SITE C CLEAN ENERGY PROJECT
SITE C FISHERIES STUDIES
PEACE RIVER FISH INVENTORY
- 2010 -

Volume 1 of 2

Prepared for

B.C. Hydro
Site C Project, Corporate Affairs
Suite 1100, Four Bentall Centre
1055 Dunsmuir Street
PO Box 49260
Vancouver, British Columbia
V6X 1V5

By

Mainstream Aquatics Ltd.
6956 Roper Road
Edmonton, Alberta
T6B 3H9

October 2011

mainstream
AQUATICS LTD

Citation: Mainstream Aquatics Ltd. 2011. Site C fisheries studies – 2010 Peace River Fish Inventory. Prepared for B.C. Hydro Site C Project, Corporate Affairs Report No. 10005F: 102 p. + plates and appendices.

NOTIFICATION

Client: B.C. Hydro Site C Project, Corporate Affairs

Report prepared by:

original signed by

Rick Pattenden, M. Sc., P. Biol.
Principal, Senior Biologist

This page is intentionally blank.

EXECUTIVE SUMMARY

B.C. Hydro is considering the Peace River Site C Hydroelectric Project (Site C) in north eastern British Columbia (BC) as a potential resource option to help meet BC's future electricity needs. B.C. Hydro is taking a stage-by-stage approach to the evaluation of Site C. B.C. Hydro is currently in Stage 3, Environmental and Regulatory Review. Fisheries studies are presently underway to add to existing baseline information and to address data gaps in order to assist in completion of Stage 3.

Currently there is baseline information that describes the fish community in the Peace River from Peace Canyon (PCN) Dam to the British Columbia/Alberta boundary. Fish investigations include historical Site C baseline studies, preliminary fish surveys completed in 2005 and 2006 and ongoing studies by the Peace River Fish Index Project under the direction of B.C. Hydro Water License Requirements (WLR) (2001 to present). In 2009, Mainstream Aquatics Ltd. completed a seasonal fish inventory on the Peace River (Mainstream 2010). The goal of the current program is continue and expand on the 2009 study in order to address data gaps in our knowledge of the Peace River fish community.

The purpose of the 2010 study was to collect baseline information to describe the fish community in the Peace River study area, which extended from the PCN Dam to 20 km downstream of the British Columbia/Alberta boundary. The study used several fish capture methods in a variety of fish habitats during three seasons. It also coordinated efforts with the 2010 WLR Peace River Fish Index Project in order to maximize sampling efficiencies and to enhance the data set. The study examined environmental conditions, fish community structure, catch rate, population characteristics, and fish health. Fish also were marked with permanent tags to monitor future growth and movement patterns.

The program was successful in achieving its goal. The Peace River supports a diverse fish community that includes coldwater and coolwater sportfish, suckers, minnows, and sculpins. Fish community structure is not constant within the study area. There is a gradual shift from a coldwater sportfish community dominated by mountain whitefish in the upstream area, to a more diverse fish community in the downstream area that is represented by multiple fish groups and species. This shift in fish community structure represents a transition from a cold, clear water fish community to a coolwater fish community that contains species that are more tolerant of adverse environmental conditions (e.g., elevated fine sediment levels and higher water temperatures).

The majority of sportfish species are numerous in main channel habitats of the Peace River. A limited number of species (spottail shiner, northern pike, and yellow perch) appear to rely heavily on side channel habitats. Sucker species and many minnow species are numerous at tributary confluences, suggesting that tributaries are focal points for these populations.

Preliminary evidence suggests that most species in the study area are represented by viable, self sustaining fish populations. The majority likely spawn and rear in tributaries before recruiting to Peace River populations. Data from only one species, mountain whitefish, indicated the potential for widespread spawning in the mainstem Peace River. Large sportfish species such as northern pike and yellow perch appear to rely heavily on protected side channel habitats for spawning and early rearing. Suckers also appear to rely on side channel habitats for rearing. A limited number of fish populations may be maintained by recruitment via entrainment through the PCN Dam. These include kokanee and lake trout. A single young-of-the-year goldeye was recorded just downstream of the Beatton River confluence, suggesting at least some recruitment to goldeye populations from the study area.

Most coldwater species were recorded upstream and downstream of the proposed Site C dam (mountain whitefish, bull trout, kokanee, and rainbow trout), as were most suckers (longnose sucker, largescale sucker, and white sucker), and sculpins (prickly sculpin and slimy sculpin), and some of the minnows (lake chub, longnose dace, redside shiner, and spottail shiner). An exception to this spatial pattern was the coolwater sportfish group. Burbot, goldeye, northern pike, walleye, and yellow perch, were largely restricted to the downstream section of the study area (i.e., downstream of the proposed Site C dam).

The present study and the 2009 work provide a good description of the Peace River fish community. Additional work can be used to confirm these findings and to increase the certainty around future interpretation of the baseline data.

ACKNOWLEDGEMENTS

This report was produced for Bruce Mattock of the Site C Project, Corporate Affairs study team.

The following Mainstream Aquatics Ltd. personnel participated in the program:

Richard Pattenden	Senior Biologist and primary author
Ben Meunier	Project Biologist and contributing author
Scott Taylor	Project Biologist and contributing author
Ashley Morton	Project Biologist
Jennie Ryman	Project Biologist
Derek Gastle	Project Biologist
Chantal Pattenden	Senior Technician and editor
Dave Winarski	Biological Technician
Kent Nuspl	Biological Technician
Julie Kline	Biological Technician

This page is intentionally blank.

TABLE OF CONTENTS

Page #

NOTIFICATION ..... **i**
EXECUTIVE SUMMARY ..... **iii**
ACKNOWLEDGEMENTS ..... **v**
TABLE OF CONTENTS ..... **vii**
LIST OF TABLES ..... **xi**
LIST OF FIGURES ..... **xiii**
1.0 INTRODUCTION **1**
1.1 BACKGROUND **1**
1.2 PURPOSE AND OBJECTIVES **1**
1.3 STUDY AREA **2**
1.4 SAMPLE PERIOD **2**
2.0 METHODS **5**
2.1 FIELD PROGRAM **5**
2.1.1 Approach and Design 5
2.1.2 Fish Capture Methods 7
2.1.3 Observed Fish 10
2.1.4 Processing Fish 10
2.1.5 Sample and Site Characteristics 13
2.1.6 Number and Distribution of Sites 14
2.2 OFFICE PROGRAM **15**
2.2.1 Quality Assurance and Quality Control 15
2.2.2 Mapping 15
2.2.3 Discharge and Water Temperature 16
2.2.4 Fish Community Structure and Catch Rate 16
2.2.5 Biological Characteristics 19
2.2.6 Distribution of Young Fish 22
2.2.7 Fish Community Health 22
3.0 RESULTS **25**
3.1 ENVIRONMENTAL CONDITIONS **25**
3.1.1 Discharge 25
3.1.2 Water Clarity 26
3.1.3 Water Temperature 27
3.1.4 Water Conductivity 27
3.2 FISH COMMUNITY STRUCTURE **29**
3.2.1 Species Composition 29
3.2 2 Fish Assemblage 30
3.2.3 Species Diversity 33

3.2.4 Species Occurrence 34
3.3 COLDWATER SPORTFISH POPULATIONS 36
3.3.1 Arctic grayling 37
3.3.1.1 Catch Rate 37
3.3.1.2 Biological Characteristics 38
3.3.1.3 Distribution of Young Fish 39
3.3.2 Bull trout 41
3.3.2.1 Catch Rate 41
3.3.2.2 Biological Characteristics 42
3.3.2.3 Distribution of Young Fish 43
3.3.3 Kokanee 45
3.3.3.1 Catch Rate 45
3.3.3.2 Biological Characteristics 46
3.3.3.3 Distribution of Young Fish 46
3.3.4 Lake trout 48
3.3.5 Lake whitefish 48
3.3.6 Mountain whitefish 49
3.3.6.1 Catch Rate 49
3.3.6.2 Biological Characteristics 50
3.3.6.3 Distribution of Young Fish 51
3.3.7 Rainbow trout 53
3.3.7.1 Catch Rate 53
3.3.7.2 Biological Characteristics 54
3.3.7.3 Distribution of Young Fish 55
3.4 COOLWATER SPORTFISH POPULATIONS 57
3.4.1 Burbot 57
3.4.1.1 Catch Rate 57
3.4.1.2 Biological Characteristics 58
3.4.1.3 Distribution of Young Fish 58
3.4.2 Goldeye 60
3.4.2.1 Catch Rate 60
3.4.2.2 Biological Characteristics 61
3.4.2.3 Distribution of Young Fish 62
3.4.3 Northern Pike 63
3.4.3.1 Catch Rate 63
3.4.3.2 Biological Characteristics 64
3.4.3.3 Distribution of Young Fish 65
3.4.4 Walleye 67
3.4.4.1 Catch Rate 67
3.4.4.2 Biological Characteristics 68
3.4.4.3 Distribution of Young Fish 69
3.4.5 Yellow Perch 71

3.4.5.1 Catch Rate 71
3.4.5.2 Biological Characteristics 71
3.4.5.3 Distribution of Young Fish 72
3.5 SUCKER POPULATIONS 74
3.5.1 Longnose Sucker 74
3.5.1.1 Catch Rate 74
3.5.1.2 Biological Characteristics 75
3.5.1.3 Distribution of Young Fish 76
3.5.2 Largescale Sucker 78
3.5.2.1 Catch Rate 78
3.5.2.2 Biological Characteristics 78
3.5.2.3 Distribution of Young Fish 80
3.5.3 White Sucker 82
3.5.3.1 Catch Rate 82
3.5.3.2 Biological Characteristics 82
3.5.3.3 Distribution of Young Fish 83
3.6 MINNOW AND SCULPIN POPULATIONS 85
3.6.1 Northern Pikeminnow 85
3.6.1.1 Catch Rate 85
3.6.1.2 Biological Characteristics 86
3.6.1.3 Distribution of Young Fish 86
3.6.2 MINNOWS GENERAL 88
3.6.3 SCULPINS GENERAL 90
3.7 FISH COMMUNITY HEALTH 91
4.0 DISCUSSION 93
4.1 ENVIRONMENTAL CONDITIONS 93
4.2 FISH COMMUNITY STRUCTURE 93
4.3 CATCH RATE 94
4.4 POPULATION CHARACTERISTICS 95
4.5 DISTRUBUTION OF YOUNG FISH 96
4.6 FISH COMMUNITY HEALTH 97
5.0 CONCLUSIONS 99
6.0 LITERATURE CITED 101

Plates

Appendix A – Site Locations
Appendix B – Definitions
Appendix C – Sample Effort and Conditions
Appendix D – Site Characteristics
Appendix E – Catch Rates
Appendix F – Biological Characteristics
Appendix G – Young Fish Distribution

Page is intentionally blank.

LIST OF TABLES

Page #

Table 1.1 Study area zones and sections, 2010 Site C Peace River Fish Inventory. 2

Table 2.1 Habitat and fish group targeted by fish capture method, 2010 Site C Peace River Fish Inventory. 7

Table 2.2 Nomenclature and abbreviations used for recorded fish species, 2010 Site C Peace River Fish Inventory 11

Table 2.3 Number of sites sampled by zone and section and season by large fish capture methods, 2010 Site C Peace River Fish Inventory. 14

Table 2.4 Number of sites sampled by zone and section and season by small fish capture methods, 2010 Site C Peace River Fish Inventory. 14

Table 2.5 Number of sites sampled by zone, section, method, and habitat area, 2010 Site C Peace River Fish Inventory. 15

Table 2.6 Number of fish enumerated by species and capture method, 2010 Site C Peace River Fish Inventory 17

Table 2.7 Summary of data sets used for analyses of fish species biological characteristics, 2010 Site C Peace River Fish Inventory 20

Table 2.8 Length of Age 0 and Age 1 fish of selected large fish species, 2010 Site C Peace River Fish Inventory 22

Table 3.1 Composition of enumerated fish species, 2010 Site C Peace River Fish Inventory (all capture methods and sample events combined). 29

Table 3.2 Distribution of fish species by section and zone recorded on the Peace River, 2010 Site C Peace River Fish Inventory (all capture methods and sample events combined). 33

Table 3.3 Mean length-at-age and condition-at-age of Arctic grayling in Zone 1 and Zone 2, 2010 Site C Peace River Fish Inventory 39

Table 3.4 Mean length-at-age and condition-at-age of bull trout in Zone 1 and Zone 2, 2010 Site C Peace River Fish Inventory 43

Table 3.5 Mean length-at-age and condition-at-age of lake whitefish (Zones 1 and 2 combined), 2010 Site C Peace River Fish Inventory 48

Table 3.6 Mean length-at-age and condition-at-age of mountain whitefish in Zone 1 and Zone 2, 2010 Site C Peace River Fish Inventory 51

Table 3.7 Mean length-at-age and condition-at-age of rainbow trout (Zones 1 and 2 combined), 2010 Site C Peace River Fish Inventory 55

Table 3.8 Mean length-at-age and condition-at-age of goldeye (Zones 1 and 2 combined), 2010 Site C Peace River Fish Inventory 61

Table 3.9 Mean length-at-age and condition-at-age of northern pike (Zones 1 and 2 combined), 2010 Site C Peace River Fish Inventory 65

Table 3.10 Mean length-at-age and condition-at-age of walleye (Zones 1 and 2 combined), 2010 Site C Peace River Fish Inventory 69

Table 3.11 Mean length-at-age and condition-at-age of yellow perch (Zones 1 and 2 combined), 2010 Site C Peace River Fish Inventory 72

Table 3.12 Mean length-at-age and condition-at-age of longnose sucker in Zone 1 and Zone 2, 2010 Site C Peace River Fish Inventory.....76

Table 3.13 Mean length-at-age and condition-at-age of largescale sucker in Zone 1 and Zone 2, 2010 Site C Peace River Fish Inventory.....80

Table 3.14 Summary of minnow and sculpin catch rates, 2010 Site C Peace River Fish Inventory (all seasons and sections combined).....88

Table 3.15 Summary of minnow and sculpin species population length characteristics, 2010 Site C Peace River Fish Inventory.....90

Table 3.16 Summary of DELT percentages for selected large fish species collected by boat electrofisher (includes fish sampled during 2010 WLR Peace River Fish Index Project), 2010 Site C Peace River Fish Inventory.....92

LIST OF FIGURES

Page #

Figure 1.1 2010 Site C Peace River Fish Inventory Study Area.....3

Figure 3.1 Peace River mean daily discharge at Water Survey of Canada Stations and PCN Dam from January to December, 2010 Site C Peace River Fish Inventory. (The fall session sampling period includes Peace River Fish Indexing Program).....25

Figure 3.2 Peace River hourly discharge at Water Survey of Canada Stations and PCN Dam during May and June, 2010 Site C Peace River Fish Inventory.....26

Figure 3.3 Mean water clarity measured at sites by section, season, and habitat, 2010 Site C Peace River Fish Inventory (MC – main channel, SC – side channel, TC – tributary confluence).....26

Figure 3.4 Mean water temperatures measured at sample sites by section, season, and habitat, 2010 Site C Peace River Fish Inventory (MC – main channel, SC – side channel, TC – tributary confluence).....27

Figure 3.5 Mean water conductivity measured at sample sites by section, season, and habitat, 2010 Site C Peace River Fish Inventory (MC – main channel, SC – side channel, TC – tributary confluence).....28

Figure 3.6 Relative contribution of fish groups by section and zone, 2010 Site C Peace River Fish Inventory (all capture methods and sample events combined).....31

Figure 3.7 Relative contribution of fish groups by habitat type and zone, 2010 Site C Peace River Fish Inventory (all capture methods and sample events combined).....32

Figure 3.8 Percent occurrence of fish species at sampled sites within each section by zone, 2010 Site C Peace River Fish Inventory (all capture methods and sample events combined).....35

Figure 3.9 Percent occurrence of fish species at sampled sites within habitat types by zone, 2010 Site C Peace River Fish Inventory (all capture methods and sample events combined).....36

Figure 3.10 Average catch rates (± SE) of Arctic grayling in study sections during spring, summer, and fall, 2010 Site C Peace River Fish Inventory (small fish ≤ 200 mm fork length and large fish > 200 mm fork length; SF – small fish method, LF – large fish method).....37

Figure 3.11 Biological characteristics of sampled Arctic grayling, 2010 Site C Peace River Fish Inventory (Table 2.6 identifies data selected for analyses).....38

Figure 3.12 Distribution of Age 0 Arctic grayling, 2010 Site C Peace River Fish Inventory.....40

Figure 3.13 Average catch rates (± SE) of bull trout in study sections during spring, summer, and fall, 2010 Site C Peace River Fish Inventory (small fish ≤ 200 mm fork length and large fish > 200 mm fork length; SF – small fish method, LF – large fish method).....41

Figure 3.14 Biological characteristics of sampled bull trout, 2010 Site C Peace River Fish Inventory (Table 2.6 identifies data selected for analyses).....42

Figure 3.15 Distribution of young (Age 1) bull trout, 2010 Site C Peace River Fish Inventory.....44

Figure 3.16 Average catch rates (± SE) of kokanee in study sections during spring, summer, and fall, 2010 Site C Peace River Fish Inventory (small fish ≤ 200 mm fork length and large fish > 200 mm fork length; SF – small fish method, LF – large fish method).....45

Figure 3.17 Biological characteristics of sampled kokanee, 2010 Site C Peace River Fish Inventory (Table 2.6 identifies data selected for analyses). 46

Figure 3.18 Distribution of young (Age 1) kokanee, 2010 Site C Peace River Fish Inventory. 47

Figure 3.19 Average catch rates (± SE) of mountain whitefish in study sections during spring, summer, and fall, 2010 Site C Peace River Fish Inventory (small fish ≤ 200 mm fork length and large fish > 200 mm fork length; SF – small fish method, LF – large fish method). 49

Figure 3.20 Biological characteristics of sampled mountain whitefish, Site C Peace River Fish Inventory 2010 (Table 2.6 identifies data selected for analyses; length-weight relationship represented by power curve in place of raw data). 50

Figure 3.21 Distribution of Age 0 mountain whitefish, 2010 Site C Peace River Fish Inventory. 52

Figure 3.22 Average catch rates (± SE) of rainbow trout in study sections during spring, summer, and fall, 2010 Site C Peace River Fish Inventory (small fish ≤ 200 mm fork length and large fish > 200 mm fork length; SF – small fish method, LF – large fish method). 53

Figure 3.23 Biological characteristics of sampled rainbow trout, 2010 Site C Peace River Fish Inventory (Table 2.6 identifies data selected for analyses). 54

Figure 3.24 Distribution of young (Age 0 and Age 1) rainbow trout, 2010 Site C Peace River Fish Inventory. 56

Figure 3.25 Average catch rates (± SE) of burbot in study sections during spring, summer, and fall, 2010 Site C Peace River Fish Inventory (small fish ≤ 200 mm fork length and large fish > 200 mm fork length; SF – small fish method, LF – large fish method). 57

Figure 3.26 Biological characteristics of burbot, 2010 Site C Peace River Fish Inventory (Table 2.6 identifies data selected for analyses). 58

Figure 3.27 Distribution of young (Age 1) burbot, 2010 Site C Peace River Fish Inventory. 59

Figure 3.28 Average catch rates (± SE) of goldeye in study sections during spring, summer, and fall, 2010 Site C Peace River Fish Inventory (small fish ≤ 200 mm fork length and large fish > 200 mm fork length; SF – small fish method, LF – large fish method). 60

Figure 3.29 Biological characteristics of sampled goldeye, 2010 Site C Peace River Fish Inventory (Table 2.6 identifies data selected for analyses). 61

Figure 3.30 Distribution of young (Age 0) goldeye, 2010 Site C Peace River Fish Inventory. 62

Figure 3.31 Average catch rates (± SE) of northern pike in study sections during spring, summer, and fall, 2010 Site C Peace River Fish Inventory (small fish ≤ 200 mm fork length and large fish > 200 mm fork length; SF – small fish method, LF – large fish method). 63

Figure 3.32 Biological characteristics of sampled northern pike, 2010 Site C Peace River Fish Inventory (Table 2.6 identifies data selected for analyses). 64

Figure 3.33 Distribution of young (Age 0) northern pike, 2010 Site C Peace River Fish Inventory. 66

Figure 3.34 Average catch rates (± SE) of walleye in study sections during spring, summer, and fall, 2010 Site C Peace River Fish Inventory (small fish ≤ 200 mm fork length and large fish > 200 mm fork length; SF – small fish method, LF – large fish method). 67

Figure 3.35 Biological characteristics of sampled walleye, 2010 Site C Peace River Fish Inventory (Table 2.6 identifies data selected for analyses). 68

Figure 3.36 Distribution of young (Age 0 and Age 1) walleye, 2010 Site C Peace River Fish Inventory. 70

Figure 3.37 Average catch rates (± SE) of yellow perch in study sections during spring, summer, and fall, 2010 Site C Peace River Fish Inventory (small fish ≤ 200 mm fork length and large fish > 200 mm fork length; SF – small fish method, LF – large fish method). 71

Figure 3.38 Biological characteristics of sampled yellow perch, 2010 Site C Peace River Fish Inventory (Table 2.6 identifies data selected for analyses). 72

Figure 3.39 Distribution of young (Age 0 and Age 1) yellow perch, 2010 Site C Peace River Fish Inventory. 73

Figure 3.40 Average catch rates (± SE) of longnose suckers in study sections during spring, summer, and fall, 2010 Site C Peace River Fish Inventory (small fish ≤ 200 mm fork length and large fish > 200 mm fork length; SF – small fish method, LF – large fish method). 74

Figure 3.41 Biological characteristics of sampled longnose sucker, 2010 Site C Peace River Fish Inventory (Table 2.6 identifies data selected for analyses; length-weight relationship represented by power curve in place of raw data). 75

Figure 3.42 Distribution of unidentified Age 0 suckers in spring and summer and Age 0 longnose sucker in fall, 2010 Site C Peace River Fish Inventory. 77

Figure 3.43 Average catch rates (± SE) of largescale suckers in study sections during spring, summer, and fall, 2010 Site C Peace River Fish Inventory (small fish ≤ 200 mm fork length and large fish > 200 mm fork length; SF – small fish method, LF – large fish method). 78

Figure 3.44 Biological characteristics of sampled largescale sucker, 2010 Site C Peace River Fish Inventory (Table 2.6 identifies data selected for analyses). 79

Figure 3.45 Distribution of unidentified Age 0 suckers in spring and summer and Age 0 largescale sucker in fall, 2010 Site C Peace River Fish Inventory. 81

Figure 3.46 Average catch rates (± SE) of white suckers in study sections during spring, summer, and fall, 2010 Site C Peace River Fish Inventory (small fish ≤ 200 mm fork length and large fish > 200 mm fork length; SF – small fish method, LF – large fish method). 82

Figure 3.47 Biological characteristics of sampled white sucker, 2010 Site C Peace River Fish Inventory (Table 2.6 identifies data selected for analyses). 83

Figure 3.48 Distribution of unidentified Age 0 suckers in spring and summer and Age 0 white sucker in fall, 2010 Site C Peace River Fish Inventory. 84

Figure 3.49 Average catch rates (± SE) of northern pikeminnow in study sections during spring, summer, and fall, 2010 Site C Peace River Fish Inventory (small fish ≤ 200 mm fork length and large fish > 200 mm fork length; SF – small fish method, LF – large fish method). 85

Figure 3.50 Biological characteristics of sampled northern pikeminnow, 2010 Site C Peace River Fish Inventory (Table 2.6 identifies data selected for analyses). 86

Figure 3.51 Distribution of young (Age 0 and Age 1) northern pikeminnow, 2010 Site C Peace River Fish Inventory 87

Figure 3.52 Average catch rates (± SE) of redside shiner in study sections during spring, summer, and fall, 2010 Site C Peace River Fish Inventory. 89

Figure 3.53 Average catch rates (± SE) of spottail shiner in study sections during spring, summer, and fall, 2010 Site C Peace River Fish Inventory. 89

Figure 3.54 Average catch rates (± SE) of slimy sculpin in study sections during spring, summer, and fall, 2010 Site C Peace River Fish Inventory. 90

Figure 3.55 Average catch rates (± SE) of prickly sculpin in study sections during spring, summer, and fall, 2010 Site C Peace River Fish Inventory..... 91

1.0 INTRODUCTION

1.1 BACKGROUND

B.C. Hydro is considering the Peace River Site C Hydroelectric Project (Site C) in north eastern British Columbia (BC) as a potential resource option to help meet BC's future electricity needs. B.C. Hydro is taking a stage-by-stage approach to the evaluation of Site C. B.C. Hydro is currently in Stage 3, Environmental and Regulatory Review. Fisheries studies are presently underway to add to existing baseline information and to address data gaps in order to assist in completion of Stage 3.

Currently there is baseline information that describes the fish community in the Peace River from Peace Canyon (PCN) Dam to the British Columbia/Alberta boundary. Fisheries investigations include historical Site C baseline studies from 1989 to 1990 (ARL 1991a, b; Pattenden *et al.* 1990, 1991), a small fish and habitat study in 1999 to 2000 (RL&L 2001), preliminary fish surveys completed in 2005 and 2006 (AMEC and LGL 2006, 2007; Mainstream 2009a), and ongoing studies (2001 to present) by the Peace River Fish Index Project under the direction of B.C. Hydro Water License Requirements (WLR) (P&E 2002; Mainstream and Gazey 2009).

Although comprehensive, some baseline information that describes the Peace River fish community is general in nature and dated, hence this project. In 2009, Mainstream Aquatics Ltd. was contracted by B.C. Hydro to conduct a seasonal fish inventory on the Peace River (Mainstream 2010). The goal of the current program is continue and expand on the 2009 study in order to address data gaps in our knowledge of the Peace River fish community.

1.2 PURPOSE AND OBJECTIVES

The purpose of the study was to collect baseline information to describe the fish community in the Peace River study area. The objectives of the study were:

1. Conduct a fish sampling program in spring, summer, and fall using multiple methods in a variety of fish habitats to collect a representative sample of the Peace River mainstem fish community.
2. Describe the fish community structure.
3. Describe the seasonal distribution and catch rates of fish populations.
4. Describe the biological characteristics and structure of fish populations.
5. Use data collected by the 2010 WLR Peace River Fish Index Project to enhance the study data.
6. Summarize the information in a concise report.

1.3 STUDY AREA

The study area included the 2009 study area (British Columbia portion of the Peace River from the Peace Canyon Dam [Km 151] to the British Columbia/Alberta boundary [Km 0]) and a section of the Peace River in Alberta from the confluence of the Pouce Coupe River (Km -6) to the confluence of the Clear River (Km -20). The fish inventory occurred in eight sections distributed throughout the study area (Table 1.1, Figure 1.1, Appendix A). For analytical purposes, sections were grouped into one of two zones relative to the position of the proposed Site C dam located at Km 64.8 – Zone 1 (Upstream) and Zone 2 (Downstream).

Table 1.1 Study area zones and sections, 2010 Site C Peace River Fish Inventory.

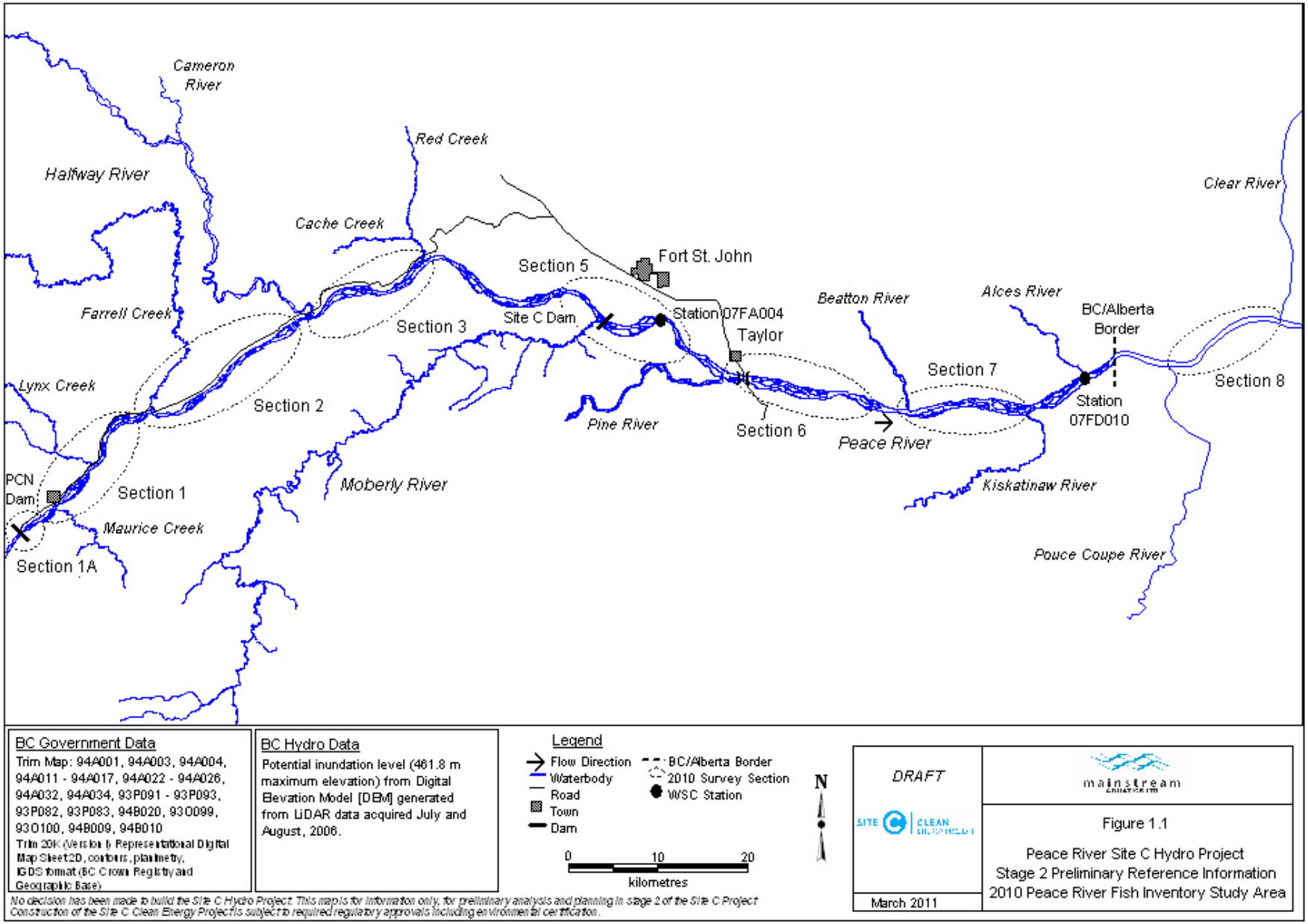
Zone[a]	Section	Section Location	Section Location[b] (km)
1 Upstream	1A	Peace River Canyon area	Km 150 to 145.2
	1	Maurice Creek area	Km 137.0 to 145.2
	2	Farrell Creek area	Km 119.7 to 125.2
	3	Halfway River area	Km 89.8 to 99.2
2 Downstream	5	Moberly River area[c]	Km 53.4 to 64.8
	6	Pine River area	Km 46.8 to 35.7
	7	Beatton River area	Km 26.7 to 13.6
	8	Pouce Coupe River area	Km -6.0 to -20.4

[a] Position relative to proposed Site C dam.
[b] Based on distance from BC/AB boundary.
[c] A small portion of Section 5 is located upstream of proposed Site C dam location (see Appendix A, Figures A5A and A5B).

Four criteria were used to determine the section boundaries. They included good spatial coverage of the study area, representation of major reaches, representation of major tributary confluences, and inclusion of previously sampled sites.

1.4 SAMPLE PERIOD

Three surveys were completed during the open water period, each of which was completed over a two and one half week period that represented a season. The spring session occurred from 26 May to 9 June, the summer session occurred from 6 to 21 July, and the fall session occurred from 30 September to 19 October 2010. Biological and catch data from the 2010 WLR Peace River Fish Index Project that was used by the present study was collected from 24 August to 23 September 2010.


Cameron River
Halfway River
Red Creek
Cache Creek
Farrell Creek
Lynx Creek
Section 1
Section 1A
Section 2
Section 3
Section 5
Section 6
Section 7
Section 8
PCN Dam
Maurice Creek
Moberly River
Site C Dam
Fort St. John
Station 07FA004
Taylor
Pine River
Peace River
Beatton River
Alces River
BC/Alberta Border
Station 07FD010
Clear River
Kiskatinaw River
Pouce Coupe River
BC Government Data
Trim Map: 94A001, 94A003, 94A004, 94A011 - 94A017, 94A022 - 94A026, 94A032, 94A034, 93P091 - 93P093, 93P082, 93P083, 94B020, 93O099, 93O100, 94B009, 94B010
Trim 20K (Version) Representational Digital Map Sheet 2D, contours, planimetry, IGDS format (BC Crown Registry and Geographic Base)
BC Hydro Data
Potential inundation level (461.8 m maximum elevation) from Digital Elevation Model [DEM] generated from LiDAR data acquired July and August, 2006.
Legend
Flow Direction
Waterbody
Road
Town
Dam
BC/Alberta Border
2010 Survey Section
WSC Station
0 10 20
kilometres
N
DRAFT
SITE C CLEAN ENERGY PROJECT
mainstream aquatics
Figure 1.1
Peace River Site C Hydro Project
Stage 2 Preliminary Reference Information
2010 Peace River Fish Inventory Study Area
March 2011
No decision has been made to build the Site C Hydro Project. This map is for information only, for preliminary analysis and planning in stage 2 of the Site C Project. Construction of the Site C Clean Energy Project is subject to required regulatory approvals including environmental certification.

This page is intentionally blank.

2.0 METHODS

2.1 FIELD PROGRAM

2.1.1 Approach and Design

In order to describe the Peace River fish community in the study area a variety of fish habitats were sampled using multiple fish capture methods during three seasons. The present study was coordinated with the WLR 2010 Peace River Fish Index Project in order to maximize sampling efficiencies and to enhance the data set collected by the present study. The large fish sampling component of the present study followed established protocols used by the WLR Program (Mainstream and Gazey 2010).

Site selection was based on two criteria. Firstly, sites were established in areas that represented all major habitats within a section. Secondly, attempts were made to use sites that had been inventoried during previous studies (Mainstream 2010; P&E 2002; Mainstream and Gazey 2010). Once a site was established, attempts were made to sample the same site during subsequent seasonal programs.

Sampling occurred within three major Peace River habitats previously described by R&L (2001) and P&E (2002) as follows:

> **Main channel -** Portion of active channel that is permanently wetted and that is characterized by moving water under the typical flow regime, and the dominance of rock (i.e., gravel, pebble, cobble, boulder, and/or bedrock) bed materials. This includes the thalweg channel and smaller channels that exhibit similar characteristics.
>
> **Side channel -** Portion of the active channel that is permanently wetted and that is characterized by slow moving or still water under the typical flow regime, and the presence of silt and sand bed materials. Includes channels protected from the main river flow that exhibit unique features such as standing water and emergent/submergent vegetation.
>
> **Tributary confluence -** Portion of the tributary confluence that is within the immediate influence of the Peace River flow regime. The habitat can be divided into the tributary channel proper and the confluence zone within the active Peace River channel. The confluence zone includes an upstream area that exhibits higher water velocities and is dominated by rock bed materials (i.e., riffle section) and a downstream area that exhibits low water velocities and bed materials dominated by silts and sands (i.e., backwater section).

Data were collected from selected major tributaries (i.e., Halfway River, Pine River, Beatton River, and Kiskatinaw River) upstream from the immediate influence of the Peace River flow regime. For analytical purposes, these data were lumped with the Tributary confluence major habitat type.

Specific sites within each major habitat type were further stratified into discrete mesohabitat types based on physical characteristics. Definitions of mesohabitat types are presented in Appendix B1. The Plates section provides illustrations of the major habitat types and selected mesohabitat types in each category.

The site selection process and the number of sites sampled within each section were designed to inventory the full range of habitats present proportional to abundance of those habitats within each section.

The study was designed to capture fish species and life stages (i.e., small and large fish) present in a variety of fish habitats. This necessitated use of multiple fish capture methods, each of which was effective for the collection of fish within a particular size range and under specific sampling conditions.

For the purposes of this study small fish were defined as ≤ 200 mm fork length and included younger life stages of large fish species and all small fish species. Large fish were defined as > 200 mm fork length, which included older life stages of all large fish species.

Fish sampling conditions are controlled primarily by water depth, water velocity, and bed material type. RL&L (2001) and P&E (2002) demonstrated that standard small fish capture techniques (e.g., backpack electrofisher and beach seine) were not always effective in main channel habitats in the Peace River due to high water velocities and fluctuating water levels. Subsequent work on the Peace River (Mainstream and Gazey 2006; Mainstream 2010) established use of a small and large fish boat electrofisher as an effective alternative to standard fish capture methods in main channel habitats to capture small fish (i.e., ≤ 200 m) and large fish (i.e., > 200 m), respectively. The beach seine also was used in the main channel area not effectively sampled by the small or large fish boat electrofisher. In total, five fish capture methods were used during the field program (Table 2.1). The methods employed were based on the size of fish targeted and the habitat sampled.

Table 2.1 Habitat and fish group targeted by fish capture method, 2010 Site C Peace River Fish Inventory.

Fish Group	Method	Main Channel	Side Channel	Tributary Confluence
Small Fish (≤ 200 mm length)	Beach Seine	x	x	x
	Backpack Electrofisher		x	x
	Small Fish Boat Electrofisher	x		
Large Fish (> 200 mm length)	Large Fish Boat Electrofisher	x	x	x
	Gill Net		x	

2.1.2 Fish Capture Methods

Standard fish capture methods were used during the field program (Bonar *et al.* 2009). In addition, the large fish boat electrofisher program followed established methods and protocols developed by the ongoing WLR Peace River Fish Index Project (Mainstream and Gazey 2010) and the small fish boat electrofisher program followed methods and protocols previously used on the Peace River (Mainstream and Gazey 2006, Mainstream 2010).

The backpack electrofisher and beach seine were used to sample wadeable shallow water areas (< 0.5 m depth) in side channels and along the mainstem channel margins. A backpack electrofisher was used to sample high velocity areas with abundant physical cover. A beach seine was used in low velocity zones (characterized by a paucity of instream cover) in water depths not effectively sampled by backpack electrofisher. Sampling occurred in discrete habitat units. Parameters measured at each fish sample site included date and time, geodetic location, sample method settings, and sample effort (i.e., seconds, length, and width sampled).

Large Fish Boat Electrofisher

A boat electrofisher was used to capture larger-sized fish (i.e., > 200 mm length) in nearshore habitats along the channel margin. Distances sampled from the channel margin varied from a few to tens of metres depending on channel bottom slope and water depth. Water depths ranged from 0.5 to 2.0 m. Sampling was restricted to areas ≤ 2.0 m deep, because boat electrofishing effectiveness on the Peace River is severely reduced beyond this depth.

A 5 m boat electrofisher propelled by a 175 Hp sport-jet inboard motor was used to sample large fish. The craft was equipped with a fixed-boom anode system and Smith-Root Type VIA electrofisher system. Electrofisher settings were generally maintained at an amperage output of 3.0 to 4.5 A, pulsed DC current, and a frequency of 60 Hz. These settings were sufficient to immobilize all species and minimize injury rates of susceptible species such as mountain whitefish.

The sampling procedure involved drifting downstream at motor idle along the channel margin, while outputting a continuous current of electricity. In general, boat position was maintained at a water depth of 1.0 m to 1.5 m by monitoring the depth with a sounder. The only instance when this sampling protocol changed occurred when backwater areas greater than two boat lengths were encountered. In these situations, the boat was turned into the backwater at its downstream end and the channel margin in the backwater area was sampled in an upstream direction.

Two netters positioned on a platform at the bow of the boat captured immobilized fish while the boat operator maintained the position of the craft along the channel margin. To provide a representative sample of the fish community netters were instructed not to bias their catch towards a particular species or fish size. Netters were equipped with nets having a diameter of 45 cm, a depth of 40 cm, and a mesh size of 5 cm. To facilitate capture of smaller fish, the bottom surface (40 cm^2) of each net had a mesh size of 1.5 cm. This mesh size allowed capture of fish to a minimum size of 200 mm.

Netters were instructed to retrieve immobilized fish of any species and size (> 200 mm) that were accessible from their netting position on the platform. To minimize the potential for electrofisher induced injury, no more than one fish was netted at a time and immobilized fish were removed from the water as quickly as possible.

The only exception to the above sampling protocol occurred when a rare species or life stage was encountered. In this situation, the boat was turned towards the fish and netters made every effort to capture the individual.

All fish captured were held in a 230 L holding tank equipped with a water circulating system, which provided a water exchange rate of 19 L/min. Upon completion of an electrofisher session, captured fish were processed and released. To avoid recapture of previously collected fish, processed fish were released several hundred metres upstream from the processing location. Sampled length of each site consisted of a single pass of approximately 1000 m. Site length was measured from geodetic locations (UTM coordinates) plotted onto geo-referenced base maps (scale 1:50,000 NTS topographic maps).

Small Fish Boat Electrofisher

A boat electrofisher was used to capture smaller-sized fish (i.e., ≤ 200 mm length) in shallow-water nearshore habitats along the channel margin. Sampled water depths ranged from 0.1 to 0.3 m.

The small fish boat electrofisher consisted of a double-bowed, inflatable drift boat equipped with a Smith-Root Type VIA electrofisher system, two fixed boom anodes on the bow and a cathode wire array on the stern. Electrofisher settings were maintained at an amperage output of 4.5 to 6.0 A, pulsed DC current at a frequency of 60 Hz.

The sampling procedure involved the operator positioning the boat perpendicular to the channel margin while drifting downstream and outputting a continuous current of electricity. A single netter, equipped with a net having a mesh size of 0.5 cm, was positioned at the bow of the boat to capture the temporarily immobilized fish and place them in a 30 L live well. Netters were instructed not to bias their catch towards a particular species in order to provide a representative sample of the fish community. Sampled length of each site consisted of a single pass of approximately 500 m. Site length was measured from geodetic locations (UTM coordinates) plotted onto geo-referenced base maps (scale 1:50,000 NTS topographic maps).

Backpack Electrofisher

Sampling was completed using a Smith-Root Type XII high output backpack electrofisher with settings maintained at an output of 300-400 VDC, 6 ms, and a frequency of 60 Hz. The backpack electrofisher operator waded upstream along the channel margin and sampled suspected fish holding areas. The netter, who was positioned in close proximity to the electrofisher operator, collected immobilized fish and placed them in a holding bucket. A single pass was used at each site; sampled length was approximately 100 m.

Beach Seine

A beach seine was used in low velocity, deep water areas not effectively sampled by backpack electrofisher. The beach seine was 4.2 m wide and 1.5 m high with a stretched mesh size of 5.0 mm (the depth of the capture bag was 1.4 m). A two-person crew sampled perpendicular to the channel margin for a predetermined distance (25 m) before turning into shore. Captured fish were placed in a holding bucket for processing. In general, three discrete hauls were completed adjacent to each other at each site. If sample effectiveness was low (e.g. snagged net), the haul was re-sampled.

Gill Net

Small mesh nylon gill nets were used to sample deep water areas in side channels (1.0 to 3.0 m deep) that could not be effectively sampled by other methods. Gill net panels were 15.2 m x 2.4 m with stretched mesh sizes of 1.9, 3.8 or 6.4 or 8.9 cm. A combination of two net panels was set perpendicular or parallel to the channel margin at each site depending on water velocity and location. Net panel size chosen was dependant on expected catch and depth of site. To maximize capture efficiency and minimize capture

mortality, gill net set times were extended from previous studies (3.5 – 6.25 hours as opposed to < 2 hours in Mainstream 2010), but checked multiple times during each set.

2.1.3 Observed Fish

The number of fish observed but not captured during each sample event during the large fish boat electrofisher program was recorded for numerically rare (< 10 individuals per sample event) adult (≥ 250 mm total length) sportfish species. The information was used to provide a better description of a fish species distribution. A standardized approach was used to enumerate observed fish. Each netter was instructed to count un-netted target fish that were present in a defined observation zone at the bow of the boat electrofisher. The observed fish data were included in the fish enumeration data for catch rate calculations.

2.1.4 Processing Fish

Biological characteristics were recorded for captured fish. Data recorded included species, fork length (± 1 mm) (total length for burbot and sculpin species), weight (± 2 g), sexual maturity from external examination, and presence of a tag, tag scar, or fin clip. Individuals that could not be identified to species in the field were assigned a unique identifier and a subsample preserved for future identification. An exception to this protocol occurred when small (i.e., < 20 mm) sculpins or suckers were encountered. These fish were identified as "Sculpin" or "Sucker" and then released. When the catch of small fish at a site was large the first ten individuals per species were measured. The remaining fish were identified to species, enumerated, and released.

Large numbers of fish (i.e., several hundred) were captured at some beach seine sites (n = 10), which precluded counting all fish in the sample. The following protocols were used at these sites. Captured fish were placed in a bucket and thoroughly mixed. An aquarium net was used to scoop a subsample from the bucket. All fish in the "scoop" were identified and enumerated. The process was repeated for a second scoop. The remaining fish were then removed from the bucket using the aquarium net (ensuring similar sized scoops), while counting the number of scoops required to empty the bucket of fish. In the office the number of fish of each species in the two "scoop" samples was tallied. The resulting fish numbers and species composition were then applied to the sample of scoops containing unidentified, uncounted fish. This was used to calculate the total number of fish of each species collected at the site.

Each fish identified to species was assigned a species label. The common name, scientific name, and label of fish species are presented in Table 2.2.

Table 2.2 Nomenclature and abbreviations used for recorded fish species, 2010 Site C Peace River Fish Inventory.

Group	Common Name	Scientific Name	Species Label
Sportfish (coldwater)	Arctic grayling	*Thymallus arcticus*	GR
	Bull trout	*Salvelinus confluentus*	BT
	Kokanee	*Oncorhynchus nerka*	KO
	Lake trout	*Salvelinus namaycush*	LT
	Lake whitefish	*Coregonus clupeaformis*	LW
	Mountain whitefish	*Prosopium williamsoni*	MW
	Pygmy whitefish	*Prosopium coulterii*	PW
	Rainbow trout	*Oncorhynchus mykiss*	RB
Sportfish (coolwater)	Burbot	*Lota lota*	BB
	Goldeye	*Hiodon alosoides*	GE
	Northern pike	*Esox lucius*	NP
	Walleye	*Sander vitreus*	WP
	Yellow perch	*Perca flavescens*	YP
Suckers	Largecale sucker	*Catostomus macrocheilus*	CSU
	Longnose sucker	*Catostomus catostomus*	LSU
	White sucker	*Catostomus commersoni*	WSC
	Sucker (young-of-the-year)	*Catostomus spp.*	YSU
Minnows[a]	Brook stickleback	*Culaea inconstans*	BSB
	Finescale dace	*Chrosomus neogaeus*	FDC
	Flathead chub	*Platygobio gracilis*	FHC
	Lake chub	*Couesius plumbeus*	LKC
	Longnose dace	*Rhinichthys cataractae*	LNC
	Northern pikeminnow	*Ptychocheilus oregonensis*	NSC
	Northern redbelly dace	*Phoxinus eos*	RDC
	Peamouth chub	*Mylocheilus caurinus*	PCC
	Redside shiner	*Richardsonius balteatus*	RSC
	Spottail shiner	*Notropis hudsonius*	STC
	Trout-perch	*Percopsis omiscomaycus*	TP
Sculpins	Prickly sculpin	*Cottus asper*	CAS
	Slimy sculpin	*Cottus cognatus*	CCG
	Spoonhead sculpin	*Cottus ricei*	CRI

[a] Includes true minnows (Family Cyprinidae), trout-perch (Family Percopsidae), and sticklebacks (Family (Gasterosteidae).

An appropriate nonlethal ageing structure (Mackay *et al.* 1990) was collected from individuals of most large fish species. The first two rays of the right pectoral fin were collected from bull trout, walleye, northern pike, longnose sucker, and largescale sucker. Several scales situated immediately below the back third of the dorsal fin and above the lateral line were collected from Arctic grayling, rainbow trout, lake whitefish, yellow perch, goldeye, and mountain whitefish. Structures were placed in labeled envelopes and air-dried before storage. No age structures were collected from burbot due to the requirement for lethal sampling.

In order to monitor movement patterns and measure growth during future studies, fish of all species ≥ 250 mm fork length and in good condition were marked using a Passive Integrated Transponder (PIT)

Tag. Tags were of the ISO type (134.2 kHz), which have a 15 digit numeric code. Tags, tag applicators, and tag readers were supplied by AVID Canada. Tags and tag applicators were sterilized in Zephiran chloride. After tag insertion, a Power Tracker VIII tag reader was used to record the numeric code.

The DELT Index (Ohio EPA 1996) was used to provide an index of the health of fish collected by large fish boat electrofisher. External examination was used to identify and count the number of deformities (D), erosion (E), lesions (L), tumours (T), cuts (C), and electrofisher injury (I) on each fish. The severity was categorized as follows:

Deformities (D)

Defined as twisted, missing, forked, or bulging body parts including deformed fins, abdomen, or skeleton (e.g.-head, vertebrae). Deformities are classified as:

- Light (DL) when they are limited to 1 deformed fin.
- Heavy (DH) when there are ≥ 2 deformed fins, or any deformity of the skeleton of other body parts exclusive of fins.

Erosion (E)

Defined as loss of tissue on the fins, and/or gill covers. Erosion is classified as:

- Light (EL) when 1 fin is not eroded past a ray fork, or the gill cover is eroded, but there is no exposed gill tissue.
- Heavy (EH) when ≥ 2 eroded fins, or gill cover eroded with exposed gill tissue.

Lesions (L)

Defined as open sores, exposed tissue, and/or prominent bloody areas. Lesions are classified as:

- Light (LL) when there are ≤ 2 lesions smaller than or equal to the size of the largest scale.
- Heavy (LH) when there are > 2 small lesions, when there is a lesion larger than the size of the largest scales, or when there is raw tissue.

Tumours (T)

Are defined as tumour like masses that cannot be easily broken when squeezed. Tumours are defined as:

- Light (TL) when ≤ 3 tumours < the diameter of the eye. Lymphocystis patches are counted as one tumour.
- Heavy (TH) when there are > 3 tumours or there is 1 tumour larger than the diameter of the eye.

Cuts (C)

Defined as distinct open wounds on the body caused by predation. Cuts are classified as:

- Light (CL) when there are ≤ 2 cuts.
- Heavy (CH) when there are > 2 cuts.

Electrofisher Injury (I)

Defined as misalignment of vertebrae (not a deformity). Electrofisher injury classified as:

- Medium (IM) when there is evidence of vertebrae misalignment from an electrofisher injury.

Multiple DELTS (M)

Occur when fish have two or more DELT anomalies. Recorded as the DELT types followed by the letter M.

2.1.5 Sample and Site Characteristics

See Appendix B for definitions and Appendix D for characteristics. Parameters measured at all sites were as follows:

- Date and time
- Geodetic location
- Sample method settings
- Sample effort (seconds/meters/area)
- Water conductivity (µ*S*/cm)
- Water temperature (^{o}C)
- Water clarity (m)
- Habitat type

Physical characteristics measured at sites located in discrete mesohabitats (i.e., beach seine, backpack electrofisher, and gill net) as follows:

- Water depth (cm)
- Water velocity (m/s)
- Substrate type (%)
- Available fish cover (%)
- D90 (cm)
- Substrate embeddedness (low, moderate, high)
- Substrate compaction (low, moderate, high)

2.1.6 Number and Distribution of Sites

The number and distribution of large and small fish boat electrofisher sites, which represented sampled sections, are summarized in Table 2.3. The number and distribution of beach seine, backpack electrofisher, and gill net sites, which represented point samples in discrete habitats, are summarized in Table 2.4. The number of sites by method and habitat area is summarized in Table 2.5. Site location data are presented in Appendix A.

Table 2.3 Number of sites sampled by zone and section and season by large fish capture methods, 2010 Site C Peace River Fish Inventory.

Zone[a]	Section	Number of Sites					
		Large Fish Boat Electrofisher			Small Fish Boat Electrofisher		
		Spring	Summer	Fall	Spring	Summer	Fall
1	1A	5	5	4	4	4	4
Upstream	1	15	17	16	13	12	12
	2	14	15	15	14	13	13
	3	17	16	16	13	14	13
2	5	18	18	18	14	14	13
Downstream	6	18	17	17	13	13	13
	7	19	14	18	12	12	12
	8	16	17	16	13	12	12
	Total	**122**	**119**	**120**	**96**	**94**	**92**

[a] Position relative to proposed Site C dam.

Table 2.4 Number of sites sampled by zone and section and season by small fish capture methods, 2010 Site C Peace River Fish Inventory.

Zone[a]	Section	Number of Sites[b]								
		Beach Seine			Backpack Electrofisher			Gill Net		
		Spr.	Sum.	Fall	Spr.	Sum.	Fall	Spr.	Sum.	Fall
1	1A									
Upstream	1	10	8	7	8	3	5			
	2	12	9	9	4	6	3			
	3	7	6	5	5	6	7	1	1	1
2	5	8	7	9	3	3	4	2	2	1
Downstream	6	10	8	8	3	2	3	1	1	1
	7	9	6	7	4	4	5	1		
	8	7	6	6	3	3	5			
	Total	**63**	**50**	**51**	**30**	**27**	**32**	**5**	**4**	**3**

[a] Position relative to proposed Site C dam.
[b] The number of sites was dependent on seasonal availability associated with water levels encountered at the time of sampling.

Table 2.5 Number of sites sampled by zone, section, method, and habitat area, 2010 Site C Peace River Fish Inventory.

Zone[a]	Section	Number of Sites[b]														
		Beach Seine			Backpack Electrofisher			Small Fish Boat Electrofisher			Gill Net			Large Fish Boat Electrofisher		
		MC[c]	SC	TC	MC	SC	TC	MC	SC	TC	MC	SC	TC	MC	SC	TC
1	1A							4						5		
Upst.	1	8	2	2	5	2	3	15						14		2
	2	2	10	1	1	4	1	16		1				14		1
	3	1	3	4	4	1	3	16		1		2		13	1	2
2	5	1	7	1	1	2	1	18				2		15	2	1
Dwst.	6	1	9	1	2		2	15				1		14	2	2
	7	1	7	2		4	2	14				1		14	2	3
	8	4	4	2	3	2	2	14						15		2
	Total	**18**	**42**	**13**	**16**	**15**	**14**	**112**	**0**	**2**	**0**	**6**	**0**	**104**	**7**	**13**

[a] Position relative to proposed Site C dam.
[b] The number of sites does not include multiple (seasonal) sample events at the site.
[c] MC – main channel; SC – side channel; TC – tributary confluence (see Section 2.1.1).

2.2 OFFICE PROGRAM

2.2.1 Quality Assurance and Quality Control

All data collected in the field were recorded on standardized forms. Forms were checked daily for errors or omissions. Data were entered into standardized data entry spreadsheets using Microsoft Excel™ or Microsoft Access™. These data were visually compared to the field forms for errors and subjected to several summary analyses including graphical examination to identify errors and outliers. The checked data were then imported into a Microsoft Access™ data file for data management and storage. All subsequent analyses used data extracted from the Microsoft Access™ data file.

2.2.2 Mapping

Geodetic location information (UTM coordinates) were tabulated and plotted onto geo-referenced base maps (scale 1:50,000 NTS topographic maps) using MapInfo Professional™. River kilometer locations were then plotted on base maps. Km 0 was assigned as the British Columbia/Alberta boundary. Study area maps in British Columbia were generated using Trim 1:20,000 (Version 1) representational digital 2D maps (IGDS format). Study area maps in Alberta were generated using Trim 1:20,000 (Version 1) representational digital 2D maps (IGDS format).

2.2.3 Discharge and Water Temperature

Preliminary Peace River discharge data (no quality assurance) from Water Survey of Canada were obtained from the following stations:

Above Pine River - Station 07FA004
Above Alces River - Station 07FD010

Peace River discharge for the Hudson's Hope area was assessed using Peace Canyon Dam discharge data provided by B.C. Hydro.

Analyses of water temperature and discharge entailed summarizing data and presenting the information in tabular and graphical form.

2.2.4 Fish Community Structure and Catch Rate

Two objectives of the study were to describe the fish community structure and the relative abundance (catch rates) of fish populations. To accomplish this goal the field program occurred during three seasons and utilized three small fish capture methods and two large fish capture methods in order to sample a variety of fish species, life stages, and habitats (see Tables 2.1 to 2.5).

Most species in the large fish group were well represented using large fish capture methods and most species in the small fish group were well represented using small fish capture methods (Table 2.6). Small fish species in the minnow and sculpin groups were scarce in the large fish catch. However, these groups as well as younger age cohorts of several large fish species were well represented using small fish capture methods. The results indicated that a variety of species and life stages were recorded using fish capture methods employed during the study.

Based on the total number of fish enumerated, beach seine, and small fish boat electrofisher were the most effective small fish capture method, while large fish boat electrofisher was the most effective large fish capture method.

Some fish capture methods did not collect large numbers of fish either due to low sample effectiveness or low sample effort. Few fish were collected using the large fish capture method gill net (n = 90 fish). The number of fish recorded using the backpack electrofisher method also was considered low (n = 3,712 fish) when compared to the beach seine and small fish boat electrofisher catches (n = 20,642 and 12,678 fish,

respectively). However, species encountered using the backpack electrofisher method were well represented by other fish capture methods.

Table 2.6 Number of fish enumerated by species and capture method, 2010 Site C Peace River Fish Inventory.

Group	Species	Small Fish Methods[a]					Large Fish Methods[a]			
		EF	BS	SF	Total	%	GN	LF	Total	%
Sportfish (coldwater)	Arctic grayling	2	3	185	*190*	*0.5*		82	*82*	*0.7*
	Bull trout			50	*50*	*0.1*	3	232	*235*	*1.9*
	Kokanee	3	12	298	*313*	*0.8*	5	219	*224*	*1.8*
	Lake trout					*0.0*		2	*2*	*<0.1*
	Lake whitefish		1		*1*	*<0.1*	10	20	*30*	*0.2*
	Mountain whitefish	776	4,416	7,074	*12,266*	*32.9*	2	8,755	*8,757*	*70.3*
	Pygmy whitefish			1	*1*	*<0.1*				*0.0*
	Rainbow trout	7		120	*127*	*0.3*		158	*158*	*1.3*
	Subtotal	*788*	*4,432*	*7,728*	*12,948*	*34.8*	*20*	*9,468*	*9,488*	*76.1*
Sportfish (coolwater)	Burbot	2		12	*14*	*<0.1*		37	*37*	*0.3*
	Goldeye		1	6	*7*	*<0.1*	2	73	*75*	*0.6*
	Northern pike	6	100	64	*170*	*0.5*	14	154	*168*	*1.3*
	Walleye	2	19	76	*97*	*0.3*	5	230	*235*	*1.9*
	Yellow perch	15	547	63	*625*	*1.7*	1	9	*10*	*0.1*
	Subtotal	*25*	*667*	*221*	*913*	*2.5*	*22*	*503*	*525*	*4.2*
Suckers	Largescale sucker	82	224	453	*759*	*2.0*		326	*326*	*2.6*
	Longnose sucker	207	1,419	720	*2,346*	*6.3*	7	1,812	*1,819*	*14.6*
	White sucker	7	22	5	*34*	*0.1*	40	197	*237*	*1.9*
	Subtotal	*296*	*1,665*	*1,178*	*3,139*	*8.4*	*47*	*2,335*	*2,382*	*19.1*
Sculpins	Prickly sculpin	49	74	133	*256*	*0.7*				*0.0*
	Slimy sculpin	397	93	1,026	*1,516*	*4.1*		1	*1*	*<0.1*
	Spoonhead sculpin	1	1		*2*	*<0.1*		1	*1*	*<0.1*
	Subtotal	*447*	*168*	*1,159*	*1,774*	*4.8*		*2*	*2*	*0.0*
Minnows[b]	Brook stickleback			1	*1*	*<0.1*			*0*	*0.0*
	Finescale dace			2	*2*	*<0.1*			*0*	*0.0*
	Flathead chub	31	44	180	*255*	*0.7*		17	*17*	*0.1*
	Lake chub	291	4,386	854	*5,531*	*14.9*				*0.0*
	Longnose dace	428	1,611	131	*2,170*	*5.8*				*0.0*
	Northern pikeminnow	44	423	104	*571*	*1.5*	1	48	*49*	*0.4*
	Northern redbelly dace	1	4	5	*10*	*<0.1*				*0.0*
	Peamouth			2	*2*	*<0.1*				*0.0*
	Redside shiner	1,319	4,779	835	*6,933*	*18.6*				*0.0*
	Spottail shiner	62	2,156	168	*2,386*	*6.4*				*0.0*
	Trout-perch	33	313	257	*603*	*1.6*				*0.0*
	Subtotal	*2,209*	*13,716*	*2,539*	*18,464*	*49.6*	*1*	*67*	*68*	*0.5*
Total		**3,765**	**20,648**	**12,825**	**37,238**	**100.0**	**90**	**12,375**	**12,465**	**100.0**

[a] Methods: EF – backpack electrofisher; BS – beach seine; SF – small fish boat electrofisher; GN – gill net; LF – large fish boat electrofisher.

[b] Includes true minnows (Family Cyprinidae), trout-perch (Family Percopsidae) and sticklebacks (Family Gasterosteidae).

Fish Community Structure - Data Selection

Fish enumeration data included fish that were physically captured and fish that were observed but not captured. Parameters used to describe the fish community structure were calculated using all fish enumeration data. This approach was adopted to avoid loss of spatial and temporal information of species presence/absence. Parameters included species composition, species assemblage, species diversity, and species occurrence. For all parameters except species composition, enumeration data were stratified by section and habitat area.

Catch Rate - Data Selection

Fish enumeration data used to calculate catch rate was based on spatial and temporal sampling effort (Tables 2.1 to 2.5) and total number of fish enumerated by fish capture method (Table 2.6). However, based on information presented in Tables 2.1 to 2.6, small fish catch rates presented in the report were based on fish enumeration data collected by beach seine and small fish boat electrofisher, while large fish catch rate presented in the report were based on fish enumeration data collected by large fish boat electrofisher.

For catch rate calculations, the number of fish enumerated represented only the number of fish captured for most methods except large fish boat electrofisher. For this method, number of fish enumerated included the number of fish captured plus the number of scarce adult sportfish observed. Scarce adult sportfish was defined as any sportfish species other than mountain whitefish that was ≥ 200 mm fork length. This approach was adopted because small fish (i.e., ≤ 200 mm length) are inherently difficult to identify when not in the hand and because counts of large numbers of fish are highly variable and imprecise (P&E and Gazey 2003).

Catch Rate Variables

Catch rate or catch-per-unit-effort (CPUE) of fish was calculated for each site by dividing the number of fish enumerated by sampling effort. Catch rate was typically expressed as number of fish per distance or area sampled (e.g., m, m^2). Catch rate for the gill net was expressed as the number of fish / area / time the gill net was set. For gill net and beach seine methods, area was calculated using the net width times length (gill net) or distance (beach seine) sampled.

Catch rates were expressed as follows:

Large Fish (≥ 200 mm fork length)
Large Fish Boat Electrofisher - Number of large fish/km
Gill Net - Number large fish/100 m^2/12 h

Small Fish (< 200 mm fork length)
Small Fish Boat Electrofisher - Number of small fish/km
Backpack Electrofisher - Number of small fish/100 m
Beach Seine - Number small fish/100 m^2

Summary values represented mean catch rate ± standard error (SE). All analyses were completed using SPSS® 13.0 for Windows. Figures were generated using Sigmaplot® 8.0.

2.2.5 Biological Characteristics

Fish biological characteristics examined included length distribution, age distribution (based on age data from a random subsample or total sample depending on fish number), length-weight relationships, length-at-age (includes growth rate), and simple length summaries. All analyses were completed using SPSS® 13.0 for Windows. Figures were generated using Sigmaplot® 8.0.

Information used for analyses of biological characteristics included data collected by the current program and data collected by the WLR 2010 Peace River Fish Index Project (Mainstream and Gazey 2011). WLR program information included biological data for all large fish species.

Data Selection

The biological characteristic examined was dependent on the species and parameter to be analyzed. Raw data for each species was first stratified by zone and month in order to reduce spatial and temporal variation and by method in order to reduce sample method bias. These data were then examined to ascertain which data set provided a sufficient sample size for analyses (Table 2.7). When sample sizes permitted, data from Zone 1 and Zone 2 were analyzed separately to allow spatial comparisons. When small sample sizes precluded meaningful spatial comparisons, the data were combined for analyses.

Age

Ageing procedures followed those described in Mackay *et al.* (1990). Scales were immersed in water and cleaned if dirty, and then placed on a microscope slide for viewing using a dissecting microscope. Mounting procedures for fin rays followed Koch and Quist (2007). Fin rays were fixed in epoxy, sectioned with a jeweler's saw, and mounted on a slide for viewing under a dissecting microscope.

Table 2.7 Summary of data sets used for analyses of fish species biological characteristics, 2010 Site C Peace River Fish Inventory.

Group	Species	Zone	Month	Method[a, c]	Length Distribution	Length-Weight	Age Distribution	Condition/ Length at Age	Length Summary
Sportfish (coldwater)	Arctic grayling	1, 2	8, 9, 10	BS, LF, SF	*	*	*	*	
	Bull trout	1, 2	8, 9, 10	BS, LF, SF	*	*	*	*	
	Kokanee	Combined	5, 6, 7	BS, LF, SF	*	*			
	Lake trout	Combined	5 to 10	ALL					*
	Lake whitefish	1, 2	8, 9, 10	BS, LF, SF	*	*	*	*	
	Mountain whitefish	Combined	5 to 10	ALL					*
	Pygmy whitefish	Combined	8, 9, 10	BS, LF, SF	*	*	*	*	
	Rainbow trout	Combined	5 to 10	EF, LF, SF	*	*			
Sportfish (coolwater)	Burbot	Combined	5, 6, 7	BS, LF, SF	*	*	*	*	
	Goldeye	Combined	5 to 10	BS, GN, LF	*	*	*	*	
	Northern pike	Combined	5, 6, 7	BS, LF, SF	*	*	*	*	
	Walleye	Combined	5, 6, 7	BS, LF, SF	*	*	*	*	
	Yellow perch	Combined	5, 6, 7	BS, LF, SF	*	*	*	*	
Suckers	Largescale sucker	1, 2	7	BS, LF, SF	*	*	*	*	
	Longnose sucker	1, 2	7	BS, LF, SF	*	*	*	*	
	White sucker	Combined	7	BS, LF, SF	*	*			
Sculpins	Prickly sculpin	Combined	5, 6, 7	ALL					*
	Slimy sculpin	Combined	5, 6, 7	ALL					*
	Spoonhead sculpin	Combined	5 to 10	ALL					*
Minnows[b]	Brook stickleback	Combined	5 to 10	ALL					*
	Finescale dace	Combined	5 to 10	ALL					*
	Flathead chub	Combined	5, 6, 7	ALL					*
	Lake chub	Combined	5, 6, 7	ALL					*
	Longnose dace	Combined	5, 6, 7	ALL					*
	Northern pikeminnow	1, 2	5, 6, 7	BS, LF, SF	*	*			
	Northern redbelly dace	Combined	5 to 10	ALL					*
	Peamouth	Combined	5 to 10	ALL					*
	Redside shiner	Combined	5, 6, 7	ALL					*
	Spottail shiner	Combined	5, 6, 7	ALL					*
	Trout-perch	Combined	5, 6, 7	ALL					*

[a] Methods: EF – backpack electrofisher; BS – beach seine; SF – small fish boat electrofisher; GN – gill net; LF – large fish boat electrofisher.

[b] Includes true minnows (Family Cyprinidae), trout-perch (Family Percopsidae) and sticklebacks (Family Gasterosteidae).

[c] Age distribution based on large fish boat electrofisher data for all species except yellow perch; yellow perch age distribution based on beach seine data.

Growth

Length-at-age of fish in each zone was compared using either the actual length at age (visual assessment) or mean length-at-age ± SE (statistical).

Where sufficient samples were available growth rate was described using the von Bertalanffy growth equation (Busacker *et al.* 1990) as follows:

$$L_t = L_\infty \left[1 - e^{\{-k(t-t_0)\}}\right]$$

Where t represents the age of the fish in years from the starting time t_0, maximum length equals L_∞, k represents the growth coefficient, and e is the base of the natural logarithm.

When convergence was not possible using the von Bertalanffy growth equation a best-fit regression model was applied. A linear regression best described the age-length relationship as follows:

$$Y = a + bX$$

Where Y = fork length (mm), a = fork length intercept, b = slope, and X = age (years).

All growth curves were generated using Sigmaplot® 8.0.

Length-Weight

The length-weight relationship was characterized based on the power function as follows:

$$W = aL^b$$

Where W = weight (g), a = constant, b = exponent, and L = length (mm).

Body Condition

Fulton's Condition Index (*K)* was used as the metric for body condition as follows:

$$K = (W/L^3) \times 100{,}000$$

Where W = weight (g), L = length (mm), and 100,000 is a scaling constant.

To minimize potential problems associated with correlations between fish length and body condition (Cone 1989), samples were stratified by age. Body condition was compared using mean K at age ± SE.

2.2.6 Distribution of Young Fish

The distribution of young fish of large-fish species was examined to ascertain potential timing and source of recruitment. Age 0 fish, or Age 1 fish in the absence of young-of-the-year, were identified based on length-at-age and/or size distributions of sampled fish. Summary metrics used for the definition of age class by season are summarized in Table 2.8. These age classes were used for examination of young fish distributions. The presence of young fish in each of the three major habitats was plotted by season using MapInfo Professional™.

Habitat use by young fish was presented as percent occurrence. Percent occurrence was calculated by dividing the number of sites in which young fish were present by the total number of sites sampled within that habitat. All sampled sites (all methods combined) were used for the calculation.

Table 2.8 Summary of length of Age 0 and Age 1 fish of selected large fish species used for examination of young fish distributions, 2010 Site C Peace River Fish Inventory.

Species	Age	Spring			Summer			Fall		
		No.	Median	Range	No.	Median	Range	No.	Median	Range
Arctic grayling	0	0			33	63.0	55 - 84	47	132.0	88 - 149
Bull trout	1	1	164.0	164	6	167.5	137 - 192	3	165.0	153 - 174
Burbot	1	3	111.0	102 - 129	0			1	164.0	164
Kokanee	1	70	69.5	47 - 109	20	95.0	65 - 114	2	136.0	134 - 138
Longnose sucker	0	0			0			231	41.0	20 - 74
Largescale sucker	0	0			0			34	42.5	33 - 62
Mountain whitefish	0	504	27.0	12 - 45	802	62.0	13 - 92	629	98.0	32 - 135
Northern pike	0	10	22.5	17 - 29	61	88.0	46 - 108	15	155.0	130 - 172
Northern pikeminnow	0	0						94	30.0	18 - 47
	1	52	62.5	26 - 85	15	48.0	42 - 68	0		
Rainbow trout	0	0			0			2	67.5	63 - 72
	1	5	78.0	55 - 80	6	126.5	91 - 142	15	171.0	132 - 194
Goldeye	0	0			1	36.0	36	0		
Walleye	0	0			26	59.0	43 - 74	0		
	1	3	127.0	104 - 128	15	86.0	76 - 103	4	100.0	93 - 105
White sucker	0	0			0			16	51.0	33 - 62
Yellow perch	0	0			23	37.0	21 - 50	0		
	1	136	53.0	27 - 65	24	74.5	66 - 85	0		
Sucker spp.	0	0			841	20.0	11 - 44	0		

2.2.7 Fish Community Health

To provide an index of the health of fish collected by large fish boat electrofisher, DELT Index values for large fish species were summarized after removing physical injury categories (i.e., cuts and electrofisher injury). Relative levels of impairment to health were based on criteria presented in Bauman *et al.* (2000).

Categories of health impairment were as follows:

Background -	DELT Index ≤ 0.5% of sample
Moderately Impaired -	DELT Index > 0.5% to 3.0%
Strongly Impaired -	DELT Index > 3.0% to 6.0%
Highly Impaired -	DELT Index > 6.0%.

For example, if 4% of the fish have DELT injuries (deformities, erosion, lesions, and/or tumors), then the population is considered Strongly Impaired and if 50% of the fish have DELT injuries then the population is considered Highly Impaired (Bauman *et al.* 2000).

This page is intentionally blank.

3.0 RESULTS

3.1 ENVIRONMENTAL CONDITIONS

3.1.1 Discharge

In 2010, Peace River mean daily discharge varied between 311 m^3/s and 2,080 m^3/s (Figure 3.1). Mean daily discharge ranged from 320 m^3/s to 1,925 m^3/s during the spring session, 372 m^3/s to 1,075 m^3/s during the summer session, and 322 m^3/s to 1,038 m^3/s during the fall session. Inputs from the major tributaries (Halfway, Moberly, Pine, Beatton, and Kiskatinaw rivers) influenced Peace River flows, particularly between May and August. Peace River discharge was higher at downstream Water Survey of Canada sites compared to upstream sites during each of the field programs. Due to extended periods of low discharge from PCN Dam, 2010 sampling in all sections upstream of the Pine River confluence occurred under low flows conditions.

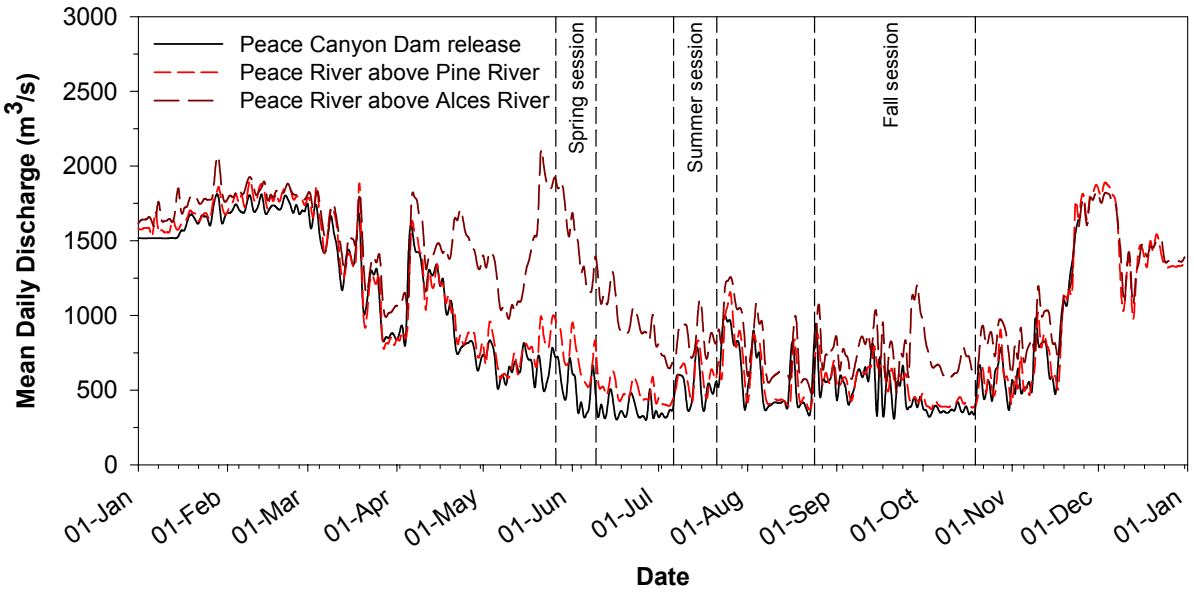


Figure 3.1 Peace River mean daily discharge at Water Survey of Canada Stations and PCN Dam from January to December, 2010 Site C Peace River Fish Inventory (the fall session sampling period includes Peace River Fish Indexing Program).

Peace River hourly discharge was influenced by releases from the PCN Dam. Hourly discharge typically fluctuated over a 24 h period as illustrated by the flow regime recorded during May 2010 (Figure 3.2). In contrast, hourly discharge in June 2010 was generally stable interspersed with rapid 12 h discharge peaks occurring on a weekly or bi-weekly basis. The fluctuation in flow was most apparent immediately downstream of the PCN Dam; however, downstream effects were dampened by tributary inputs and

downstream flow attenuation. Fluctuations of hourly discharge occurred within the entire study area, which is an approximate distance of 172 km.

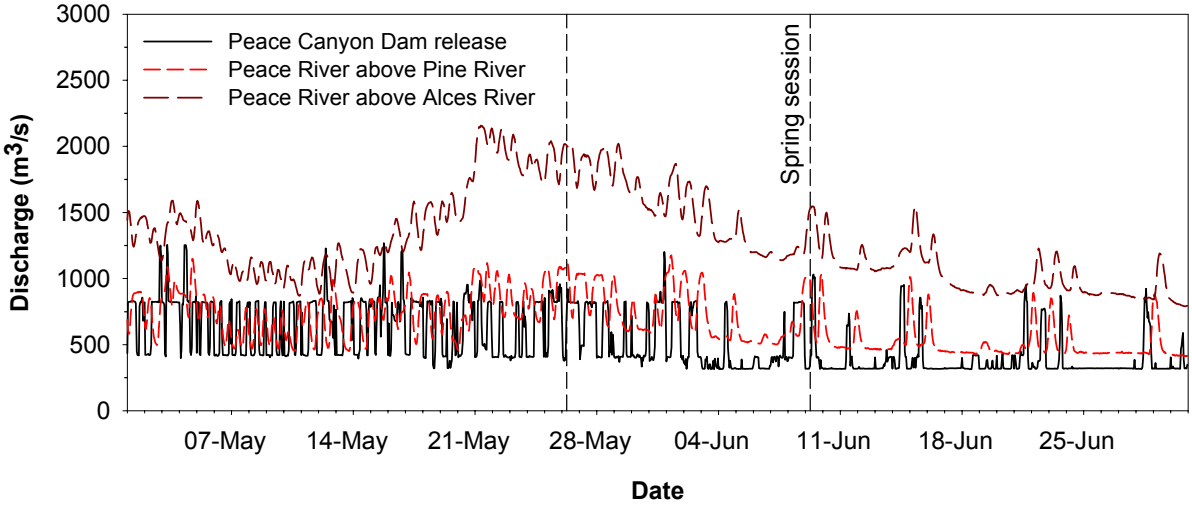


Figure 3.2 Peace River hourly discharge at Water Survey of Canada Stations and PCN Dam during May and June, 2010 Site C Peace River Fish Inventory.

3.1.2 Water Clarity

Water clarity of the Peace River recorded at sample sites varied over space and time (Figure 3.3, Appendix C). During all seasons water clarity was generally highest in upstream sections and lowest in downstream sections. Water clarity was lowest during spring in most sections except Section 1A, which is located immediately downstream of the PCN Dam.

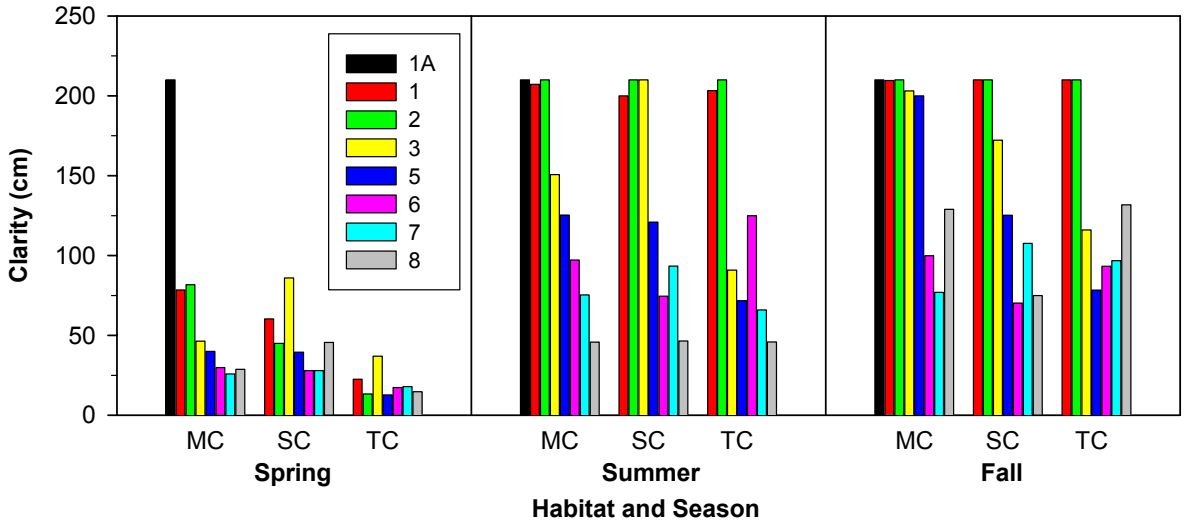


Figure 3.3 Mean water clarity measured at sites by section, season, and habitat, 2010 Site C Peace River Fish Inventory (MC – main channel, SC – side channel, TC – tributary confluence).

In 2010, there were no large differences in water clarity between main channel (MC) and side channel (SC) sites within each section. In spring water clarity at tributary confluence sites (TC) was low (≤ 25 cm).

3.1.3 Water Temperature

Surface water temperatures of the Peace River measured at sampled sites varied over space and time (Figure 3.4, Appendix C). Mean water temperatures ranged from 5.6^{0}C to 23.4^{0}C, with temperatures being intermediate in spring, highest in summer, and lowest in fall. During spring and summer, lowest values were recorded nearest to the PCN Dam (Section 1A), while highest temperatures were recorded at sites located at downstream locations (Sections 7 and 8). The pattern was reversed in fall.

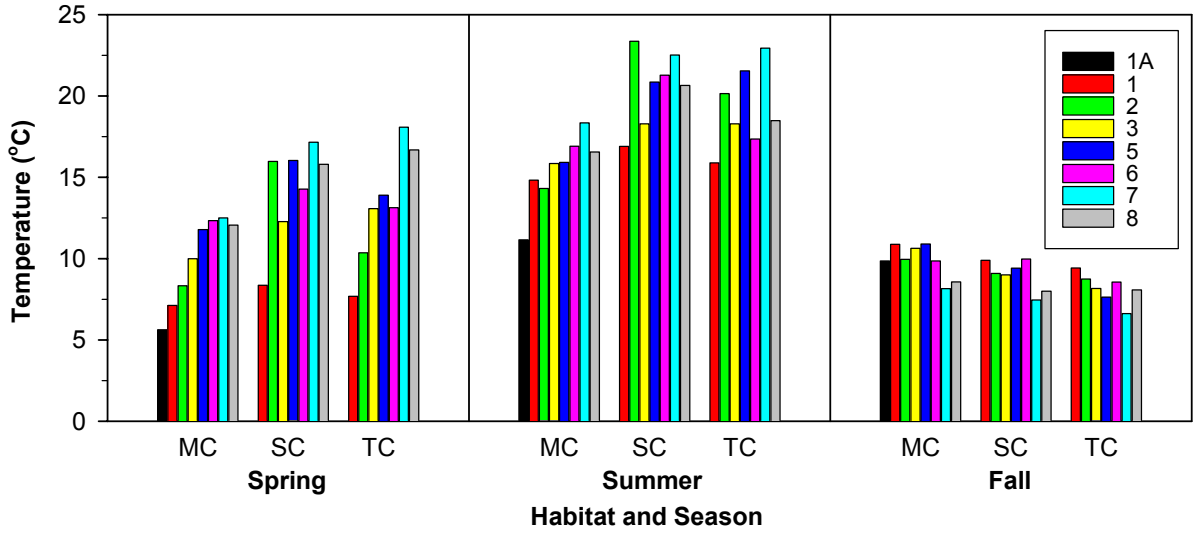


Figure 3.4 Mean water temperatures measured at sample sites by section, season, and habitat, 2010 Site C Peace River Fish Inventory (MC – main channel, SC – side channel, TC – tributary confluence).

Water temperatures differed between habitat areas. In spring and summer, average water temperatures in side channel (SC) and tributary confluence (TC) areas were higher than in main channel (MC) areas – differences ≥ 3^{0}C were not uncommon. Point measurements during summer also recorded very high temperatures in side channels (23.4^{0}C) and tributary confluences (22.9^{0}C).

3.1.4 Water Conductivity

Water conductivity of the Peace River was generally stable over space and time (Figure 3.5, Appendix C). Mean conductivity ranged from 126 µ*S*/cm to 393 µ*S*/cm, but this range reflected differences between sampled areas rather than section or season. Mean conductivity at main channel (MC) sites during the entire field program ranged from 154 µ*S*/cm to 234 µ*S*/cm. Values recorded at side channel (SC) sites

during the entire field program were more variable. They ranged from 126 µ*S*/cm to 380 µ*S*/cm. The highest values (> 600 µ*S*/cm; *n* = 5) were recorded at side channel and tributary confluence sites in Sections 5, 6, and 8 (EF0503, BS0609, BS0616, and EF0801; Appendix C3 and C4). Reasons for the high values are not known, but may be related to ground water inputs or anthropogenic causes.

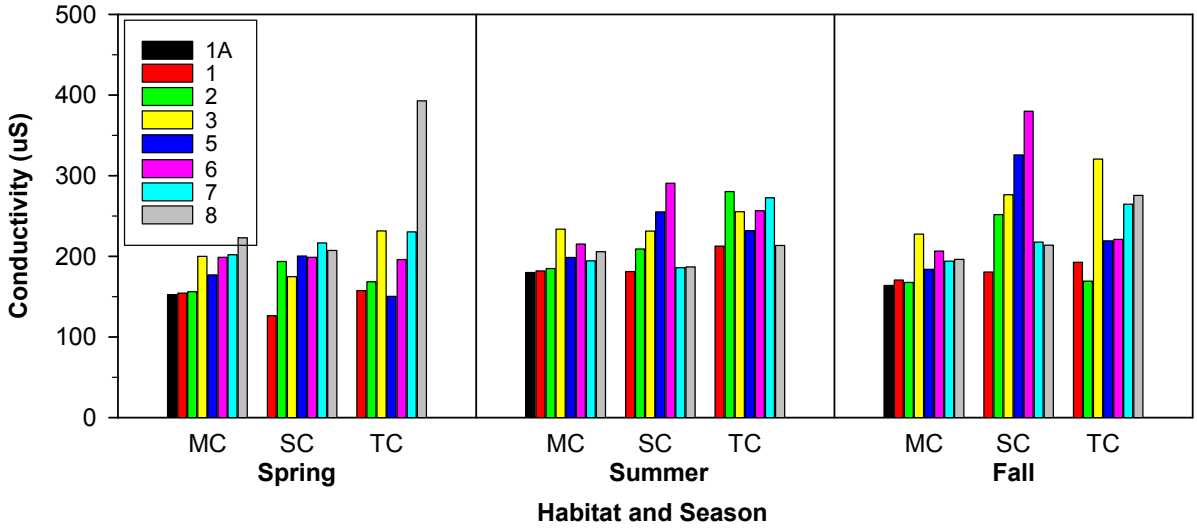


Figure 3.5 Mean water conductivity measured at sample sites by section, season, and habitat, 2010 Site C Peace River Fish Inventory (MC – main channel, SC – side channel, TC – tributary confluence).

Mean water conductivity at tributary confluence (TC) areas were more variable than at main channel or side channel areas (range of 150 µ*S*/cm to 392 µ*S*/cm) and tended to be the highest values recorded in each section.

3.2 FISH COMMUNITY STRUCTURE

3.2.1 Species Composition

In total, 49,703 fish representing 30 species were recorded during the Peace River Fish Inventory in 2010 (Table 3.1). The recorded species included 8 coldwater sportfish, 5 coolwater sportfish, 3 suckers, 3 sculpins, and 11 minnows (includes true minnows, trout-perch, and sticklebacks).

Table 3.1 Composition of enumerated fish species, 2010 Site C Peace River Fish Inventory (all capture methods and sample events combined).

Group[a]	Species	Total	Percent
Sportfish (coldwater)	Arctic grayling	272	0.5
	Bull trout	285	0.6
	Kokanee	537	1.1
	Lake trout	2	0.0
	Lake whitefish	31	0.1
	Mountain whitefish	21,023	42.3
	Pygmy whitefish	1	0.0
	Rainbow trout	285	0.6
	Subtotal	*22,436*	*45.1*
Sportfish (coolwater)	Burbot	51	0.1
	Goldeye	82	0.2
	Northern pike	338	0.7
	Walleye	332	0.7
	Yellow perch	635	1.3
	Subtotal	1,438	*2.9*
Suckers	Largescale sucker	1,085	2.2
	Longnose sucker	4,165	8.4
	White sucker	271	0.5
	Subtotal	*5,521*	*11.1*
Sculpins	Prickly sculpin	256	0.5
	Slimy sculpin	1,517	3.1
	Spoonhead sculpin	3	0.0
	Subtotal	*1,776*	3.6
Minnows[b]	Brook stickleback	1	0.0
	Finescale dace	2	0.0
	Flathead chub	272	0.5
	Lake chub	5,531	11.1
	Longnose dace	2,170	4.4
	Northern pikeminnow	620	1.2
	Northern redbelly dace	10	0.0
	Peamouth	2	0.0
	Redside shiner	6,935	14.0
	Spottail shiner	2,386	4.8
	Trout-perch	603	1.2
	Subtotal	*18,532*	*37.3*
Total		**49,703**	**100.0**

[a] Does not include unidentified fish.

[b] Includes true minnows (Family Cyprinidae), trout-perch (Family Percopsidae) and sticklebacks (Family Gasterosteidae).

Coldwater sportfish accounted for a much higher percentage of the sample (45.1%) compared to suckers (11.1%) and coolwater sportfish (2.9%). The minnow group also accounted for a much higher percentage of the sample (37.3%) compared to sculpins (3.6%).

The numerically dominant fish species in the coldwater sportfish group and the most numerous fish recorded during the study was mountain whitefish (21,023 fish). The next most numerically important coldwater sportfish species were kokanee (537 fish), rainbow trout (285 fish), bull trout (285 fish), and Arctic grayling (272 fish). Each of the three remaining coldwater sportfish was scarce. These included lake trout (2 fish), lake whitefish (31 fish), and pygmy whitefish (1 fish). Overall coolwater sportfish were less abundant than coldwater sportfish. The numerically dominant fish species in the coolwater sportfish group was yellow perch (635 fish) followed by northern pike (338 fish), and walleye (332 fish). The two remaining coolwater sportfish, burbot (51 fish), and goldeye (82 fish) were scarce.

Longnose sucker was the numerically dominant species in the sucker group (4,165 fish). The other two species, largescale sucker and white sucker, accounted for 1,085 fish and 271 fish, respectively.

Redside shiner was the numerically dominant species in the minnow group (6,935 fish). Lake chub (5,531 fish), longnose dace (2,170 fish), spottail shiner (2,386 fish), northern pikeminnow (620 fish), trout-perch (603 fish), and flathead chub (272 fish) were well represented. Each of the remaining species in this group, which included brook stickleback, finescale dace, northern redbelly dace, and peamouth were scarce (≤ 10 fish).

Slimy sculpin was the numerically dominant species in the sculpins (1,517 fish). Prickly sculpin accounted were well represented (256 fish), but spoonhead sculpin were scarce (3 fish).

3.2 2 Fish Assemblage

The fish assemblage recorded during the field program was not constant among sections (Figure 3.6). The coldwater sportfish group accounted for the majority of the sample in each section; however, their contribution decreased from upstream to downstream. A high of 87.1% recorded in Section 1A declined to 58.0% in Section 3. Downstream of the proposed Site C Dam (Zone 2) coldwater sportfish accounted for ≤ 28.0% of the sample in each section. A similar pattern was recorded for the sculpin group. The contribution of sculpins ranged from 12.6% in Sections 1A to 7.8% in Section 3. The percentage of sculpins in each section was ≤ 2.0 in each section located in Zone 2.

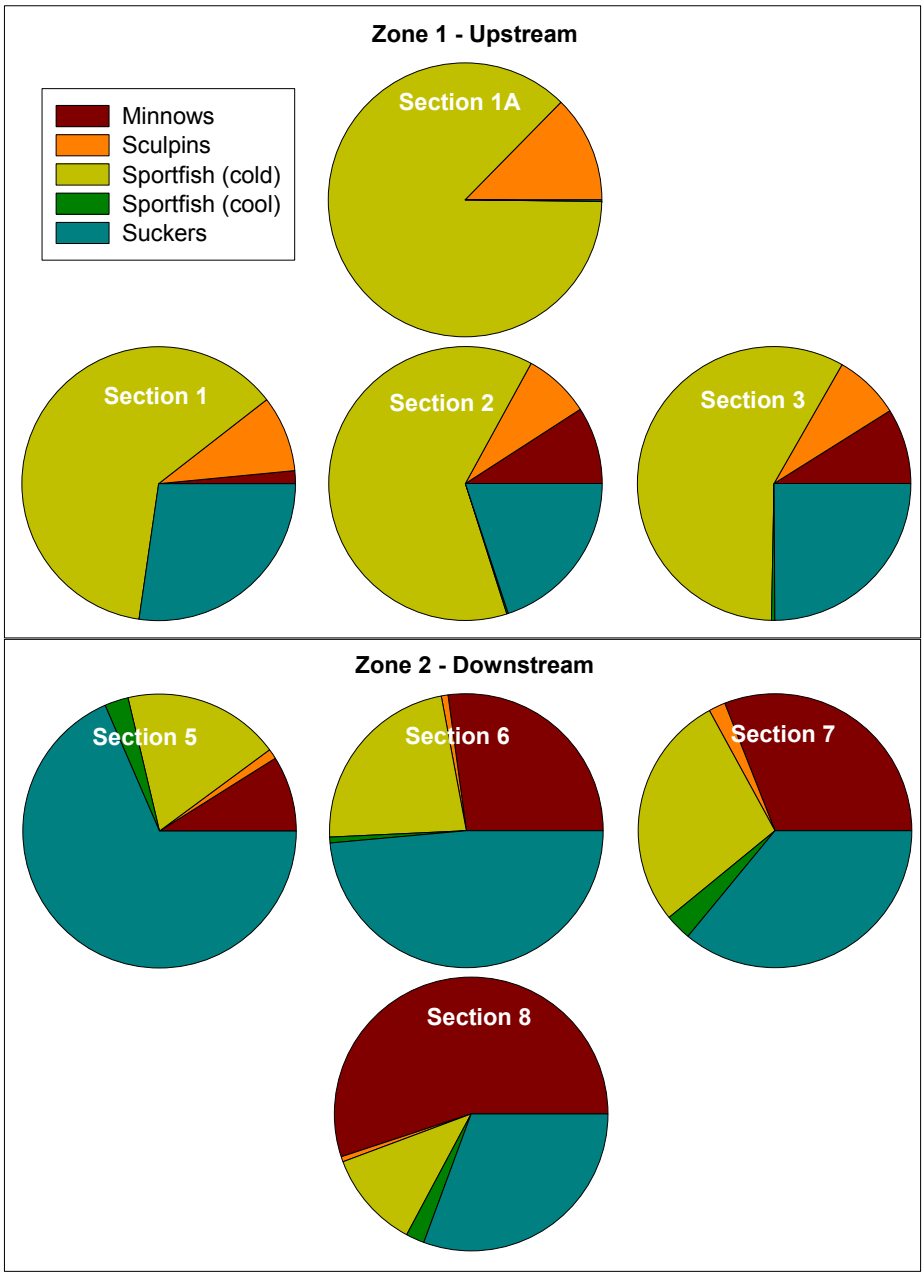


Figure 3.6 Relative contribution of fish groups by section and zone, 2010 Site C Peace River Fish Inventory (all capture methods and sample events combined).

The spatial trends recorded for the coolwater sportfish, sucker, and minnow groups were the reverse of trends for the coldwater sportfish and sculpin groups. There was an increase in the numerical contribution from upstream to downstream. Coolwater sportfish were largely absent from all sections in Zone 1. In Zone 2 their contribution ranged from 0.7% (Section 6) to 2.8% (Section 5). For the sucker group, a low of 0.2% recorded in Section 1A increased to ≥ 36.0% in Zone 2 sections. The largest change occurred between Section 3 (24.9%) and Section 5 (68.5%). Similarly, the minnow group accounted for a small

percentage of the sample in Sections 1A through to Section 5 (≤ 8.9%). The contribution of this group was ≥ 27.1% in Section 6 to Section 8.

The fish assemblage also differed by habitat type (Figure 3.7). In Zone 1, upstream of Site C, the contribution of coldwater sportfish was higher in the main channel area (79.6%) compared to side channel (33.1%) and tributary confluence areas (24.2%). A similar pattern was recorded for the sculpin group in Zone 1. In contrast, suckers were more prominent in side channels (37.3%) and tributary confluence areas (54.1%) compared to main channel areas (9.8%). The results for minnows were similar to the sucker results. The contribution of the minnow group was higher in side channels and tributary confluences than in main channel areas. Coolwater sportfish were rarely encountered in Zone 1.

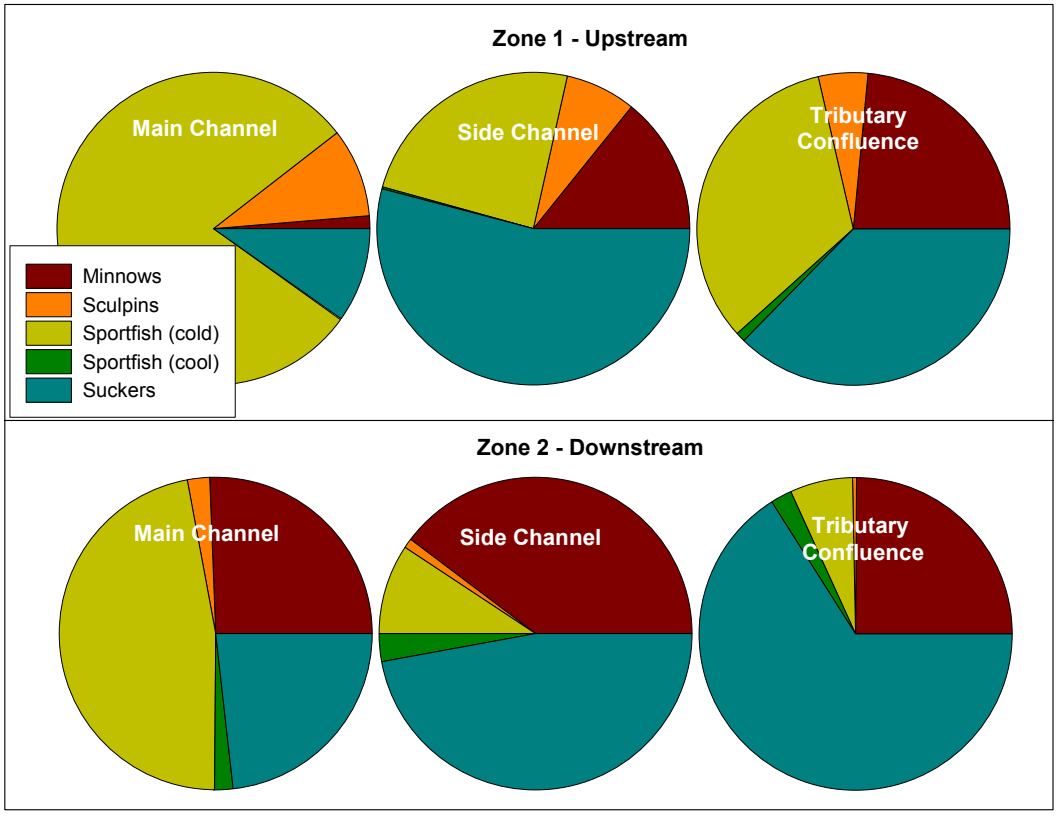


Figure 3.7 Relative contribution of fish groups by habitat type and zone, 2010 Site C Peace River Fish Inventory (all capture methods and sample events combined).

The relative contribution of each group changed in Zone 2. Within each habitat type, the contribution of coldwater sportfish and sculpins was lower in Zone 1 compared to Zone 2. The reverse was true for coolwater sportfish, suckers, and minnows. This shift reflects the spatial differences within the study area illustrated by Figure 3.6.

Although the relative contribution of each group differed by Zone, the pattern within each habitat remained the same. The coldwater sportfish group and the sculpin group were most prominent in main channel areas, while the contribution of minnows was generally higher in side channel and tributary confluence areas. Coolwater sportfish and suckers were also more prominent in these two areas.

3.2.3 Species Diversity

In total, 30 fish species were recorded during the study, but the number of species differed between sections (Table 3.2). The number of species increased from upstream to downstream. Seven species were recorded in Section 1A, which is located immediately below the PCN Dam. In Sections 1, 2, and 3 which are located upstream of the Moberly River, 15, 16, and 19 species were recorded, respectively. Species diversity increased to ≥ 24 species in the remaining four sections (Sections 5, 6, 7, and 8).

Table 3.2 Distribution of fish species by section and zone recorded on the Peace River, 2010 Site C Peace River Fish Inventory (all capture methods and sample events combined).

Group	Species	Zone 1 – Upstream				Zone 2 – Downstream			
		1A	1	2	3	5	6	7	8
Sportfish (coldwater)	Arctic grayling			+	+	+	+	+	+
	Bull trout	+	+	+	+	+	+	+	+
	Kokanee	+	+	+	+	+	+	+	+
	Lake trout		+		+				
	Lake whitefish		+	+	+	+	+		
	Mountain whitefish	+	+	+	+	+	+	+	+
	Pygmy whitefish					+			
	Rainbow trout	+	+	+	+	+	+	+	+
Sportfish (coolwater)	Burbot				+	+	+	+	+
	Goldeye					+	+	+	+
	Northern pike			+	+	+	+	+	+
	Walleye					+	+	+	+
	Yellow perch					+	+	+	+
Suckers	Longnose sucker		+	+	+	+	+	+	+
	Largescale sucker	+	+	+	+	+	+	+	+
	White sucker		+		+	+	+	+	+
Sculpins	Prickly sculpin	+	+	+	+	+	+	+	+
	Slimy sculpin	+	+	+	+	+	+	+	+
	Spoonhead sculpin						+	+	
Minnows[a]	Brook stickleback								+
	Finescale dace								+
	Flathead chub						+	+	+
	Lake chub		+	+	+	+	+	+	+
	Longnose dace		+	+	+	+	+	+	+
	Northern pikeminnow		+	+	+	+	+	+	+
	Northern redbelly dace					+	+	+	+
	Peamouth							+	
	Redside shiner		+	+	+	+	+	+	+
	Spottail shiner			+	+	+	+	+	+
	Trout-perch					+	+	+	+
Total Number of Species		**7**	**15**	**16**	**19**	**24**	**25**	**25**	**25**

[a] Includes true minnows (Family Cyprinidae), trout-perch (Family Percopsidae), and sticklebacks (Family Gasterosteidae).

The majority of fish species recorded during the study were widely distributed (Table 3.2). In total, 16 species were recorded in 6 or more sections. These included Arctic grayling, bull trout, kokanee, mountain whitefish, rainbow trout, northern pike, longnose sucker, largescale sucker, white sucker, prickly sculpin, slimy sculpin, lake chub, longnose dace, northern pikeminnow, redside shiner, and spottail shiner.

Of the 14 species that exhibited a more restricted distribution (present in ≤ 5 sections), most (13 species) were located only in Zone 2 and/or in the lower portion of Zone 1 (Section 3). These included pygmy whitefish, burbot, goldeye, walleye, yellow perch, spoonhead sculpin, brook stickleback, finescale dace, flathead chub, northern redbelly dace, peamouth, and trout-perch. Lake whitefish was located in five sections (Section 1 to Section 6).

3.2.4 Species Occurrence

The occurrence of fish at sample sites within each section varied depending on species and section (Figure 3.8). As expected from numbers presented in Table 3.1, species that were numerically scarce also occurred sporadically in the study area. In the sportfish group, lake trout, lake whitefish, and pygmy whitefish were infrequently encountered in any one section. For each of these species, percent occurrence did not exceed 4.2% in Zone 1 and Zone 2. In the minnow group, brook stickleback, finescale dace, northern redbelly dace, and peamouth occurred at very few sites in each section within Zone 1 and Zone 2 (≤ 3.4%). Spoonhead sculpin in the sculpin group was rarely recorded (≤ 1.6% of sampled sites).

For several species, percent occurrence differed between Zones 1 and 2. In the sportfish and sculpin groups, bull trout, kokanee, rainbow trout, and prickly sculpin were more frequently encountered in Zone 1 compared to Zone 2. Slimy sculpin occurred equally in both zones. The opposite was true for the coolwater sportfish burbot, goldeye, northern pike, walleye, and yellow perch. Similarly, in the sucker and minnow groups the occurrence of longnose suckers, largescale suckers, white suckers, flathead chub, lake chub, longnose dace, northern pikeminnow, spottail shiners, redside shiners, and trout-perch were generally higher at sites in Zone 2 compared to sites in Zone 1. Arctic grayling was the only coldwater sportfish that occurred more frequently at sites within most sections in Zone 2 compared to Zone 1. Mountain whitefish occurrence did not differ between zones.

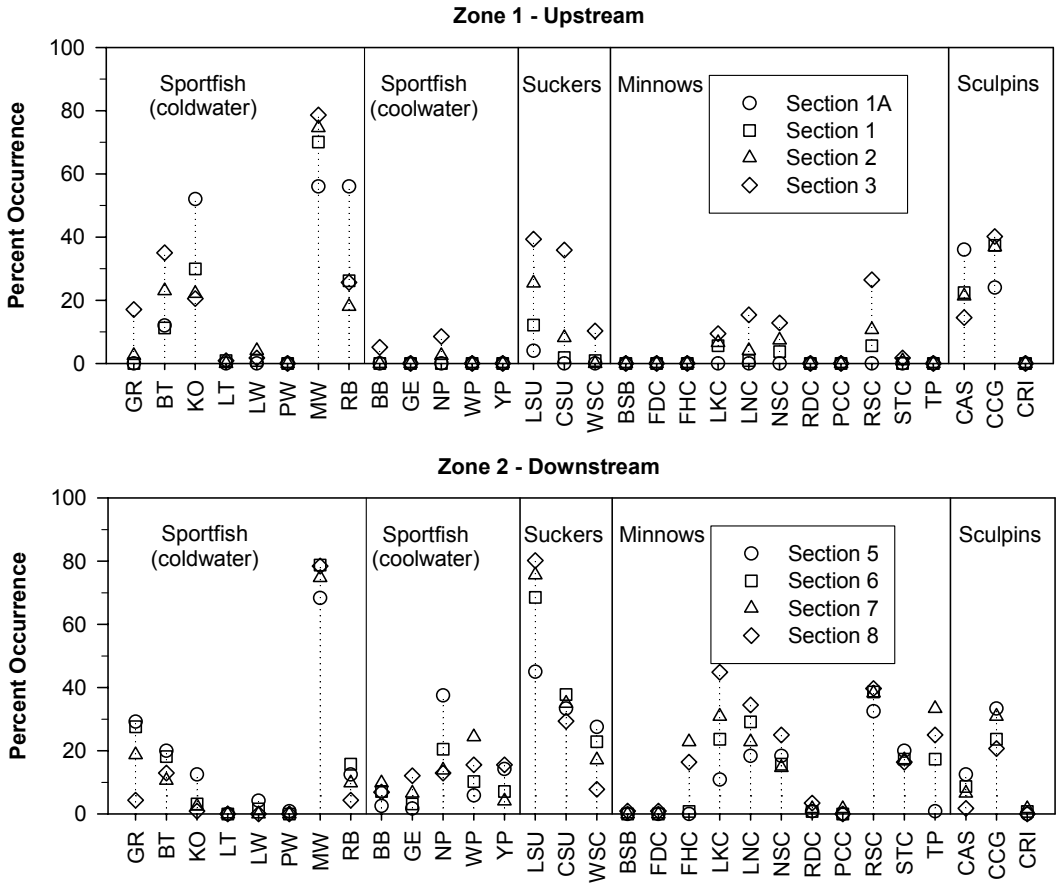


Figure 3.8 Percent occurrence of fish species at sampled sites within each section by zone, 2010 Site C Peace River Fish Inventory (all capture methods and sample events combined).

Although the occurrence of the majority of species differed between zones, species occurrence in the three habitat types was generally consistent (Figure 3.9). The sportfish species Arctic grayling, bull trout, kokanee, mountain whitefish, and rainbow trout were most often encountered in main channel areas. Burbot, goldeye, and walleye were most likely to occur at tributary confluences. Lake whitefish, northern pike, and yellow perch were frequently encountered in side channel areas.

In the sucker group, longnose sucker, largescale sucker, and white sucker were most frequently encountered at tributary confluence areas in Zone 1. The occurrence of all three sucker species shifted to mainstem and/or side channel areas in Zone 2.

The majority of species in the minnow group were most frequently recorded at sites located in tributary areas. The two exceptions were spottail shiner and redside shiner.

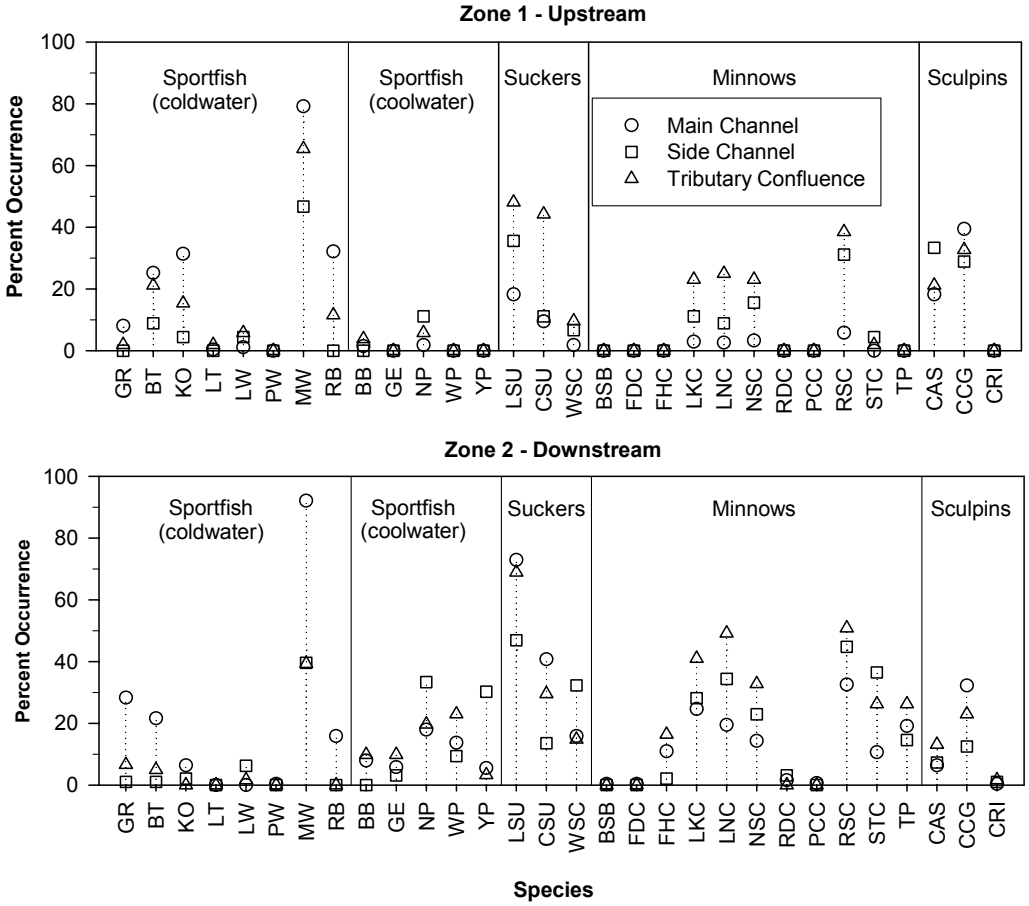


Figure 3.9 Percent occurrence of fish species at sampled sites within habitat types by zone, 2010 Site C Peace River Fish Inventory (all capture methods and sample events combined).

Spottail shiner primarily occurred in side channel areas, while redside shiners were frequently encountered in side channel and tributary confluence areas. In the sculpin group, prickly sculpin was likely to occur at sites in side channel and tributary confluences, whereas slimy sculpin were most likely to be found in main channel areas.

3.3 COLDWATER SPORTFISH POPULATIONS

Information presented in this section includes summaries of catch rates, biological characteristics, and recruitment of selected coldwater sportfish populations. Raw data and summaries for all coldwater sportfish populations are presented in Appendix E (catch rates), Appendix F (biological characteristics), and Appendix G (young fish distribution). It should be noted that biological characteristics data collected during the present study were augmented with data collected from the 2010 WLR Peace River Fish Index Project (Mainstream and Gazey 2011). Appendix F identifies those data.

3.3.1 Arctic grayling

3.3.1.1 Catch Rate

In total, 272 Arctic grayling were enumerated in the study area. Arctic grayling were recorded in main channel areas; this species was not encountered in side channels and was recorded at only one tributary area (Figure 3.10). Catch rates of small Arctic grayling were higher than for large Arctic grayling. Mean catch rates of small Arctic grayling reached 3.0 fish/km, while mean catch rates for large Arctic grayling did not exceed 1.0 fish/km.

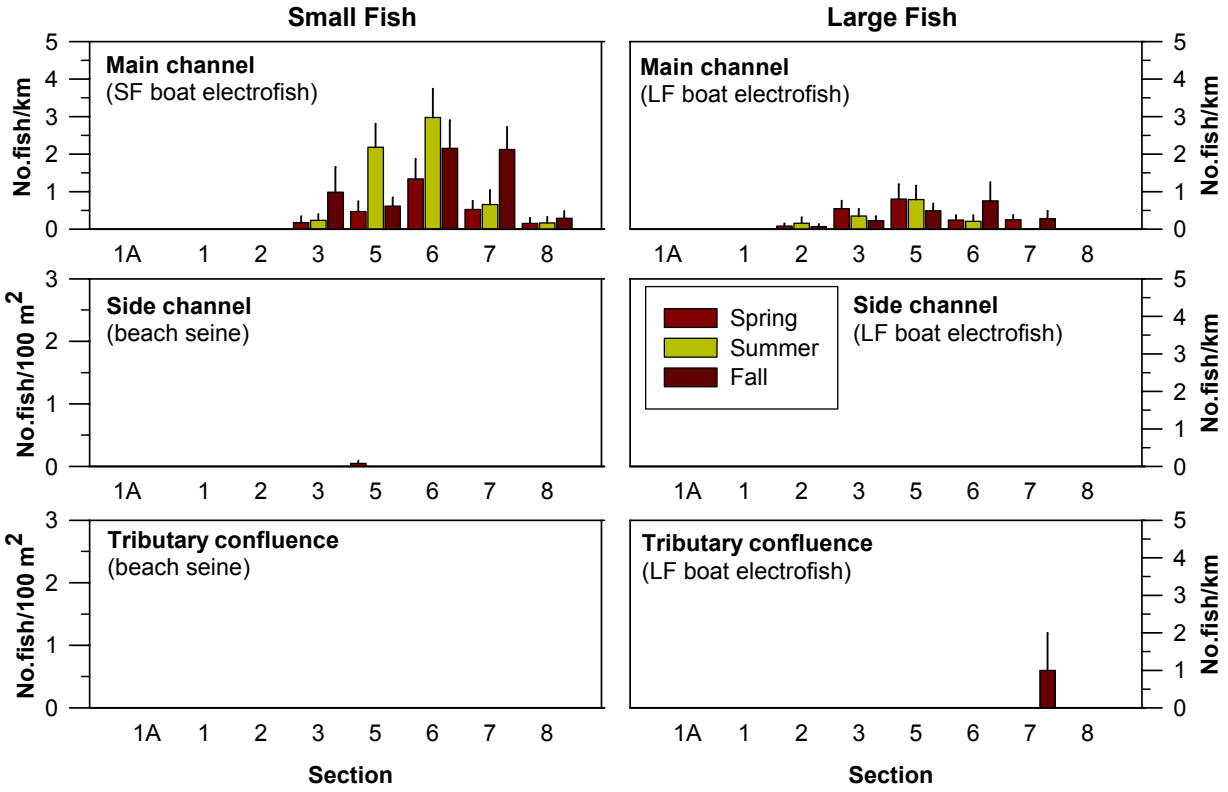


Figure 3.10 Average catch rates (± SE) of Arctic grayling in study sections during spring, summer, and fall, 2010 Site C Peace River Fish Inventory (small fish ≤ 200 mm fork length and large fish > 200 mm fork length; SF – small fish method, LF – large fish method).

Catch rates of large Arctic grayling were highest in Section 3 to Section 6, while the catch rates of small Arctic grayling were highest in Section 3 to Section 7. These spatial patterns may reflect the distribution of recruitment sources of small Arctic grayling (Sections 3 to 7 are located in immediate vicinities of major tributaries to the Peace River [Figure 1.1]), as well as the distribution of habitats preferred by Arctic grayling.

Generally, there were no substantial differences in seasonal catch rates of large Arctic grayling. However, catch rates of small Arctic grayling were highest in summer and fall. The elevated small fish catch rates in summer and fall suggest an influx of fish to the Peace River from tributaries or an increase in catchability.

3.3.1.2 Biological Characteristics

In total, 150 Arctic grayling were used to describe biological characteristics – 42 from Zone 1 and 108 from Zone 2. Sampled fish ranged in length from 88 mm to 362 mm, ranged in weight from 14 g to 632 g, and ranged from Age 0 to Age 5.

The size and age distributions of Arctic grayling differed between Zone 1 and Zone 2 (Figure 3.11). Based on the combined sample from all capture methods, Arctic grayling captured in Zone 1 were almost entirely Age 2 and older (≥ 150 mm). Arctic grayling captured in Zone 2 ranged from Age 0 to Age 4 including a large proportion of Age 0 and Age 1 individuals (≤ 150 mm).

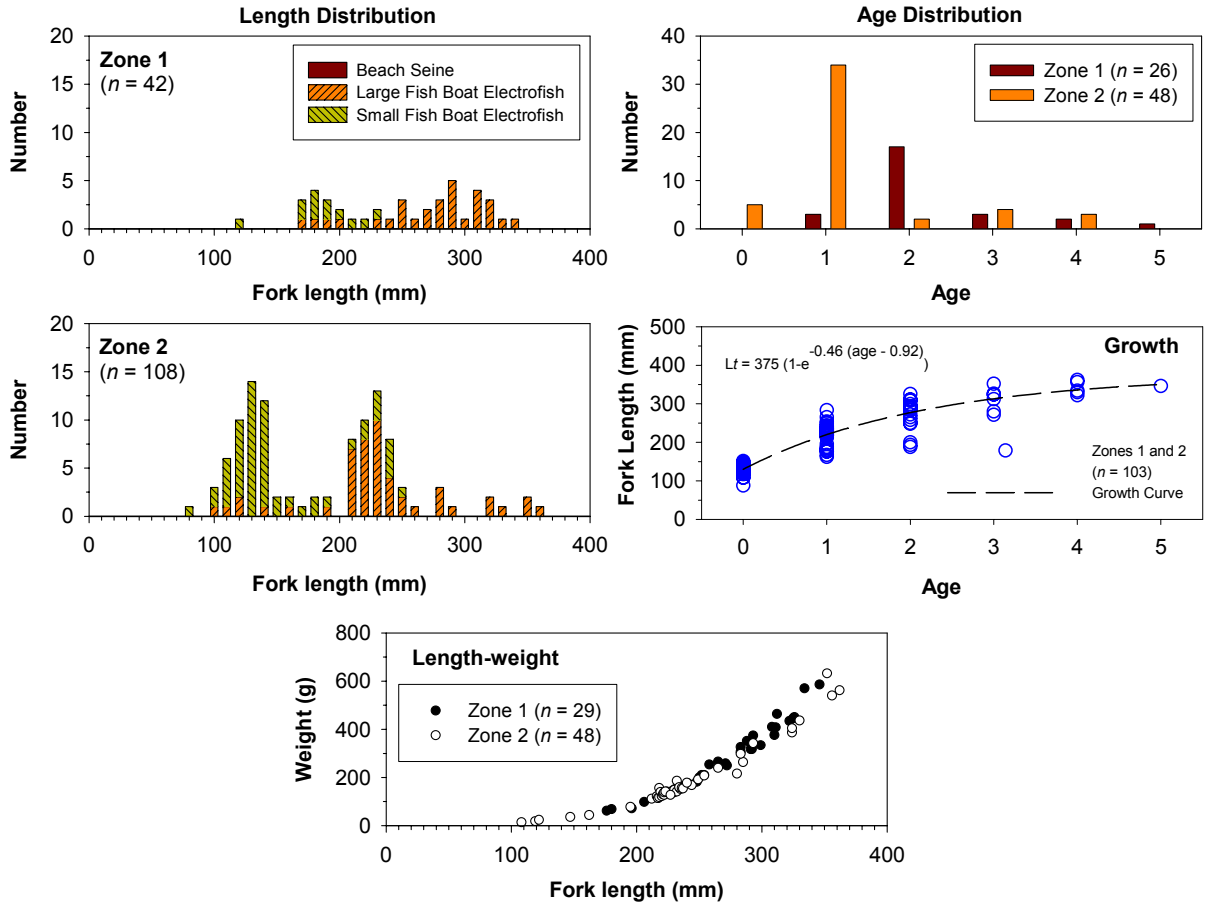


Figure 3.11 Biological characteristics of sampled Arctic grayling, 2010 Site C Peace River Fish Inventory (Table 2.6 identifies data selected for analyses).

A visual assessment of the length-weight relationship (Figure 3.11) and a comparison of length-at-age and condition-at-age summaries (Table 3.3) indicated no substantial differences between zones in Arctic grayling condition or growth. The growth curve using the combined data indicated a von Bertalanffy growth form.

Table 3.3 Mean length-at-age and condition-at-age of Arctic grayling in Zone 1 and Zone 2, 2010 Site C Peace River Fish Inventory.

Age	Fork Length				Condition (*K*)			
	Zone 1		Zone 2		Zone 1		Zone 2	
	n	**Mean (± 95%CI)**	***n***	**Mean (± 95%CI)**	***n***	**Mean (± 95%CI)**	***n***	**Mean (± 95%CI)**
0	1	125.0	26	129.4 ± 5.9			4	1.16 ± 0.18
1	6	190.2 ± 24.6	35	226.7 ± 7.6	3	1.18 ± 0.12	34	1.22 ± 0.04
2	18	281.6 ± 14.6	4	239.8 ± 90.7	17	1.34 ± 0.05	2	1.25 ± 1.39
3	3	303.0 ± 71.0	4	320.0 ± 47.3	3	1.37 ± 0.33	4	1.19 ± 0.31
4	2	328.0 ± 76.2	3	349.3 ± 42.3	2	1.41 ± 1.46	3	1.20 ± 0.04
5	1	346.0			1	1.41		

3.3.1.3 Distribution of Young Fish

There were spatial, seasonal, and habitat differences in the distribution of Age 0 Arctic grayling in the Peace River (Figure 3.12). Overall, Age 0 Arctic grayling were most often recorded downstream of the proposed Site C dam (Zone 2) in Sections 5, 6, and 7. Age 0 Arctic grayling were infrequently encountered in upstream sections (Sections 1, 2, and 3) and in the downstream Section 8. Main channels were the primary habitat. Age 0 Arctic grayling were infrequently encountered in spring, the percentage of sites containing fish increased from summer to fall.

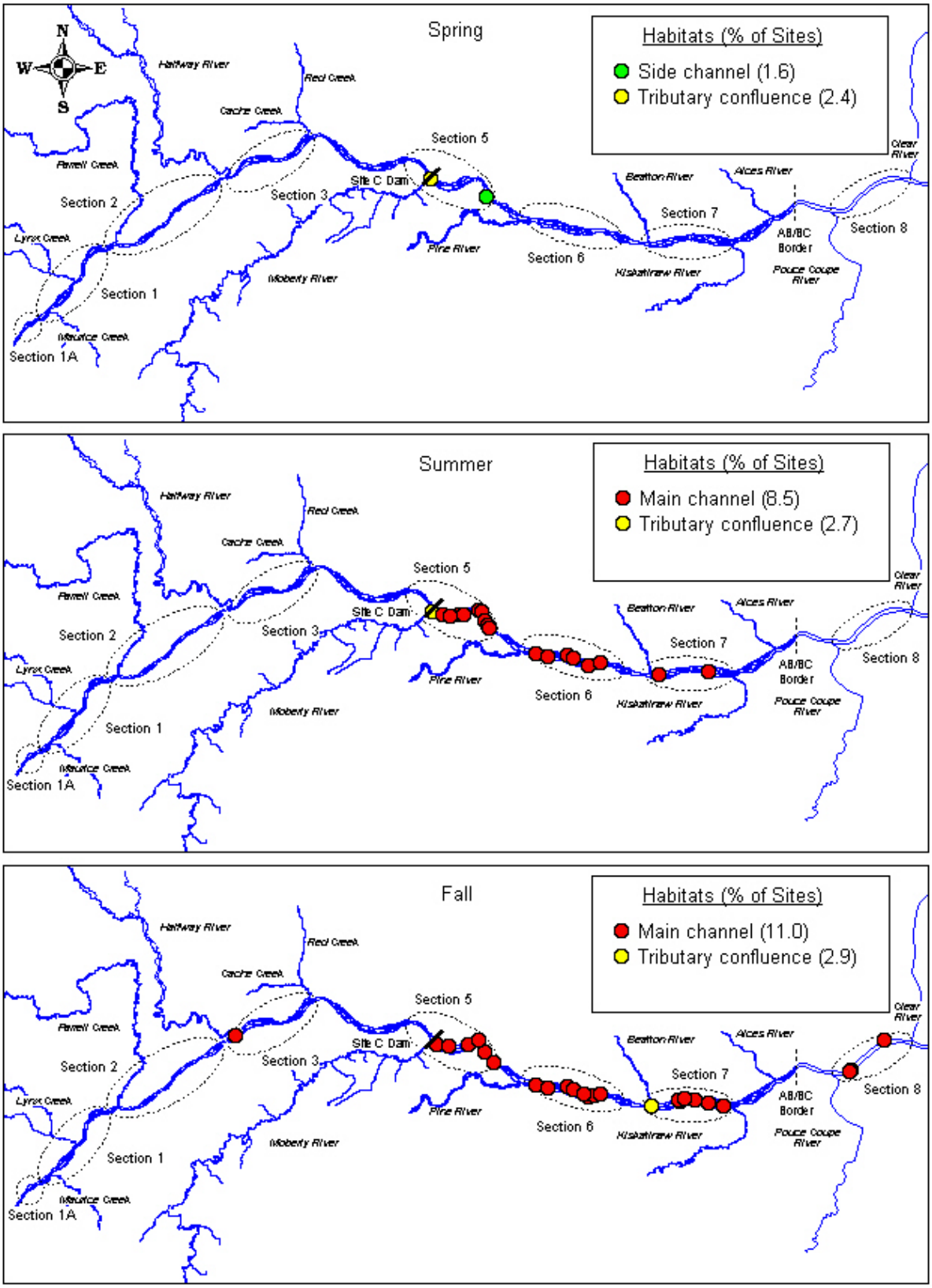


Figure 3.12 Distribution of Age 0 Arctic grayling (% of sites with Age 0 Arctic grayling recorded), 2010 Site C Peace River Fish Inventory.

3.3.2 Bull trout

3.3.2.1 Catch Rate

In total, 285 bull trout were enumerated in the study area. Bull trout were encountered in main channel areas, side channel areas, and tributary confluence areas, but the catch was almost entirely composed of larger fish (> 200 mm fork length) (Figure 3.13). Mean catch rates of large bull trout in main channel areas and side channel areas rarely exceeded 1.5 fish/km.

Higher mean catch rates were recorded at tributary confluence areas in Sections 1, 2, and 3 during spring and/or fall. In all cases the high catch rates were caused by the presence of 2 to 4 fish. The high catch rate recorded in Section 3 in spring occurred in the Halfway River confluence area, where 16 adult bull trout were recorded. A concentration of adult bull trout also was recorded in the same location in spring 2008 (Mainstream 2009b) and spring 2009 (Mainstream 2010).

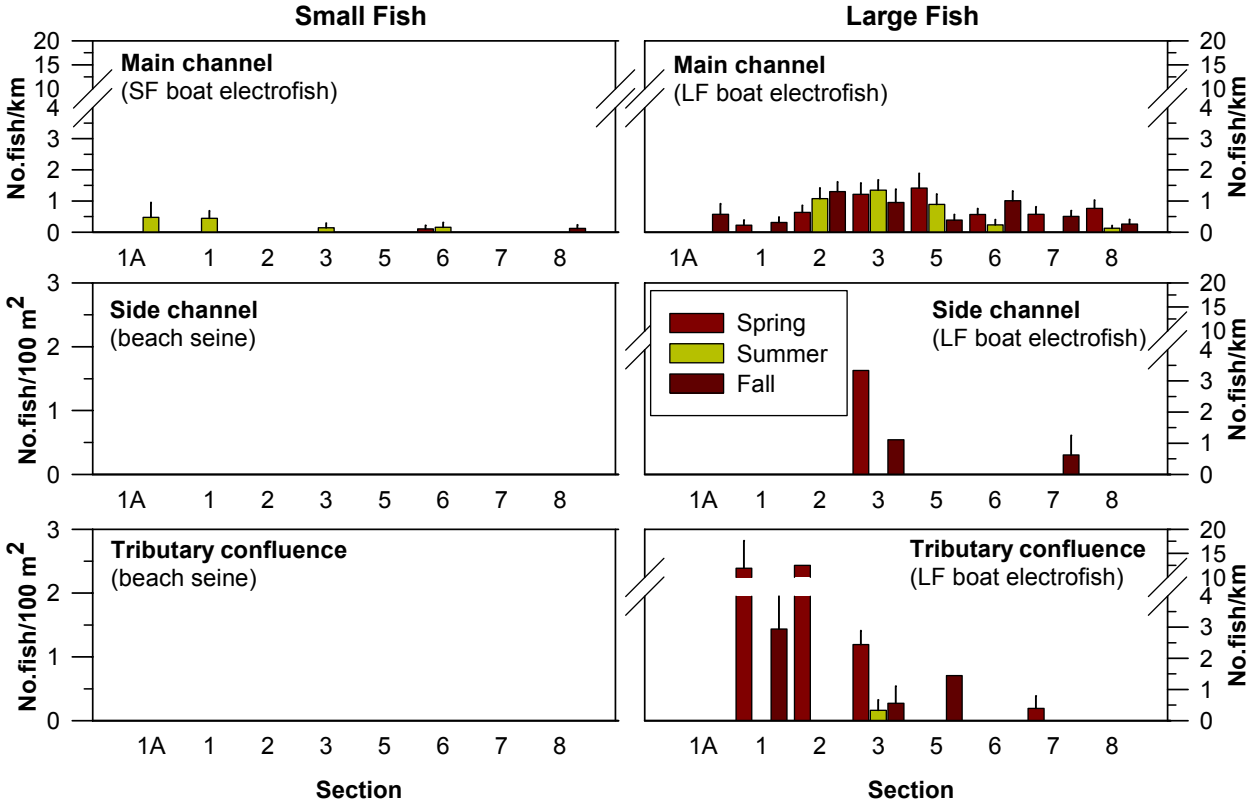


Figure 3.13 Average catch rates (± SE) of bull trout in study sections during spring, summer, and fall, 2010 Site C Peace River Fish Inventory (small fish ≤ 200 mm fork length and large fish > 200 mm fork length; SF – small fish method, LF – large fish method).

Large bull trout were recorded in all sections during the study, but catch rates were highest in Sections 2 to 6. Small bull trout were encountered in several sections during the study (Sections 1A, 1, 3, 6, and 8), but no more than one fish was recorded at any one time. There were no strong seasonal differences in bull trout catch rates.

3.3.2.2 Biological Characteristics

In total, 149 bull trout were used to describe biological characteristics – 169 from Zone 1 and 85 from Zone 2. Sampled fish ranged in length from 153 mm to 880 mm, ranged in weight from 36 g to 8,880 g, and ranged from Age 1 to Age 13.

Based on a visual assessment size and age distributions of bull trout did not differ between Zone 1 and Zone 2 (Figure 3.14). Both samples were dominated by juveniles and subadults (200 mm length to 600 mm length; Age 2 to Age 6). Low numbers of small, young fish (≤ 200 mm length; ≤ Age 1) and large, older fish (600 mm length to > Age 6) were encountered in both zones.

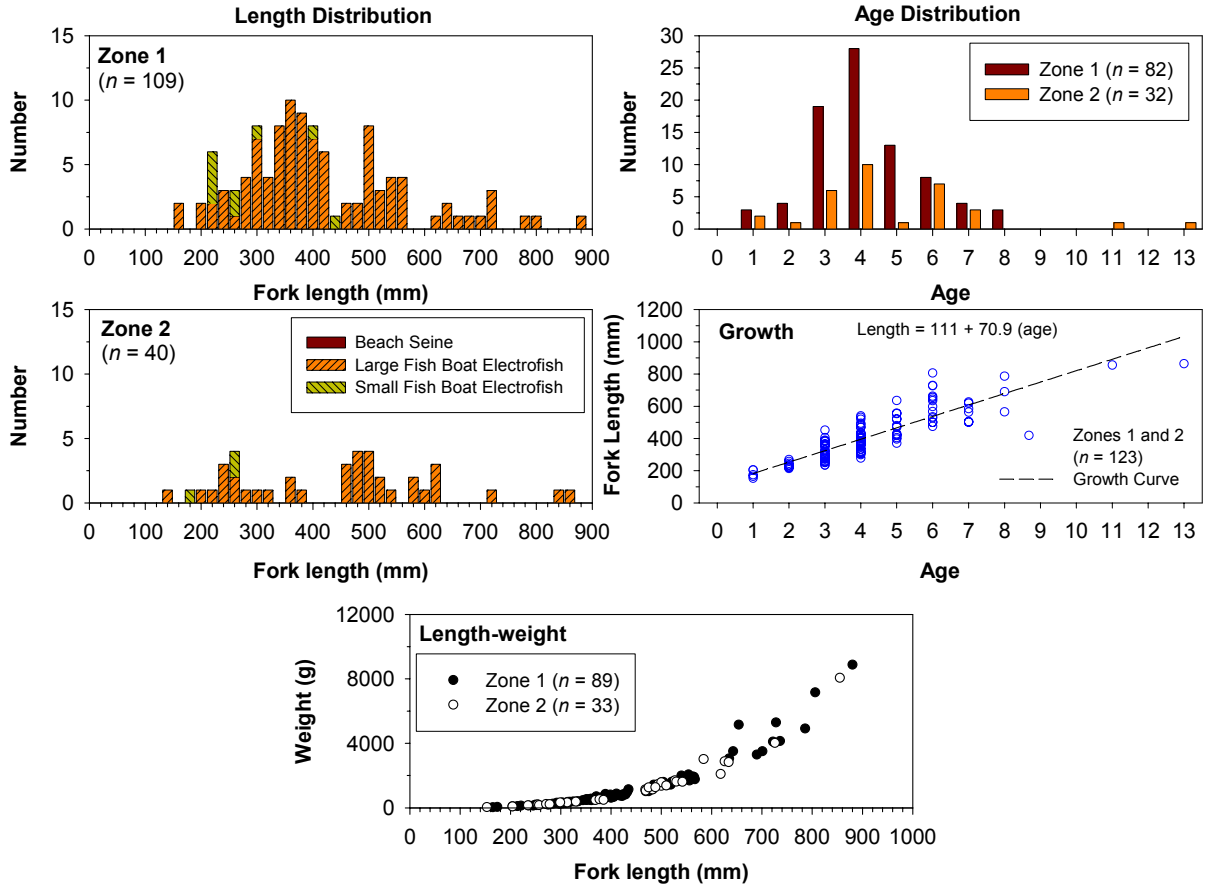


Figure 3.14 Biological characteristics of sampled bull trout, 2010 Site C Peace River Fish Inventory (Table 2.6 identifies data selected for analyses).

A visual assessment of the length-weight relationship (Figure 3.14) and a comparison of length-at-age and condition-at-age summaries (Table 3.4) indicated no differences between zones in bull trout condition or growth. The growth curve using the combined data indicated a linear growth form. The lack of a von Bertalanffy growth form is likely an artifact of the small sample of adult fish, and therefore, it is not representative of the growth rate of the population. It does indicate; however, that bull trout in the Peace River exhibit a high growth rate.

Table 3.4 Mean length-at-age and condition-at-age of bull trout in Zone 1 and Zone 2, 2010 Site C Peace River Fish Inventory.

Age	Fork Length				Condition (*K*)			
	Zone 1		Zone 2		Zone 1		Zone 2	
	n	**Mean (± 95%CI)**	***n***	**Mean (± 95%CI)**	***n***	**Mean (± 95%CI)**	***n***	**Mean (± 95%CI)**
0								
1	3	181.0 ± 50.7	2	178.5 ± 324.0	3	0.97 ± 0.37	2	1.03 ± 1.11
2	7	227.3 ± 10.0	2	262.5 ± 69.9	4	1.06 ± 0.18	1	0.92
3	23	321.8 ± 24.6	6	276.3 ± 39.0	17	1.13 ± 0.07	6	1.14 ± 0.06
4	29	386.4 ± 22.5	10	415.7 ± 61.8	27	1.12 ± 0.05	10	1.05 ± 0.08
5	13	474.5 ± 47.0	1	480.0	13	1.05 ± 0.04	1	1.03
6	8	636.6 ± 85.0	7	565.7 ± 84.2	6	1.33 ± 0.31	6	1.14 ± 0.08
7	4	517.5 ± 48.3	3	609.3 ± 55.4	3	1.20 ± 0.24	3	1.19 ± 0.78
8	3	680.3 ± 275.3			3	1.02 ± 0.07		
9								
10								
11			1	855.0			1	1.29
12								
13			1	864.0				

3.3.2.3 Distribution of Young Fish

No Age 0 bull trout were captured in the study area. There were spatial and seasonal differences in the recruitment of young (Age 1) bull trout in the Peace River (Figure 3.15). Young bull trout were recorded primarily in the upper portion of the study area (Sections 1, 2, and 3). This included seven Age 1 fish caught in summer and fall (one in Section 1A, four in Section 1, one in Section 2, and one in Section 3). All young bull trout in Zone 1 were recorded in main channel habitats. Based on the assumption that young bull trout do not migrate upstream long distances upstream in the Peace River from the confluence of the Halfway River, the presence of young bull trout far upstream (i.e., approximately 17 – 44 km upstream) of the Halfway River, which is thought to be the primary spawning and rearing system for the Peace River population provides evidence of alternate sources of recruitment for this population (i.e., entrainment through PCN Dam), Only three young bull trout were recorded downstream of the proposed Site C dam (Zone 2). All were captured in Section 6. This included two fish recorded in main channel areas and one fish recorded at the confluence of the Pine River.

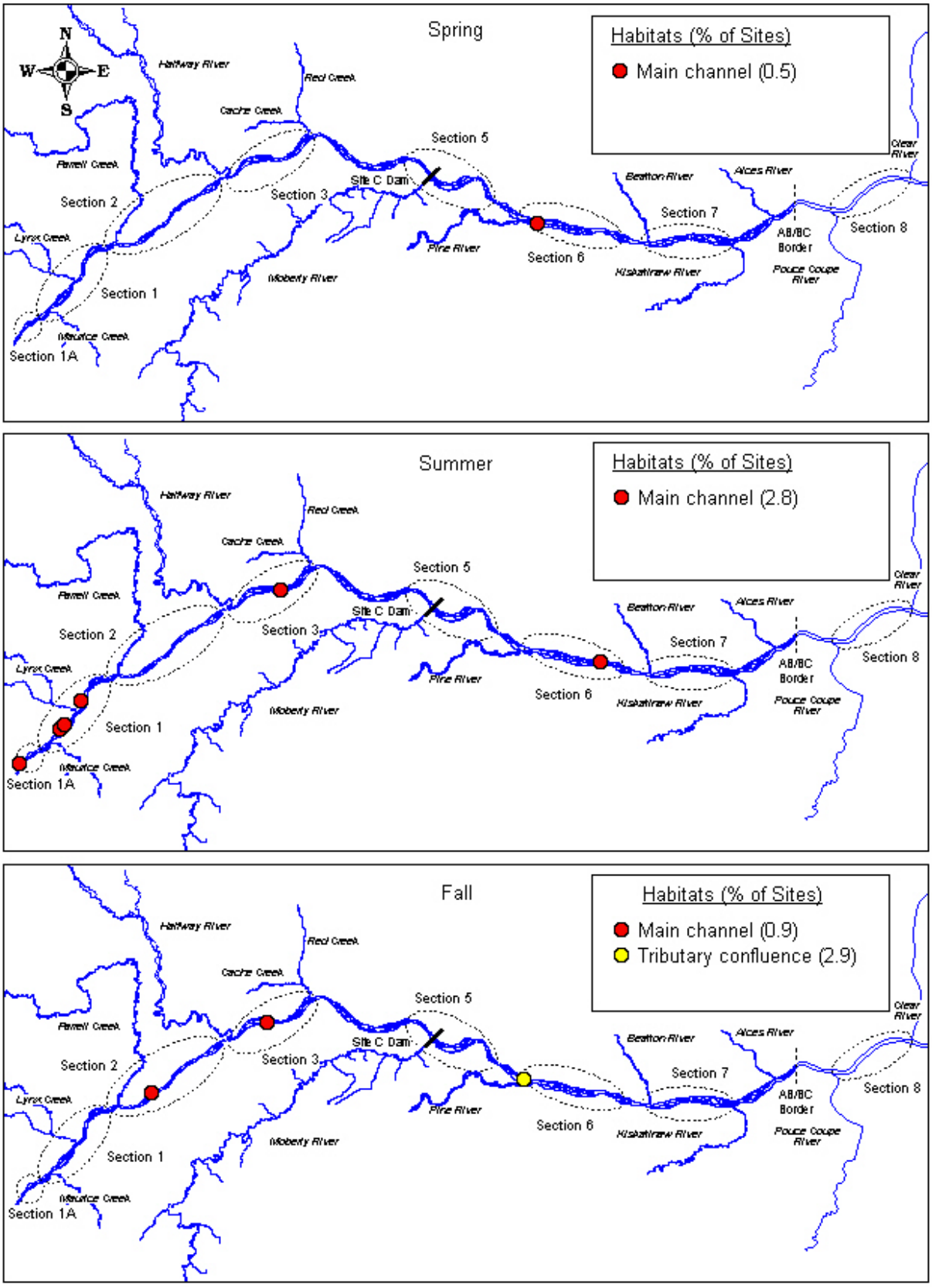


Figure 3.15 Distribution of young (Age 1) bull trout, 2010 Site C Peace River Fish Inventory.

3.3.3 Kokanee

3.3.3.1 Catch Rate

In total, 537 kokanee were enumerated in the study area. Kokanee catch rates were highest in main channel areas. This species was rarely encountered in side channel or tributary confluence areas (Figure 3.16). The only exception occurred in spring in Section 1 when large and small kokanee were recorded at confluences of Maurice Creek and Lynx Creek.

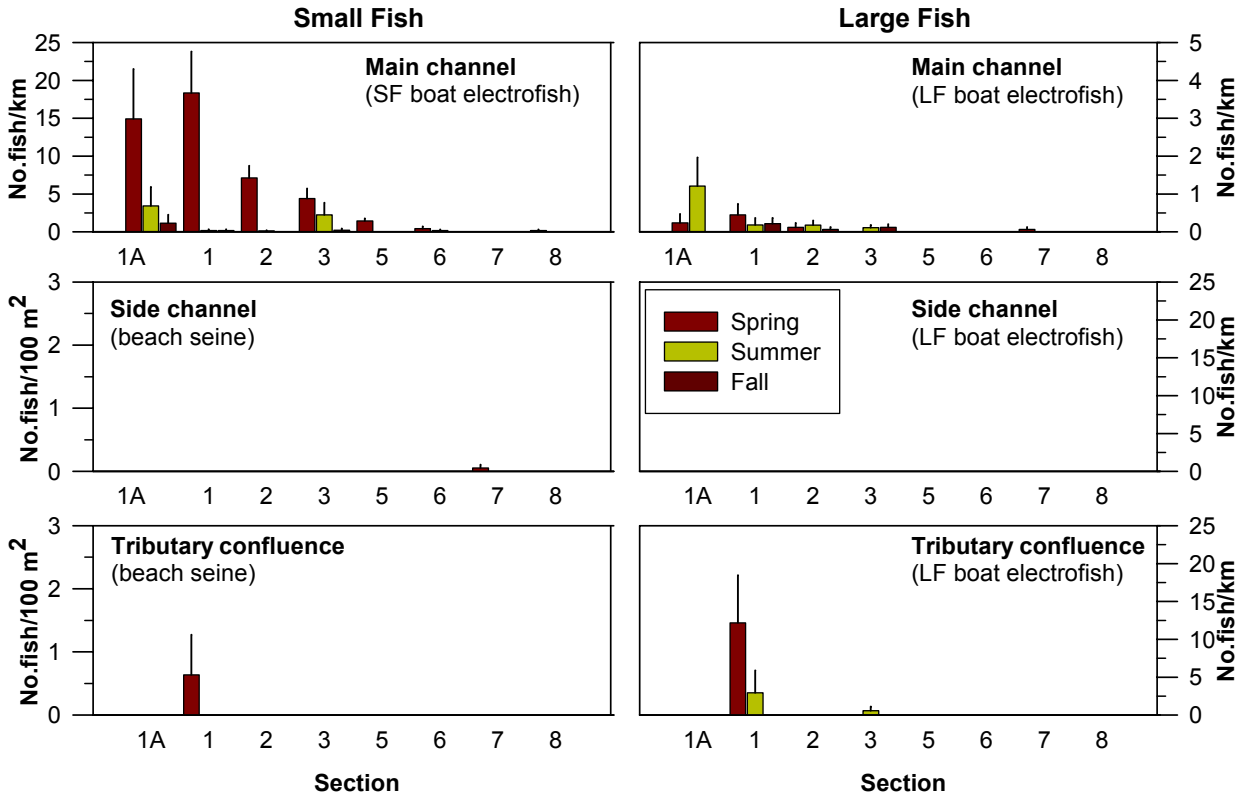


Figure 3.16 Average catch rates (± SE) of kokanee in study sections during spring, summer, and fall, 2010 Site C Peace River Fish Inventory (small fish ≤ 200 mm fork length and large fish > 200 mm fork length; SF – small fish method, LF – large fish method)

Mean catch rates of small kokanee in main channel areas were highest in Sections 1A and 1 (> 14 fish/km), but declined rapidly in downstream sections. Large kokanee also were most abundant in upstream sections, but catch rates did not exceed 1.4 fish/km. The spatial pattern of kokanee catch rate may reflect recruitment of fish from upstream of the PCN Dam.

There was a distinct seasonal difference in kokanee catch rates. Catch rates were highest in spring and low in summer. Small and large kokanee were infrequently encountered in fall.

3.3.3.2 Biological Characteristics

In total, 376 kokanee were used to describe biological characteristics (Figure 3.17). Sampled fish ranged in length from 47 mm to 225 mm and ranged in weight from 24 g to 124 g. Data from both zones were combined for analyses and the kokanee sample was not aged.

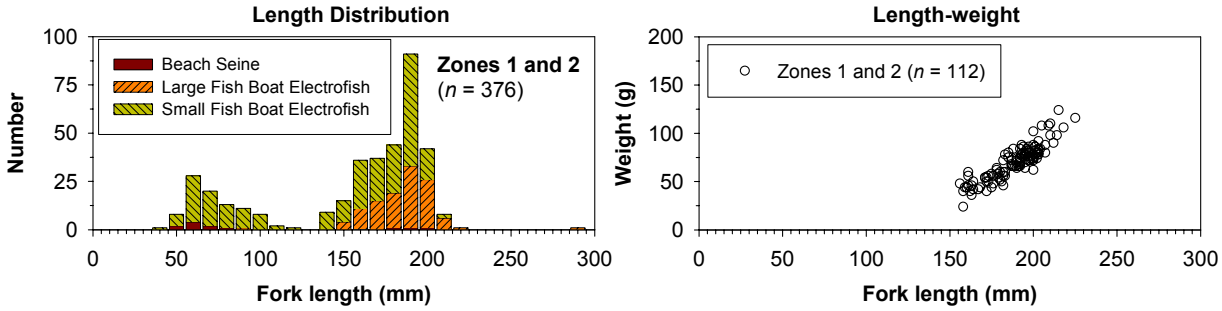


Figure 3.17 Biological characteristics of sampled kokanee, 2010 Site C Peace River Fish Inventory (Table 2.6 identifies data selected for analyses).

The size distribution of kokanee suggested numerical dominance of two age classes – Age 1 (80 mm to 110 mm length) and Age 2 and 3 (135 mm to 200 mm length).

The length-weight relationship (Figure 3.17) indicated allometric growth and condition (*K*) estimate of the sample (1.03 ± 0.01) indicated good body condition.

3.3.3.3 Distribution of Young Fish

Young kokanee recorded in the study area were suspected Age 1 fish. There were strong spatial and seasonal differences in the distribution of young kokanee (Figure 3.18).

In spring, numerous young kokanee were recorded throughout Zone 1 in Sections 1A, 1, 2, and 3 and in Section 5 of Zone 2. In contrast, few fish (*n* = 4) were recorded in downstream sections (Sections 6, 7, and 8). Most young kokanee were recorded in main channel habitats. One individual was recorded at the confluence of Lynx Creek in Section 1 and one fish was recorded in a side channel in Section 7.

The number of young kokanee encountered in summer was low and most were recorded in Zone 1.
In fall, two young kokanee were recorded in Section 3 in main channel habitat.

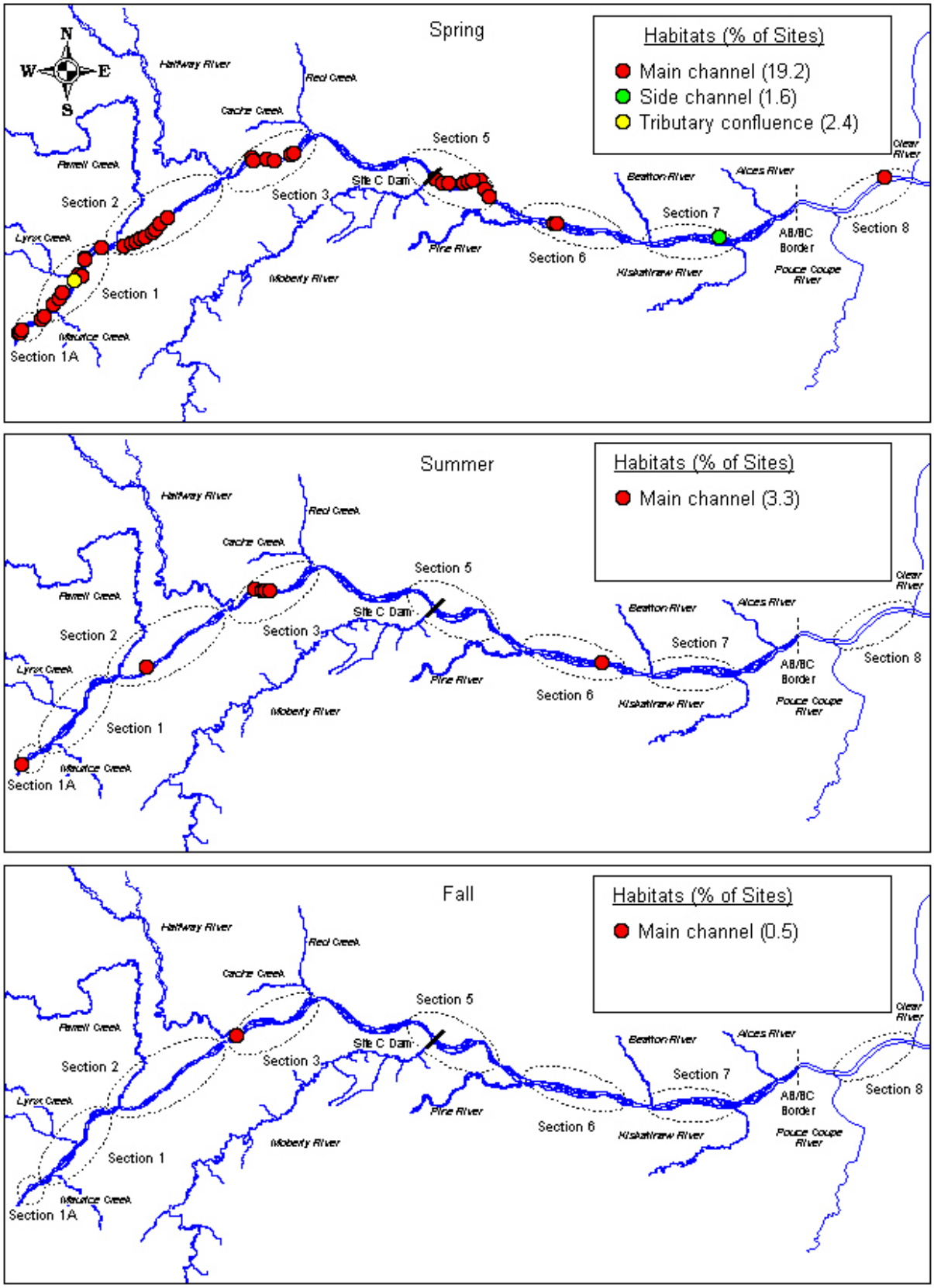


Figure 3.18 Distribution of young (Age 1) kokanee, 2010 Site C Peace River Fish Inventory.

3.3.4 Lake trout

Lake trout were scarce in the Peace River. Two fish were recorded in the study area (Appendix E Figure E1). This included one fish at the confluence of Lynx Creek in Section 1 (620 mm) and one fish in the downstream end of Section 3.

3.3.5 Lake whitefish

Few lake whitefish were recorded in the study area (n = 31). Lake whitefish were recorded in side channel areas in Sections 5 and 6 and at tributary confluence areas in Sections 1, 2, and 5 (Appendix E Figure E2). A small number of fish were also recorded in main channel areas in Section 2.

In total, 23 lake whitefish were used to describe biological characteristics (Appendix E Figure E3). Sampled fish ranged in length from 255 mm to 446 mm, ranged in weight from 182 g to 1,273 g and ranged from Age 3 to Age 8. The size and age distribution of lake whitefish was limited to larger (≥ 250 mm length) and older fish (Age 3 to Age 8) individuals (Table 3.5). The length-weight relationship (Appendix E Figure E3) indicated allometric growth while the growth curve showed a classic von Bertalanffy growth form. The condition (K)-at-age estimate of the sample indicated good body condition.

Table 3.5 Mean length-at-age and condition-at-age of lake whitefish (Zones 1 and 2 combined), 2010 Site C Peace River Fish Inventory.

Age	Fork Length		Condition (K)	
	n	**Mean (± 95%CI)**	***n***	**Mean (± 95%CI)**
0				
1				
2				
3	2	258.5 ± 44.5	2	1.15 ± 1.77
4	3	354.3 ± 143.4	3	1.34 ± 0.23
5	5	386.0 ± 35.4	5	1.19 ± 0.13
6	6	395.2 ± 12.3	3	1.26 ± 0.14
7	3	402.0 ± 94.8	3	1.27 ± 0.35
8	3	393.0 ± 65.9	2	1.24 ± 0.19

3.3.6 Mountain whitefish

3.3.6.1 Catch Rate

Mountain whitefish catch rates were very high in the Peace River study area (Figure 3.19). Small and large mountain whitefish were found in all sections and all habitat areas, but catches of both size groups were highest in main channel areas. Catch rates of large and small mountain whitefish exhibited distinct spatial patterns. Average catch rates of large mountain whitefish in main channel areas increased from approximately 40.0 fish/km in Section 1A, to peak levels in Section 1 and 2 (approximately 60 fish/km), and then gradually declined to approximately 10 fish/km in Section 8. This spatial pattern was consistent among seasons, although there was a trend of decreasing rates from spring to fall in Sections 1A and 1.

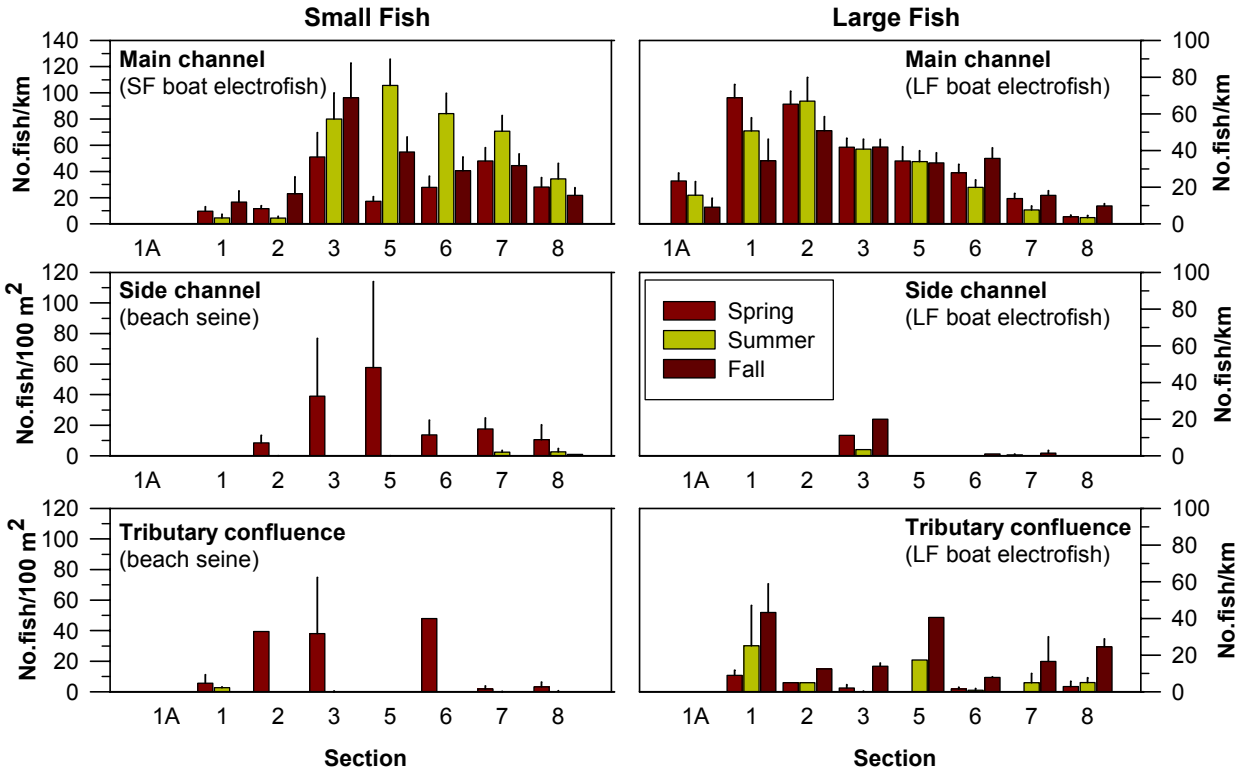


Figure 3.19 Average catch rates (± SE) of mountain whitefish in study sections during spring, summer, and fall, 2010 Site C Peace River Fish Inventory (small fish ≤ 200 mm fork length and large fish > 200 mm fork length; SF – small fish method, LF – large fish method).

Small mountain whitefish exhibited a different spatial trend. Catch rates were lowest in the uppermost Sections 1A, 1, and 2 (≤ 16.6 fish/km), then increased in Section 3 and Section 5 reaching 105.6 fish/km. Catch rates of small mountain whitefish then declined farther downstream to approximately 25 fish/km in Section 8.

Catch rates of small mountain whitefish exhibited seasonal differences. In spring, highest catch rates were recorded in Sections 3 to 7. In summer, catch rates were highest in Sections 5 to 8. In fall the highest mean catch rate was in Section 3 (96.3 fish/km).

The patterns of large and small mountain whitefish catch rates suggest spatial segregation of younger and older cohorts of the Peace River population. Small (younger) fish occur primarily from Section 3 downstream, while large (older) fish are most abundant from Section 2 upstream.

3.3.6.2 Biological Characteristics

In total, 11,094 mountain whitefish were used to describe biological characteristics – 6,994 from Zone 1 and 4,100 from Zone 2. A subsample of fish was used for age related metrics – 452 from Zone 1 and 373 from Zone 2. Sampled fish ranged in length from 32 mm to 495 mm, ranged in weight from 6 g to 1,676 g, and ranged from Age 0 to Age 12 (Figure 3.20).

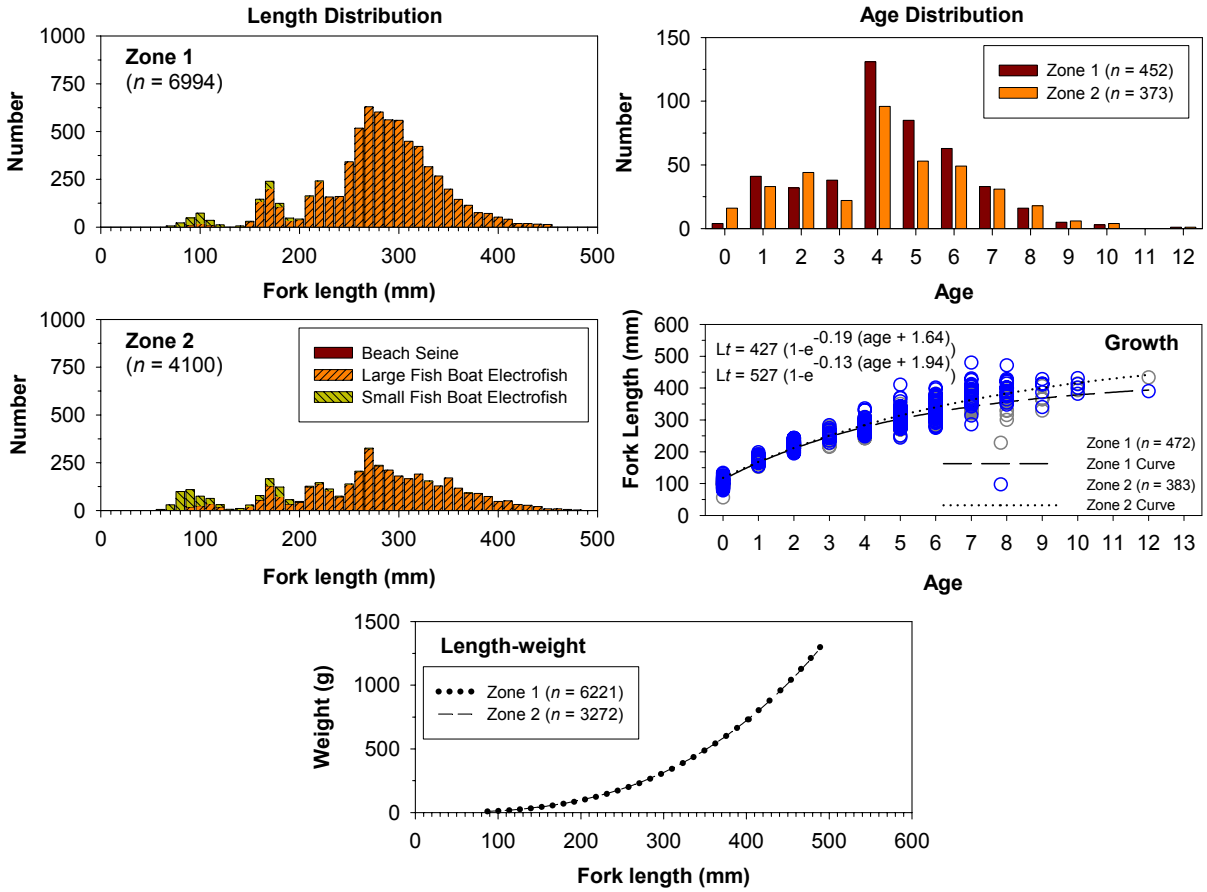


Figure 3.20 Biological characteristics of sampled mountain whitefish, 2010 Site C Peace River Fish Inventory (Table 2.6 identifies data selected for analyses; length-weight relationship represented by power function [see section 2.2.5] in place of raw data).

The size and age distributions of mountain whitefish differed between Zone 1 and Zone 2 (Figure 3.20). The mountain whitefish population in Zone 1 was dominated by a strong modal peak between 275 mm length and 410 mm length, which represented Age 4 to Age 6 fish. Three smaller modal peaks were recorded from 70 mm length to 120 mm length (Age 0), 150 mm length to 190 mm length (Age 1), and 190 mm length to 250 mm length (Age 3). In contrast, mountain whitefish in Zone 2 exhibited a wide, multimodal size distribution with good representation by smaller (≤ 200 mm length), younger fish (Age 0 to Age 2,) and by larger (≥ 450 mm), older (≥ Age 7) fish.

A visual assessment of the length-weight relationship (Figure 3.20) and condition-at-age summaries (Table 3.6) indicated no large differences between zones in mountain whitefish condition. However, the length-at-age summary and the growth curve indicated spatial difference in growth. After Age 3 mountain whitefish in Zone 1 grow at a slower rate and reached a smaller length-at-age compared to fish in Zone 2.

Table 3.6 Mean length-at-age and condition-at-age of mountain whitefish in Zone 1 and Zone 2, 2010 Site C Peace River Fish Inventory.

Age	Fork Length				Condition (*K*)			
	Zone 1		Zone 2		Zone 1		Zone 2	
	n	**Mean (± 95%CI)**	***n***	**Mean (± 95%CI)**	***n***	**Mean (± 95%CI)**	***n***	**Mean (± 95%CI)**
0	24	98.3 ± 5.0	26	106.0 ± 6.0	4	0.87 ± 0.34	12	0.98 ± 0.11
1	41	172.9 ± 2.6	33	176.3 ± 3.4	41	1.10 ± 0.03	32	1.08 ± 0.03
2	32	222.9 ± 3.0	44	221.9 ± 3.9	32	1.10 ± 0.03	44	1.12 ± 0.02
3	38	251.9 ± 4.8	22	253.7 ± 5.7	38	1.16 ± 0.03	21	1.14 ± 0.03
4	131	274.3 ± 2.4	96	279.3 ± 3.3	130	1.19 ± 0.02	96	1.18 ± 0.02
5	85	299.5 ± 3.4	53	310.2 ± 8.5	85	1.18 ± 0.02	53	1.21 ± 0.03
6	63	321.7 ± 5.2	49	331.0 ± 8.8	62	1.16 ± 0.03	49	1.16 ± 0.03
7	33	349.0 ± 7.8	31	376.5 ± 13.0	32	1.16 ± 0.05	31	1.16 ± 0.04
8	16	355.8 ± 14.3	18	397.2 ± 15.0	16	1.14 ± 0.05	18	1.09 ± 0.05
9	5	366.4 ± 33.9	6	398.5 ± 33.3	5	1.15 ± 0.16	6	1.08 ± 0.08
10	3	402.3 ± 26.6	4	406.5 ± 32.6	3	1.26 ± 0.21	4	0.97 ± 0.20
11								
12	1	433.0	1	390.0	1	1.12	1	1.13

3.3.6.3 Distribution of Young Fish

Age 0 mountain whitefish were widely distributed in the study area (Figure 3.21). Fish were recorded in most sections (all except Section 1A) during all seasons. The presence of Age 0 mountain whitefish in the Peace River in spring, which represented recently emerged fish, indicated that mountain whitefish spawning occurs as far upstream as Section 1. The absence of Age 0 mountain whitefish in Section 1A provides evidence that there is minimal or no recruitment from upstream sources. Habitat use by Age 0 mountain whitefish varied by season. In spring, fish were recorded most often in side channel habitats. In summer and fall Age 0 mountain whitefish were more likely to occur in main channel sites.

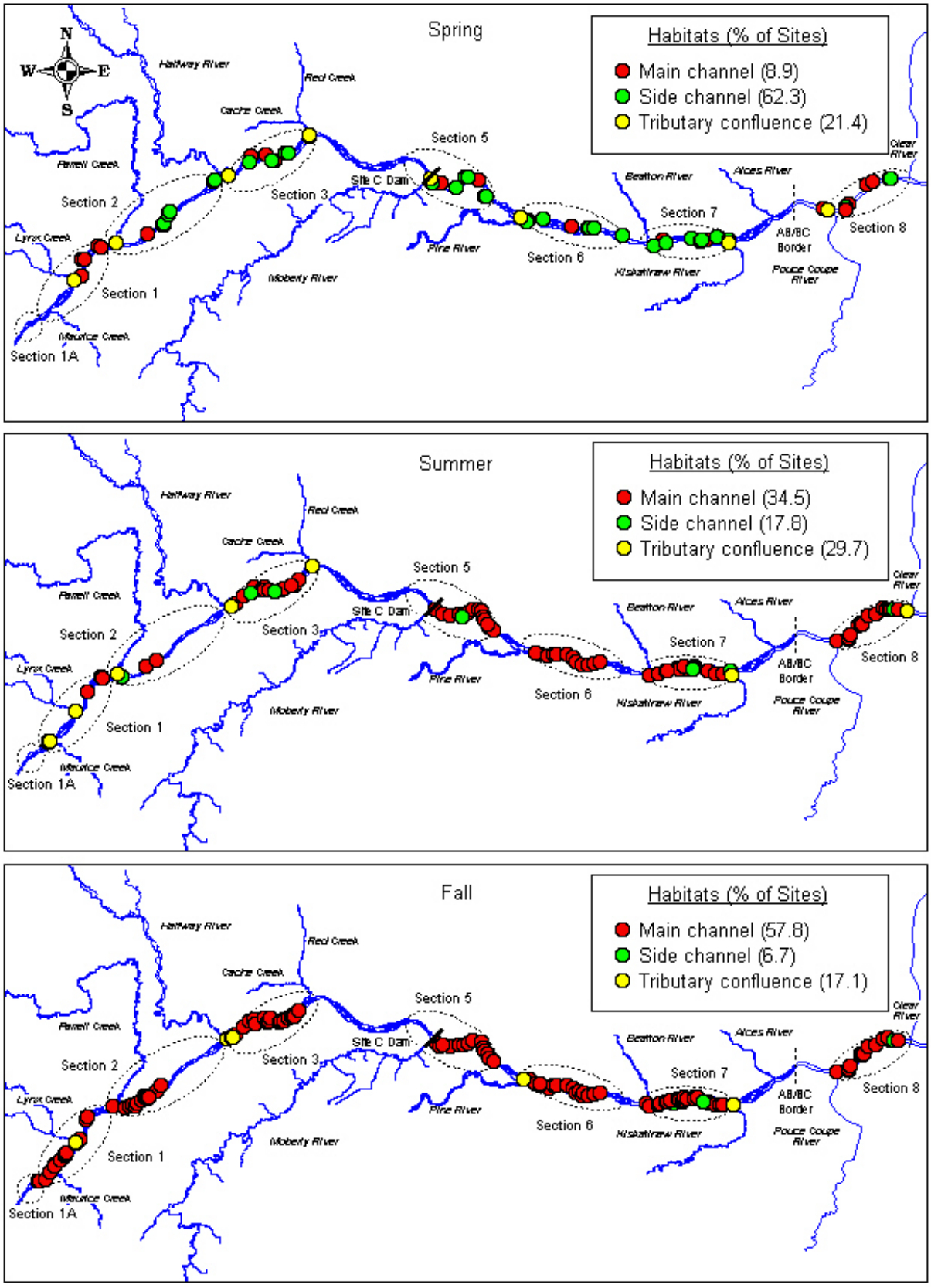


Figure 3.21 Distribution of Age 0 mountain whitefish, 2010 Site C Peace River Fish Inventory.

3.3.7 Rainbow trout

3.3.7.1 Catch Rate

In total, 285 rainbow trout were enumerated during the study. Rainbow trout catch rates were highest in main channel areas and fish were rarely encountered in side channel and tributary confluence areas (Figure 3.22). Average catch rates of small and large rainbow trout were generally similar and did not exceed 2.9 fish/km. Catch rates of both size groups of rainbow trout were highest in Sections 1A to Section 3 although both large and small fish were recorded in all study sections. There was a general trend for catch rates of rainbow trout to decline from upstream to downstream.

There were seasonal differences in rainbow trout catch rate. In fall, small individuals were found only in Section 1.

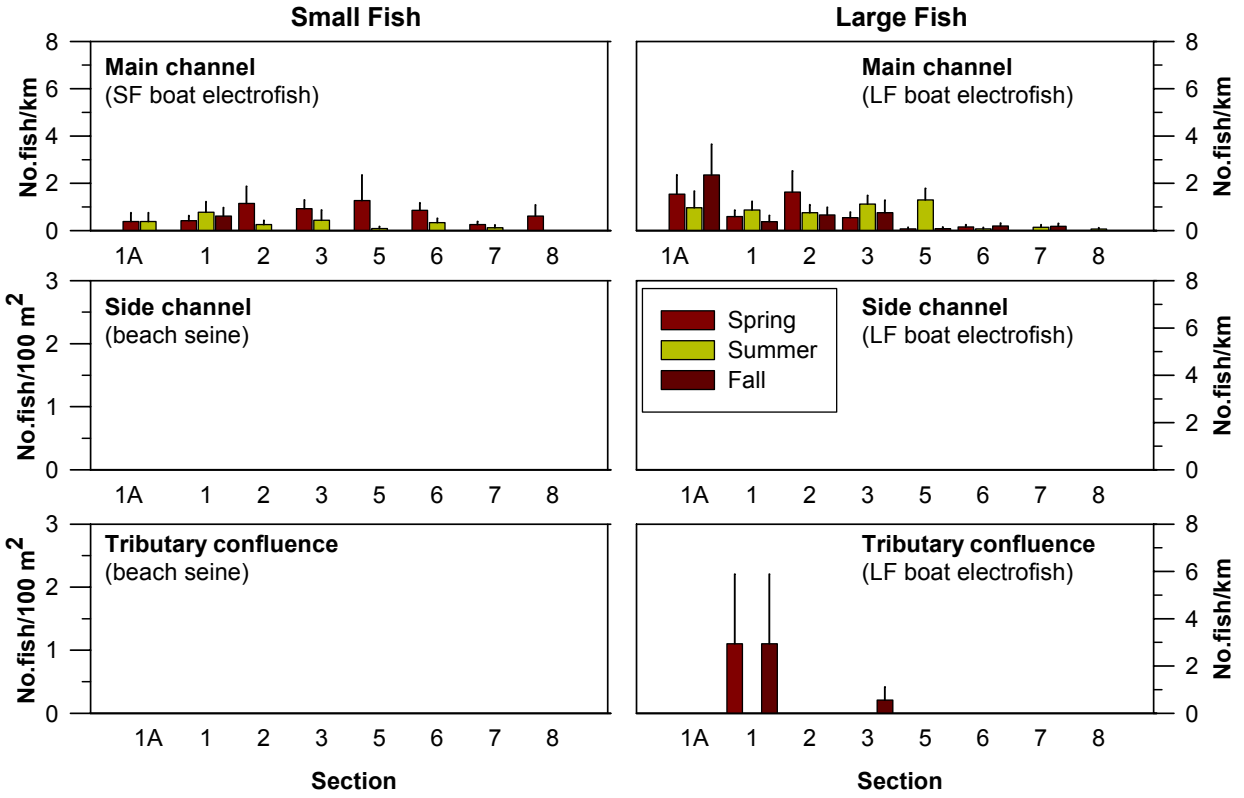


Figure 3.22 Average catch rates (± SE) of rainbow trout in study sections during spring, summer, and fall, 2010 Site C Peace River Fish Inventory (small fish ≤ 200 mm fork length and large fish > 200 mm fork length; SF – small fish method, LF – large fish method).

3.3.7.2 Biological Characteristics

In total, 169 rainbow trout were used to describe biological characteristics (Figure 3.23). Sampled fish ranged in length from 132 mm to 594 mm and ranged in weight from 24 g to 2,090 g, and ranged from Age 1 to Age 6. Data from both zones were combined for analyses. The size distribution of rainbow trout was broad and contained several modal peaks indicating good representation from several age classes. The age distribution generated from the large fish boat electrofisher catch was numerically dominated by Age 2 fish followed by a progressive decline of older age classes.

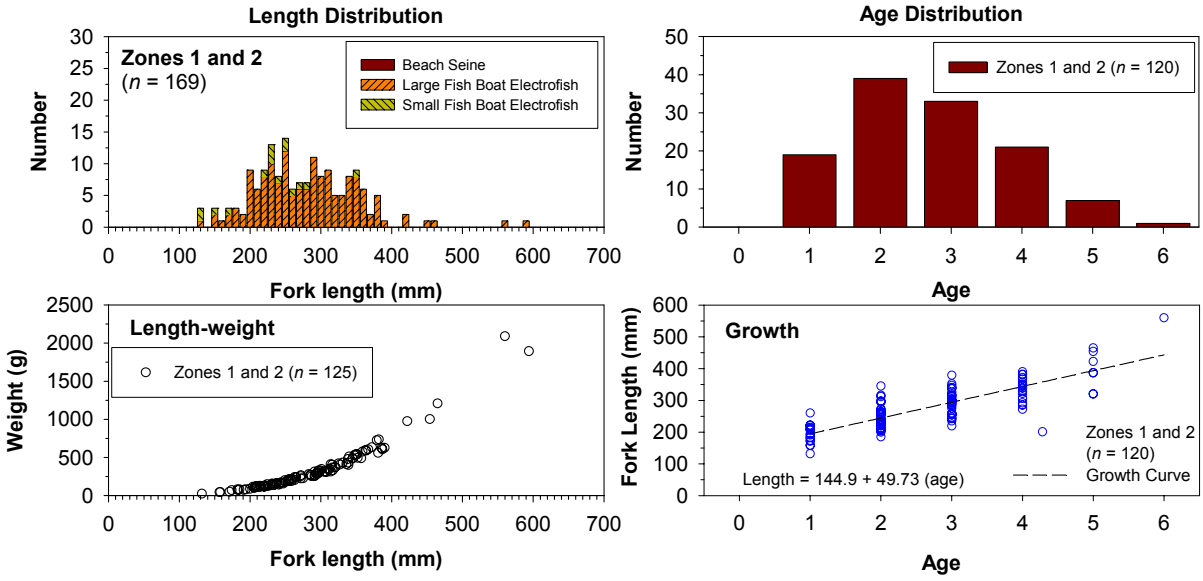


Figure 3.23 Biological characteristics of sampled rainbow trout, 2010 Site C Peace River Fish Inventory (Table 2.6 identifies data selected for analyses).

The length-weight relationship illustrated in Figure 3.23 indicated allometric growth and condition (*K*) at-age estimates presented in Table 3.7 indicated good body condition (K ≥ 1.00). A visual assessment of the linear growth curve and length-at-age summary (Table 3.7) indicated rapid growth.

Table 3.7 Mean length-at-age and condition-at-age of rainbow trout (Zones 1 and 2 combined), 2010 Site C Peace River Fish Inventory.

Age	Fork Length		Condition (*K*)	
	n	**Mean (± 95%CI)**	***n***	**Mean (± 95%CI)**
0				
1	19	196.1 ± 14.3	19	1.18 ± 0.04
2	39	247.3 ± 11.7	38	1.19 ± 0.03
3	33	291.5 ± 13.7	33	1.18 ± 0.03
4	21	335.4 ± 15.6	19	1.16 ± 0.04
5	7	393.4 ± 54.0	7	1.14 ± 0.08
6	1	560.0	1	1.19

3.3.7.3 Distribution of Young Fish

Age 0 rainbow trout accounted for a small percentage of young rainbow trout (Age 0 and Age 1 fish) in the study area (3.6% of sample; Appendix F). All Age 0 fish were recorded in fall suggesting that Age 0 rainbow trout initially rear in tributaries before entering the Peace River.

Young rainbow trout (Age 0 and Age 1) were encountered most frequently upstream of the proposed Site C dam location (Figure 3.24). Most fish were recorded at sites in Sections 1A, 1, 2, and 3, with a limited number of fish occurring at sites in Sections 5 and 7 (5 sites in spring and 3 sites in summer). The presence of young rainbow trout in Sections 1 and 2 correspond to tributaries that provide potential spawning and rearing areas for the Peace River rainbow trout population (Maurice Creek, Lynx Creek, and possibly Farrell Creek). The cluster of sites containing young rainbow trout in Section 3, suggests that rainbow trout may recruit from the Halfway River or disperse from upstream areas of the Peace River. All young rainbow trout were recorded in main channel habitats.

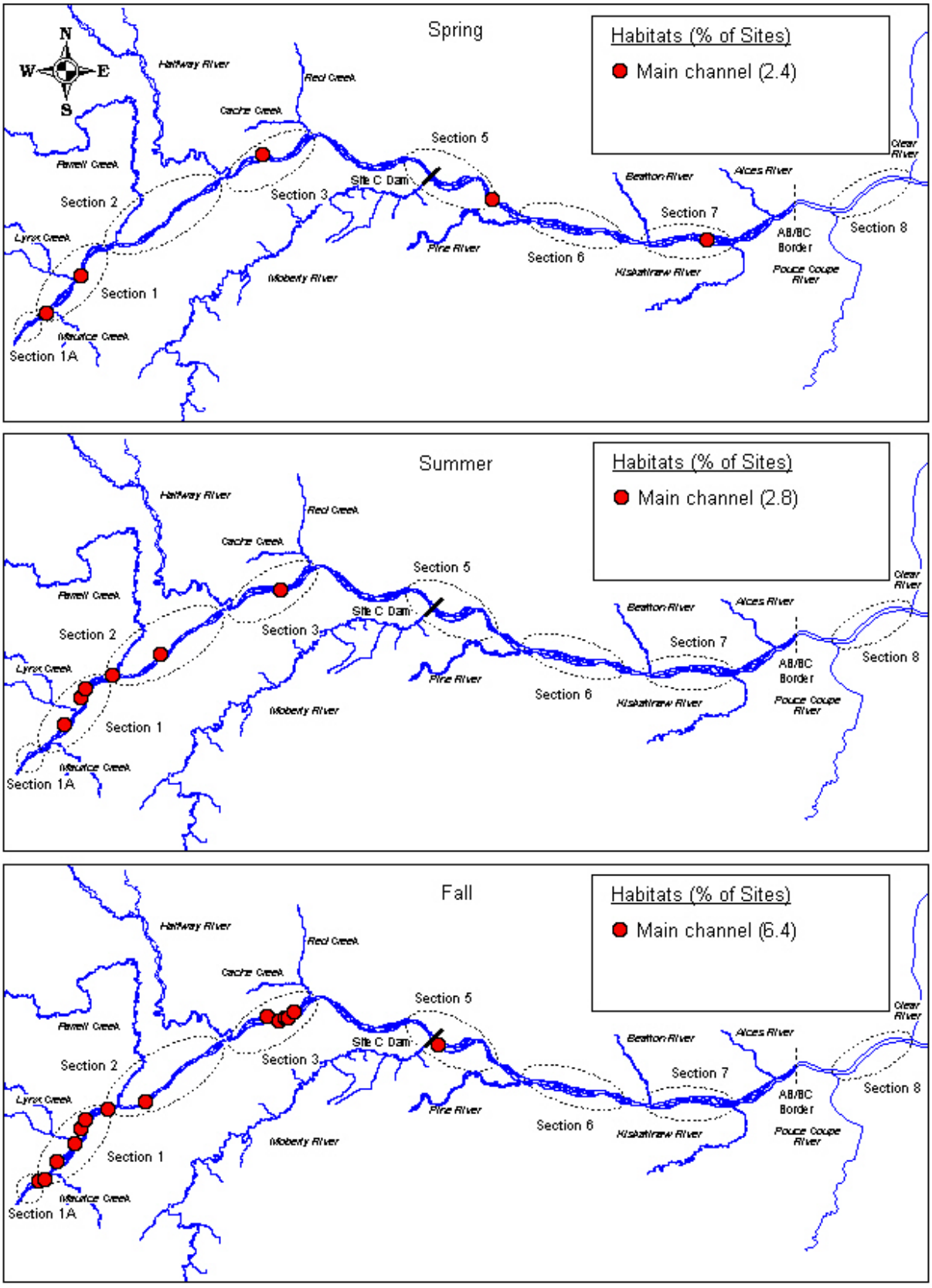


Figure 3.24 Distribution of young (Age 0 and Age 1) rainbow trout, 2010 Site C Peace River Fish Inventory.

3.4 COOLWATER SPORTFISH POPULATIONS

Information presented in this section includes summaries of catch rates, and biological characteristics of selected coolwater sportfish populations. Raw data and summaries for all coolwater sportfish populations are presented in Appendix E (catch rates), Appendix F (biological characteristics), and Appendix G (young fish distribution). It should be noted that biological characteristics data collected during the present study were augmented with data collected from the 2010 WLR Peace River Fish Index Project (Mainstream and Gazey 2011). Appendix F identifies those data.

3.4.1 Burbot

3.4.1.1 Catch Rate

In total, 51 burbot were enumerated during the study and catch rates were low (Figure 3.25). Small burbot were rarely encountered. Large burbot were recorded in Sections 3, 5, 6, 7, and 8. Large burbot catch rates ranged from 0.1 fish/km to 2.2 fish/km, but were highest in spring in Sections 7 and 8. This species was recorded in main channel and tributary confluence areas. Tributary confluences where burbot were encountered included the Halfway, Pine, Beatton, Kiskatinaw, and Pouce Coupe Rivers.

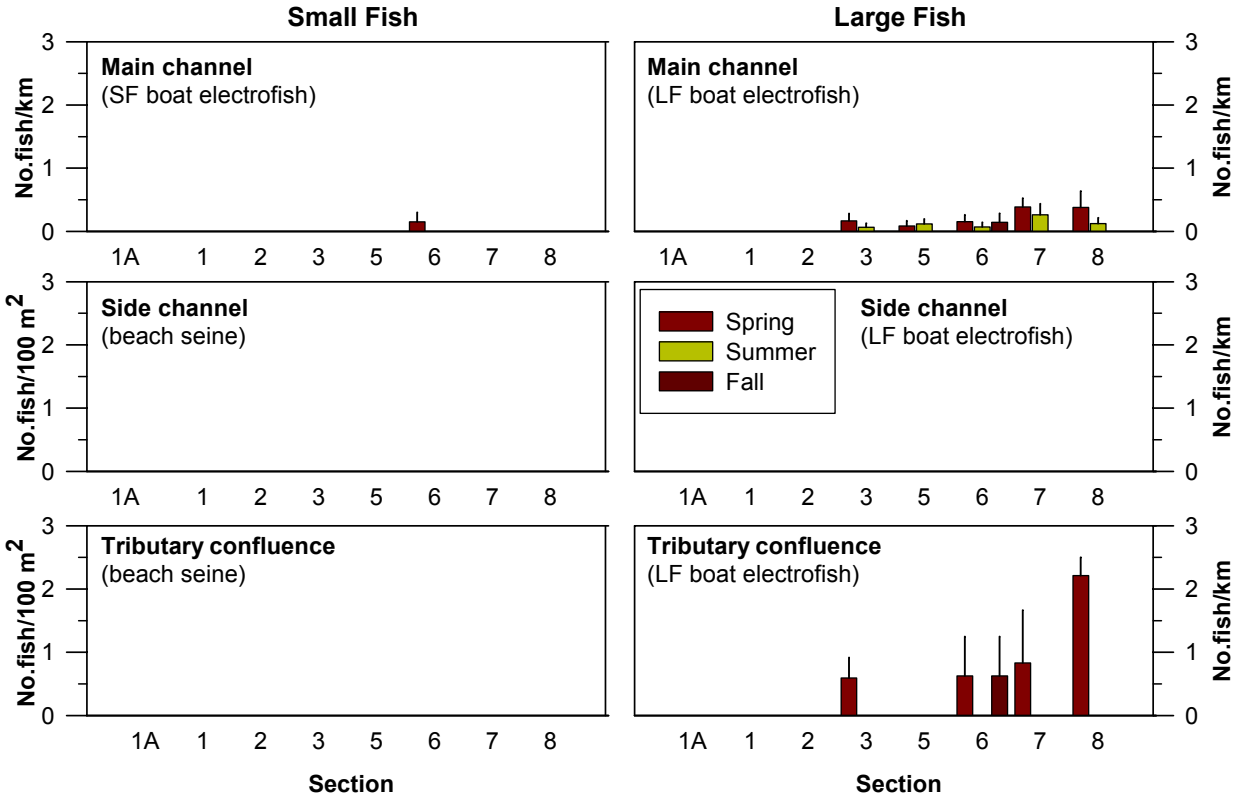


Figure 3.25 Average catch rates (± SE) of burbot in study sections during spring, summer, and fall, 2010 Site C Peace River Fish Inventory (small fish ≤ 200 mm fork length and large fish > 200 mm fork length; SF – small fish method, LF – large fish method).

3.4.1.2 Biological Characteristics

In total, 26 burbot were used to describe biological characteristics (Figure 3.26). Sampled fish ranged in length from 102 mm to 642 mm and ranged in weight from 20 g to 1,884 g. Burbot from the study area were not aged.

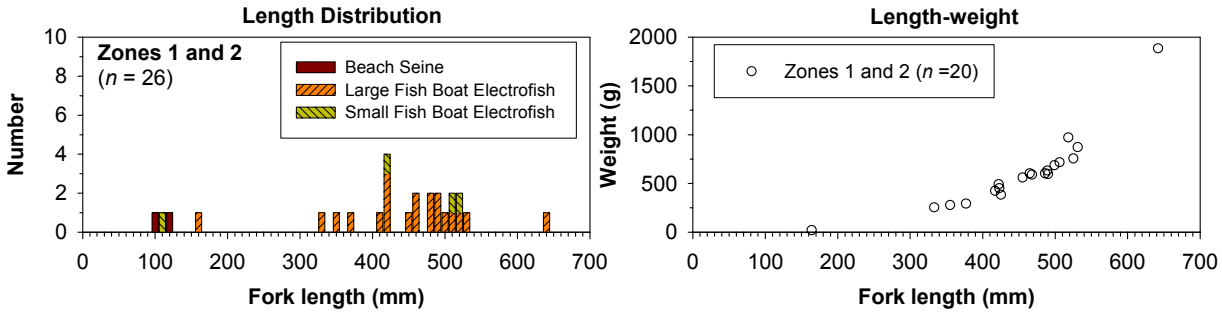


Figure 3.26 Biological characteristics of burbot, 2010 Site C Peace River Fish Inventory (Table 2.6 identifies data selected for analyses).

3.4.1.3 Distribution of Young Fish

Young burbot (Age 1) were encountered in three locations during the study (Figure 3.27). Two fish were recorded in Section 6 and one fish was recorded in Section 3.

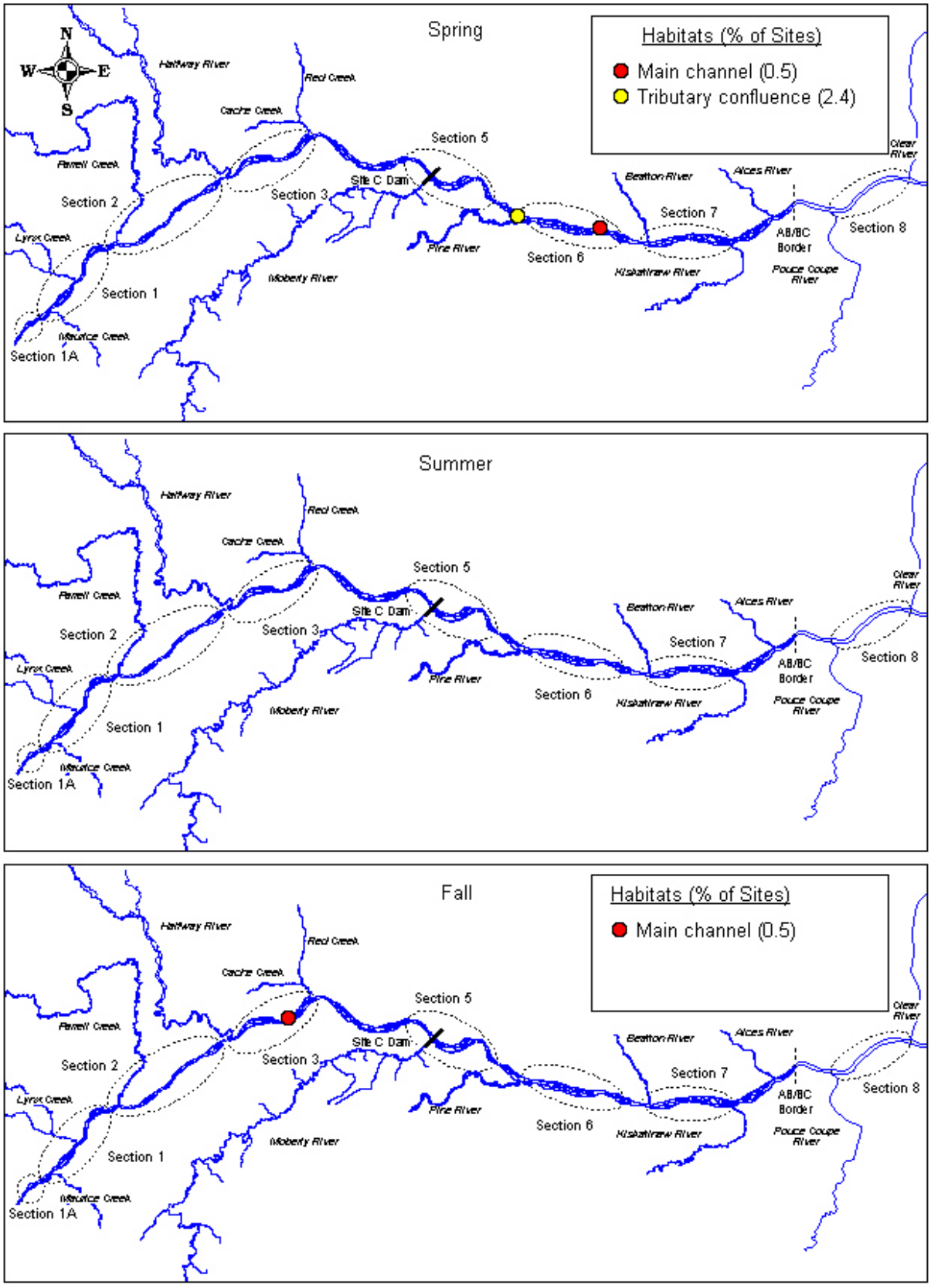


Figure 3.27 Distribution of young (Age 1) burbot, 2010 Site C Peace River Fish Inventory.

3.4.2 Goldeye

3.4.2.1 Catch Rate

In total, 82 goldeye were enumerated during the study. Goldeye were recorded only in sections downstream of the proposed Site C dam location (Sections 5 to 8), but catch rates were highest in Sections 7 and 8 (Figure 3.28). Large goldeye dominated the catch. A single small goldeye was recorded during the study. Large goldeye occurred in all three habitat areas, but catch rates in main channel and side channel areas were low.

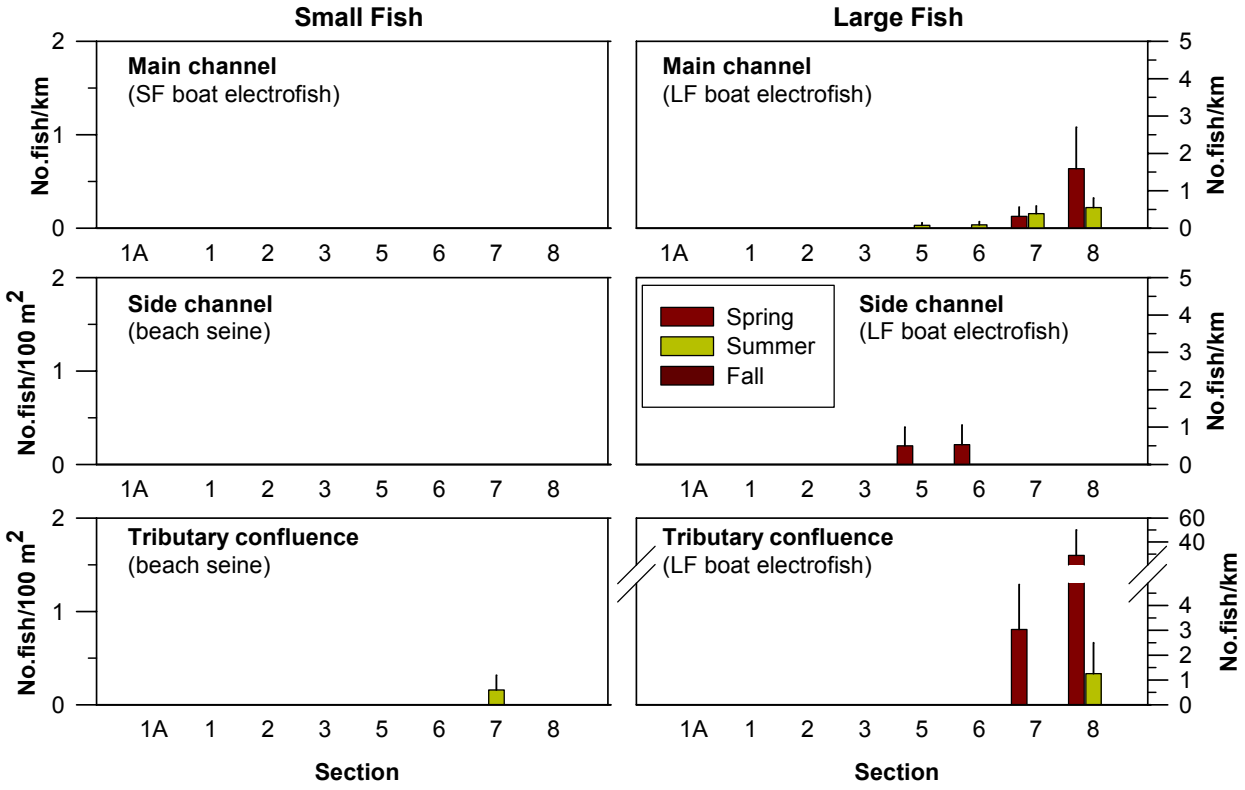


Figure 3.28 Average catch rates (± SE) of goldeye in study sections during spring, summer, and fall, 2010 Site C Peace River Fish Inventory (small fish ≤ 200 mm fork length and large fish > 200 mm fork length; SF – small fish method, LF – large fish method).

Large goldeye catch rates were highest in spring, low in summer, and no fish were recorded in the study area during fall. Highest catch rates were recorded at tributary confluences in spring. A catch rate of 28.9 fish/km was recorded at the confluence of the Beatton River. Large goldeye were also recorded at the confluences of the Kiskatinaw River, Pouce Coupe River, and Clear River.

3.4.2.2 Biological Characteristics

In total, 46 goldeye were used to describe biological characteristics (Figure 3.29). All but one goldeye recorded during the study were ≥ 321 mm length and were adults (Age 8 to Age 15). The condition (*K*) at-age estimates presented indicated good body condition (K > 1.00) (Table 3.8). One young-of-the-year goldeye (fork length = 36 mm) was captured at the confluence of the Beatton River in Section 7

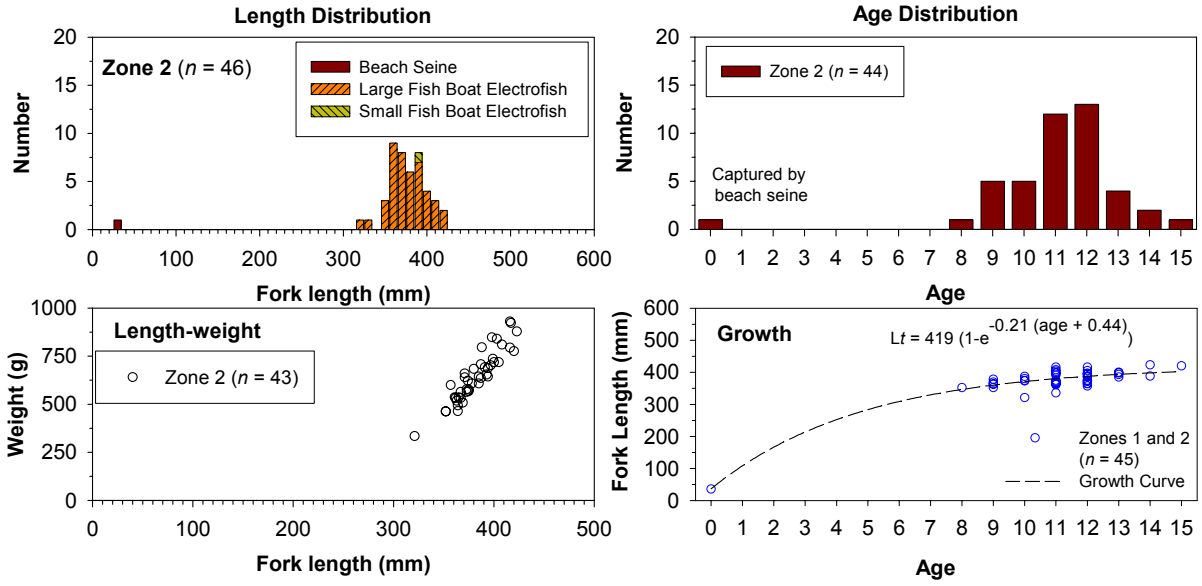


Figure 3.29 Biological characteristics of sampled goldeye, 2010 Site C Peace River Fish Inventory (Table 2.6 identifies data selected for analyses).

Table 3.8 Mean length-at-age and condition-at-age of goldeye (Zones 1 and 2 combined), 2010 Site C Peace River Fish Inventory.

Age	Fork Length		Condition (*K*)	
	n	**Mean (± 95%CI)**	***n***	**Mean (± 95%CI)**
0	1	36.0		
1				
2				
3				
4				
5				
6				
7				
8	1	352.0	1	1.06
9	5	365.0 ± 11.8	5	1.07 ± 0.07
10	5	367.0 ± 32.7	5	1.13 ± 0.11
11	13	381.1 ± 14.0	11	1.15 ± 0.05
12	13	383.3 ± 10.6	13	1.14 ± 0.06
13	4	394.0 ± 10.6	4	1.17 ± 0.19
14	2	405.5 ± 222.4	2	1.26 ± 1.29
15	1	420.0	1	1.05

3.4.2.3 Distribution of Young Fish

A single young (Age 0) goldeye was recorded during the study (Figure 3.30). This fish was encountered in Section 7 at the Beatton River confluence.

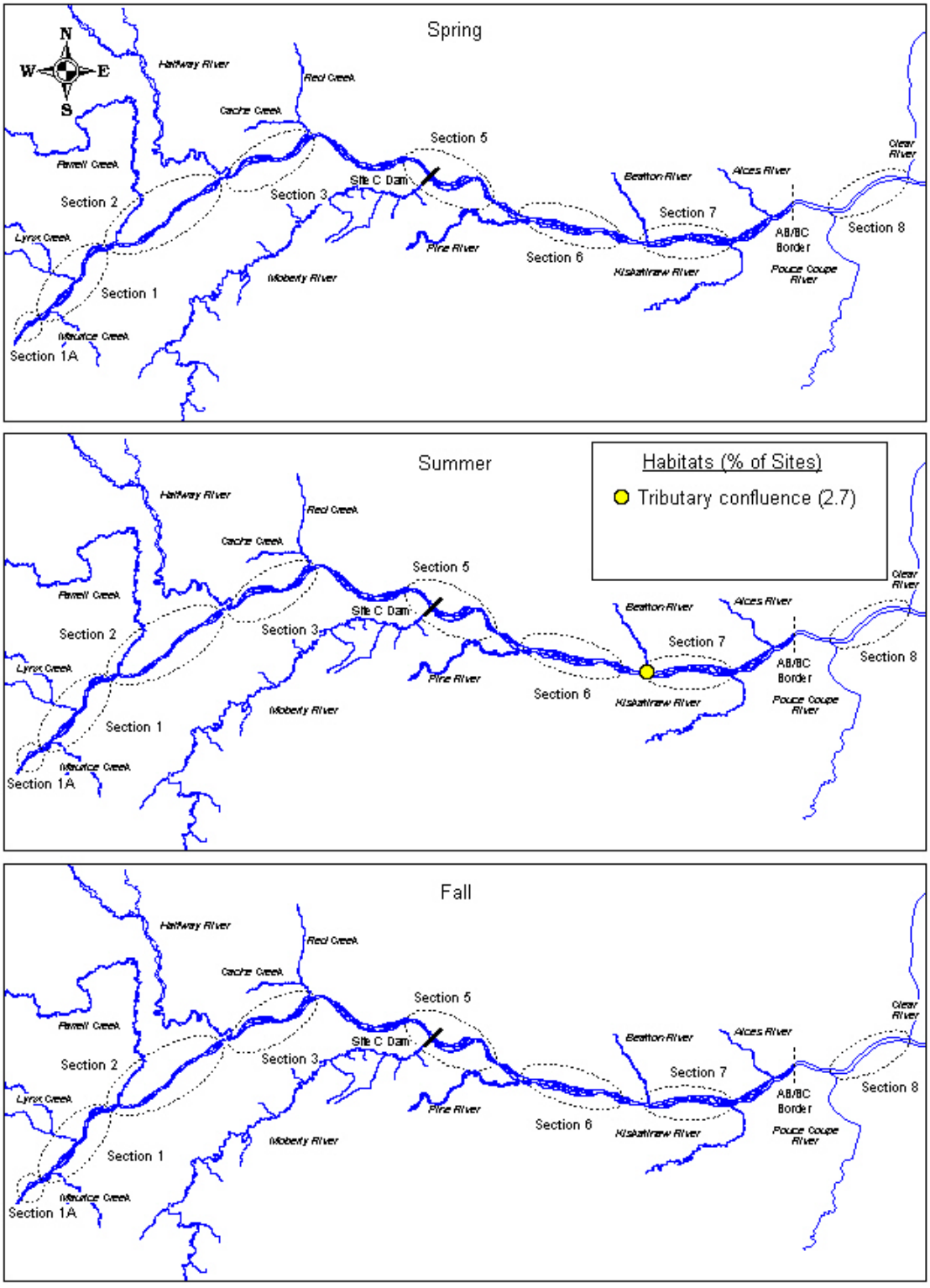


Figure 3.30 Distribution of young (Age 0) goldeye, 2010 Site C Peace River Fish Inventory.

3.4.3 Northern Pike

3.4.3.1 Catch Rate

In total, 338 northern pike were recorded in the study area. Small and large northern pike were recorded in Sections 2 to 8, but catch rates were highest in Sections 5, 6, and 7 (Figure 3.31). Small and large fish were recorded in all three habitats, but catch rates of both groups were higher in side channel and tributary confluence areas than in main channel areas.

Average catch rates of large and small northern pike in main channel areas were ≤ 1.2 fish/km. Average catch rates in side channel and tributary confluence areas were ≥ 0.6 fish/km (large fish) and were ≥ 0.1 fish/100 m^2 (small fish). Catch rates were higher in summer compared to catch rates recorded in spring and fall.

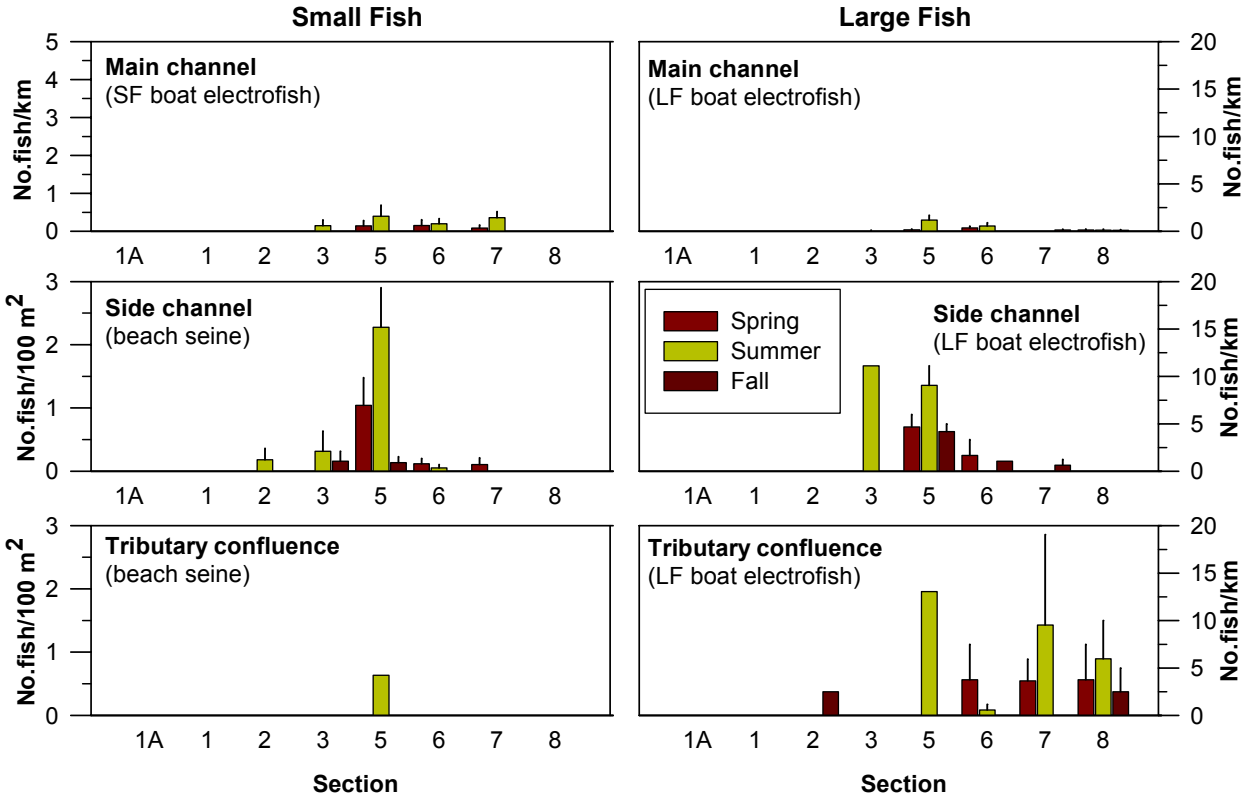


Figure 3.31 Average catch rates (± SE) of northern pike in study sections during spring, summer, and fall, 2010 Site C Peace River Fish Inventory (small fish ≤ 200 mm fork length and large fish > 200 mm fork length; SF – small fish method, LF – large fish method).

3.4.3.2 Biological Characteristics

In total, 157 northern pike were used to describe biological characteristics (Figure 3.32). Sampled fish ranged in length from 17 mm to 950 mm, ranged in weight from 58 g to 5,810 g, and ranged from Age 0 to Age 8. Data from both zones were combined for analyses. The size distribution of northern pike was broad and contained several modal peaks indicating good representation by several age classes.

The age distribution generated from the large fish boat electrofisher catch was numerically dominated by Age 4 fish followed by a rapid decline of older age classes. The absence of Age 0 fish in the age distribution was an artifact of the fish capture method rather than an absence of this age class from the population – note length distribution in Figure 3.31 that is based on multiple capture methods.

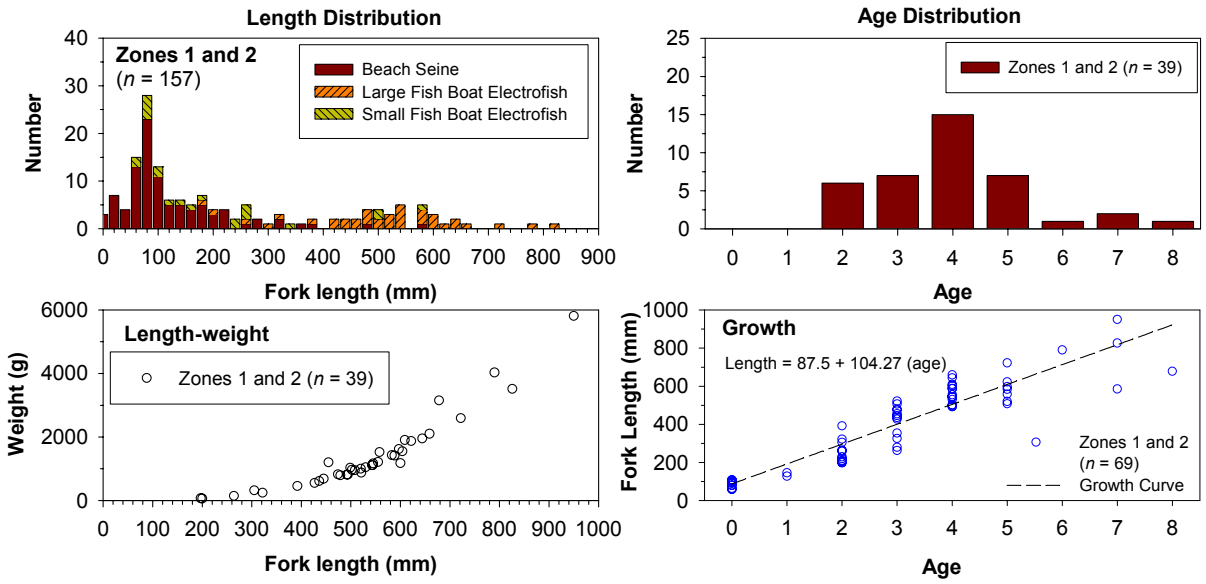


Figure 3.32 Biological characteristics of sampled northern pike, 2010 Site C Peace River Fish Inventory (Table 2.6 identifies data selected for analyses).

The length-weight relationship illustrated in Figure 3.32 indicated allometric growth and condition (*K*) at-age estimates presented in Table 3.9 was < 1.00. A visual assessment of the growth curve and length-at-age summary (Table 3.9) indicated rapid linear growth.

Table 3.9 Mean length-at-age and condition-at-age of northern pike (Zones 1 and 2 combined), 2010 Site C Peace River Fish Inventory.

Age	Fork Length		Condition (*K*)	
	n	**Mean (± 95%CI)**	***n***	**Mean (± 95%CI)**
0	14	89.1 ± 10.4		
1	2	136.5 ± 108.0		
2	13	251.5 ± 35.3	6	0.84 ± 0.17
3	12	413.6 ± 55.5	7	0.80 ± 0.20
4	16	562.1 ± 28.2	15	0.71 ± 0.04
5	7	587.1 ± 66.6	7	0.75 ± 0.06
6	1	790.0	1	0.82
7	3	787.0 ± 461.1	2	0.65 ± 0.35
8	1	678.0	1	1.01

3.4.3.3 Distribution of Young Fish

There were spatial, seasonal, and habitat differences in the distribution of young (Age 0) northern pike in the study area (Figure 3.33). Young northern pike were recorded as far upstream as Section 2, but were most frequently recorded downstream of the proposed Site C dam location in Sections 5, 6, and 7. Young northern pike were most frequently recorded in side channel areas during all seasons. Highest fish numbers occurred in side channel areas (Appendix G); however, fish were also found in main channel and tributary confluence areas.

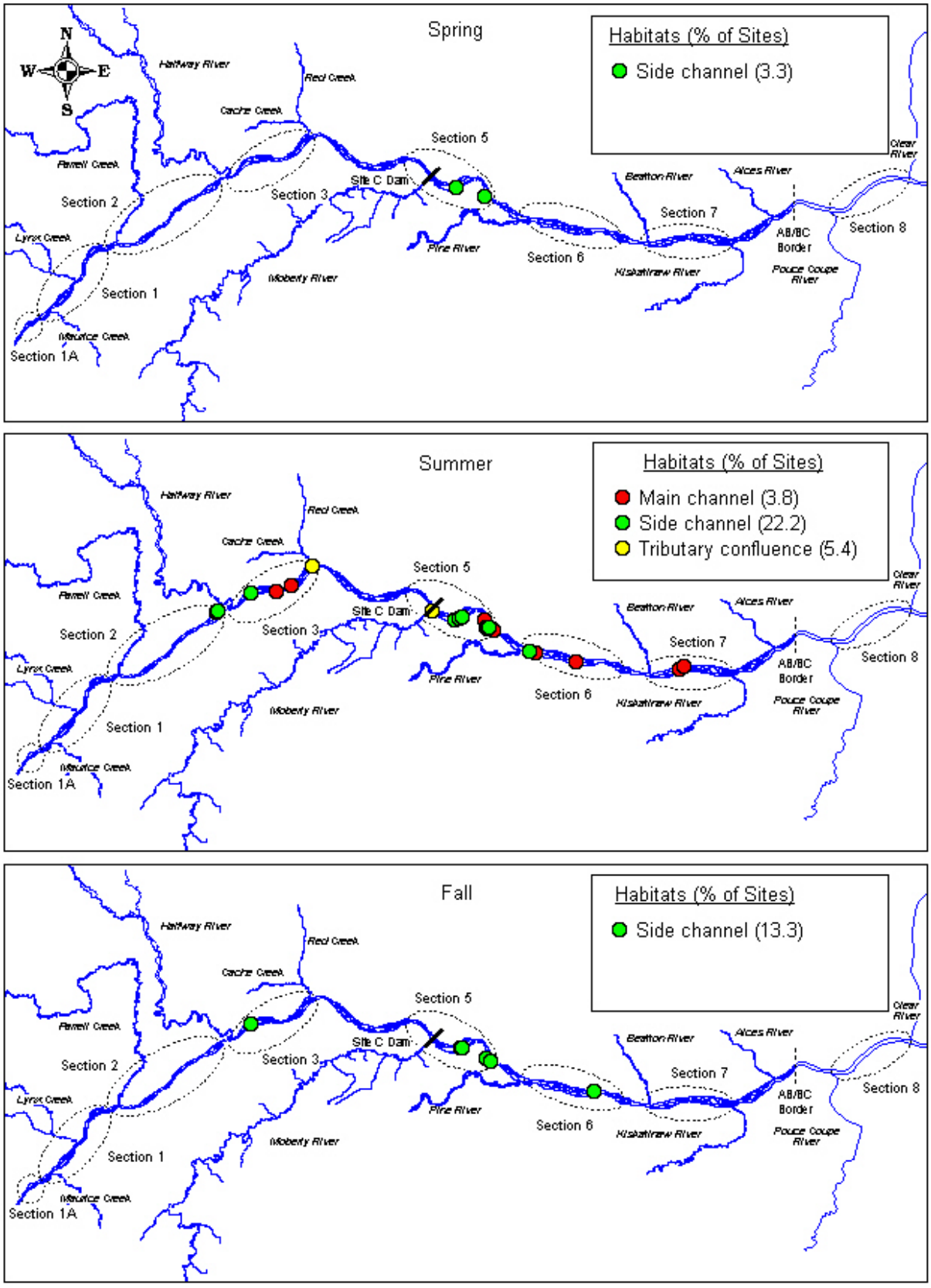


Figure 3.33 Distribution of young (Age 0) northern pike, 2010 Site C Peace River Fish Inventory.

3.4.4 Walleye

3.4.4.1 Catch Rate

In total, 332 walleye were enumerated during the study. Walleye were only encountered in the downstream portion of the study area in Sections 5, 6, 7, and 8 (Figure 3.34). Small fish were scarce. Large walleye occurred in all three habitat areas, but catch rates in main channel and side channels areas were low (< 3.1 fish/km) compared to catch rates in tributary confluence areas (up to 55.6 fish/km). Fish were recorded at confluences of the Moberly River, Beatton River, Kiskatinaw River, Pouce Coupe River, and Clear River. A total of 87 fish were recorded at the confluence of the Beatton River (Section 7) during a single sample session. There were no strong seasonal variations in walleye catch rates.

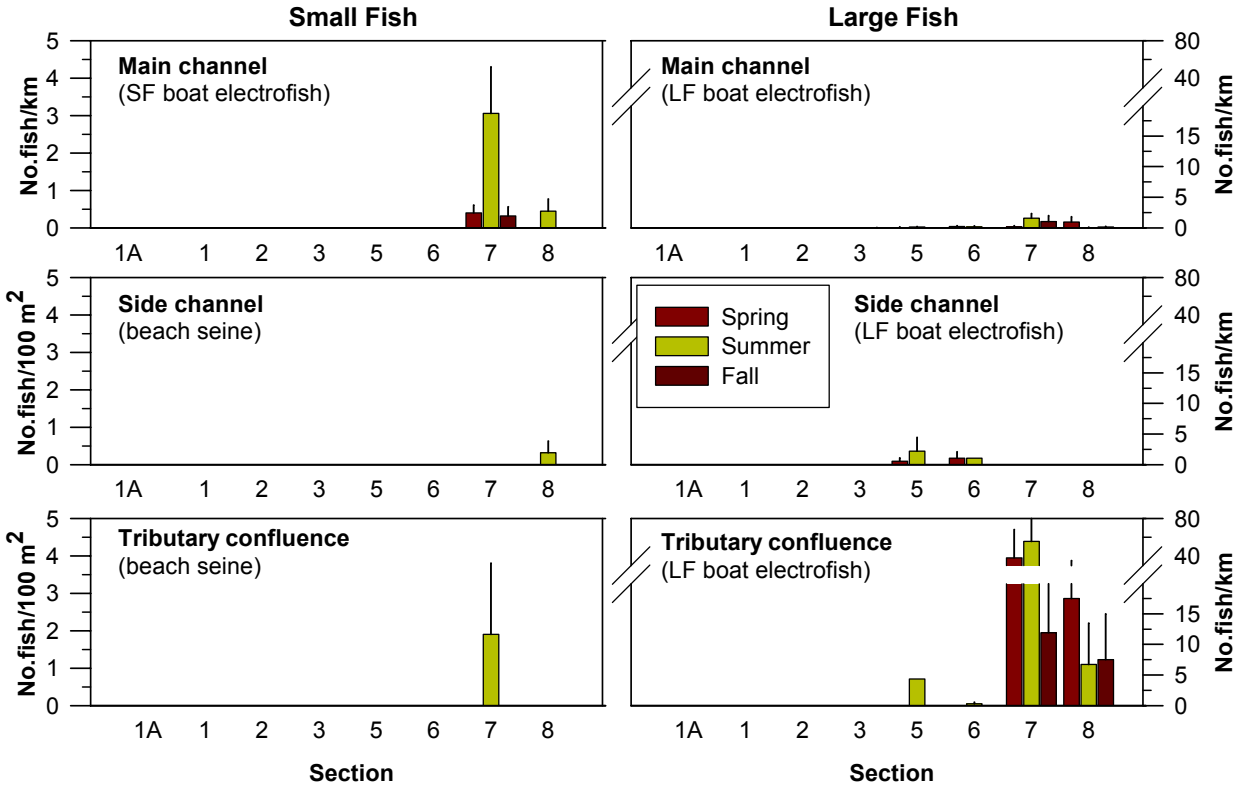


Figure 3.34 Average catch rates (± SE) of walleye in study sections during spring, summer, and fall, 2010 Site C Peace River Fish Inventory (small fish ≤ 200 mm fork length and large fish > 200 mm fork length; SF – small fish method, LF – large fish method).

3.4.4.2 Biological Characteristics

In total, 174 walleye were used to describe biological characteristics (Figure 3.35). Sampled fish ranged in length from 43 mm to 586 mm and ranged in weight from 48 g to 1,758 g, and ranged from Age 0 to Age 16. Data from both zones were combined for analyses. The size distribution of walleye was broad, but was composed of discrete groupings. The first two modal peaks at 50 mm length and at 170 mm length represented Age 0 and Age 1, fish respectively. The other group (340 mm length to 510 mm length) likely represented adult fish (Age 4 to Age 13). The age distribution generated from the large fish boat electrofisher catch was numerically dominated by Age 6 and 7 fish with a gradual decline in the numbers of older fish.

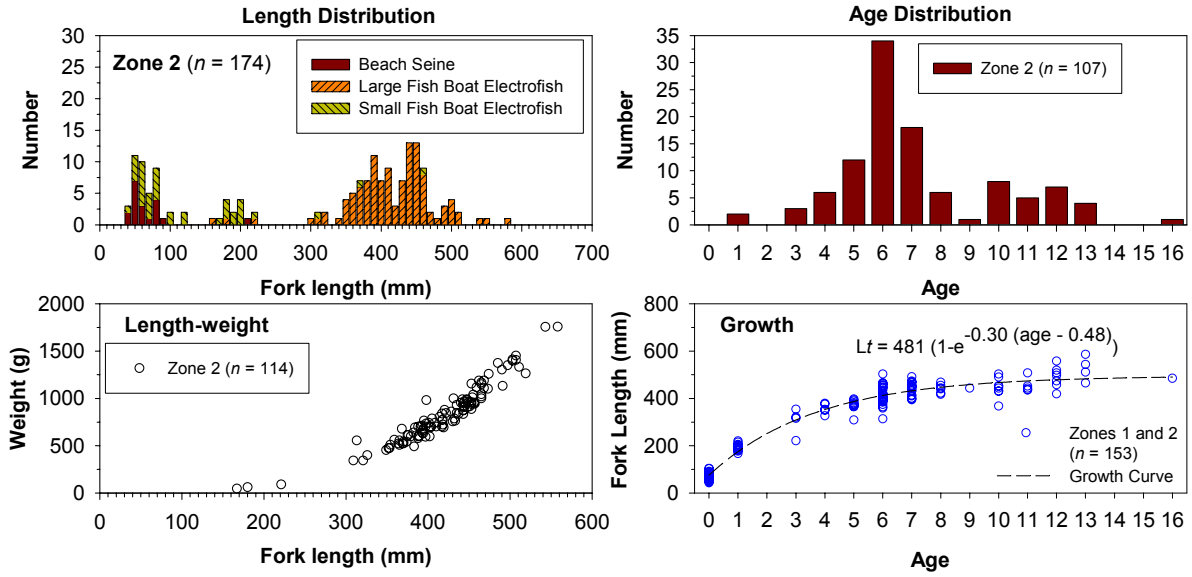


Figure 3.35 Biological characteristics of sampled walleye, 2010 Site C Peace River Fish Inventory (Table 2.6 identifies data selected for analyses).

The length-weight relationship illustrated in Figure 3.35 indicated allometric growth and condition (K) at-age estimates presented in Table 3.10 indicated good body condition ($K \geq 1.00$). A visual assessment of the growth curve and length-at-age summary (Table 3.10) indicated a von Bertalanffy growth form.

Table 3.10 Mean length-at-age and condition-at-age of walleye (Zones 1 and 2 combined), 2010 Site C Peace River Fish Inventory.

Age	Fork Length		Condition (*K*)	
	n	**Mean (± 95%CI)**	***n***	**Mean (± 95%CI)**
0	31	70.5 ± 6.0		
1	14	193.9 ± 8.5	2	1.05 ± 0.21
3	4	302.8 ± 90.9	3	1.01 ± 0.40
4	6	355.7 ± 20.3	6	1.11 ± 0.04
5	12	371.6 ± 14.3	12	1.10 ± 0.04
6	35	411.4 ± 12.6	34	1.11 ± 0.05
7	19	441.6 ± 13.3	17	1.07 ± 0.07
8	6	441.0 ± 20.3	6	1.11 ± 0.03
9	1	443.0	1	1.01
10	8	446.1 ± 34.4	8	1.11 ± 0.12
11	5	454.8 ± 37.2	5	1.03 ± 0.07
12	7	490.1 ± 41.7	7	1.03 ± 0.09
13	4	526.3 ± 81.3	3	1.09 ± 0.20
14				
15				
16	1	485.0	1	1.20

3.4.4.3 Distribution of Young Fish

All young walleye (Age 0 and 1) were recorded in Section 7 and Section 8 (Figure 3.36) Age 0 fish were recorded at and immediately downstream of the Beatton River confluence in Section 7 and immediately downstream of the Pouce Coupe River confluence in Section 8. Young walleye were also recorded in main channel and side channel areas away from tributary confluences.

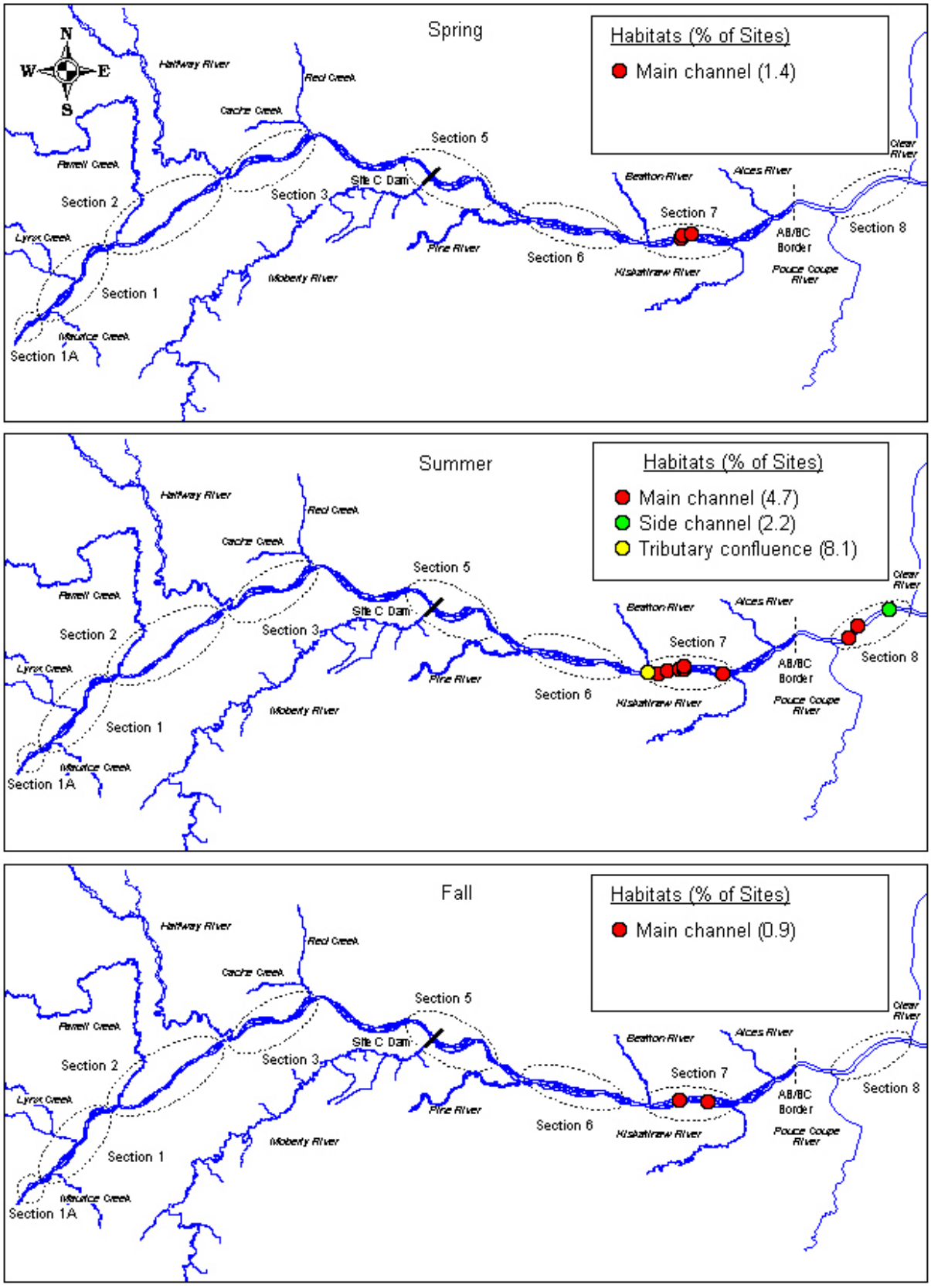


Figure 3.36 Distribution of young (Age 0 and Age 1) walleye, 2010 Site C Peace River Fish Inventory.

3.4.5 Yellow Perch

3.4.5.1 Catch Rate

In total, 635 yellow perch were enumerated during the study. The distribution of yellow perch was spatially and seasonally restricted (Figure 3.37). All fish recorded during the study were small fish (≤ 200 mm fork length). Although yellow perch were recorded in Sections 5, 6, 7, and 8, high catch rates occurred only in Section 5 and Section 8. In Section 5, yellow perch were exclusively recorded in side channels during spring and summer. In these areas, catch rates were as high as 15.8 fish/100 m^2. In Section 8, yellow perch catches were recorded in spring and summer in all three habitat types, but catch rates were highest in the main channel in spring (7.5 fish/km).

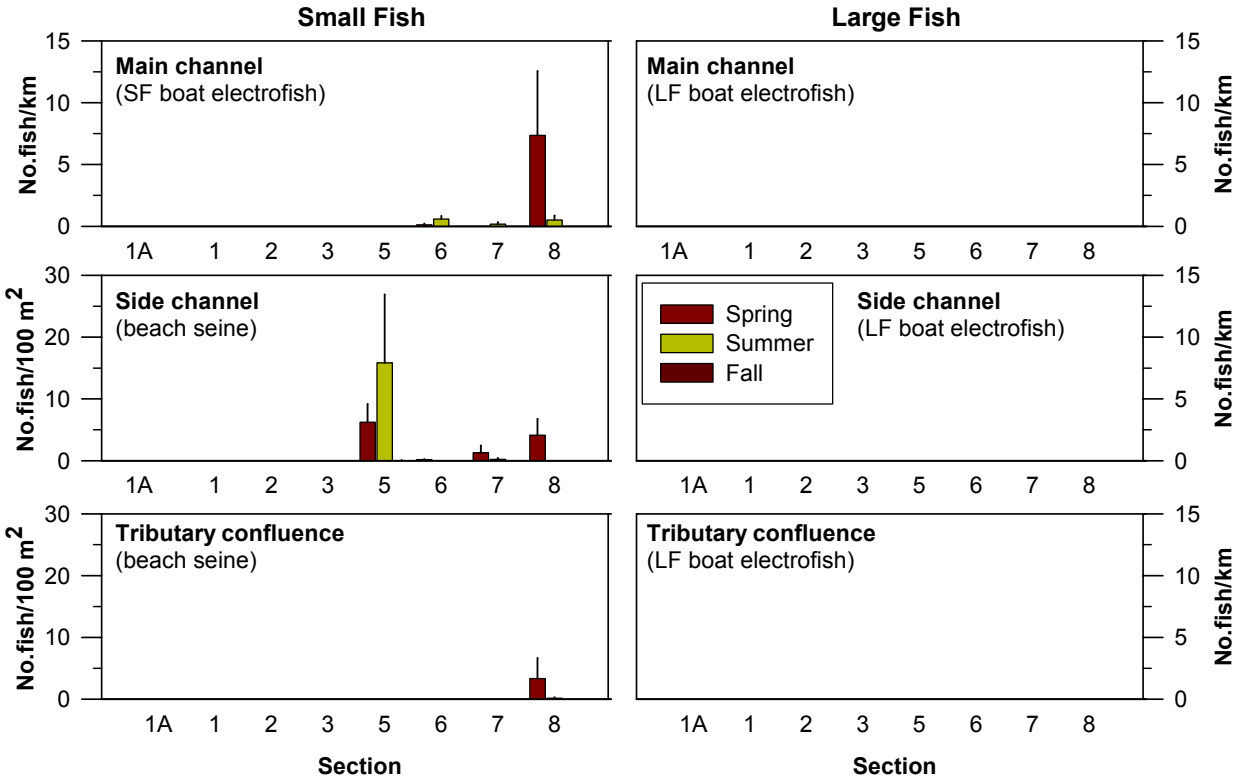


Figure 3.37 Average catch rates (± SE) of yellow perch in study sections during spring, summer, and fall, 2010 Site C Peace River Fish Inventory (small fish ≤ 200 mm fork length and large fish > 200 mm fork length; SF – small fish method, LF – large fish method).

3.4.5.2 Biological Characteristics

In total, 265 yellow perch were used to describe biological characteristics (Figure 3.38). Sampled fish ranged in length from 21 mm to 184 mm and ranged in weight from 6 g to 76 g. Yellow perch were recorded only in Zone 2. The size distribution of yellow perch contained several modal peaks indicating representation by several age classes. The age distribution generated by the beach seine catch was numerically dominated by Age 1 fish with a gradual decline in the numbers of older fish. The length-

weight relationship indicated allometric growth and condition (*K*) estimate of the sample (1.26 ± 0.13) indicated good body condition. The growth curve and length-at-age summary (Table 3.11) showed a linear growth form.

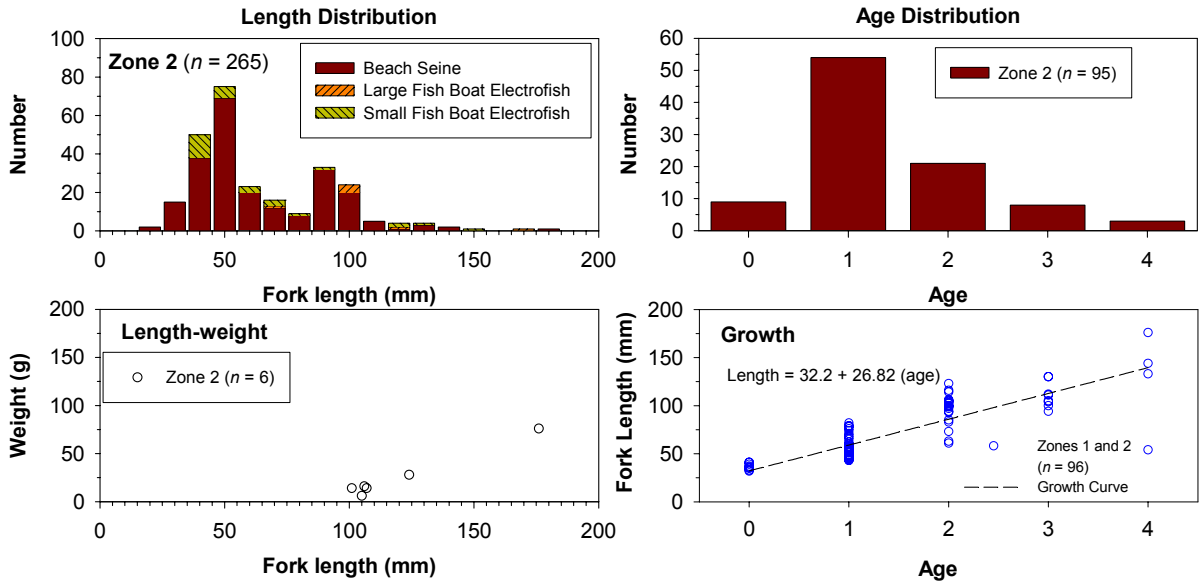


Figure 3.38 Biological characteristics of sampled yellow perch, 2010 Site C Peace River Fish Inventory (Table 2.6 identifies data selected for analyses).

Table 3.11 Mean length-at-age and condition-at-age of yellow perch (Zones 1 and 2 combined), 2010 Site C Peace River Fish Inventory.

Age	Fork Length		Condition (*K*)	
	n	**Mean (± 95%CI)**	***n***	**Mean (± 95%CI)**
0	9	36.6 ± 2.5		
1	54	55.4 ± 2.8		
2	21	96.4 ± 7.2		
3	8	110.8 ± 11.0		
4	4	126.8 ± 82.5	1	1.39

3.4.5.3 Distribution of Young Fish

All young yellow perch (Age 0 and Age 1) recorded during the study were found downstream of the proposed Site C dam location in Sections 5, 6, 7, and 8 (Figure 3.39). The majority of fish were recorded in side channel habitats.

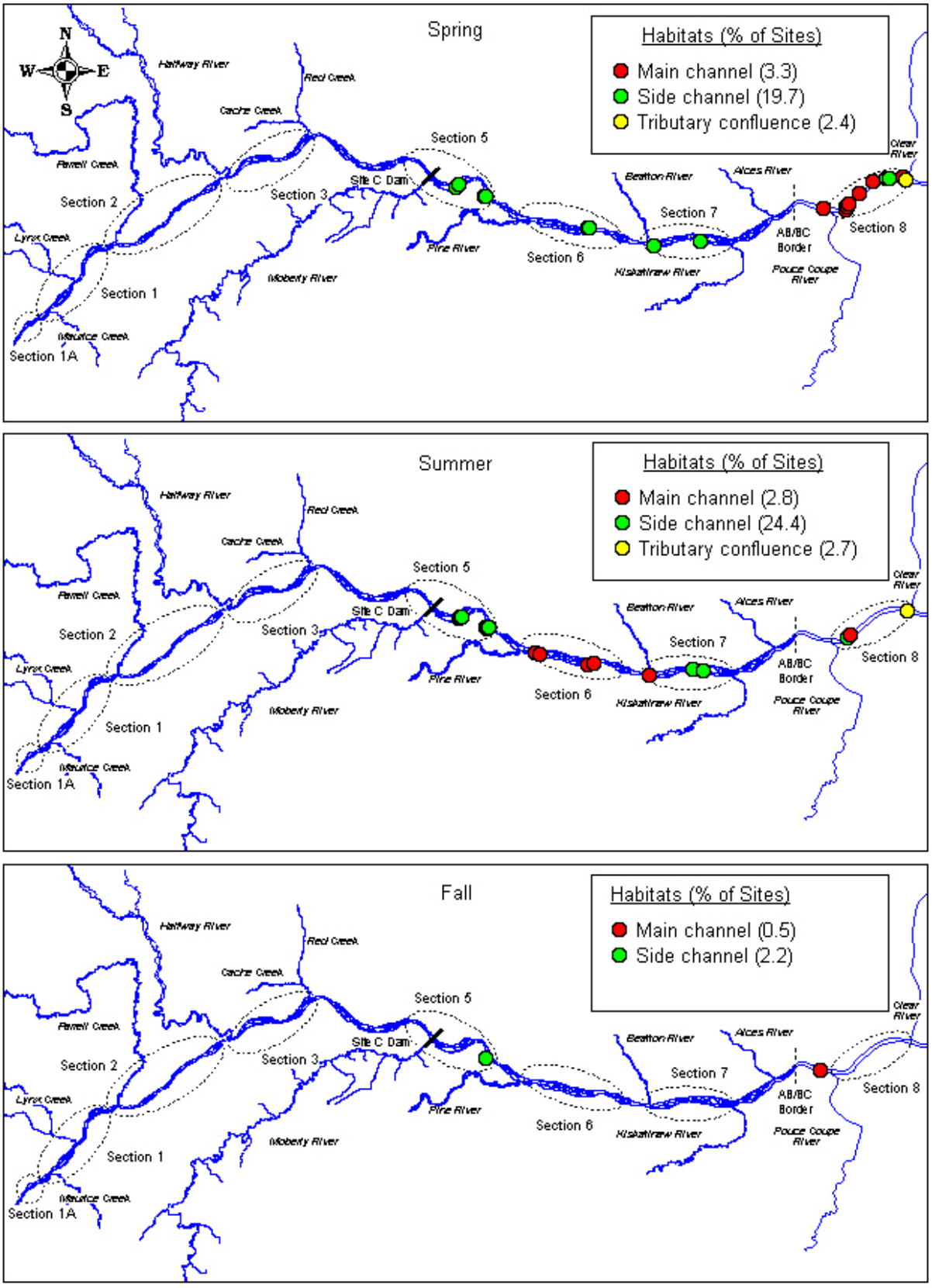


Figure 3.39 Distribution of young (Age 0 and Age 1) yellow perch, 2010 Site C Peace River Fish Inventory.

3.5 SUCKER POPULATIONS

3.5.1 Longnose Sucker

3.5.1.1 Catch Rate

In total, 4,165 longnose suckers were enumerated during the study and this species was found in all eight sections and in all three habitats (Figure 3.40). In main channel areas, longnose suckers catch rates increased from upstream to downstream. Catch rates of large fish were low in Section 1A to Section 2 (≤ 0.5 fish/km), but increased to a high of approximately 15 fish/km in Sections 6, 7, and 8. A similar pattern was recorded for small longnose suckers.

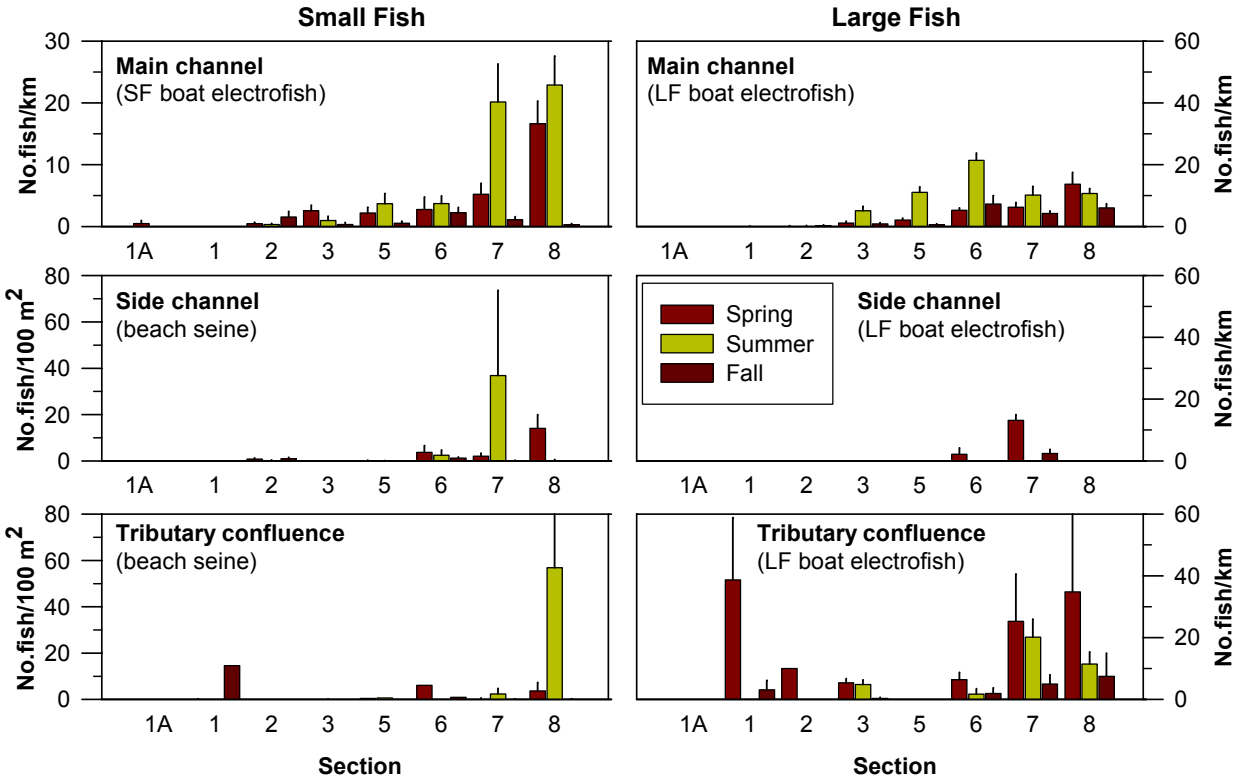


Figure 3.40 Average catch rates (± SE) of longnose suckers in study sections during spring, summer, and fall, 2010 Site C Peace River Fish Inventory (small fish ≤ 200 mm fork length and large fish > 200 mm fork length; SF – small fish method, LF – large fish method).

High catch rates of large longnose suckers were recorded at tributary confluence habitats (38.6 fish/km), but fish were generally scarce in side channel habitats. Small longnose suckers were found in side channel and tributary confluence habitats, but catch rates were generally low.

There were seasonal variations in longnose suckers catch rates in main channel habitat. Catch rates were intermediate in spring, highest in summer, and lowest in fall. It should be noted that Age 0 suckers were not differentiated to species in spring and summer, and therefore, were not included in this analysis.

3.5.1.2 Biological Characteristics

In total, 1,254 longnose suckers were used to describe biological characteristics – 157 from Zone 1 and 1,097 from Zone 2 (Figure 3.41). Sampled fish ranged in length from 17 mm to 591 mm, ranged in weight from 16 g to 1,744 g, and ranged from Age 0 to Age 17.

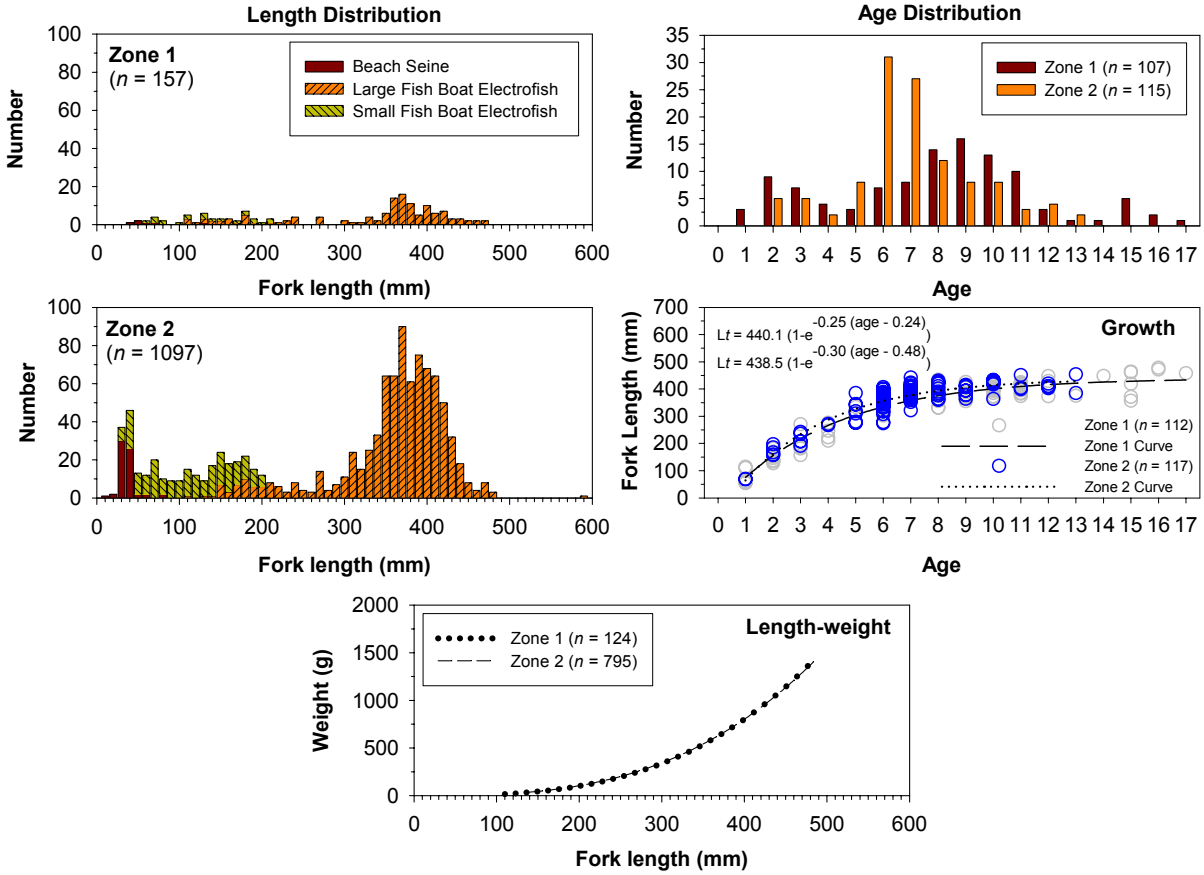


Figure 3.41 Biological characteristics of sampled longnose sucker, 2010 Site C Peace River Fish Inventory (Table 2.6 identifies data selected for analyses; length-weight relationship represented by power curve in place of raw data).

Based on combined samples from all capture methods, size distributions in both zones were broad and contained several modal peaks suggesting the presence of multiple age classes. Samples from both zones were dominated by larger (≥ 350 mm length), older (≥ Age 5) fish. The size and age distributions of longnose suckers differed between Zone 1 and Zone 2. In Zone 1 smaller, (≤ 300 mm length), younger (≤ Age 4) fish were not well represented. In contrast, Zone 2 contained higher numbers of young and subadult fish (20 mm to 300 mm length; Ages 0 to 4).

The age distribution generated by the large fish electrofisher was numerically dominated by Age 8 to Age 11 fish in Zone 1 and by Age 6 and Age 7 fish in Zone 2. The age and length distribution differed in that younger fish (≤ Age 4) were not strongly represented. This is an artifact of the age data used for the analysis (large fish boat electrofisher only)

A visual assessment of the length-weight relationship (Figure 3.41), length-at-age, and condition (K)-at-age summaries (Table 3.12) indicated no differences between zones. The growth curve of the combined data showed a classic von Bertalanffy growth form.

Table 3.12 Mean length-at-age and condition-at-age of longnose sucker in Zone 1 and Zone 2, 2010 Site C Peace River Fish Inventory.

Age	Fork Length				Condition (*K*)			
	Zone 1		Zone 2		Zone 1		Zone 2	
	n	Mean (± 95%CI)	*n*	Mean (± 95%CI)	*n*	Mean (± 95%CI)	*n*	Mean (± 95%CI)
0								
1	7	82.4 ± 26.1	2	68.5 ± 6.4	3	1.28 ± 0.30		
2	10	151.0 ± 12.9	5	173.0 ± 21.6	8	1.32 ± 0.05	5	1.27 ± 0.22
3	7	209.6 ± 37.3	5	216.6 ± 26.4	5	1.34 ± 0.22	3	1.26 ± 0.09
4	4	238.5 ± 46.4	2	269.5 ± 31.8	4	1.30 ± 0.16	2	1.25 ± 1.27
5	3	332.7 ± 34.9	8	316.3 ± 32.9	3	1.25 ± 0.22	8	1.21 ± 0.07
6	7	352.9 ± 27.9	31	356.4 ± 12.2	7	1.19 ± 0.12	30	1.27 ± 0.04
7	8	374.8 ± 12.1	27	385.9 ± 10.1	8	1.31 ± 0.09	27	1.26 ± 0.02
8	14	370.2 ± 15.9	12	396.7 ± 15.8	14	1.21 ± 0.04	12	1.34 ± 0.11
9	16	381.6 ± 10.7	8	392.6 ± 15.4	15	1.24 ± 0.04	8	1.20 ± 0.09
10	13	404.7 ± 12.5	8	418.4 ± 19.3	13	1.27 ± 0.09	8	1.21 ± 0.09
11	10	403.4 ± 12.9	3	418.0 ± 71.3	10	1.26 ± 0.05	3	1.30 ± 0.43
12	3	416.3 ± 95.9	4	410.5 ± 11.4	3	1.28 ± 0.13	4	1.31 ± 0.13
13	1	375.0	2	419.5 ± 438.4	1	1.24	2	1.21 ± 0.76
14	1	448.0			1	1.37		
15	5	414.4 ± 61.6			4	1.30 ± 0.19		
16	2	474.5 ± 44.5			2	1.21 ± 1.02		
17	1	458.0			1	1.16		

3.5.1.3 Distribution of Young Fish

The distribution of Age 0 longnose suckers was examined based on the fall sample (Figure 3.42). During spring and summer Age 0 suckers were not differentiated to species. Age 0 longnose suckers were widespread in the study area in fall. They were found in all sections and in all habitat types.

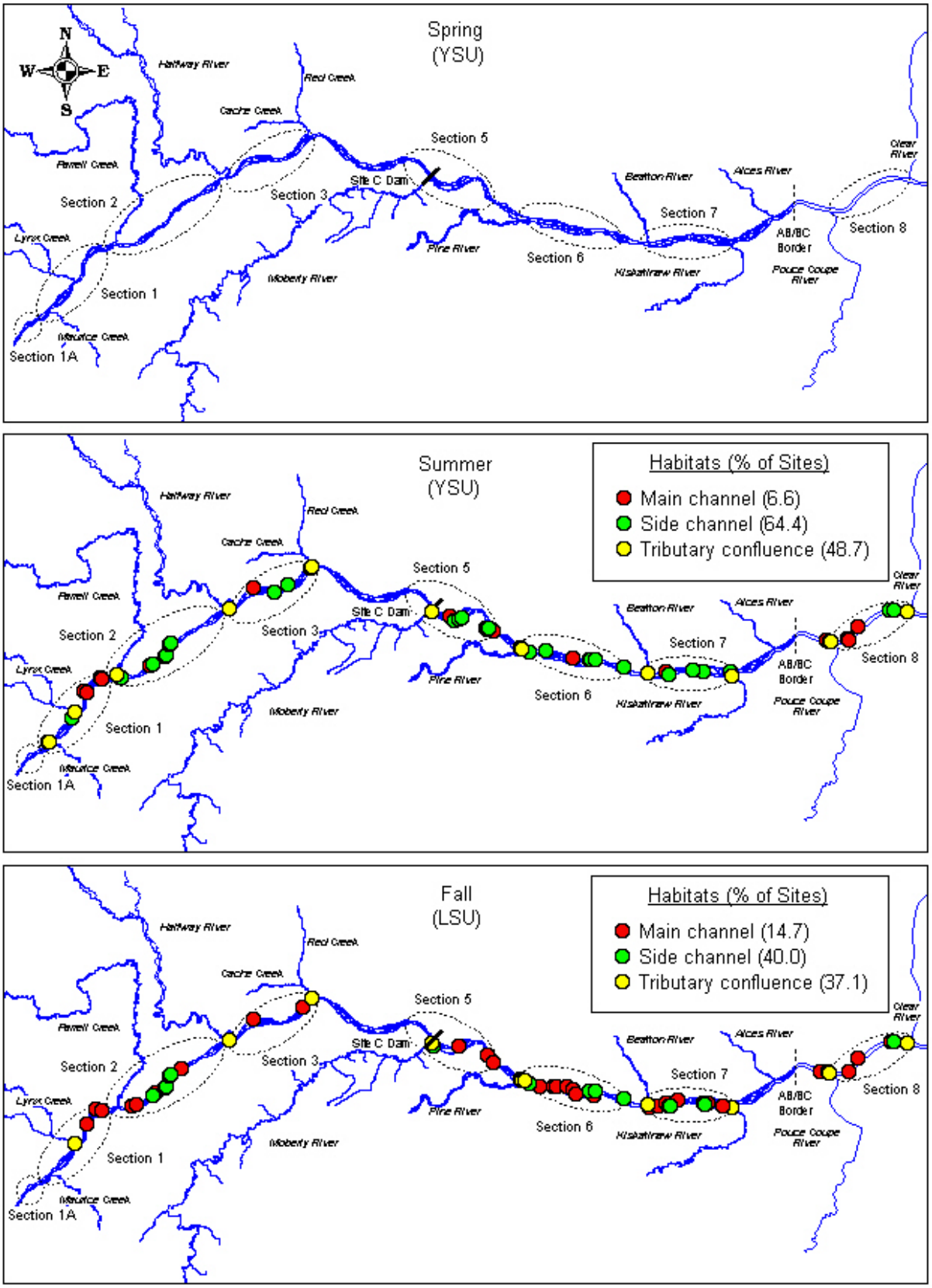


Figure 3.42 Distribution of unidentified Age 0 suckers in spring and summer and Age 0 longnose sucker in fall, 2010 Site C Peace River Fish Inventory.

3.5.2 Largescale Sucker

3.5.2.1 Catch Rate

In total, 1,085 largescale suckers were enumerated during the study and fish were located in most sections and in all three habitats (Figure 3.43). Largescale suckers were absent only from Section 1A. In main channel areas, catch rates of small and large fish were generally ≤ 5.0 fish/km.

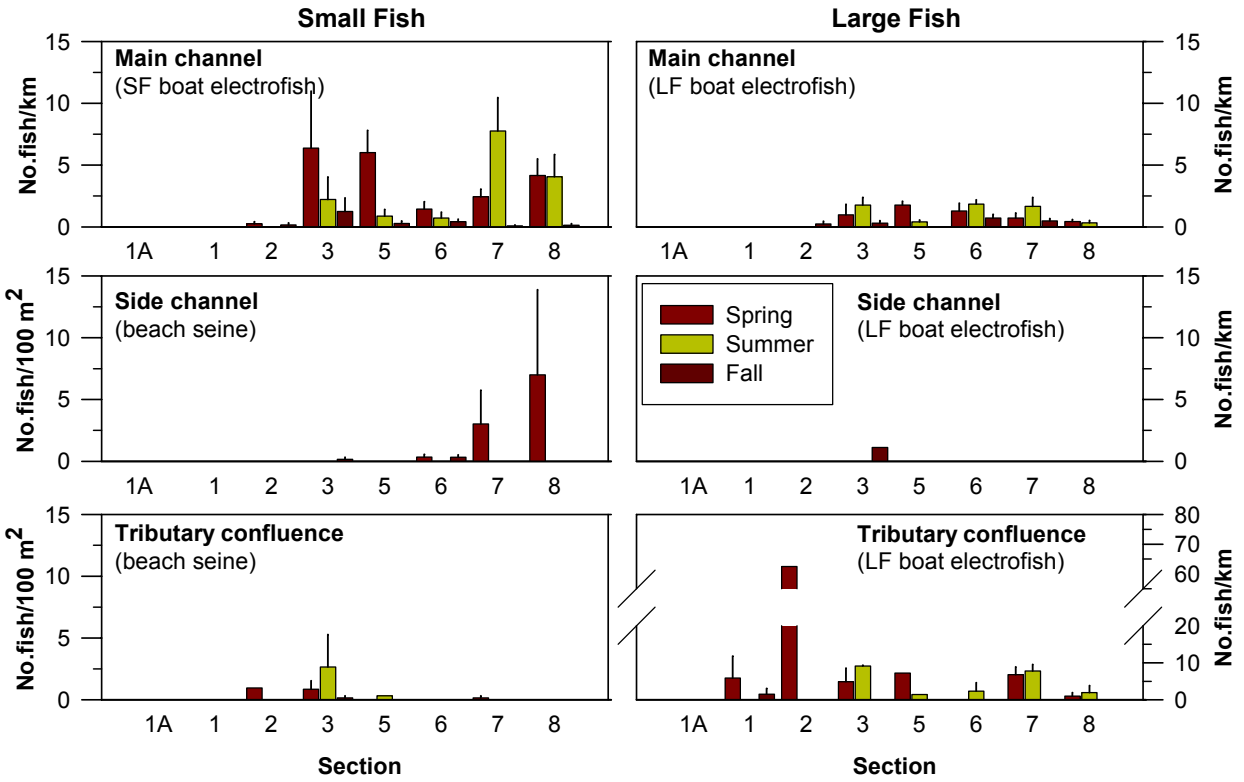


Figure 3.43 Average catch rates (± SE) of largescale suckers in study sections during spring, summer, and fall, 2010 Site C Peace River Fish Inventory (small fish ≤ 200 mm fork length and large fish > 200 mm fork length; SF – small fish method, LF – large fish method).

Large fish catch rates were higher in tributary confluence areas compared to main channel areas. The highest catch rate was recorded at the Farrell Creek confluence (Section 2) in spring (62.5 fish/km). Large fish were scarce in side channel habitat. Small fish were mostly encountered in main channel areas where catch rates reached up to 7.8 fish/km in Section 7.

3.5.2.2 Biological Characteristics

In total, 295 largescale suckers were used to describe biological characteristics – 116 from Zone 1 and 179 from Zone 2 (Figure 3.44). Sampled fish ranged in length from 52 mm to 581 mm, ranged in weight from 20 g to 2,230 g, and ranged from Age 0 to Age 23.

The size and age distributions of largescale sucker were similar to that of longnose suckers, but older fish (to Age 23) were recorded (Figure 3.44). Based on combined samples from all capture methods, the size distribution was broad and contained several modal peaks suggesting the presence of multiple age classes. The sample was dominated by smaller (≤ 200 mm length), younger fish and larger (≥ 400 mm length), older fish. The intermediate size range and age group were poorly represented.

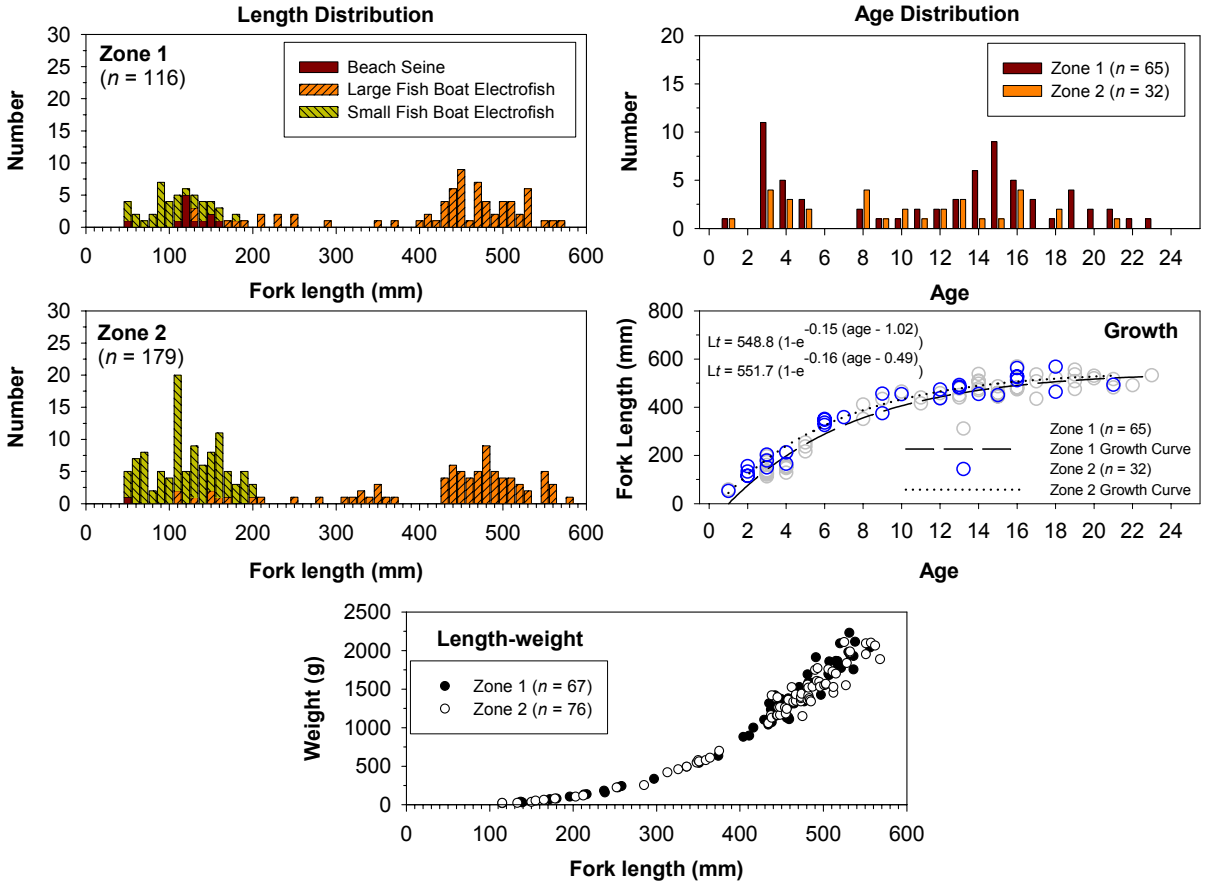


Figure 3.44 Biological characteristics of sampled largescale sucker, 2010 Site C Peace River Fish Inventory (Table 2.6 identifies data selected for analyses).

A visual assessment of the length-weight relationship indicated allometric growth, and condition-at-age summaries (Table 3.13) indicated good condition. The growth curve showed a classic von Bertalanffy growth form.

Table 3.13 Mean length-at-age and condition-at-age of largescale sucker in Zone 1 and Zone 2, 2010 Site C Peace River Fish Inventory.

Age	Fork Length				Condition (*K*)			
	Zone 1		Zone 2		Zone 1		Zone 2	
	n	**Mean (± 95%CI)**	***n***	**Mean (± 95%CI)**	***n***	**Mean (± 95%CI)**	***n***	**Mean (± 95%CI)**
0								
1	1	58.0	1	52.0				
2			4	129.5 ± 30.2			4	1.33 ± 0.38
3	11	144.5 ± 18.7	3	177.0 ± 65.9	4	1.41 ± 0.06	3	1.24 ± 0.43
4	5	159.6 ± 39.5	2	188.5 ± 298.6	1	1.37	2	1.34 ± 1.02
5	3	235.7 ± 47.3			3	1.37 ± 0.04		
6			4	340.3 ± 18.3			4	1.3 ± 0.03
7			1	359.0			1	1.25
8	2	381.0 ± 381.2			2	1.27 ± 0.25		
9	1	434.0	2	415.5 ± 514.6	1	1.27	2	1.32 ± 0.13
10	1	465.0	1	454.0	1	1.30	1	1.35
11	2	428.0 ± 152.5			2	1.38 ± 0.13		
12	2	448.0 ± 127.1	2	455.0 ± 228.7	2	1.30 ± 0.38	2	1.33 ± 0.76
13	3	455.7 ± 47.5	3	485.7 ± 14.1	3	1.33 ± 0.22	3	1.32 ± 0.26
14	6	500.2 ± 25.4	1	455.0	6	1.34 ± 0.10	1	1.25
15	9	456.7 ± 9.7	1	450.0	9	1.32 ± 0.09		
16	5	496.8 ± 50.3	4	531.8 ± 33.9	4	1.41 ± 0.13	4	1.24 ± 0.25
17	3	492.7 ± 129.2			3	1.34 ± 0.60		
18	1	521.0	2	516.0 ± 660.7	1	1.25	2	1.18 ± 1.91
19	4	518.8 ± 56.0			3	1.23 ± 0.09		
20	2	525.0 ± 63.5			2	1.41 ± 1.02		
21	2	499.5 ± 222.4	1	493.0	2	1.35	1	1.48
22	1	491.0			1	1.62		
23	1	532.0			1	1.29		

3.5.2.3 Distribution of Young Fish

The distribution of Age 0 largescale suckers was examined based on the fall sample (Figure 3.45). During spring and summer Age 0 suckers were not differentiated to species. Age 0 largescale suckers were encountered in all habitat types in Sections 2, 3, 5, and 6.

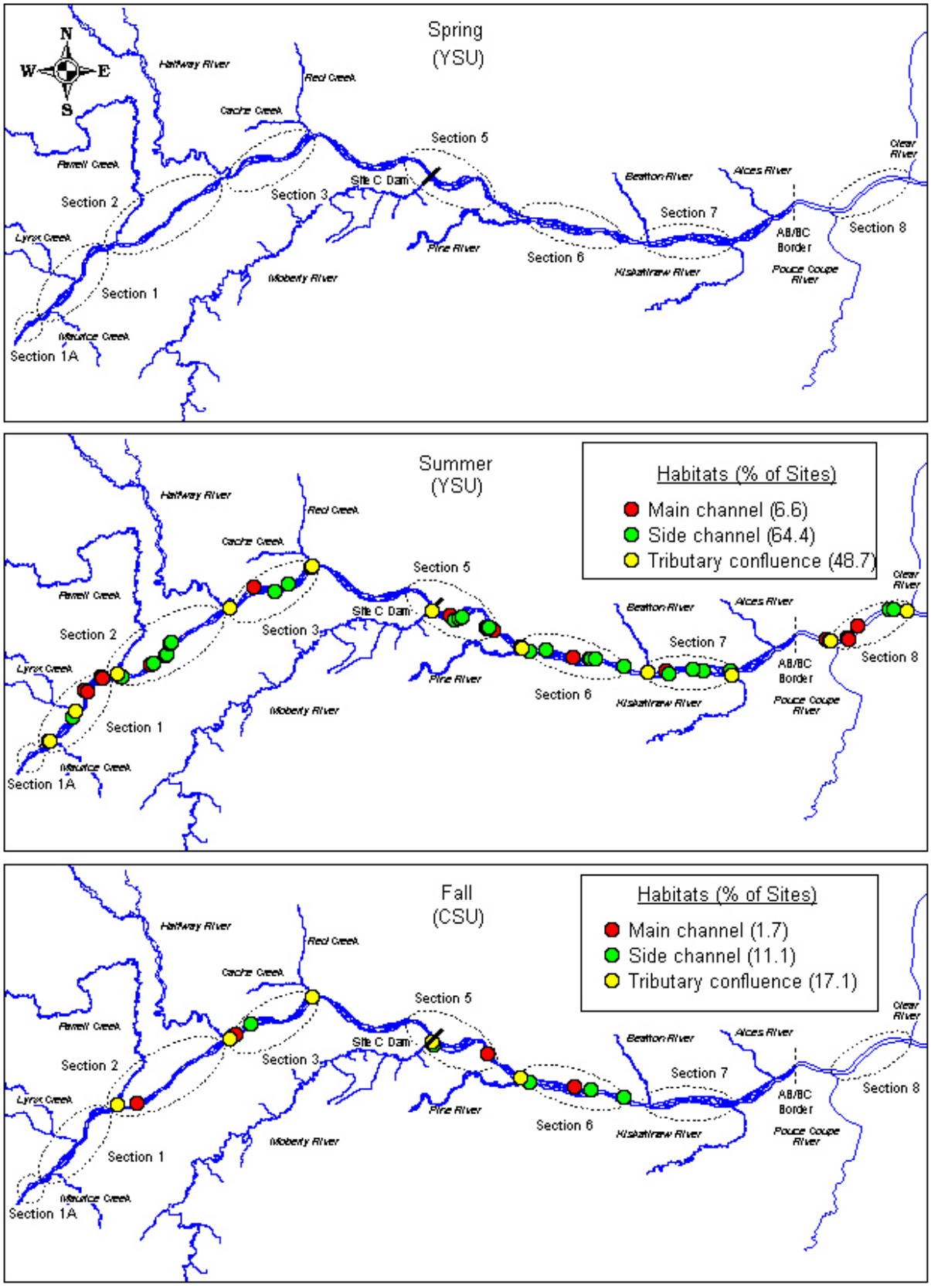


Figure 3.45 Distribution of unidentified Age 0 suckers in spring and summer and Age 0 largescale sucker in fall, 2010 Site C Peace River Fish Inventory.

3.5.3 White Sucker

3.5.3.1 Catch Rate

In total, 271 white suckers were enumerated during the study and catch rates were low (Figure 3.46). White suckers were primarily recorded in Sections 3 to 7 and fish were present in all three habitats. Catch rates of large white suckers were low in main channel areas (approximately 0.5 fish/km), intermediate at tributary confluences (approximately 2.0 fish/km), and highest in side channel areas (approximately 5.0 fish/km). Small fish catch rates were very low in all three habitat types.

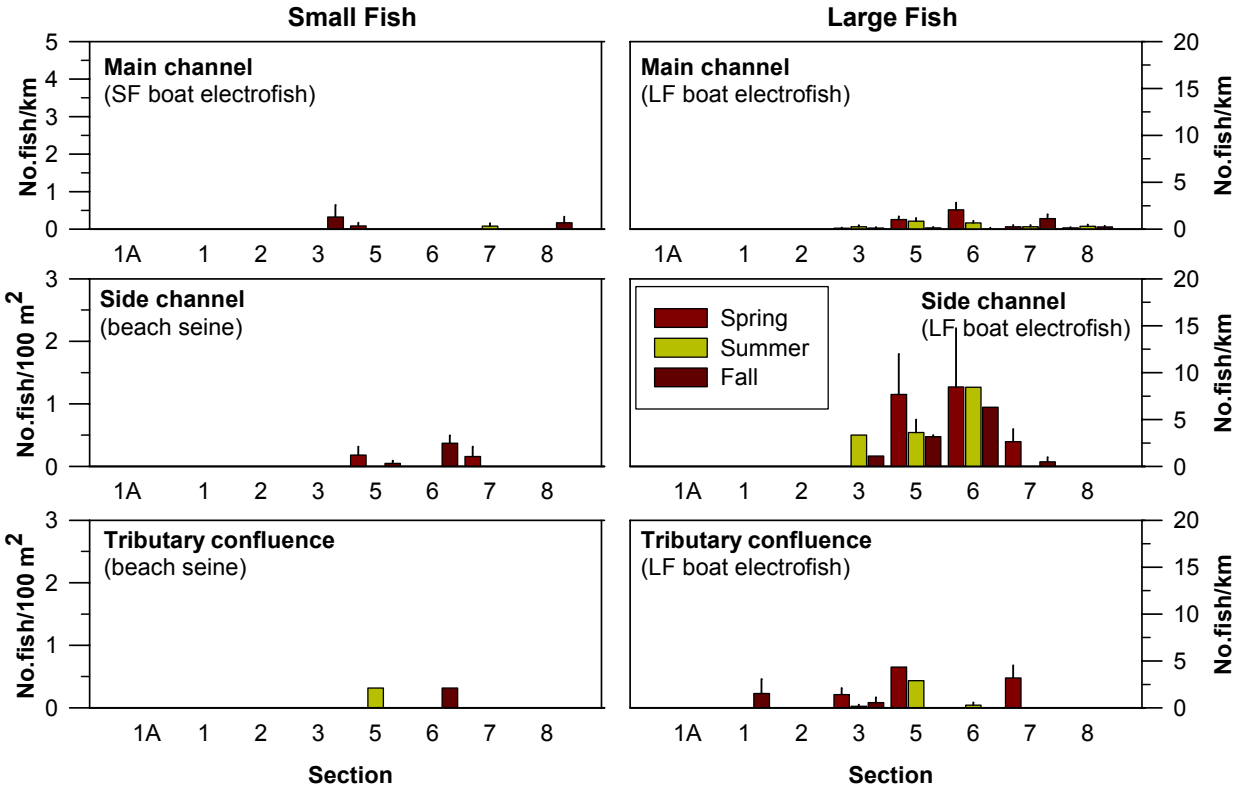


Figure 3.46 Average catch rates (± SE) of white suckers in study sections during spring, summer, and fall, 2010 Site C Peace River Fish Inventory (small fish ≤ 200 mm fork length and large fish > 200 mm fork length; SF – small fish method, LF – large fish method).

3.5.3.2 Biological Characteristics

In total, 57 white suckers were used to describe biological characteristics (Figure 3.47). Sampled fish ranged in length from 64 mm to 466 mm and ranged in weight from 118 g to 1,320 g. Data from both zones were combined for analyses but the white sucker sample was not aged. Based on combined samples from all capture methods, the size distribution of white sucker was dominated by large individuals (≥ 300 mm length).

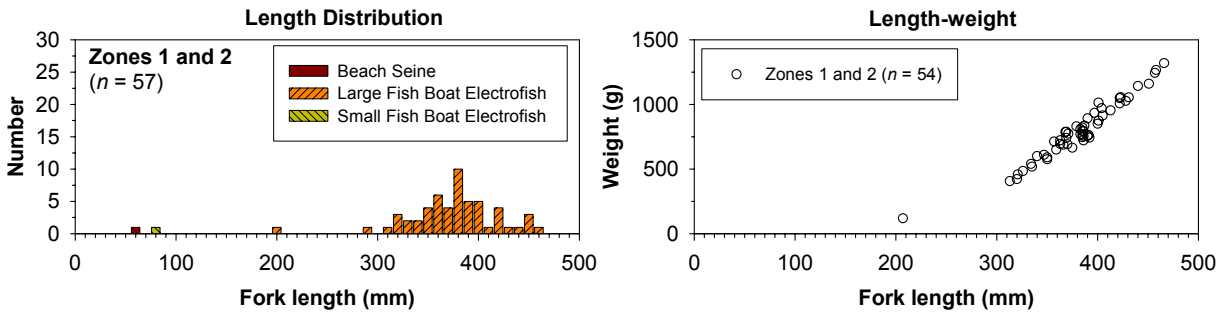


Figure 3.47 Biological characteristics of sampled white sucker, 2010 Site C Peace River Fish Inventory (Table 2.6 identifies data selected for analyses).

The length-weight relationship indicated allometric growth and condition (K) estimate of the sample (1.39 ± 0.01) indicated good body condition.

3.5.3.3 Distribution of Young Fish

The distribution of Age 0 white suckers was examined based on the fall sample (Figure 3.48). During spring and summer Age 0 suckers were not differentiated to species. All Age 0 white sucker were found downstream of the proposed Site C dam location. The majority occurred in Section 6. Side channels and main channels were the dominant habitat types.

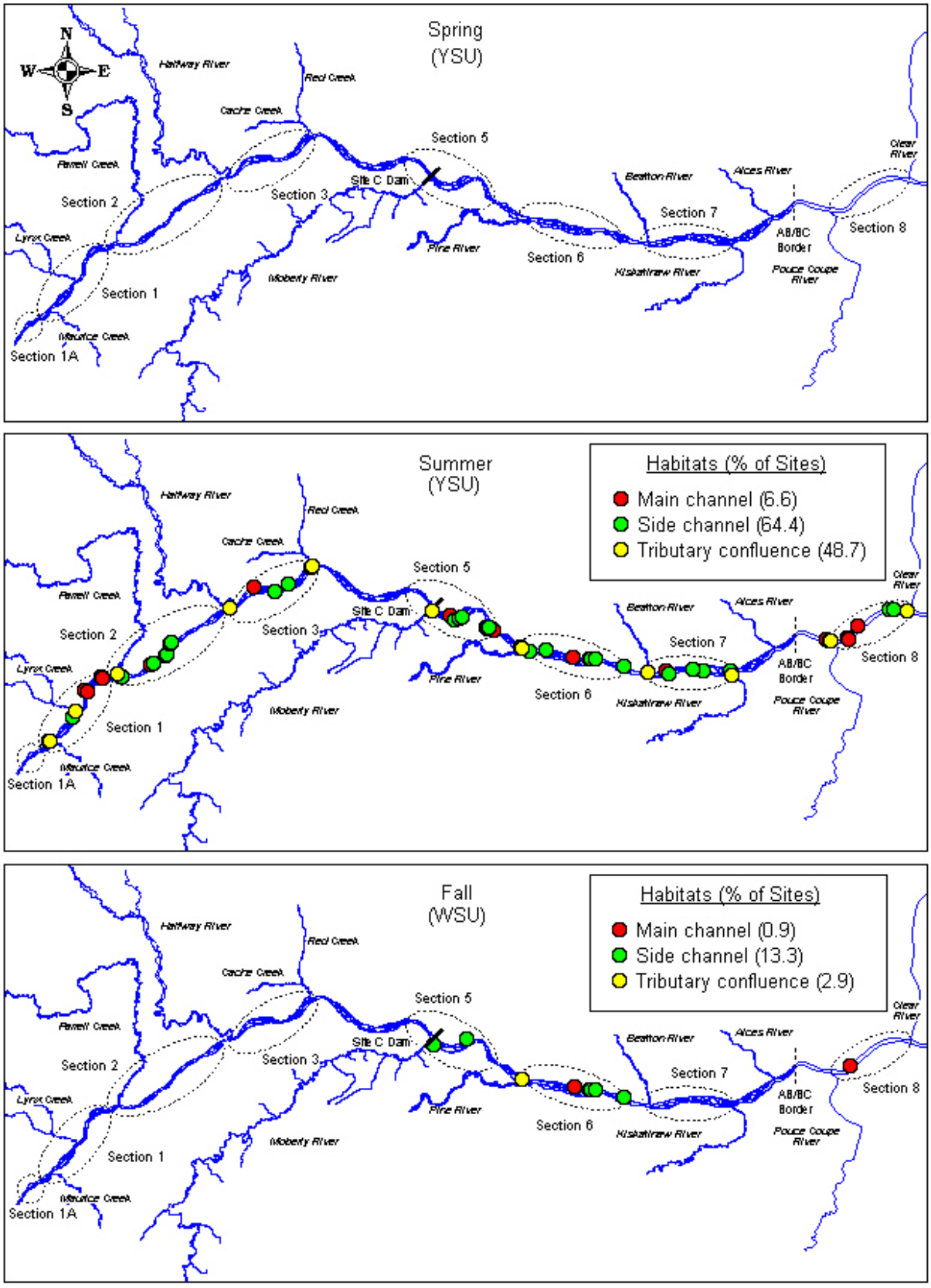


Figure 3.48 Distribution of unidentified Age 0 suckers in spring and summer and Age 0 white sucker in fall, 2010 Site C Peace River Fish Inventory.

3.6 MINNOW AND SCULPIN POPULATIONS

Information presented in this section includes detailed summaries for the only large fish minnow species present in the study area – northern pikeminnow. General summaries for other selected minnow and sculpin are also provided for catch rates (Table 3.14) and fish length (Table 3.15). Raw data and summaries for all species are presented in Appendix E (catch rates) and Appendix F (biological characteristics).

3.6.1 Northern Pikeminnow

3.6.1.1 Catch Rate

In total, 620 northern pikeminnow were enumerated during the study. Northern pikeminnow were recorded in most sections except Sections 1A and 1; this species was also recorded in all three habitat areas (Figure 3.49). There was no strong spatial pattern in the northern pikeminnow catch rates. Large fish catch rates typically were highest in tributary confluence areas (up to 10.0 fish/km), but rarely exceeded 0.5 fish/km in main channel and side channel areas. Small fish catch rates were also higher at tributary confluence areas (beach seine catch up to 10.0 fish/100 m^2).

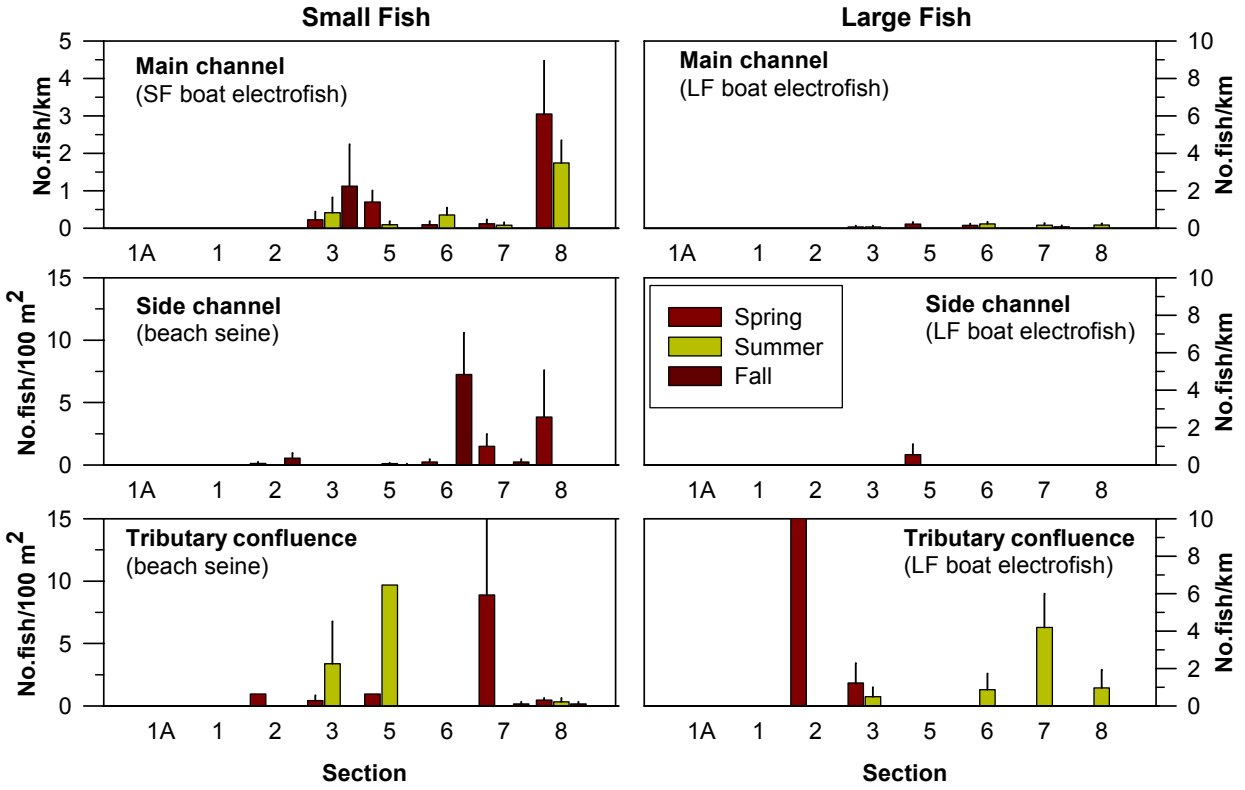


Figure 3.49 Average catch rates (± SE) of northern pikeminnow in study sections during spring, summer, and fall, 2010 Site C Peace River Fish Inventory (small fish ≤ 200 mm fork length and large fish > 200 mm fork length; SF – small fish method, LF – large fish method).

3.6.1.2 Biological Characteristics

In total, 207 northern pikeminnow were used to describe biological characteristics (Figure 3.50). Sampled fish ranged in length from 26 mm to 521 mm and ranged in weight from 22 g to 1,770 g. The northern pikeminnow sample was not aged.

Based on combined samples from all capture methods, the size distribution of northern pikeminnow was dominated by smaller fish (≤ 220 mm length) whereas fish > 300 mm length were poorly represented (Figure 3.50). The length-weight relationship indicated allometric growth and condition (*K*) estimate of the sample (1.19 ± 0.02) indicated good body condition.

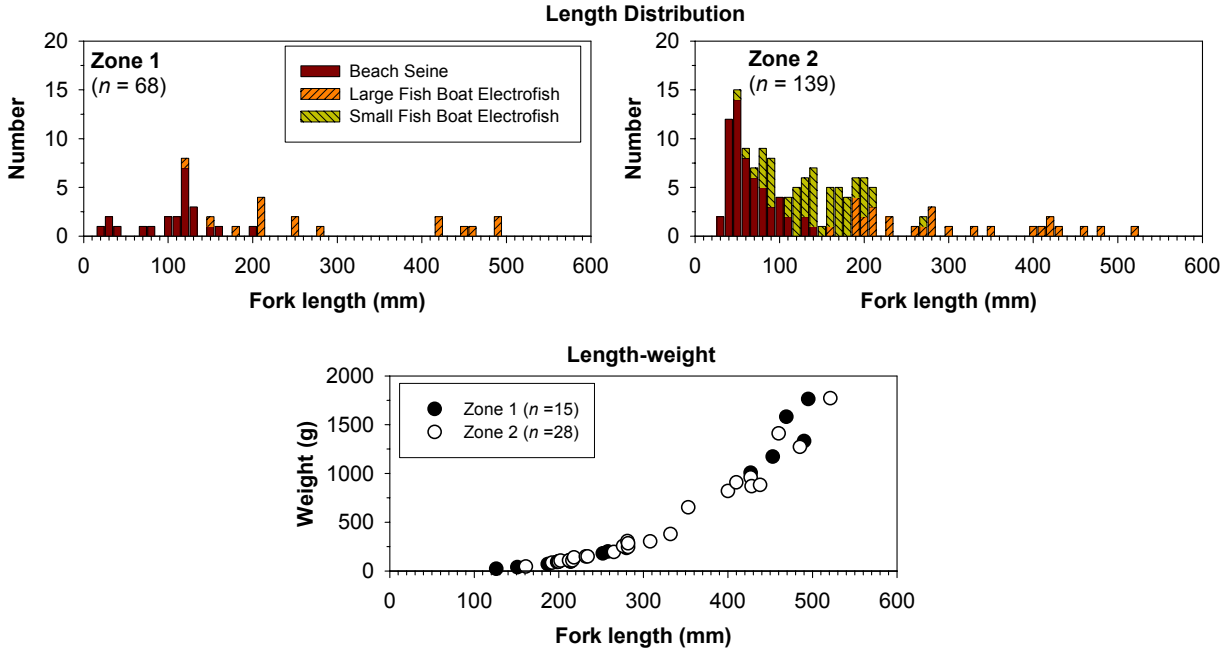


Figure 3.50 Biological characteristics of sampled northern pikeminnow, 2010 Site C Peace River Fish Inventory (Table 2.6 identifies data selected for analyses).

3.6.1.3 Distribution of Young Fish

Young (Age 0 and Age 1) northern pikeminnow age categories were determined by visual assessment of the length distribution data. Young pikeminnow were recorded in most sections except Sections 1A and were encountered in all three habitat types (Figure 3.51).

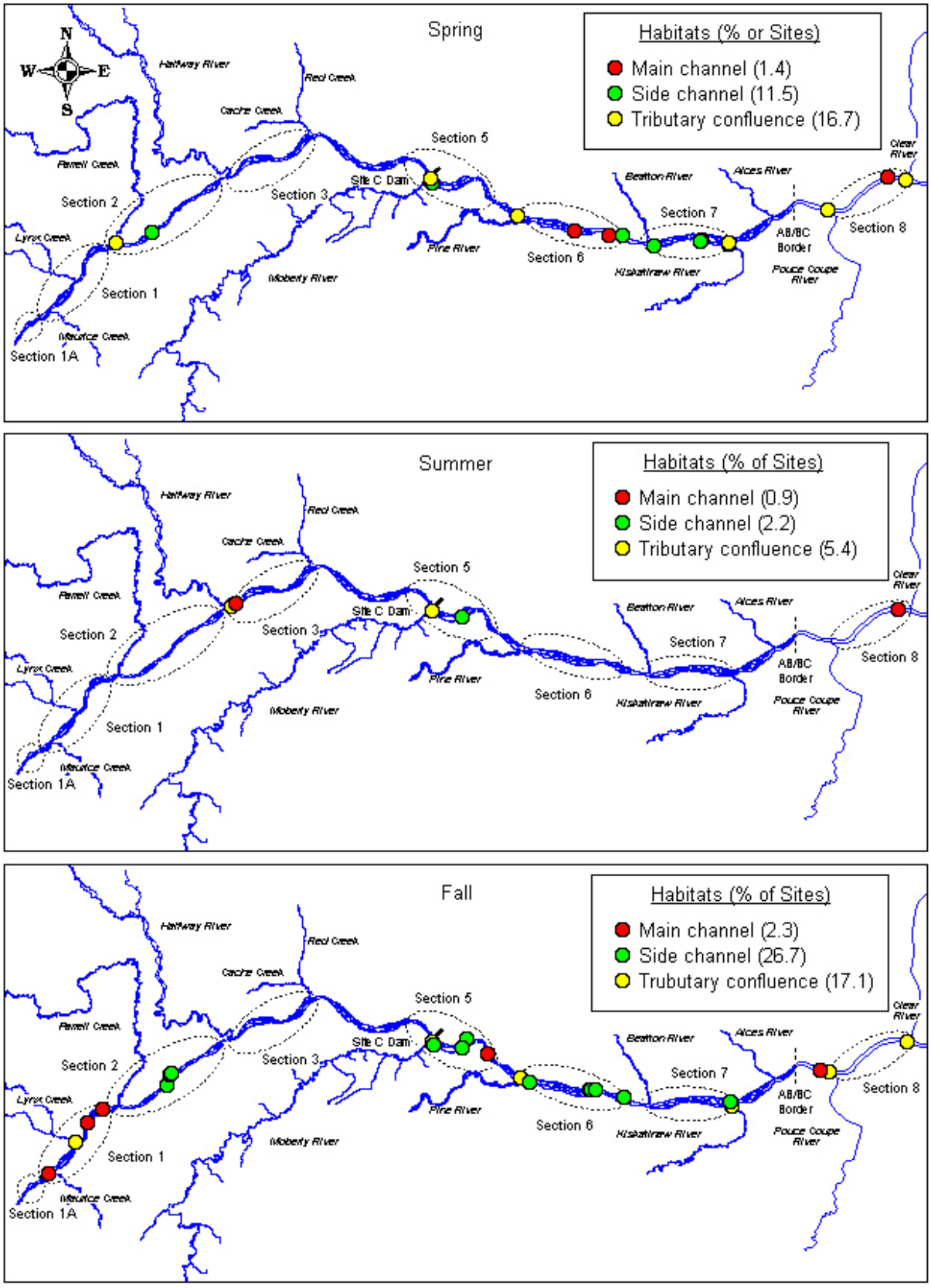


Figure 3.51 Distribution of young (Age 0 and Age 1) northern pikeminnow, 2010 Site C Peace River Fish Inventory.

3.6.2 MINNOWS GENERAL

Brook stickleback (Appendix E Figure E5), finescale dace (Appendix E Figure E6), northern redbelly dace (Appendix E Figure E9), and peamouth (Appendix E Figure E10) were scarce in the study area (Table 3.14) and the total number of fish of each species encountered was ≤ 10. These species were mostly recorded in main channel habitats and were found only in Zone 2.

Table 3.14 Summary of minnow and sculpin catch rates, 2010 Site C Peace River Fish Inventory (all seasons and sections combined).

Group	Species	Main Channel (No. fish/km)[a]		Side Channel (No. fish/100 m^2)[b]		Tributary Confluence (No. fish/100 m^2)[c]	
		Mean	Maximum	Mean	Maximum	Mean	Maximum
Minnows[d]	Brook stickleback	0.01	0.15	0.00	0.00	0.00	0.00
	Flathead chub	0.78	9.43	0.01	0.11	0.26	2.70
	Finescale dace	0.01	0.22	0.00	0.00	0.00	0.00
	Lake chub	4.32	37.24	10.66	191.32	3.50	51.11
	Longnose dace	0.65	4.06	1.74	27.45	14.77	292.70
	Northern redbelly dace	0.02	0.31	0.01	0.08	0.00	0.00
	Peamouth	0.01	0.24	0.00	0.00	0.00	0.00
	Redside shiner	4.18	30.12	13.37	75.56	6.48	27.62
	Spottail shiner	0.65	12.48	4.91	37.51	0.79	8.89
	Trout-perch	1.29	8.18	0.67	6.03	1.69	17.46
Sculpins	Prickly sculpin	1.20	11.75	0.16	1.27	0.10	0.63
	Slimy sculpin	5.71	26.06	0.12	1.35	0.25	1.59
	Spoonhead sculpin	0.00	0.00	0.00	0.08	0.00	0.00

[a] Based on small fish boat electrofisher catch data; *n* = 278 sample events.
[b] Based on beach seine catch data; *n* = 93 sample events.
[c] Based on beach seine catch data; *n* = 34 sample events.
[d] Includes true minnows (Family Cyprinidae), trout-perch (Family Percopsidae), and sticklebacks (Family Gasterosteidae).

Flathead chub (Appendix E Figure E7), lake chub (Appendix E Figure E11), longnose dace (Appendix E Figure E8), and trout-perch (Appendix E Figure E12) were more numerous (Table 3.14). These species occurred in all three habitat types, but they were more abundant in Zone 2.

Redside shiners were the most numerous minnow species encountered during the study. Catch rates of redside shiner often exceeded 20 fish/100 m^2 in the beach seine samples from all three habitat types; however, highest catch rates were recorded at side channel and main channel sites (Figure 3.52). Catch rates of this species were highest in sections located in Zone 2, but redside shiner were numerous as far upstream as Section 2 in Zone 1.

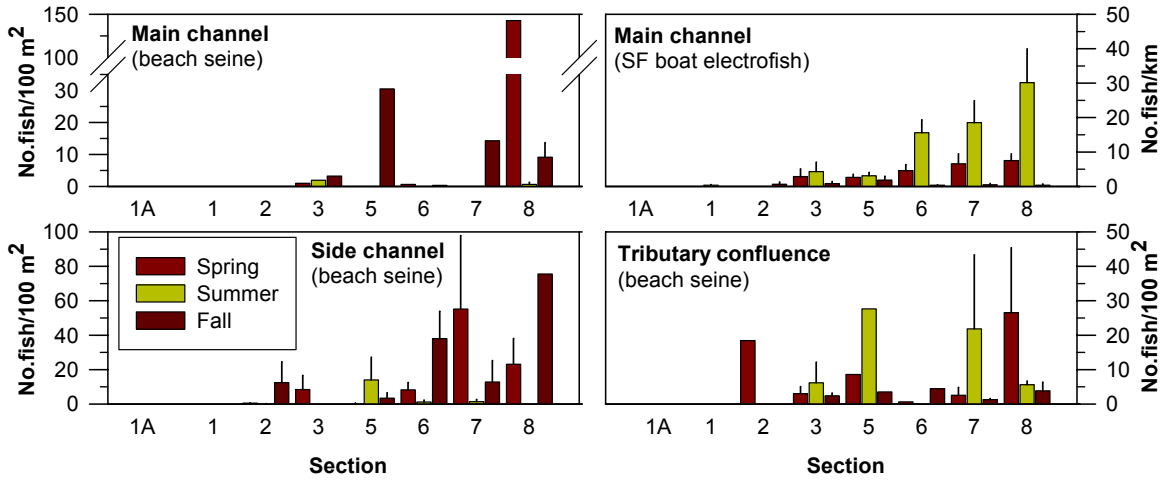


Figure 3.52 Average catch rates (± SE) of redside shiner in study sections during spring, summer, and fall, 2010 Site C Peace River Fish Inventory.

Catch rates of spottail shiners were also high. Catch rates of spottail shiner often exceeded 10 fish/100 m^2 in the beach seine samples. Spottail shiners were most numerous in side channel areas (Figure 3.53). Spottail shiner catch rates were high in main channel areas of Section 6 and tributary confluence areas in Section 7.

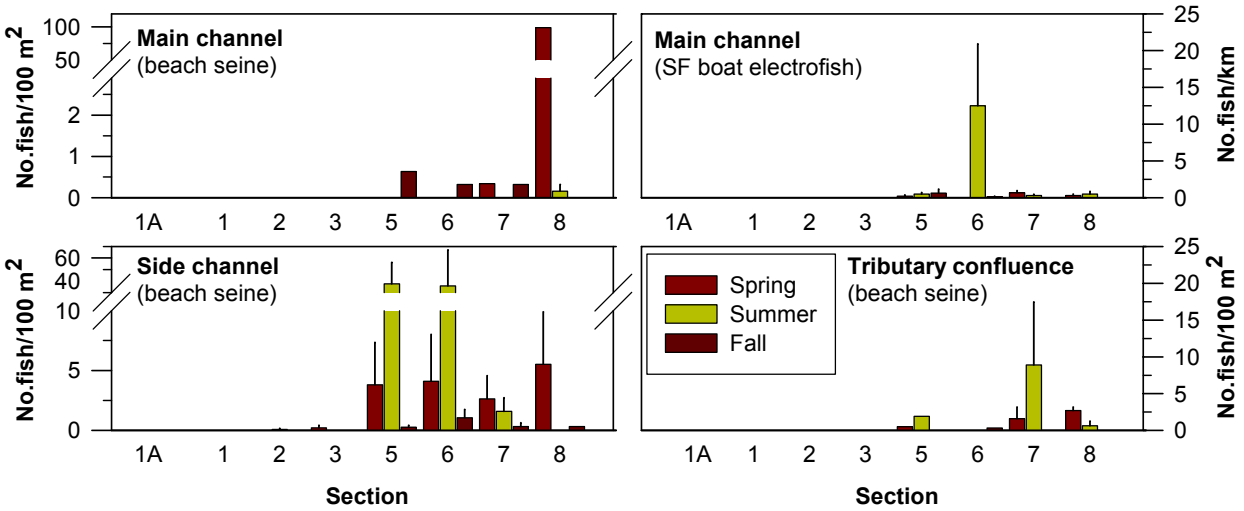


Figure 3.53 Average catch rates (± SE) of spottail shiner in study sections during spring, summer, and fall, 2010 Site C Peace River Fish Inventory.

Table 3.15 Summary of minnow and sculpin species population length characteristics, 2010 Site C Peace River Fish Inventory.

Group	Species	Length (mm)		
		Sample	Median	Range
Minnows[a]	Brook stickleback	1	59	59-59
	Finescale dace	2	63	62-63
	Flathead chub	172	122	38-248
	Lake chub	566	53	11-119
	Longnose dace	413	36	11-95
	Northern redbelly dace	10	49	29-73
	Peamouth chub	2	107	95-118
	Redside shiner	971	74	13-142
	Spottail shiner	307	39	15-84
	Trout-perch	290	52	21-82
Sculpins	Prickly sculpin	213	64	22-148
	Slimy sculpin	794	59	21-116
	Spoonhead sculpin	3	67	34-90

[a] Includes true minnows (Family Cyprinidae), trout-perch (Family Percopsidae), and sticklebacks (Family (Gasterosteidae).

3.6.3 SCULPINS GENERAL

Spoonhead sculpins (Appendix E Figure E13) were scarce in the study area; only three fish were recorded from the study area. This species was recorded at the confluence of the Pine River (Section 6) and in main channel and side channel habitats in Section 7.

Slimy sculpins were the most numerous sculpin species encountered during the study. Catch rates were consistently highest in main channel habitats and often exceeded 5 fish/km in the small fish boat electrofisher catch (Figure 3.54). Catch rates were highest in Sections 1 to 5.

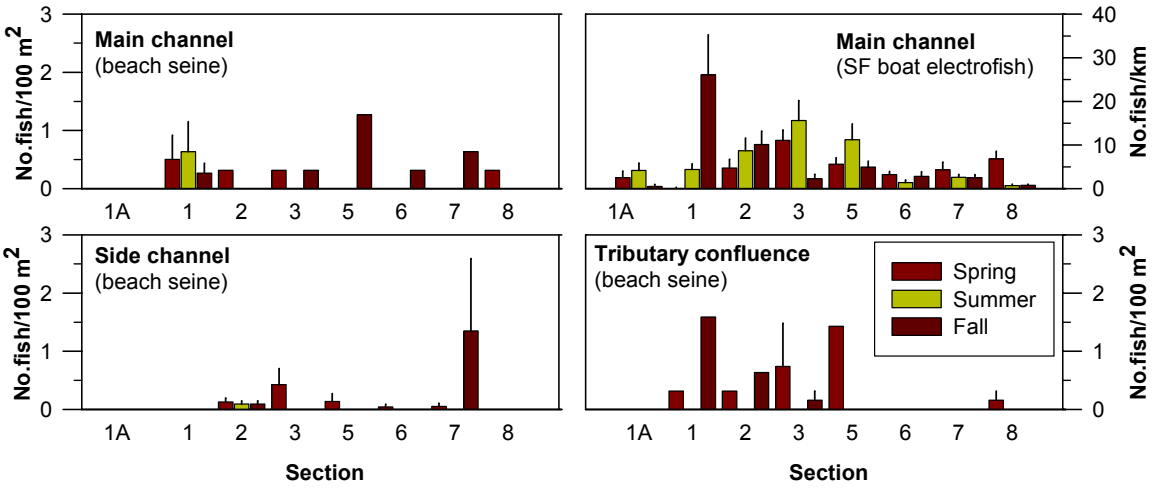


Figure 3.54 Average catch rates (± SE) of slimy sculpin in study sections during spring, summer, and fall, 2010 Site C Peace River Fish Inventory.

Prickly sculpin also were numerous in the study area. Catch rates were highest in main channel habitats; they averaged 1.2 fish/km in the small fish boat electrofisher catch (Figure 3.55). Catch rates of prickly sculpins in main channel habitats declined from upstream to downstream. Catch rates were highest in Section 1A (11.8 fish/km in summer) and lowest in Section 8 (< 0.4 fish/km).

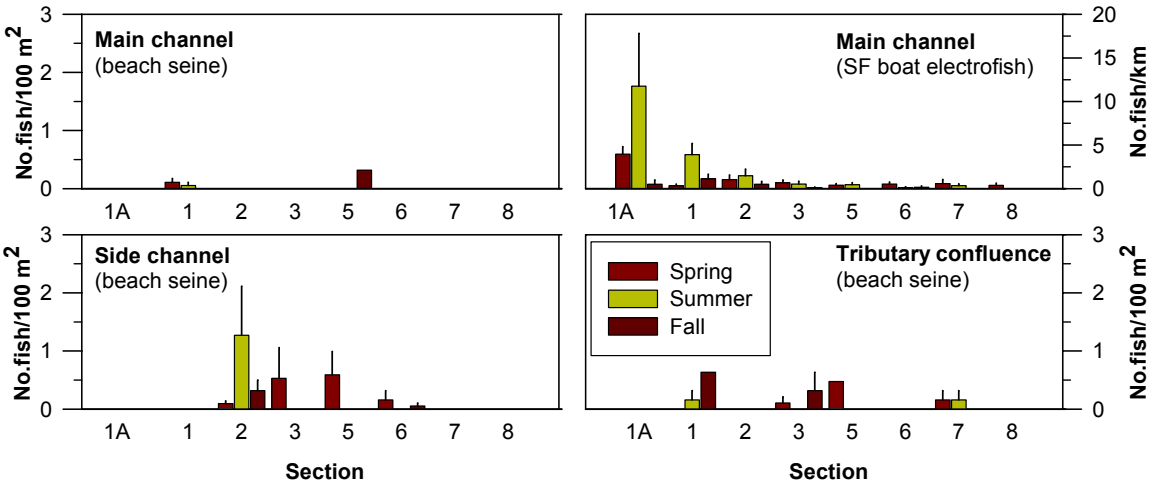


Figure 3.55 Average catch rates (± SE) of prickly sculpin in study sections during spring, summer, and fall, 2010 Site C Peace River Fish Inventory.

3.7 FISH COMMUNITY HEALTH

Based on the DELT Index values, evidence of impairment to health (presence of deformity, erosion, lesion, or tumour) was recorded for twelve species (Table 3.16). These included nine sportfish (Arctic grayling, bull trout, burbot, goldeye, kokanee, mountain whitefish, northern pike, rainbow trout, and walleye) and three suckers (longnose sucker, largescale sucker, and white sucker). Other species recorded during the study either had insufficient sample sizes or did not exhibit signs of poor health. These included lake trout, lake whitefish, and yellow perch.

Evidence of poor physical health differed by species and section. In the sportfish group, values ranged from 0.0% to 100.0%. In the suckers group, percentages ranged from 0.0% to 9.9%. The two highest percentages recorded for specific species and sections were 100.0% for northern pike in Section 2 and 25.0% for burbot in Section 8. In both instances the value was based on evidence from a small number of fish (≤ 4 individuals).

Table 3.16 Summary of DELT percentages for selected large fish species collected by boat electrofisher (includes fish sampled during 2010 WLR Peace River Fish Index Project), 2010 Site C Peace River Fish Inventory.

Group	Species	Sample Size	Section and DELT Percentages							
			1A	1	2	3	5	6	7	8
Sportfish	Arctic grayling	118	-	0.0	0.0	10.5	7.8	0.0	0.0	0.0
	Bull trout	220	0.0	6.7	0.0	0.0	7.0	0.0	0.0	0.0
	Burbot	20	-	-	-	0.0	0.0	0.0	0.0	25.0
	Goldeye	44	-	-	-	-	0.0	0.0	0.0	3.0
	Kokanee	143	7.1	2.5	6.3	0.0	0.0	0.0	0.0	-
	Mountain whitefish	17,101	0.0	0.9	0.8	0.5	0.6	0.6	0.9	1.5
	Northern pike	63	-	-	100.0	16.7	6.3	20.0	0.0	16.7
	Rainbow trout	225	0.0	4.8	0.0	0.0	0.0	0.0	0.0	0.0
	Walleye	137	-	-	-	0.0	0.0	16.7	1.0	4.8
Suckers	Longnose sucker	2,224	-	6.1	1.9	5.9	4.9	8.2	9.9	9.4
	Largescale sucker	379	-	0.0	0.0	6.1	1.9	5.9	3.4	0.0
	White sucker	231	-	0.0	-	6.1	0.0	9.9	9.1	0.0
Minnows	Northern pikeminnow	61	-	-	0.0	3.6	0.0	0.0	0.0	0.0

4.0 DISCUSSION

4.1 ENVIRONMENTAL CONDITIONS

Environmental conditions recorded during the 2010 field program were generally typical of the Peace River in the study area, with the exception of low water levels. The spatial and temporal pattern and values of the measured parameters; water temperature, water clarity, and water conductivity were similar to findings in 2009 by Mainstream (2010).

One difference between the two studies was the occurrence of low (i.e., near minimum flow) water levels during the present study that exhibited reduced daily fluctuations compared to the typical flow regime experienced in the study area. These conditions were dampened in downstream sections by discharge from the Pine River.

4.2 FISH COMMUNITY STRUCTURE

Species Composition

In total, 30 species were recorded in the mainstem Peace River. This number is the same as the number recorded in 2009 (Mainstream 2010) and is similar to the 31 species recorded during historical studies of the Peace River (e.g., Pattenden *et al*. 1990, RL&L 2001, P&E 2002, AMEC and LGL 2006). The species composition during the present study included 8 coldwater sportfish, 5 coolwater sportfish, 3 suckers, 3 sculpins, and 11 minnows (includes true minnows, trout-perch, and sticklebacks). In terms of numerical importance, coldwater sportfish dominated, followed by suckers, minnows, sculpins, and then coolwater sportfish. Overall, mountain whitefish was the numerically dominant species.

Several incidental or numerically scarce fish species were recorded during the study. These included lake trout, lake whitefish, pygmy whitefish (coldwater sportfish), brook stickleback, finescale dace, northern redbelly dace, peamouth (minnows), and spoonhead sculpin (sculpins). Coolwater sportfish species were not numerically abundant, even in portions of the study area where they were common.

Distribution

Similar to results for 2009, the distribution of fish species in the study area was related to their catch rates (more numerous fish typically were more widespread) and aligned with their habitat requirements (coldwater versus coolwater; side channel versus main channel). In general, species diversity was lower in the upper portion of the study area (Zone 1) and higher in the lower portion of the study area (Zone 2).

Most coldwater species were recorded upstream and downstream of the proposed Site C dam (mountain whitefish, bull trout, kokanee, and rainbow trout), as were most suckers (longnose sucker, largescale sucker, and white sucker), and sculpins (prickly sculpin and slimy sculpin), and some of the minnows (lake chub, longnose dace, redside shiner, and spottail shiner). The one exception to this pattern was the coolwater sportfish group. Burbot, goldeye, northern pike, walleye, and yellow perch were largely restricted to the downstream portion of the study area (i.e., downstream of the proposed Site C dam).

4.3 CATCH RATE

Catch rates results of the present study were similar to findings by other Peace River fish inventories. Notable differences between this study and 2009 included higher catch rates of large Arctic grayling and lower catch rates of kokanee in 2009.

Spatial

Although many species were widely distributed in the study area, most exhibited spatial patterns of catch rates. None of the species collected during the study were numerous in Section 1A, immediately downstream of the PCN Dam.

Catch rates of most coldwater sportfish were higher upstream of the proposed Site C dam and catch rates declined downstream of this location. This was true for rainbow trout and kokanee, which were abundant only in upstream sections. The one exception to this general spatial pattern was Arctic grayling. Catch rates of this species were similar upstream and downstream of the proposed Site C dam location. However, the distribution of this species was largely restricted to sections that included major tributaries (i.e., Section 3 – Halfway River; Section 5 – Moberly River; Section 6 – Pine River; Section 7 – Beatton River).

Sculpin catch rates exhibited the same spatial pattern as coldwater sportfish. Prickly sculpin catch rates declined sharply downstream of the proposed Site C dam location. Slimy sculpin catch rates also declined, but this species remained abundant as far downstream as Section 8

Suckers, minnows, and coolwater sportfish exhibited a catch rate pattern opposite to that of coldwater sportfish and sculpins. Catch rates of most species in these groups were higher downstream of the proposed Site C dam.

Seasonal

There were differences in seasonal catch, that may have reflected variable catchability due to changing sampling conditions (e.g., colder water temperatures in spring) and seasonal growth of younger fish into the large fish cohort (i.e., fish became large enough to capture later in the season). However, some seasonal patterns corresponded to predicted movement strategies of study area fish populations. For example, large Arctic grayling were largely absent from the spring sample, which suggested that adult fish had entered tributaries to spawn. A concentration of adult bull trout was recorded in the Halfway River confluence area in spring, which was identical to findings made in 2008 (Mainstream 2009b) and 2009 (Mainstream 2010).

Goldeye were recorded in the study area but were restricted to downstream Sections 5 to 8. The presence of adult goldeye in the study area during spring suggests that a portion of the goldeye population, which overwinters in Alberta may migrate into British Columbia to spawn. This is confirmed by the capture of a single young-of-the-year goldeye downstream of the Beatton River confluence.

The catch data also suggested a seasonal increase in numbers of small fish of several sportfish and sucker species. The absence of young fish (young-of-the-year and juveniles) in spring followed by an increase in catch rates during summer and fall provides an indication that these fish may be recruiting to the mainstem Peace River from tributaries or via entrainment through the PCN Dam. This seasonal pattern was recorded for Arctic grayling, rainbow trout, longnose sucker, and largescale sucker.

Habitat Use

Similar to 2009 results, catch rates of several fish species indicated patterns of habitat use. All coldwater species and sculpin species were most frequently encountered and catch rates were highest in main channel habitats. Suckers and minnows also occurred in main channel habitats, but were more often encountered and were more numerous in tributary confluences and in side channel habitats.

A small number of species occurred primarily in specific habitat types. Examples included spottail shiner, yellow perch, and northern pike use of side channels, as well as goldeye and walleye use of tributary confluences.

4.4 POPULATION CHARACTERISTICS

Several fish population characteristics (length and age distribution, length-weight relationship and condition, length-at-age, and growth rate) were used to examine the present status of selected large fish

species populations recorded in the study area. In general, the results showed that most fish populations were viable. Evidence included good representation by small and large fish, normal body condition, and good growth (based on age samples from selected species). It should be noted that the term viable does not differentiate between two recruitment strategies. The first strategy involves a self sustaining population that relies on natural recruitment through reproduction. The second strategy involves population maintenance by recruitment from upstream sources via entrainment from the PCN Dam.

Some populations were represented by a small number of fish, and as such, may be transients from populations located outside the study area (e.g., upstream of PCN dam or tributaries). Species that fit this description include lake trout, lake whitefish, pygmy whitefish, brook stickleback, finescale dace, northern redbelly dace, peamouth, and spoonhead sculpin. Kokanee were abundant in the study area, but their population may be maintained by recruitment via entrainment through the PCN Dam.

4.5 DISTRUBUTION OF YOUNG FISH

The seasonal distribution of young fish (Age 0, or Ages 0 and 1) provided evidence of potential recruitment sources for large fish species populations recorded in the study area. Sources of potential recruitment can be evaluated based on the predicted life history strategy of the population, the presence of recently emerged fry, the absence of young fish, and the spatial and temporal changes in the distribution of young fish. Recruitment of small fish species was not examined during the present study.

The assessment identified tributaries as likely sources of recruitment for several coldwater sportfish in the study area. These included Arctic grayling, bull trout, rainbow trout, and mountain whitefish. Within this group, the presence of recently emerged mountain whitefish fry in spring indicated that this population also spawned in the mainstem Peace River as far upstream as Section 1. Potential tributary sources for most of the coldwater sportfish occur from the Pine River confluence upstream. The one exception was Arctic grayling that appeared to recruit from as far downstream as the Beatton River.

Young fish of several coldwater species were recorded immediately below the PCN Dam. These include bull trout, kokanee, and rainbow trout. Because it is highly unlikely that these small fish have the capability to move upstream to the PCN Dam, it is probable that they originated from upstream sources via entrainment through the PCN Dam.

Recruitment sources of coolwater sportfish were species specific. Based on the capture of a small number of fish, walleye appear to recruit from the Beatton River and possibly the Pouce Coupe River in Alberta.

Northern pike and yellow perch spawn and rear in side channel habitats. The presence of Age 0 fish of both species confirms that these populations use side channels as sources of recruitment. A single young-of-the-year goldeye was recorded just downstream of the Beatton River confluence during the present study. Prior to this record, young goldeye have not been recorded in the Peace River upstream of the Smoky River confluence in Alberta (Mainstream 2006).

4.6 FISH COMMUNITY HEALTH

Large fish captured using a boat electrofisher were examined for physical health using the DELT Index method. Seven large fish species showed evidence of physical anomalies indicating health impairment. Higher DELT Index values were recorded for a number of species in sections downstream of the Pine River confluence indicating increased impairment of health (Bauman *et al.* 2000).

Page is intentionally blank.

5.0 CONCLUSIONS

The 2010 Peace River Fish Inventory collected baseline information to describe the fish community in the Peace River from PCN Dam to the British Columbia/Alberta boundary. This was accomplished by sampling nine sections distributed throughout the study area using multiple fish capture methods in a variety of habitats during three seasons. The study examined fish community structure, fish catch rates, population characteristics, and fish health. Fish also were marked with permanent tags to monitor future growth and movement patterns.

The program was successful in achieving its goal. The Peace River supports a diverse fish community that includes coldwater and coolwater sportfish, suckers, minnows, and sculpins. Fish community structure is not constant within the study area. There is a gradual shift from a coldwater sportfish community dominated by mountain whitefish in the upstream area, to a more diverse fish community in the downstream area that is represented by multiple fish groups and species. This shift in fish community structure represents a transition from a cold clear water fish community to a coolwater fish community that contains species that are more tolerant of elevated fine sediment levels and higher water temperatures.

The majority of sportfish species were most numerous and resided in main channel habitats of the Peace River. A limited number of species (spottail shiner, northern pike, and yellow perch) appear to rely heavily on side channel habitats. The catch of sucker species and many minnow species suggested that tributaries are focal points for these populations.

The results suggest that most species in the study area are represented by viable, self sustaining fish populations. Data from only one species, mountain whitefish, indicated widespread spawning in the mainstem Peace River. Most fish populations likely spawn and rear in tributaries, before recruiting to Peace River populations. Some large fish species (northern pike and yellow perch) rely heavily on protected side channel habitats for spawning and early rearing. A limited number of populations may be maintained by recruitment via entrainment through the PCN Dam. These include kokanee and lake trout. A single young-of-the-year goldeye was recorded just downstream of the Beatton River confluence, suggesting possible recruitment to goldeye populations from the study area.

The present study and the 2009 work (Mainstream 2010) provide a good description of the Peace River fish community. Additional work can be used to confirm these findings and to increase the certainty around future interpretation of the baseline data.

6.0 LITERATURE CITED

Aquatic Resources Ltd. 1991a. Peace River Site C Development: Fisheries Habitat and Tributary Surveys 1989 Studies. Prepared for B.C. Hydro. 106 p. + Appendices.

Aquatic Resources Ltd. 1991b. Peace River Site C Development: Fisheries Habitat and Tributary Surveys 1990 Studies. Prepared for B.C. Hydro. 81 p. + Appendices.

AMEC Earth & Environmental and LGL Limited. 2006. Fish and Aquatic Investigations 2005. Volumes 1 and 2. Prepared for B.C. Hydro.

AMEC Earth & Environmental and LGL Limited. 2007. Peace River Fisheries Investigation 2006. Prepared for B.C. Hydro. 180 p.

Bauman *et al.* 2000. Fish Tumors or Other Deformities Prepared for the Lake Erie LAMP Preliminary Beneficial Use Impairment Assessment.

Bonar, S.A., W.A. Hubert, and D.W. Willis, (editors). 2009. Standard methods for sampling North American freshwater fishes. American Fisheries Society, Bethesda, Maryland.

Busacker, G.P., I.R. Adleman, and E.M. Goolish. 1990. Growth. Pages 363-387 *in* C.B. Schreck and P. B. Moyle, editors. Methods for fish biology. American Fisheries Society, Bethesda, Maryland.

Cone. 1989. The need to reconsider the use of condition indices in fishery science. Transactions of the American Fisheries Society 118: 510 - 514.

Koch, J.D., and M.C. Quist. 2007. A technique for preparing fin rays and spines for age and growth analysis. North American Journal of Fisheries Management 27: 782-784.

Mackay, W.C., G.R. Ash and H.J. Norris, (editors). 1990. Fish ageing methods for Alberta. RL&L Environmental Services Ltd. in association with Alberta Fish and Wildlife Division and University of Alberta, Edmonton. 113 p.

Mainstream Aquatics Ltd. 2006. Baseline Fish Inventory Study. Dunvegan Hydroelectric Project. Prepared for Glacier Power Ltd. Report No. 04011F: 100 pp. + Appendices.

Mainstream Aquatics Ltd. 2009a. Small fish surveys in the Halfway River and Peace River – 2006. Prepared for B.C. Hydro Engineering Services. Report No. 06019F01: 41 p. + Appendices.

Mainstream Aquatics Ltd. 2009b. Site C fisheries studies – Fish use of tributaries in spring and fall. Prepared for B.C. Hydro. Report No. 08008BF: 64 p. + Appendices.

Mainstream Aquatics Ltd. 2010. Site C fisheries studies – Peace River Fish Inventory. Prepared for BC Hydro Site C Project, Corporate Affairs Report No. 09008AF: 90 p. + plates (Volume 1) and appendices (Volume 2).

Mainstream Aquatics Ltd. and W.J. Gazey Research. 2006. Peace River Fish Indexing Program – Phase 5 Studies. Prepared for B.C. Hydro. Report No. 05016F: 118 p. + Appendices.

Mainstream Aquatics Ltd. and W.J. Gazey Research. 2009. Peace River Fish Community Indexing Program - 2008 Studies. Prepared for B.C. Hydro. Report No. 08011F: 93 pp. + Appendices.

Mainstream Aquatics Ltd. and W.J. Gazey Research. 2010. Peace River Fish Index Project - 2009 Studies. Prepared for B.C. Hydro. Report No. 09011F: 80 pp. + Appendices.

Mainstream Aquatics Ltd. and W.J. Gazey Research. 2011. Peace River Fish Index Project - 2010 Studies. Prepared for B.C. Hydro. Report No. 01011D: 96 pp.

Ohio EPA. 1996. Ohio EPA's Guide to DELT Anomalies (Deformities, Erosion, Lesions and Tumors) *in* Bauman *et al.* 2000. Fish Tumors or Other Deformities Prepared for the Lake Erie LAMP Preliminary Beneficial Use Impairment Assessment.

Pattenden, R., C. McLeod, G. Ash and K. English. 1990. Fish Movement and Population - Status (Draft) in Peace River Site C Hydroelectric Development Pre-construction Fisheries Studies. Unpublished report by RL&L Environmental Services Ltd. for B.C. Hydro Environmental Resources.

Pattenden, R., C. McLeod, G. Ash and K. English. 1991. Fish Movement and Population Status 1990 Studies (Interim Final Report) in Peace River Site C Hydroelectric Development Pre-construction Fisheries Studies. Unpublished report by R.L.&L. Environmental Services Ltd for B.C. Hydro Environmental Resources.

P&E Environmental Consultants Ltd. 2002. Peace River Fish Indexing Program – Phase 1 Studies. Unpublished report prepared by P&E Environmental Consultants Ltd., Edmonton, Alberta and LGL Ltd., Sidney, British Columbia for B.C. Hydro Power Supply Environmental Services. 76 p + Appendices.

P&E Environmental Consultants Ltd. and W.J. Gazey Research. 2003. Peace River Fish Indexing Program – Phase 2 Studies. Prepared for B.C. Hydro. P&E Report No. 02011F: 86 p + Appendices.

RL&L Environmental Services Ltd. 2001. Peace River fish habitat utilization study. Prepared for B.C. Hydro - Environmental Services, Burnaby, BC. RL&L Report No. 725F: 72 p. + Appendices.

This page is intentionally blank.

PLATES

(taken from Mainstream 2010)

This page is intentionally blank.

Plate 1 Backwater habitat located in the main channel.

Plate 4 SFN habitat located in the main channel.

Plate 2 Flat habitat located in the main channel.

Plate 5 SSC habitat located in the main channel.

Plate 3 SFC habitat located in the main channel.

Plate 6 SSN habitat located in the main channel**.**

Plate 7 Typical **f**lat habitat found in a side channel.

Plate 10 Typical riffle habitat found in a side channel.

Plate 8 High quality oxbow habitat in a side channel.

Plate 11 Tributary confluence **b**ackwater habitat.

Plate 9 Low quality oxbow habitat in a side channel.

Plate 12 Tributary confluence riffle habitat**.**