitat assessments were limited to the areas where fish sampling was conducted. This allowed us to develop a more accurate description of the types of habitat being used by fish species in Trudel Creek. Habitat was described in terms of depth, cover type, amount and location of cover, substrate texture and riparian vegetation. The suitability of the habitat for spawning, rearing, and overwintering was described in detail and features such as tributaries, obstructions, and spawning areas were noted. Dissolved oxygen concentrations were collected at some of the sites, and oxygen profiles were constructed for two of the lakes. In addition, the instream vegetation was identified and the extent and density of vegetation was estimated.

2.2 Fish Community

Fish community sampling focused on capturing juvenile pike and whitefish in potential spawning and rearing areas within each survey location. Capturing these individuals can be considered an indicator of spawning activity because juveniles do not stray far from the spawning grounds in the first year. Sampling was conducted using beach seining and electrofishing. Seines were 10 m in length, 0.8 m in depth and had 1/8" mesh to maximize the probability of capturing small fish. Electrofishing was conducted in shallow areas where efficient capture was possible, and the area covered by each electrofishing pass was measured. Catch-per-unit-effort (CPUE) was estimated for each method. For seining, CPUE is calculated as the area of the seine net multiplied by the distance sampled. For electrofishing, CPUE is calculated as the number of fish captured per 100 electrofishing seconds.

Most of the captured fish were measured, weighed, and released alive. Captured fish that were not target species (i.e. sculpins and sticklebacks) were counted, and released alive, and only a subset of those captured were measured. No aging structures were taken because it was assumed that most of the fish captured were less than 1 year old.

3. RESULTS

3. Results

3.1 Fish Habitat

A total of 11 sites were visited on Trudel Creek and Taltson River. At each site fish sampling and habitat assessments were conducted at up to six locations. Habitat assessments of the whole river were not conducted because the focus of this study was on rearing and spawning habitat near the stream margins; however, it is estimated that water levels were on average 0.2 to 0.5 m lower than they were during the previous assessment in October, 2006. The type and amount of habitat available along the stream margins were not noticeably different than they were during the October trip; however, the quality of the habitat was considerably lower due to the absence of instream vegetation (Plate 3.1-1). Most of the instream vegetation seen during the October sampling trip had died and been washed away during the winter months, leaving many sites devoid of cover. The most abundant forms of live vegetation observed during the spring sampling trip were moss, which grew in thick mats in sheltered, flooded, wetland areas, and sedges, which occupied a similar habitat (Plate 3.1-2). Moss did not appear to be a favourable cover type for fish as it was dense and rooted to the substrate, leaving little room for fish to hide underneath. Much of the vegetative cover that could be used by fish was in the form of floating mats of dead vegetation, which collected in sheltered bays and backwater areas (Plate 3.1-3).

Plate 3.1-1. Shoreline of site TD1 in October 2006 (left) and May 2007 (right) showing relative absence of instream vegetation.

This study focused on shallow, near-shore areas where juvenile fish and spawners were most likely to congregate. Habitat types ranged from shallow, muddy bays with little or no cover (Plate 3.1-4), to deep, boulder-dominated riffle edges with turbulent flow (Plate 3.1-5). The mean depth of electrofished areas ranged from 0.2 m at TD5, to 0.45 m at TD6, while the mean depth of seined areas ranged from 0.2 m at TD2 to 1.2 m at TD1. The majority of sampled areas were dominated by fine sediment (62%), followed by gravel (15%) and boulder (13%).

Barriers to fish migration were identified from the air and investigated on the ground. The most likely barrier to fish occurs just upstream of Trudel Lake, where Trudel Creek flows over a 3 to 4 m high falls, followed by an extremely turbulent set of rapids (Plate 3.1-6). The overall drop in water level was estimated to be approximately 10 m over a 200 m distance (Plate 3.1-7). This prevents fish from travelling upstream into Unnamed Lake and upper Trudel Creek. It is therefore likely that fish populations located upstream of that point have either been there since the before the spillway was constructed, or arrived there by travelling downstream over the spillway. Other potential barriers exist downstream of Gertrude Lake; however, these appear to be less steep and may be passable at low water levels.

Plate 3.1-2. Moss and sedge vegetation in a backwater bay, site TD3

Plate 3.1-3. Floating mats of dead vegetation in a small tributary to Gertrude Lake

Plate 3.1-4. Shallow, sandy bay at TD2 looking upstream.

Plate 3.1-5. Boulder/bedrock shoreline at the Trudel Lake inflow, looking downstream.

Plate 3.1-6. Rapids upstream of Trudel Lake, looking upstream

Plate 3.1-7. Aerial view of the rapids upstream of Trudel Lake

3.2 Fish Community

3.2.1 Community and CPUE

Sampling summaries, including catch-per-unit-effort (CPUE) are included in Appendix 3.2-1.

A total of 179 fish were captured during the spring low flow fisheries assessment. Most of the fish captured were juvenile northern pike (*Esox lucius*, Plate 3.2-1), followed by slimy sculpins (*Cottus cognatus*, Plate 3.2-2), ninespine sticklebacks (*Pungitius pungitius*), sucker species (*Catostomus* spp., Plate 3.2-3), burbot (*Lota lota*, Plate 3.2-4), and minnow species (probably spottail shiners – *Notropis hudsonius*, Plate 3.2-5) (Table 3.2-1). Conspicuously absent from the sampling were target species lake whitefish (*Coregonus clupeaformis*) and walleye (*Sander vitreus*). These species were not encountered, despite rigorous sampling of several types of near-shore habitat. Lake whitefish spawn in the fall and juveniles emerge in April or May of the following year. The spring thaw occurred later in 2007 than in previous years, thus it is possible that whitefish juveniles had not yet emerged from the spawning grounds. Juvenile walleye hatch in the fall, and are known to utilize similar habitat to juvenile pike. Limited numbers of adult walleye have been captured in the Trudel Creek system in previous years, and it is possible that the juveniles occur in such low abundances that they were simply not detected during this sampling trip.

Plate 3.2-1. Juvenile northern pike (*Esox lucius*) captured at TD2

Plate 3.2-2. Slimy sculpin (*Cottus cognatus*) captured at Gertrude Lake

Plate 3.2-3. Juvenile sucker (probably longnose – *Catostomus catostomus*) caught at TD6

Plate 3.2-4. Juvenile burbot (*Lota lota*) captured at Trudel Lake

Plate 3.2-5. Juvenile minnow (probably spottail shiner – *Notropis hudsonius*) captured at Trudel Lake

Table 3.2-1
Species Captured from Trudel Creek and Taltson River, May 2007

Species	Number	% of Total
Northern pike	87	49
Slimy sculpin	76	42
Ninespine stickleback	6	3
Sucker spp.	5	3
Burbot	3	2
Minnow spp.	2	1

Trudel Lake and site TD2 had the highest species richness of the all the sites (4 species), while TD5 had the lowest species richness (1 species). Site TD5 is located between Trudel Lake and Gertrude Lake on a straight section of river. The banks of this section are high and steep, resulting in a lack of the shallow, weedy habitat favoured by pike, and also of the shallow, boulder/cobble habitat favoured by sculpins (Plate 3.2-6). Trudel Lake and TD2 both have a wider variety of habitat types including shallow backwaters, tributaries, and boulder patches, and this variety is likely the reason for the higher species richness (Plate 3.2-7).

Plate 3.2-6. Aerial view of site TD5 looking upstream towards Trudel Lake. Note the homogenous habitat throughout the reach.

Plate 3.2-7. Aerial view of site TD2, with a large, shallow shelf in the foreground, and boulder-cobble habitat in the upper right corner of the photo.

Beach seining was found to be a highly inefficient method of capturing juvenile fish in the study area. A total of 8 beach seine hauls were conducted at TD1, TD2, Trudel Lake and Unnamed Lake, covering an area of 5138 m^2 with an average depth of 0.8 m. A total of 10 fish were captured by this method (1 pike, 2 sculpins, 6 sticklebacks and 1 sucker), for a total catch-per-unit-effort (CPUE) of 0.2 fish/100 m^2 of seined area. Because this method did not seem to be an effective method for capturing our target species, it was abandoned in favour of electrofishing.

A total of 24,234 seconds of electrofishing effort were expended over an area of 12,689 m^2 on Trudel Creek and the Taltson River in May, 2007. The mean electrofishing CPUE for all species captured ranged from 0.134 fish/100 s at TD4 to 2.699 fish/100 s at TD6 (Figure 3.2-1). Northern pike CPUE ranged from 0 fish/100 s at TD6 to 0.912 fish/100 s at TD2. Slimy sculpin CPUE ranged from 0 fish/100s at several sites to 2.149 fish/100 s at TD6. Other species were not captured in large enough numbers at enough sites to make comparisons of CPUE.

3.2.2 Length, Weight and Condition

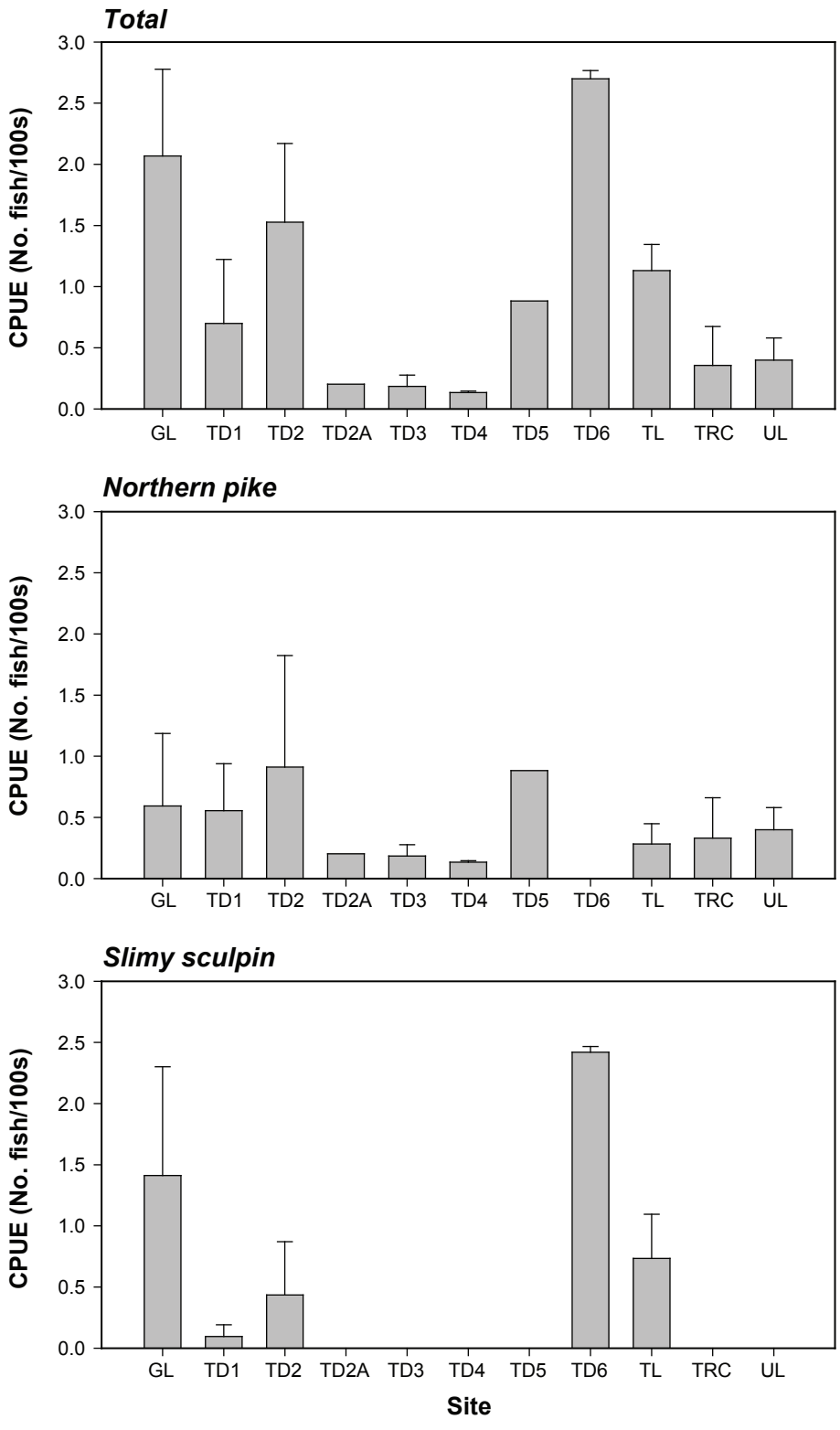
All fish length and weight data are presented in Appendix 3.2-2. Length, weight, and condition data for fish captured during this sampling period are summarized for each species in Table 3.2-2.

Northern pike were captured at all sites except TD6, where pike habitat was extremely limited, and were most abundant in Unnamed Lake (Table 3.2-2). Pike ranged in length from 107 mm in Gertrude Lake to 201 mm at TD4 (Figure 3.2-2). Mean weight ranged from 7.19 g in Gertrude Lake to 60.77 g at TD4. Condition (a measure of fish "fatness") ranged from 0.497 g/mm^3 at the Taltson/Trudel confluence to 0.613 g/mm^3 at Unnamed Lake.

Slimy sculpin were abundant in the Trudel Creek system, but were mostly limited to sites with boulder or cobble habitat. They were captured at five out of the eleven sites (Table 3.2-2). Sculpins ranged in mean length from 53 mm at TD6 to 73 mm at TD2, and in mean weight from 1.95 g to 4.97 g at the same sites (Figure 3.2-3). Slimy sculpin condition ranged from 1.013 g/mm^3 in Trudel Lake to 1.192 g/mm^3 in Gertrude Lake.

A length-frequency distribution constructed for northern pike indicates that at least three age classes may have been captured within the project area in May 2007 (Figure 3.2-4). Three modes occur in the distribution: one between 120 and 140 mm, one between 220 and 240 mm, and a third between 260 and 280 mm. The majority of fish captured were likely aged 1+, because young-of-the-year do not emerge until later in the season.

The length-frequency distribution for slimy sculpins does not indicate age classes. Only one mode appears between 50 and 60 mm in the distribution. This distribution is not an accurate reflection of age classes due to the small size and relatively slow growth rate of these fish.



Note: Error bars represent standard error of the mean.

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Mean Electrofishing Catch-per-Unit-Effort at Sites along Trudel Creek and Taltson River, May 2007

FIGURE 3.2-1

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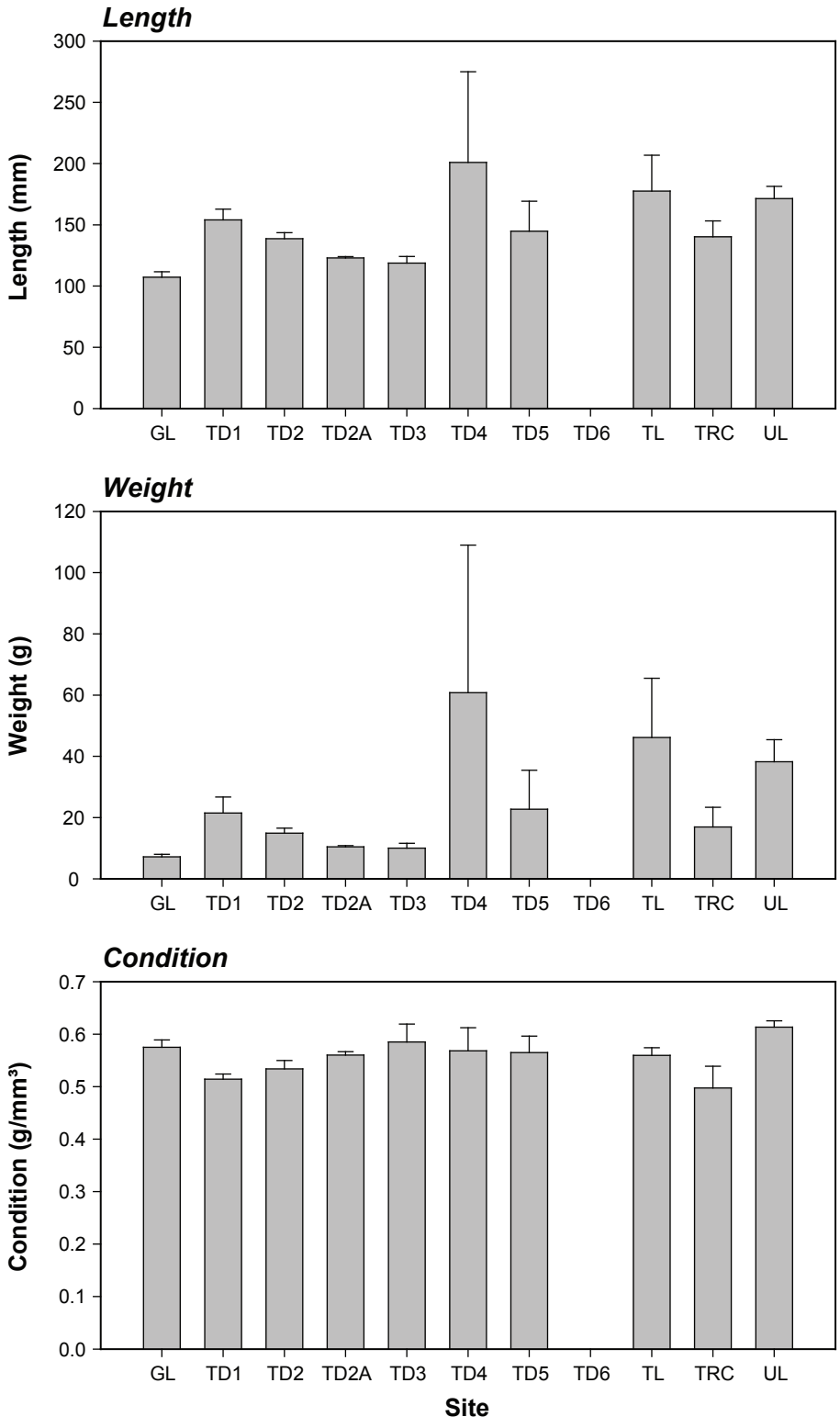
Table 3.2-2
Summary of Fish Abundance, Length, Weight and Condition at Sites along Trudel Creek and Taltson River, May 2007

			Length (mm)				Weight (g)				Condition (g/mm^3)			
Species	**Site**	**N**	**Mean**	**Min**	**Max**	**SE**	**Mean**	**Min**	**Max**	**SE**	**Mean**	**Min**	**Max**	**SE**
Burbot	TL	2	167	120	214	47	32.48	13.75	51.20	18.73	0.66	0.52	0.80	0.14
	TRC	1	146	146	146	-	22.50	22.50	22.50	-	0.72	0.72	0.72	-
Slimy Sculpin	TD1	4	54	42	67	5	2.01	0.69	4.03	0.72	1.13	0.91	1.34	0.12
	TD2	8	73	54	88	4	4.97	1.59	8.16	0.94	1.13	0.92	1.40	0.06
	TL	17	61	31	96	4	2.96	0.19	10.85	0.62	1.01	0.64	1.30	0.05
	GL	26	69	42	94	2	4.37	0.65	12.80	0.51	1.19	0.88	1.54	0.03
	TD6	21	53	33	72	2	1.95	0.38	4.45	0.28	1.10	0.74	1.49	0.04
Minnow spp.	TD2	1	35	35	35	-	0.32	0.32	0.32	-	0.75	0.75	0.75	-
	TL	1	42	42	42	-	0.50	0.50	0.50	-	0.67	0.67	0.67	-
Northern pike	TD1	12	154	129	237	9	21.47	10.87	76.45	5.26	0.51	0.48	0.57	0.01
	TD2	17	139	110	190	5	14.90	7.44	34.06	1.66	0.53	0.34	0.65	0.02
	TD2A	2	123	122	124	1	10.43	10.06	10.80	0.37	0.56	0.55	0.57	0.01
	TD3	4	119	110	132	5	9.99	7.41	14.60	1.59	0.59	0.50	0.65	0.03
	UL	24	171	120	273	10	38.22	9.99	116.70	7.23	0.61	0.42	0.70	0.01
	TD4	2	201	127	275	74	60.77	12.54	109.00	48.23	0.57	0.52	0.61	0.04
	TL	7	178	104	298	29	46.15	6.67	141.50	19.34	0.56	0.52	0.63	0.01
	TD5	4	145	101	215	25	22.73	6.22	60.60	12.73	0.56	0.47	0.61	0.03
	GL	6	107	98	123	4	7.19	5.40	9.68	0.80	0.57	0.52	0.62	0.01
	TRC	9	140	113	232	13	16.90	4.76	66.90	6.46	0.50	0.19	0.58	0.04
Ninespine stickleback	UL	6	38	34	46	2	0.41	0.22	0.88	0.11	0.69	0.51	0.90	0.06
Sucker spp.	TD2	1	78	78	78	-	4.46	4.46	4.46	-	0.94	0.94	0.94	-
	UL	1	38	38	38	-	0.50	0.50	0.50	-	0.91	0.91	0.91	-
	GL	1	61	61	61	-	2.36	2.36	2.36	-	1.04	1.04	1.04	-
	TD6	2	54	41	67	13	1.82	0.62	3.01	1.20	0.95	0.90	1.00	0.05



Note: Error bars represent standard error of the mean.

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Mean Length, Weight, and Condition of Northern Pike Captured at Sites along Trudel Creek and Taltson River, May 2007

FIGURE 3.2-2

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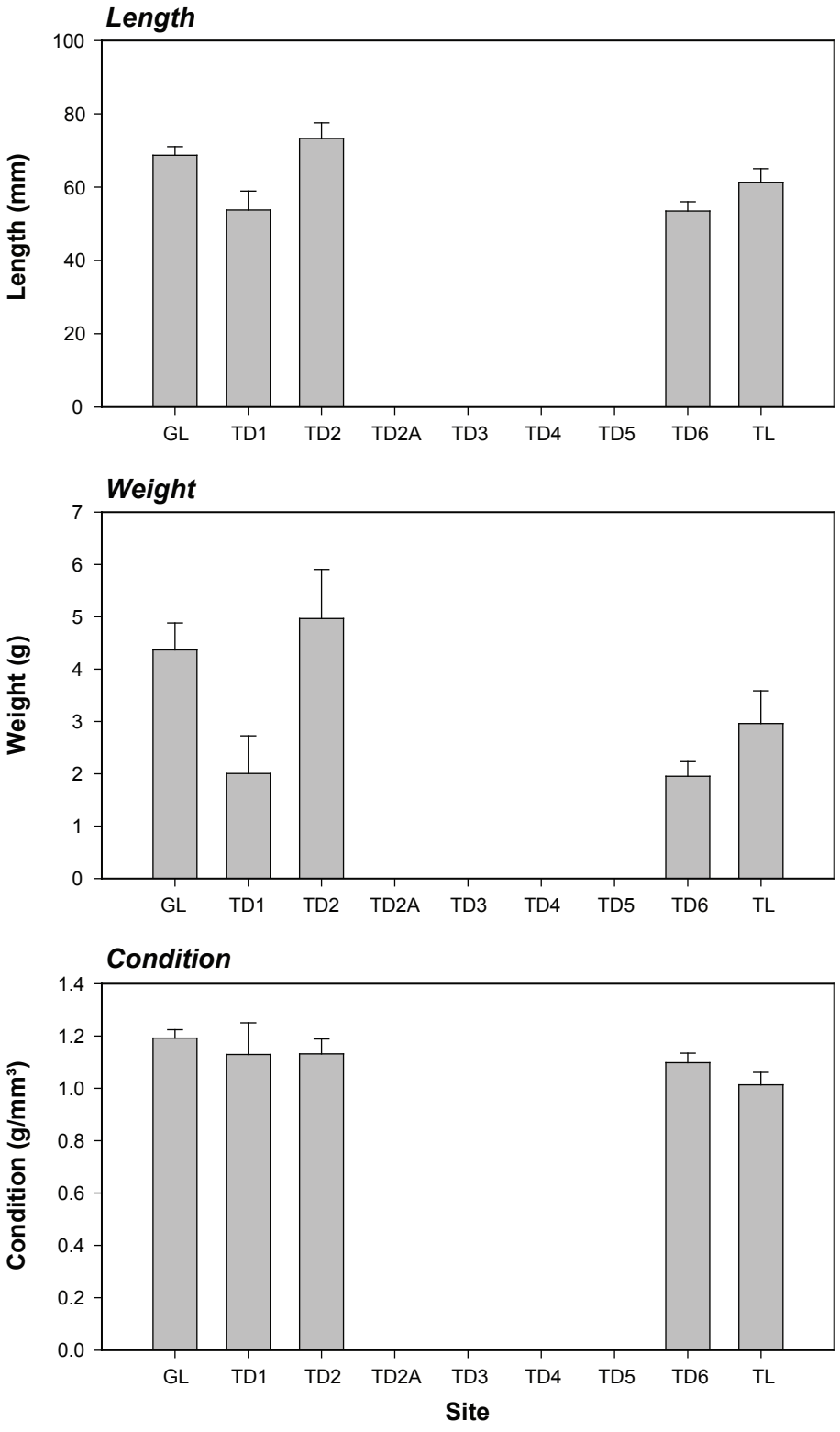
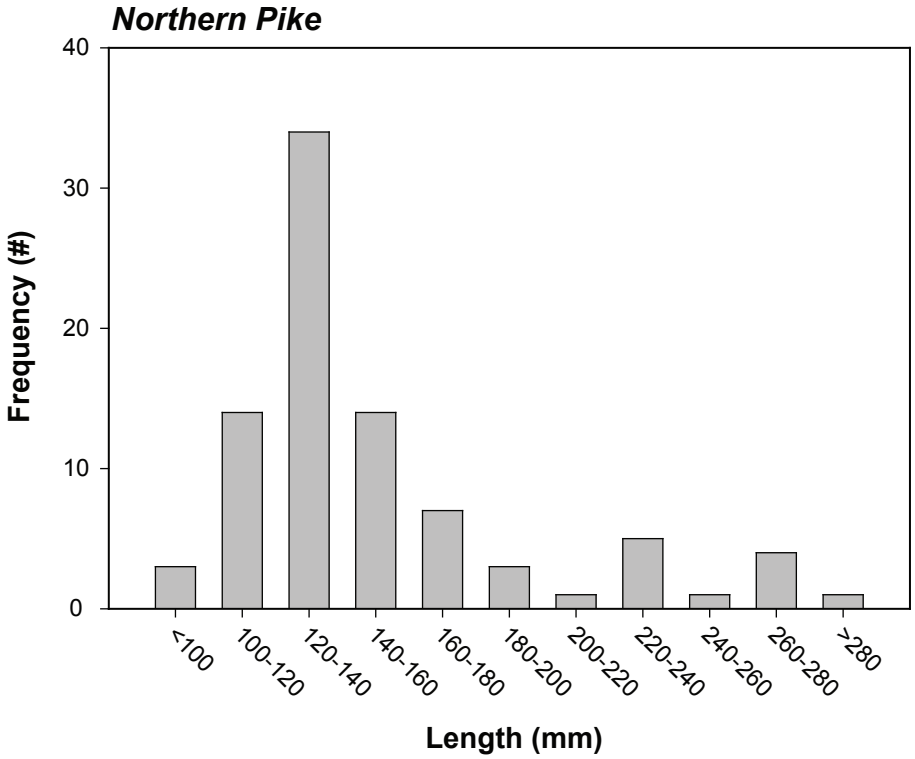
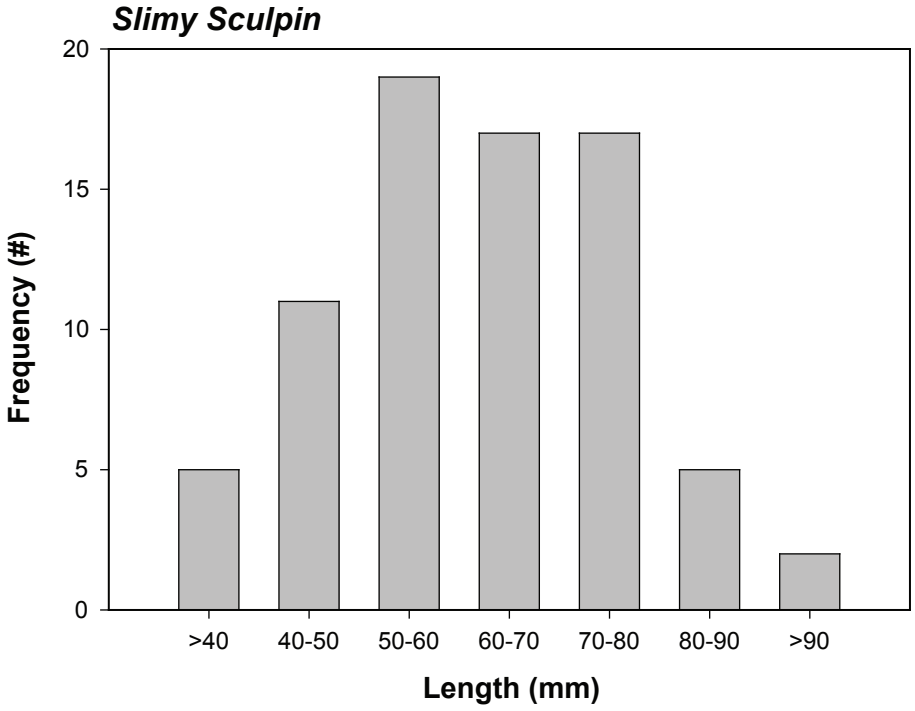


Note: Error bars represent standard error of the mean.

Mean Length, Weight, and Condition of Slimy Sculpin Captured at Sites along Trudel Creek and Taltson River, May 2007

FIGURE 3.2-3





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Length-Frequency Distributions for Northern Pike and Slimy Sculpin Captured at Sites along Trudel Creek and Taltson River, May 2007

FIGURE 3.2-4

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4. SUMMARY

4. Summary

This report presents preliminary data on the species composition and habitat encountered during the May 2007 sampling trip on Trudel Creek and the Taltson River. In general, our observations indicate that spawning and rearing habitat for northern pike is less abundant that previously thought, primarily due to the loss of significant amounts of instream vegetation over winter. Rooted, weedy vegetation was sparse in most areas during the sampling period, even in areas where thick weed beds were observed in October. More common throughout the watershed were backwater bays and ponds that were dominated by moss and sedges; however, pike were not found in high abundances in these areas. Instead, juvenile pike seemed to display preferences for floating mats of dead vegetation, which were found mostly in sheltered bays where wind and currents deposit them. Pike were also associated with large fields of small woody debris.

Pike were found almost exclusively in shallow areas with fine substrates. Areas with boulder or cobble substrates were not used by pike, and instead harboured high densities of sculpins. Sampling sites that had steep banks and little or no off-channel habitat also yielded few pike.

Further analysis of the data will aid in the creation of a set of habitat preferences for juvenile northern pike, as well as in a quantification of available early spring pike habitat in Trudel Creek.

APPENDIX 3.2-1A
BEACH SEINE SAMPLING AND HABITAT SUMMARY

Appendix 3.2-1a
Beach Seine Sampling and Habitat Summary

Site ID	Method	#	Date in	Time in	Date out	Time out	Haul ID	Net Type	Length	Depth	Mesh Size	Width (m)	Length (m)	Area (m^2)	Habitat	Depth (m)	Species
TD1	BS	1	11-May	15:20	11-May	15:40	1	SN	10	1.2	1/8"	24	5	120	Littoral	1.2	CC
TD1	BS	2	12-May	9:00	12-May	9:55	1	SN	10	1.2	1/8"	107	8	856	Littoral	1	CC
TD1	BS	3	12-May	10:00	12-May	10:15	1	SN	10	1.2	1/8"	41	7	287	Littoral	1.4	NFC
TD2	BS	1	12-May	13:55	12-May	14:05	1	SN	10	1.2	1/8"	30	8	240	Littoral	0.2	NFC
TL	BS	1	15-May	11:15	15-May	11:30	1	SN	10	1.2	1/8"	47	8	376	Littoral	0.8	NFC
TL	BS	2	15-May	12:00	15-May	12:20	1	SN	10	1.2	1/8"	38	8	304	Littoral	0.8	NFC
UL	BS	1	14-May	13:00	14-May	13:50	1	SN	10	1.2	1/8"	40	20	800	Littoral	0.6	NSB
UL	BS	1	14-May	13:00	14-May	13:50	1	SN	10	1.2	1/8"	40	20	800	Littoral	0.6	SU
UL	BS	1	14-May	13:00	14-May	13:50	1	SN	10	1.2	1/8"	40	20	800	Littoral	0.6	NP
UL	BS	2	14-May	14:50	14-May	15:15	1	SN	10	1.2	1/8"	37	15	555	Littoral	0.5	NSB

(continued)

Species
NP = Northern pike
BB = Burbot
M = Minnow spp.
CCG = Slimy sculpin
SU = Sucker spp.
NSB = Ninespine stickleback
NFC = No fish caught

Stage
J = Juvenile
A = Adult

Activity
R = Rearing
S = Spawning
H = Holding

Substrate
F = fine
G = gravel
C = cobble
B = boulder
R = bedrock

Cover Amount
L = low
M = moderate
A = abundant

Cover type
B = boulder
DP = deep pool
IV = instream veg
SWD = small woody debris
UC = undercut bank

Veg type
H = horsetail
M = moss
S = sedge
W = weeds
N = none

Appendix 3.2-1a
Beach Seine Sampling and Habitat Summary (completed)

Site ID	Stage	Total Fish	Min Length	Max Length	Activity	Comment	Habitat	Dominant Substrate	Sub-dominant Substrate	Cover Amount	Dominant Cover	Subdominant Cover	Vegetation Type
TD1	J	1	52	-	R		main channel	C	F	L	IV		W
TD1	J	1	54	-	R		main channel	F	G	L	IV		W
TD1		0					main channel	F	G	L	IV		W
TD2		0					bay	F	G	L	IV		W
TL		0					shore	F	G	L	N		N
TL		0					shore	F	C	L	IV	B	W
UL	A	5	34	47	R		shore	F	C	M	SWD	B	W
UL	J	1	38	-	R		shore	F	C	M	SWD	B	W
UL	J	1	167	-	R		shore	F	C	M	SWD	B	W
UL	A	1	46	-	R		bay	F	F	L	IV		W

APPENDIX 3.2-1B
ELECTROFISHING SAMPLING AND HABITAT SUMMARY

Appendix 3.2-1b
Electrofishing Sampling and Habitat Summary

SITE ID	Method	#	Pass	Time in	Time out	Electrofishing seconds	Length (m)	Width (m)	Area (m^2)	Depth (m)	Enclosure	Voltage	Frequency	Pulse	Make	Model	Species	Stage	Age	Total fish	Minimum length (mm)	SITE ID
TD1	EF	1	1	16:20	16:55	696	110	3	330	0.25	O	550	50	4	SR	LR-24	SU	J		1	-	TD1
TD1	EF	1	1	16:20	16:55	696	110	3	330	0.25	O	550	50	4	SR	LR-24	CCG	J		2	42	TD1
TD1	EF	1	1	16:20	16:55	696	110	3	330	0.25	O	550	50	4	SR	LR-24	NP	J		9	129	TD1
TD1	EF	2	1	10:00	10:30	537	120	3	360	0.25	O	600	50	4	SR	LR-24	NP	J		2	153	TD1
TD1	EF	3	1	11:10	11:30	435	40	7	280	0.15	O	480	30	4	SR	LR-24	NFC			0		TD1
TD2	EF	1	1	13:00	13:25	585	50	10	500	0.15	O	500	30	4	SR	LR-24	NP	J		16	110	TD2
TD2	EF	2	1	14:00	14:25	185	40	10	400	0.2	O	580	30	4	SR	LR-24	M	J		1	35	TD2
TD2	EF	3	1	9:15	9:40	613	45	20	900	0.5	O	550	30	4	SR	LR-24	CCG	J A		8	54	TD2
TD3	EF	1	1	9:15	9:40	380	57	5	285	0.3	O	400	30	4	SR	LR-24	NFC			0		TD3
TD3	EF	2	1	10:10	10:40	722	80	5	400	0.3	O	450	30	4	SR	LR-24	NP	J		2	110	TD3
TD3	EF	3	1	13:10	13:30	726	85	2	170	0.15	O	550	30	4	SR	LR-24	NP	J		2	110	TD3
UL	EF	1	1	13:10	13:45	1068	105	5	525	0.3	O	500	30	4	SR	LR-24	NP	J		4	120	UL
UL	EF	2	1	15:30	16:10	770	80	4	320	0.2	O	420	30	4	SR	LR-24	NP	J		1	180	UL
UL	EF	3	1	16:20	17:10	1006	85	4	340	0.2	O	400	30	4	SR	LR-24	NP	J		11	120	UL
UL	EF	4	1	13:00	13:25	686	120	2	240	0.4	O	500	30	4	SR	LR-24	NP	J		2	160	UL
UL	EF	5	1	14:10	14:40	926	50	20	1000	0.3	O	450	30	4	SR	LR-24	NP	J		1	158	UL
TD4	EF	1	1	9:15	9:45	824	89	4	356	0.3	O	430	30	4	SR	LR-24	NP	J		1	127	TD4
TD4	EF	2	1	10:15	11:00	686	62	13	806	0.3	O	530	30	4	SR	LR-24	NP	J		1	275	TD4
TL	EF	1	1	15:15	15:40	738	95	2	190	0.4	O	700	30	4	SR	LR-24	CCG	J A		12	37	TL
TL	EF	1	1	15:15	15:40	738	95	2	190	0.4	O	700	30	4	SR	LR-24	BB	J		1	214	TL
TL	EF	2	1	16:15	16:45	305	78	2	156	0.4	O	650	30	4	SR	LR-24	CCG	J		3	31	TL
TL	EF	3	1	9:15	9:55	622	145	2	290	0.3	O	450	30	4	SR	LR-24	NP	J		4	126	TL
TL	EF	3	1	9:15	9:55	622	145	2	290	0.3	O	450	30	4	SR	LR-24	BB	J		1	120	TL
TL	EF	4	1	10:30	11:05	616	90	3	270	0.5	O	530	30	4	SR	LR-24	M	J		1	42	TL
TL	EF	4	1	10:30	11:05	616	90	3	270	0.5	O	530	30	4	SR	LR-24	CCG	A		2	71	TL
TL	EF	4	1	10:30	11:05	616	90	3	270	0.5	O	530	30	4	SR	LR-24	NP	J		3	104	TL
GL	EF	1	1	11:45	12:15	308	78	2	156	0.3	O	730	30	4	SR	LR-24	CCG	J A		6	48	GL
GL	EF	2	1	12:30	13:10	541	75	3	225	0.4	O	530	30	4	SR	LR-24	CCG	J A		20	42	GL
GL	EF	3	1	13:55	14:10	253	28	1	28	0.15	O	530	30	4	SR	LR-24	NP	J		6	98	GL
GL	EF	4	1	14:20	14:30	390	53	3	159	0.3	O	600	30	4	SR	LR-24	SU	J		1	61	GL
TD5	EF	1	1	12:40	13:05	453	30	4	120	0.2	O	500	30	4	SR	LR-24	NP	J		4	101	TD5
TD6	EF	1	1	9:45	10:15	608	85	4	340	0.5	O	550	30	4	SR	LR-24	CCG	J A		15	33	TD6
TD6	EF	1	1	9:45	10:15	608	85	4	340	0.5	O	550	30	4	SR	LR-24	SU	J		1	41	TD6
TD6	EF	2	1	11:00	11:10	253	85	2	170	0.4	O	550	30	4	SR	LR-24	CCG	J A		6	40	TD6
TD6	EF	2	1	11:00	11:10	253	85	2	170	0.4	O	550	30	4	SR	LR-24	SU	J		1	67	TD6
TRC	EF	1	1	13:00	13:20	286	65	4	260	0.25	O	550	30	4	SR	LR-24	NFC			0		TRC
TRC	EF	2	1	14:15	14:45	1273	76	4	304	0.4	O	500	30	4	SR	LR-24	BB	J		1	146	TRC
TRC	EF	3	1	15:25	15:50	909	67	2	134	0.5	O	500	30	4	SR	LR-24	NP	J		9	113	TRC
TD2A	EF	1	1	11:00	11:20	989	97	5	485	0.2	O	500	30	4	SR	LR-24	NP	J		2	122	TD2A

(continued)

Method
EF = Electrofishing
SN = Seining

Enclosure
O = Open
C = Closed

Make
SR = Smith-Root

Species
NP = Northern pike
BB = Burbot
M = Minnow spp.
CCG = Slimy sculpin
SU = Sucker spp.
NSB = Ninespine stickleback
NFC = No fish caught

Substrate
F = fine
G = gravel
C = cobble
B = boulder
R = bedrock

Cover Amount
L = low
M = moderate
A = abundant

Cover type
B = boulder
DP = deep pool
IV = instream veg
SWD = small woody debris
UC = undercut bank

Veg type
H = horsetail
M = moss
S = sedge
W = weeds
N = none

Appendix 3.2-1b
Electrofishing Sampling and Habitat Summary (completed)

Maximum length (mm)	Activity	Comment	Habitat	Dominant Substrate	Sub-dominant Substrate	Cover Amount	Dominant Cover	Subdominant Cover	Vegetation Type
-	R	Lost	main channel	C	F	L	B	IV	W
67	R		main channel	C	F	L	B	IV	W
237	R		main channel	C	F	L	B	IV	W
157	R		backwater	F	F	A	ICE	IV	W
			backwater	F	F	L	IV		W
190	R		shelf	F	F	A	IV		W
-	R	Possibly shiner (minnow spp.)	shelf	F	F	L	IV		W
88	R		riffle	B	C	L	B		N
			pond	F	F	A	IV	DP	W
132	R		backwater	F	F	A	IV		M S W
123	R		backwater	F	F	A	IV		S M W
273	R		shore	F	F	M	IV		H M W
-	R		shore	F	F	A	SWD	IV	H S M
264	R		shore	F	F	A	SWD	IV	H S
236	R		inflow	F	F	L	IV		M
-	r		shore	F	F	A	SWD	IV	W
-	R		shore	F	F	A	IV		W M
-	R		shore	F	F	A	IV		M H
96	R		main channel	B	R	M	B	DP	N
-	R		main channel	B	R	M	B	DP	N
67	R		main channel	R	B	M	B	DP	N
298	R		inflow	F	F	L	DP	UC	N
-	R		inflow	F	F	L	DP	UC	N
-	R	Possibly shiner (minnow spp.)	shore	G	B	L	B	IV	W
73	R		shore	G	B	L	B	IV	W
139	R		shore	G	B	L	B	IV	W
78	R	missed ~5	shore	G	C	L	IV		W
94	R		outflow	B	C	L	B		N
123	R		trib	F	F	A	IV	SWD	W S
-	R		shore	B	C	M	B		N
215	R		backwater	F	F	L	IV	UC	W
71	R		shoal	G	C	L	B		N
-	R		shoal	G	C	L	B		N
72	R		shore	F	C	L	IV		W
-	R		shore	F	C	L	IV		W
			sandbar	F	F	L			N
-	R		backwater	F	F	A	IV		H M S W
232	R		trib	F	G	A	IV	UC	S W
124	R		backwater	F	F	A	IV	DP	H S M

APPENDIX 3.2-2
INDIVIDUAL FISH DATA

Appendix 3.2-2
Individual Fish Data

Site #	MTD	#	H/P	Spec.	Length	Weight	Condition	ln(length)	ln(weight)	ln(condition)	Voucher #	Comment 1
TL	EF	3	1	BB	120	13.75	0.796	4.787	2.621	-0.229		
TRC	EF	2	1	BB	146	22.5	0.723	4.984	3.114	-0.324		missed 1 adult and maybe 1 juv. Pike
TL	EF	1	1	BB	214	51.2	0.522	5.366	3.936	-0.649		BS 1- no veg, sand substrate, vertical fine banks (eroding) depth ~1?
TL	EF	2	1	CCG	31	0.19	0.638	3.434	-1.661	-0.450		
TD6	EF	1	1	CCG	33	0.38	1.057	3.497	-0.968	0.056		
TL	EF	1	1	CCG	37	0.52	1.027	3.611	-0.654	0.026		
TD6	EF	2	1	CCG	40	0.77	1.203	3.689	-0.261	0.185		
TD6	EF	2	1	CCG	40	0.66	1.031	3.689	-0.416	0.031		
TD6	EF	1	1	CCG	41	0.76	1.103	3.714	-0.274	0.098		
TD1	EF	1	1	CCG	42	0.69	0.931	3.738	-0.371	-0.071		
GL	EF	2	1	CCG	42	0.65	0.877	3.738	-0.431	-0.131		
TD6	EF	1	1	CCG	42	0.55	0.742	3.738	-0.598	-0.298		
TD6	EF	1	1	CCG	43	0.63	0.792	3.761	-0.462	-0.233		
TD6	EF	1	1	CCG	44	0.93	1.092	3.784	-0.073	0.088		
GL	EF	1	1	CCG	48	1.19	1.076	3.871	0.174	0.073		
TD6	EF	1	1	CCG	49	1.75	1.487	3.892	0.560	0.397		
TL	EF	1	1	CCG	50	1.11	0.888	3.912	0.104	-0.119		
GL	EF	2	1	CCG	50	1.14	0.912	3.912	0.131	-0.092		
TD6	EF	1	1	CCG	50	1.28	1.024	3.912	0.247	0.024		
TD1	BS	1	1	CCG	52	1.88	1.337	3.951	0.631	0.290		
TD6	EF	1	1	CCG	52	1.5	1.067	3.951	0.405	0.065		
TL	EF	2	1	CCG	53	1.4	0.940	3.970	0.336	-0.061		
TD1	BS	2	1	CCG	54	1.43	0.908	3.989	0.358	-0.096		
TD2	EF	3	1	CCG	54	1.59	1.010	3.989	0.464	0.010		
TL	EF	1	1	CCG	54	1.58	1.003	3.989	0.457	0.003		
TD6	EF	2	1	CCG	54	1.77	1.124	3.989	0.571	0.117		
TL	EF	1	1	CCG	55	1.46	0.878	4.007	0.378	-0.131		
TL	EF	1	1	CCG	56	1.58	0.900	4.025	0.457	-0.106		
GL	EF	1	1	CCG	56	2.22	1.264	4.025	0.798	0.234		
TD6	EF	1	1	CCG	56	2.2	1.253	4.025	0.788	0.225		
TD6	EF	1	1	CCG	57	1.55	0.837	4.043	0.438	-0.178		
TL	EF	1	1	CCG	58	2.05	1.051	4.060	0.718	0.049		
TL	EF	1	1	CCG	58	1.48	0.759	4.060	0.392	-0.276		
TD6	EF	1	1	CCG	59	2.25	1.096	4.078	0.811	0.091		
TD2	EF	3	1	CCG	60	1.98	0.917	4.094	0.683	-0.087		
GL	EF	2	1	CCG	60	2.04	0.944	4.094	0.713	-0.057		
GL	EF	2	1	CCG	60	2.36	1.093	4.094	0.859	0.089		
TD6	EF	1	1	CCG	60	2.13	0.986	4.094	0.756	-0.014		
GL	EF	2	1	CCG	62	3.02	1.267	4.127	1.105	0.237		
TD6	EF	1	1	CCG	62	2.85	1.196	4.127	1.047	0.179		
TL	EF	1	1	CCG	64	2.99	1.141	4.159	1.095	0.132		
GL	EF	2	1	CCG	64	3.18	1.213	4.159	1.157	0.193		
TD6	EF	2	1	CCG	64	3.12	1.190	4.159	1.138	0.174		
TD6	EF	2	1	CCG	64	3.08	1.175	4.159	1.125	0.161		
GL	EF	1	1	CCG	65	3.42	1.245	4.174	1.230	0.219		Missed ~5
GL	EF	2	1	CCG	65	3.33	1.213	4.174	1.203	0.193		
GL	EF	2	1	CCG	65	2.84	1.034	4.174	1.044	0.034		
TD2	EF	3	1	CCG	66	2.98	1.037	4.190	1.092	0.036		
GL	EF	2	1	CCG	66	3.44	1.197	4.190	1.235	0.179		
GL	EF	2	1	CCG	66	3.69	1.283	4.190	1.306	0.250		
TD1	EF	1	1	CCG	67	4.03	1.340	4.205	1.394	0.293		
TL	EF	2	1	CCG	67	3.9	1.297	4.205	1.361	0.260		
TL	EF	1	1	CCG	68	3.28	1.043	4.220	1.188	0.042		
GL	EF	2	1	CCG	70	4.42	1.289	4.248	1.486	0.254		
TD6	EF	1	1	CCG	70	4.24	1.236	4.248	1.445	0.212		
TL	EF	1	1	CCG	71	2.8	0.782	4.263	1.030	-0.245		
TL	EF	4	1	CCG	71	4.6	1.285	4.263	1.526	0.251		
GL	EF	2	1	CCG	71	4.38	1.224	4.263	1.477	0.202		
TD6	EF	1	1	CCG	71	4.18	1.168	4.263	1.430	0.155		
TD6	EF	2	1	CCG	72	4.45	1.192	4.277	1.493	0.176		
TD2	EF	3	1	CCG	73	4.27	1.098	4.290	1.452	0.093		
TL	EF	4	1	CCG	73	5.01	1.288	4.290	1.611	0.253		
GL	EF	2	1	CCG	73	4.88	1.254	4.290	1.585	0.227		
GL	EF	2	1	CCG	73	4.62	1.188	4.290	1.530	0.172		
GL	EF	1	1	CCG	76	5.68	1.294	4.331	1.737	0.258		
GL	EF	2	1	CCG	76	6.08	1.385	4.331	1.805	0.326		
GL	EF	1	1	CCG	77	4.82	1.056	4.344	1.573	0.054		
GL	EF	1	1	CCG	78	4.75	1.001	4.357	1.558	0.001		
GL	EF	2	1	CCG	78	6.88	1.450	4.357	1.929	0.371		
GL	EF	2	1	CCG	78	5.4	1.138	4.357	1.686	0.129		
TD2	EF	3	1	CCG	80	5.52	1.078	4.382	1.708	0.075		
TL	EF	1	1	CCG	80	5.55	1.084	4.382	1.714	0.081		
TD2	EF	3	1	CCG	81	7.44	1.400	4.394	2.007	0.336		
TD2	EF	3	1	CCG	84	7.79	1.314	4.431	2.053	0.273		
GL	EF	2	1	CCG	85	7.24	1.179	4.443	1.980	0.165		
GL	EF	2	1	CCG	87	9.09	1.380	4.466	2.207	0.322		
TD2	EF	3	1	CCG	88	8.16	1.197	4.477	2.099	0.180	1	taken for ID
GL	EF	2	1	CCG	94	12.8	1.541	4.543	2.549	0.432		

Method

EF = Electrofishing

BS = Beach seine

Species

NP = Northern pike

BB = Burbot

M = Minnow spp.

CCG = Slimy sculpin

SU = Sucker spp.

NSB = Ninespine stickleback

NFC = No fish caught

(continued)

Appendix 3.2-2
Individual Fish Data (continued)

Site #	MTD	#	H/P	Spec.	Length	Weight	Condition	ln(length)	ln(weight)	ln(condition)	Voucher #	Comment 1
TL	EF	1	1	CCG	96	10.85	1.226	4.564	2.384	0.204		EF 3 - missed ~ 3-4 NP
TD2	EF	2	1	M	35	0.32	0.746	3.555	-1.139	-0.293		
TL	EF	4	1	M	42	0.5	0.675	3.738	-0.693	-0.393		possibly shiner (minnow spp.)
GL	EF	3	1	NP	98	5.4	0.574	4.585	1.686	-0.556		
GL	EF	3	1	NP	100	5.64	0.564	4.605	1.730	-0.573		
GL	EF	3	1	NP	100	5.97	0.597	4.605	1.787	-0.516		
TD5	EF	1	1	NP	101	6.22	0.604	4.615	1.828	-0.505		
GL	EF	3	1	NP	103	6.82	0.624	4.635	1.920	-0.471		
TL	EF	4	1	NP	104	7.06	0.628	4.644	1.954	-0.466		
TL	EF	4	1	NP	106	6.67	0.560	4.663	1.898	-0.580		
TD2	EF	1	1	NP	110	7.44	0.559	4.700	2.007	-0.582		
TD3	EF	2	1	NP	110	8.61	0.647	4.700	2.153	-0.436		
TD3	EF	3	1	NP	110	7.41	0.557	4.700	2.003	-0.586		
TD2	EF	1	1	NP	111	8.83	0.646	4.710	2.178	-0.438		
TRC	EF	3	1	NP	113	7.82	0.542	4.727	2.057	-0.613		
TRC	EF	3	1	NP	114	8.45	0.570	4.736	2.134	-0.562		
TD2	EF	1	1	NP	118	8.41	0.512	4.771	2.129	-0.670		
GL	EF	3	1	NP	119	9.61	0.570	4.779	2.263	-0.562		
UL	EF	1	1	NP	120	10.15	0.587	4.787	2.317	-0.532		
UL	EF	3	1	NP	120	9.99	0.578	4.787	2.302	-0.548		
TRC	EF	3	1	NP	122	10.54	0.580	4.804	2.355	-0.544		
TD2A	EF	1	1	NP	122	10.06	0.554	4.804	2.309	-0.591		Part of tail missing
TD3	EF	3	1	NP	123	9.34	0.502	4.812	2.234	-0.689		
GL	EF	3	1	NP	123	9.68	0.520	4.812	2.270	-0.654		
TRC	EF	3	1	NP	123	9.14	0.491	4.812	2.213	-0.711		
TD2	EF	1	1	NP	124	9.25	0.485	4.820	2.225	-0.723		
TD2	EF	1	1	NP	124	11.76	0.617	4.820	2.465	-0.483		
TRC	EF	3	1	NP	124	10.71	0.562	4.820	2.371	-0.577		
TD2A	EF	1	1	NP	124	10.8	0.566	4.820	2.380	-0.568		
TRC	EF	3	1	NP	125	11	0.563	4.828	2.398	-0.574		
UL	EF	3	1	NP	126	11.61	0.580	4.836	2.452	-0.544		
TL	EF	3	1	NP	126	11.65	0.582	4.836	2.455	-0.541		
UL	EF	3	1	NP	127	13.05	0.637	4.844	2.569	-0.451		
TD4	EF	1	1	NP	127	12.54	0.612	4.844	2.529	-0.491		DO: 3.8 mg/L
TD5	EF	1	1	NP	127	9.71	0.474	4.844	2.273	-0.746		
TD2	EF	1	1	NP	128	12.17	0.580	4.852	2.499	-0.544		
TD1	EF	1	1	NP	129	10.87	0.506	4.860	2.386	-0.681		
TD1	EF	1	1	NP	131	11.26	0.501	4.875	2.421	-0.691		
TD2	EF	1	1	NP	131	12.28	0.546	4.875	2.508	-0.605		
TD3	EF	2	1	NP	132	14.6	0.635	4.883	2.681	-0.454		EF3- Missed 4 NP
UL	EF	5	1	NP	132	15.65	0.680	4.883	2.750	-0.385		
UL	EF	5	1	NP	132	15.19	0.660	4.883	2.721	-0.415		
TD1	EF	1	1	NP	135	12.01	0.488	4.905	2.486	-0.717		
TD2	EF	1	1	NP	136	13.75	0.547	4.913	2.621	-0.604		
TD5	EF	1	1	NP	136	14.4	0.572	4.913	2.667	-0.558		
TD1	EF	1	1	NP	137	14.68	0.571	4.920	2.686	-0.561		
TRC	EF	3	1	NP	137	14.76	0.574	4.920	2.692	-0.555		
TD2	EF	1	1	NP	138	14.18	0.540	4.927	2.652	-0.617		fungus on tail
TD1	EF	1	1	NP	139	14.06	0.524	4.934	2.643	-0.647		
TD2	EF	1	1	NP	139	9.2	0.343	4.934	2.219	-1.071		
UL	EF	3	1	NP	139	15.57	0.580	4.934	2.745	-0.545		
TL	EF	4	1	NP	139	13.92	0.518	4.934	2.633	-0.657		
TD1	EF	1	1	NP	140	13.93	0.508	4.942	2.634	-0.678		
UL	EF	3	1	NP	140	17.42	0.635	4.942	2.858	-0.454		
TD2	EF	1	1	NP	142	15.56	0.543	4.956	2.745	-0.610		
TD2	EF	1	1	NP	143	16.73	0.572	4.963	2.817	-0.558		
UL	EF	3	1	NP	143	20.39	0.697	4.963	3.015	-0.361		
TD2	EF	1	1	NP	144	16.76	0.561	4.970	2.819	-0.578		
UL	EF	3	1	NP	147	19.34	0.609	4.990	2.962	-0.496		
TD1	EF	1	1	NP	149	16.15	0.488	5.004	2.782	-0.717		
TD1	EF	2	1	NP	153	17.45	0.487	5.030	2.859	-0.719		
TD1	EF	1	1	NP	153	17.58	0.491	5.030	2.867	-0.712		
TD2	EF	1	1	NP	154	17.6	0.482	5.037	2.868	-0.730		
UL	EF	5	1	NP	155	22.86	0.614	5.043	3.129	-0.488		
TD2	EF	1	1	NP	156	19.5	0.514	5.050	2.970	-0.666		
TD1	EF	2	1	NP	157	21.51	0.556	5.056	3.069	-0.587		
UL	EF	5	1	NP	158	26.1	0.662	5.063	3.262	-0.413		
UL	EF	4	1	NP	160	27.2	0.664	5.075	3.303	-0.409		
UL	EF	1	1	NP	163	26.69	0.616	5.094	3.284	-0.484		
UL	EF	3	1	NP	163	28.37	0.655	5.094	3.345	-0.423		
UL	EF	3	1	NP	166	30.18	0.660	5.112	3.407	-0.416		
UL	BS	1	1	NP	167	25.91	0.556	5.118	3.255	-0.586		
TD2	EF	1	1	NP	169	25.75	0.533	5.130	3.248	-0.628		
TRC	EF	3	1	NP	172	22.75	0.447	5.147	3.125	-0.805		
UL	EF	2	1	NP	180	33.89	0.581	5.193	3.523	-0.543		
TD1	EF	1	1	NP	188	31.66	0.476	5.236	3.455	-0.741		
UL	EF	3	1	NP	189	28.47	0.422	5.242	3.349	-0.863		
TD2	EF	1	1	NP	190	34.06	0.497	5.247	3.528	-0.700		

Method
EF = Electrofishing
BS = Beach seine

Species
NP = Northern pike
BB = Burbot
M = Minnow spp.
CCG = Slimy sculpin
SU = Sucker spp.
NSB = Ninespine stickleback
NFC = No fish caught

(continued)

Appendix 3.2-2
Individual Fish Data (completed)

Site #	MTD	#	H/P	Spec.	Length	Weight	Condition	ln(length)	ln(weight)	ln(condition)	Voucher #	Comment 1
TD5	EF	1	1	NP	215	60.6	0.610	5.371	4.104	-0.495		
TRC	EF	3	1	NP	232	66.9	0.536	5.447	4.203	-0.624		missed 2 BB and 1 or 2 NP
TL	EF	3	1	NP	233	66.25	0.524	5.451	4.193	-0.647		
UL	EF	4	1	NP	236	84.2	0.641	5.464	4.433	-0.445		
TD1	EF	1	1	NP	237	76.45	0.574	5.468	4.337	-0.555		
TL	EF	3	1	NP	237	76	0.571	5.468	4.331	-0.561		
UL	EF	5	1	NP	247	102.63	0.681	5.509	4.631	-0.384		
UL	EF	3	1	NP	264	102.19	0.555	5.576	4.627	-0.588		
UL	EF	1	1	NP	267	113.42	0.596	5.587	4.731	-0.518		
UL	EF	1	1	NP	273	116.7	0.574	5.609	4.760	-0.556		
TD4	EF	2	1	NP	275	109	0.524	5.617	4.691	-0.646		
TL	EF	3	1	NP	298	141.5	0.535	5.697	4.952	-0.626		
UL	BS	1	1	NSB	34	0.32	0.814	3.526	-1.139	-0.206		
UL	BS	1	1	NSB	34	0.23	0.585	3.526	-1.470	-0.536		
UL	BS	1	1	NSB	35	0.22	0.513	3.555	-1.514	-0.667		
UL	BS	1	1	NSB	37	0.28	0.553	3.611	-1.273	-0.593		
UL	BS	1	1	NSB	42	0.55	0.742	3.738	-0.598	-0.298		
UL	BS	2	1	NSB	46	0.88	0.904	3.829	-0.128	-0.101		
UL	BS	1	1	SU	38	0.5	0.911	3.638	-0.693	-0.093		
TD6	EF	1	1	SU	41	0.62	0.900	3.714	-0.478	-0.106		
GL	EF	4	1	SU	61	2.36	1.040	4.111	0.859	0.039		
TD6	EF	2	1	SU	67	3.01	1.001	4.205	1.102	0.001		
TD2	EF	3	1	SU	78	4.46	0.940	4.357	1.495	-0.062		

Method

EF = Electrofishing

BS = Beach seine

Species

NP = Northern pike

BB = Burbot

M = Minnow spp.

CCG = Slimy sculpin

SU = Sucker spp.

NSB = Ninespine stickleback

NFC = No fish caught