Abundance and Distribution of Fish in Clackamas County Urban Streams

Final Report 2002-03

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EXECUTIVE SUMMARY

From summer 2002 through spring 2003, the Oregon Department of Fish and Wildlife (ODFW) and Water Environment Services investigated and inventoried fish communities in Clackamas County streams. We conducted fish surveys in three general areas of urban Clackamas County: (1) the Kellogg Creek watershed, which drains into the Willamette River, (2) the Rock Creek watershed, which drains into the Clackamas River, and (3) numerous tributaries of the lower Tualatin River. Streams surveyed within the Kellogg Creek watershed included Kellogg, Mt. Scott, Phillips, and Dean creeks. We surveyed Rock and Trillium creeks within the Rock Creek watershed. We surveyed 13 tributaries of the Lower Tualatin River, including Fields, Tate, Ek, Wilson, Shiply, Pecan, Athey, Saum, and five unnamed creeks. Unlike the other watersheds, tributaries of the Tualatin River were not surveyed from 1997 through 1999.

We conducted fish habitat surveys in five areas within the Kellogg Creek watershed near habitat restoration projects. Four of these areas had been initially surveyed from 1997 through 1999, prior to implementation of the restoration projects. The fifth area was on Cedar Creek, which was not included in past or current fish surveys.

We sampled sixteen fish bearing streams in 145 reach/time surveys, collecting and examining almost 10,000 individuals. Among the fish collected, more than three-quarters (77%) were sculpins, 13% were minnow species, 6% were salmon and trout, and 3% were lamprey species. We identified 16 native species from six families. We identified seven alien species from four families, but they constituted less than 1% of the total catch. We found no fish in Ek and two of the unnamed creeks, all tributaries of the Tualatin River.

Cutthroat trout *Oncorhynchus clarki* were the most common salmonid and were present in 12 of 16 fish-bearing streams. We observed cutthroat trout throughout most of the Kellogg Creek and Rock Creek watersheds, and in seven of 13 tributaries of the lower Tualatin River. Successful recruitment of cutthroat trout was evident in Fields, Mt. Scott, and Rock creeks. The largest cutthroat trout individuals were observed in Mt. Scott Creek.

We found rainbow/steelhead trout in only five streams, with most individuals observed in the Rock Creek watershed. We observed rainbow/steelhead trout in some tributaries of the lower Tualatin River, but only in spring. We found no rainbow/steelhead trout in the Kellogg Creek watershed.

Only the Rock Creek watershed sustained year-round populations of salmonids other than cutthroat trout. Rainbow/steelhead trout were most abundant in fall, whereas coho salmon abundance was more evenly distributed throughout the year. Distribution of coho salmon and Chinook salmon were limited to the Rock Creek watershed.

Lampreys were observed throughout the Kellogg Creek watershed, in Rock Creek, and in eight of 13 tributaries of the lower Tualatin River. A few lampreys were identified to species: adult western brook lamprey *Lampetra richardsoni* and Pacific lamprey outmigrants (macropthalmia) *L. tridentata*.

Index of Biotic Integrity (IBI) scores for all sampling efforts in fish-bearing streams ranged from 10 to 75. The mean IBI for all sampling efforts per stream reach indicated 10 of 34 fish-bearing reaches were marginally impaired with the balance severely impaired. No mean IBI scores were considered acceptable. Only one of 127 total IBI scores was considered acceptable.

Some key habitat parameters have changed significantly since previous surveys. In reach 1 of Mt. Scott Creek, the percent of stream categorized as glide has decreased considerably, as has the percentage of substrate consisting of silt. Number of boulders has increased. Silt has also decreased in reach 4 of Mt. Scott Creek, whereas shade has increased. We observed little change to date in Dean Creek.

Despite extensive urban development, some Clackamas County streams still contain a relatively diverse assemblage of native fish species, including salmonids. Although relatively widespread, alien species still comprise a small percentage of individuals. Fish assemblages have obviously changed throughout the period of urban development, but persistence of native species, especially those most sensitive to habitat degradation, confirms the potential benefits of habitat protection and restoration.

We make the following recommendations for resource management and further research:

- Continue to follow recommendations offered as part of the final report of 1997-99 surveys (Friesen and Zimmerman 1999).

- In conjunction with other stakeholders develop priorities for habitat protection and restoration in urban Clackamas County watersheds. Include short term (instream improvements), medium term (habitat protection), and long term (land-use planning) objectives, strategies, and actions.

- Conduct fish and habitat inventories at regular intervals (3-5 years) to evaluate trends and provide information for pre- and post-treatment evaluations.

- Conduct annual surveys in selected streams (i.e., Mt. Scott, Rock, and Fields creeks) to evaluate spawning of salmonids and Pacific lamprey.

- Conduct intensive surveys to evaluate abundance, biomass, spatial structure, habitat use, and movements of salmonids in Rock Creek and within the Kellogg Creek watershed.

- Continue to monitor and evaluate habitat improvement projects, and use results from intensive fish surveys to evaluate relationships between changes in habitat and changes in fish populations.

INTRODUCTION

As population and industrial use have increased, water quality and habitat in streams of urban Clackamas County have been degraded. Before the Oregon Department of Fish and Wildlife (ODFW) and Water Environment Services cooperated to conduct initial surveys from 1997 through 1999 (Friesen and Zimmerman 1999), little information existed about the presence, distribution, and abundance of fish species in these streams. Information on available habitat was also scarce. In 2002, ODFW and Water Environment Services identified a need to update information on streams previously surveyed (tributaries of the Clackamas and Willamette rivers), and to conduct initial surveys on streams previously un-surveyed (tributaries of the Tualatin River). Fish and habitat surveys provide important baseline or trend information on species distribution and abundance, and may assist managers to set priorities on aquatic habitat protection and restoration work. This is particularly important for protection of species listed under the federal Endangered Species Act (ESA). This report presents the results of our investigations of fish communities in urban Clackamas County streams. Specifically, we:

1. Identify fish species assemblages and their distribution within selected streams and stream reaches;
2. Identify seasonal changes in distribution throughout those streams and reaches;
3. Calculate an Index of Biotic Integrity (IBI) and evaluate relative fish community health;
4. Estimate abundance of salmonid species in the sampling sites;
5. Review life history characteristics and population dynamics of salmonids species;
6. Summarize fish habitat information near habitat restoration projects and compare information to that collected prior to restoration.

Urban stream surveys conducted within the Portland metropolitan area (Ward 1995; Friesen and Ward 1996; Leader 2001a; Leader 2001b; Graham and Ward 2002; Tinus et al. 2003), and within Clackamas County specifically (Friesen and Zimmerman 1999) documented numerous salmonid species including cutthroat trout *Oncorhynchus clarki*, rainbow/steelhead trout *O. mykiss*, coho salmon *O. kisutch*, and Chinook salmon *O. tshawytscha*. Currently, the lower Columbia River and upper Willamette River Chinook salmon evolutionary significant units (ESU), and lower Columbia River and upper Willamette River steelhead ESUs are listed under the federal ESA as threatened (NOAA 1999). In 1999, lower Columbia River coho salmon were listed as an endangered species under the Oregon state ESA (Chilcote 1999).

Other species of interest include lamprey *Lampetra spp.* and torrent sculpin *Cottus rhotheus*. Both have unique habitat needs. Lampreys require a diversity of habitat types depending on life history stage. They have possibly declined throughout much of their historic range in western North America (Close et al. 1995; Vella et al. 1999). Western brook lamprey *L. richardsoni* and Pacific lamprey *L. tridentata* live within the study area. All Portland area lamprey species have been petitioned for listing under the federal ESA. Torrent sculpin have been collected in very few streams within the Portland urban area (Ward 1995; Friesen and Ward 1996; Friesen and Zimmerman 1999; Leader 2001a; Leader 2001b; Graham and Ward 2002; Tinus et al. 2003) and like salmonids and lampreys, may be sensitive to habitat degradation and pollution.

METHODS

Study Area

We conducted fish surveys in three general areas of urban Clackamas County: (1) the Kellogg Creek watershed, which drains into the Willamette River, (2) the Rock Creek watershed, which drains into the Clackamas River, and (3) numerous tributaries of the lower Tualatin River (Figure 1). Streams within the Kellogg Creek watershed included Kellogg Creek, which flows into the Willamette River at Milwaukie, Mt. Scott Creek, which flows into Kellogg Creek between Milwaukie and Clackamas, and Phillips and Dean Creeks, which flow into Mt. Scott Creek near Clackamas. We surveyed Rock and Trillium creeks within the Rock Creek watershed. Rock Creek enters the Clackamas River upstream of Clackamas. We surveyed 13 tributaries of the Lower Tualatin River, including Fields, Tate, Ek, Wilson, Shiply, Pecan, Athey, Saum, and five unnamed creeks. Unlike the other watersheds, tributaries of the Tualatin River were not surveyed from 1997 through 1999.

We conducted fish habitat surveys in five areas within the Kellogg Creek watershed near habitat restoration projects (Figure 1). Four of these areas had been initially surveyed from 1997 through 1999, prior to implementation of the restoration projects. The fifth area was on Cedar Creek (Figure 1), which was not included in past or current fish surveys.

Field Sampling

Presence/Absence Sampling

We conducted fish surveys using a backpack electrofisher during summer at or near minimum flows. Backpack electrofisher settings varied from 200-400 volts at 30 Hz DC. Within each stream reach we sampled 20% of the fast water units (riffles and cascades), glides, and pools (Hankin and Reeves 1988). Reaches were delineated by significant landscape changes, major tributaries, or passage barriers (Moore et al. 2001). We randomly selected one of the first five units of each habitat type as a starting point for sampling each reach, then sampled every fifth unit of each habitat type. Electrofishing was limited to one pass through each designated habitat unit. We measured length and width of each unit to calculate total surface area electrofished.

Fish collected from each habitat unit were identified, measured, and examined for anomalies. Fish were then released back into the habitat unit where they were collected.

Seasonal Sampling

During presence/absence (P/A) surveys we identified an easily accessible, representative 100-m length of each stream reach to be sampled seasonally with the backpack electrofisher (Figure 1). During each season (summer 2002 – spring 2003), block nets were placed at each end of the 100-m sampling area to prevent fish from escaping capture. We started surveys at the downstream end of the sampling area and worked upstream collecting as many fish as possible. If salmonids were collected in the first pass, we conducted up to two additional passes until no salmonids

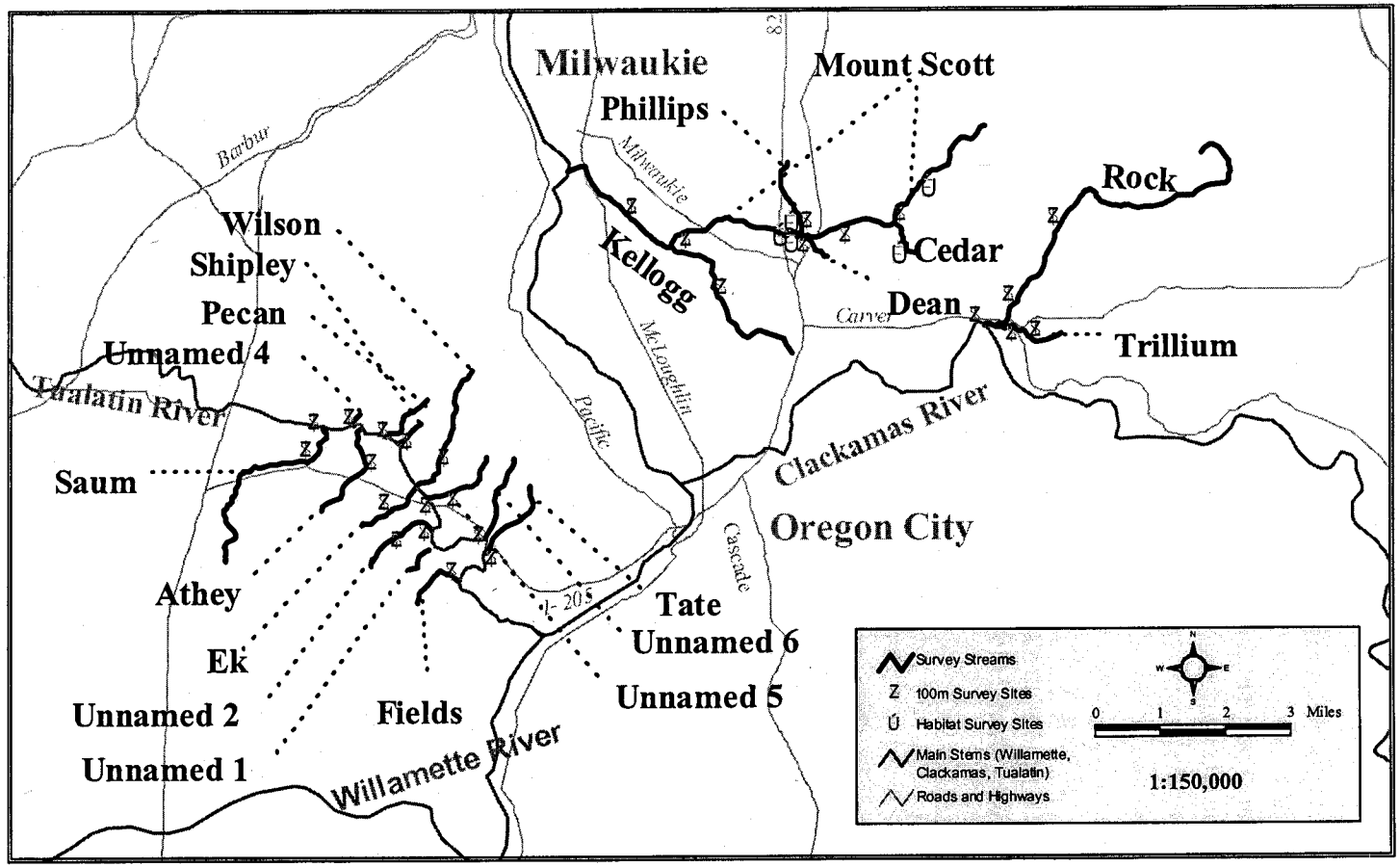

Figure 1. Location of streams, 100-m sites, and habitat restoration sites surveyed in urban Clackamas County, summer 2002 – spring 2003.

were captured (maximum of three passes; Armour et al. 1983). Fish were identified to species, measured, examined for anomalies, and released downstream of the lower block net. In second and third passes, only salmonids were collected and examined.

Habitat Surveys

We conducted fish habitat surveys using standardized ODFW sampling protocol (Moore et al. 2001). Habitat surveys were conducted in early summer 2003 near habitat restoration sites on Mt. Scott, Phillips, Dean, and Cedar creeks (Figure 1). Surveys began downstream of each site and continued upstream through the site (Appendix D). We identified habitat units (pools, glides, riffles, etc.), and measured or estimated length, width, and depth of each unit surveyed. Within each unit we counted the number of boulders, and visually estimated substrate composition (silt or organic matter, sand, gravel, cobble, boulders, and bedrock), percent each bank was eroded, percent of total bank that was undercut, and woody debris volume and distribution. We used a clinometer to estimate stream shading by measuring the angle, in degrees, from the middle of the stream channel to the apex of the riparian canopy or landform on each side of the stream.

Data Analysis

Index of Biotic Integrity

We calculated an IBI for P/A and seasonal multiple-pass removal surveys (MPR). An IBI is a scoring criteria used to assess the ecological condition of a stream as it relates to fish assemblage conditions (Reynolds et al. 2003). The IBI is useful for assessing the effects of humans on entire fish assemblages. We generated IBIs for Clackamas County streams by applying our fish collection data to a set of 12 metrics (Table 1). All fish collected and identified were used to calculate IBI's for P/A surveys. Fish collected and examined in the first pass of MPR surveys were used to calculate seasonal IBIs. IBI scores are based on a possible maximum score of 100. Streams with an IBI $\leq$50 are considered severely impaired, streams scoring 51-74 are marginally impaired, and streams with a score $\geq$75 are considered acceptable. IBI scores based on fish information cannot be calculated for streams with no fish.

Salmonid Abundance Estimates

We used a population estimate model for MPR survey information (Armour et al. 1983) to estimate salmonid abundance by individual species within 100-m sites. Low or irregular (where catches did not decrease with each electrofishing pass) catches precluded population estimates in many stream reaches.

Table 1. IBI scoring criteria used for Clackamas County streams, 2002-2003, modified from Hughes et al. (1998). Each metric is scored on a scale from 0-10. Raw data values at low end of the ranges (high end of ranges for metrics 8, 10, and 12) are scored as 0; those at the high end (low end for metrics 8, 10, and 12) are scored as 10. Scores between the upper and lower thresholds are calculated by linear interpolation. Final IBI scores are given as a percentage of the maximum total of 120.

Metric	Raw values: Stream order 1	Raw values: Stream orders 2 and 3
Taxonomic richness		
(1) Number of native families	0 – 4	0 – 7
(2) Number of native species	0 – 5	0 – 11
Habitat guilds		
(3) Number of native benthic species	0 – 3	0 – 7
(4) Number of native water column species	0 – 2	0 – 4
(5) Number of hider species	0 – 4	0 – 4
(6) Number of sensitive species	0 – 2	0 – 5
(7) Number of native nonguarding lithophil nester species[a]	0 – 3	0 – 3
(8) Percent tolerant individuals	10 – 0	10 – 0
Trophic guilds		
(9) Percent filter-feeding individuals	0 – 10	0 – 10
(10) Percent omnivores	10 – 0	10 – 0
Individual health and abundance		
(11) Percent of target species that include lunkers[b]	0 – 100	0 – 100
(12) Percent of individuals with anomalies	2 – 0	2 – 0

[a]Species that create nests in gravel or smaller substrates to spawn.
[b]Lunkers are relatively large individuals of the following species and sizes: prickly sculpin *Cottus asper* (100 mm), torrent sculpin *C. rhotheus* (100 mm), rainbow/steelhead trout *Oncorhynchus mykiss* (300 mm), cutthroat trout *O. clarki* (250 mm), chiselmouth *Acrocheilus alutaceus* (300 mm), northern pikeminnow *Ptychocheilus oregonensis* (300 mm), and largescale sucker *Catostomus macrocheilus* (300 mm).

Life History and Population Dynamics

We examined seasonal proportion of catch at fork length (FL) interval by salmonid species and location to help identify life history characteristics and population dynamics. Length-frequency distributions were plotted graphically and examined visually for ranges of FL values, nodes in distribution, and temporal shifts in distribution.

Habitat Surveys

To evaluate general stream morphology we determined the proportion of surveyed areas composed of glides. We calculated the mean depth, percent of substrate composed of silt, and total number of boulders in each area surveyed. We also calculated mean shading (0-180 degrees) for each area. When applicable, we qualitatively compared this summary information to information collected prior to restoration projects.

RESULTS

From summer 2002 through spring 2003 we sampled sixteen fish bearing streams in 145 reach/time surveys. We collected and examined almost 10,000 individuals. Among the fish collected, more than three-quarters (77%) were sculpins, 13% were minnow species, 6% were salmon and trout, and 3% were lamprey species. We identified 16 native species from six families (Table 2). We identified seven alien species from four families, but they constituted less than 1% of the total catch. We found no fish in Ek, unnamed 1, and unnamed 4 creeks, all tributaries of the Tualatin River.

Species Assemblages and Distribution

Cutthroat trout were the most common salmonid (Table 2) and were present in 12 of 16 fish-bearing streams (Appendices A and B). We observed cutthroat trout throughout most of the Kellogg Creek and Rock Creek watersheds, and in seven of the 13 tributaries of the lower Tualatin River.

We found rainbow/steelhead trout in only five streams, with most individuals (87 of 93) observed in the Rock Creek watershed (Appendices A and B). We found no rainbow/steelhead trout in the Kellogg Creek watershed. Distribution of coho salmon and Chinook salmon were limited to the Rock Creek watershed. All coho salmon and Chinook salmon were juveniles.

Lampreys were observed throughout the Kellogg Creek watershed, in Rock Creek, and in eight of 13 tributaries of the lower Tualatin River (Appendices A and B). A few lampreys were identified to species: adult western brook lamprey and Pacific lamprey outmigrants (macropthalmia).

We found sculpins in all fish-bearing streams except Fields and unnamed 2 creeks, both tributaries of the lower Tualatin River (Appendices A and B). The most abundant and widely distributed species was reticulate sculpin. Other than two prickly sculpin individuals found in the lowest reach of unnamed 5 Creek, distributions of prickly sculpins and riffle sculpins were limited to the Kellogg Creek watershed. Distribution of torrent sculpins was limited to Rock Creek, where we found only a few individuals.

Table 2. Fish collected during presence/absence (P/A) and the first pass of multiple-pass removal (MPR) surveys in Clackamas County streams, summer 2002 – spring 2003.

Family,	Catch		Proportion of Total	
Species	P/A	MPR	P/A	MPR
Petromyzontidae				
Brook lamprey *Lampetra richardsoni*	0	88	0.000	0.013
Pacific lamprey *Lampetra tridentata*	0	3	0.000	<0.001
Unidentified lamprey *Lampetra* spp.[a]	0	155	0.000	0.022
Cyprinidae				
Goldfish *Carassius auratus*[b]	1	4	<0.001	0.001
Northern pikeminnow *Ptychocheilus oregonensis*	0	30	0.000	0.004
Longnose dace *Rhinichthys cataractae*	3	17	0.001	0.003
Speckled dace *Rhinichthys osculus*	59	478	0.020	0.070
Redside shiner *Richardsonius balteatus*	119	553	0.041	0.082
Catostomidae				
Largescale sucker *Catostomus macrocheilus*	0	41	0.000	0.006
Unknown Sucker *Catostomus* spp.	4	13	0.001	0.002
Ictaluridae[b]				
Yellow bullhead *Ameiurus nebulosus*	2	0	0.001	0.000
Salmonidae				
Cutthroat trout *Onchorhynchus clarki*	91	327	0.031	0.048
Coho salmon *Onchorhynchus kisutch*	16	71	0.006	0.010
Rainbow trout/steelhead *Onchorhynchus mykiss*	12	81	0.004	0.012
Chinook salmon *Onchorhynchus tshawytscha*	1	10	<0.001	0.001
Unidentified salmonids *Salmonidae* spp.	1	9	<0.001	0.001
Poeciliidae[b]				
Western mosquitofish *Gambusia affinis*	10	14	0.003	0.002
Gasterosteidae				
Three-spined stickleback *Gasterosteus aculeatus*	0	3	0.000	<0.001
Cottidae				
Prickly sculpin *Cottus asper*	80	149	0.028	0.022
Riffle sculpin *Cottus gulosus*	0	7	0.000	0.001
Reticulate sculpin *Cottus perplexus*	1193	2409	0.412	0.355
Torrent sculpin *Cottus rhotheus*	4	2	0.001	<0.001
Unidentified sculpins *Cottidae* spp.	1259	2301	0.435	0.339

Table 2. (continued).

Family, Species	Catch P/A	Catch MPR	Proportion of Total P/A	Proportion of Total MPR
Centrarchidae[b]				
Pumpkinseed *Lepomis gibbosus*	0	11	0.000	0.002
Bluegill *Lepomis macrochirus*	1	0	<0.001	0.000
Smallmouth bass *Micropterus dolomieu*	0	2	0.000	<0.001
Largemouth bass *Micropterus salmoides*	5	8	0.002	0.001

[a]Ammocoetes were not keyed to species. Western brook lamprey *Lampetra richardsoni* and Pacific lamprey *Lampetra tridentata* were observed but not consistently enumerated.
[b]Alien families or species.

We observed additional native species in many streams (Appendices A and B). Redside shiners and speckled dace were the most common minnows. Native minnows were observed throughout the Kellogg Creek and Rock Creek watersheds, but minnow distribution in tributaries of the lower Tualatin River was limited to presence of northern pikeminnow in Tate and unnamed 6 creeks. Distribution of longnose dace was limited to Rock Creek. Largescale suckers were the only sucker species observed, with distribution limited to the Kellogg Creek and Rock Creek watersheds.

We found alien species throughout the Kellogg Creek and Rock Creek watersheds, and in four of the 13 tributaries of the lower Tualatin River. No species was particularly widespread or locally abundant (Appendices A and B). We found largemouth bass in five streams, mosquitofish in four streams, pumpkinseed in three streams and smallmouth bass in two streams. Bluegill, goldfish, and yellow bullhead were each found in one stream.

Seasonal Distribution of Sensitive Species

Temporal distribution of salmonids expressed as the proportion collected varied by species and among streams (Table 3). Cutthroat trout were most abundant in summer and fall, and least abundant in spring. Only the Rock Creek watershed sustained year-round populations of salmonids other than cutthroat trout. Rainbow/steelhead trout were most abundant in fall, whereas coho salmon abundance was more evenly distributed throughout the year. Abundance of coho salmon in Trillium Creek increased in winter, concurrent with a decrease in abundance in Rock Creek. We observed rainbow/steelhead trout in some tributaries of the lower Tualatin River, but only in spring (Appendix B).

Table 3. Temporal distribution of salmonids collected by species and stream. Distribution is the proportion of total fish collected where N > 30.

Species, Stream	Season				N
	Summer	Fall	Winter	Spring	
Cutthroat trout					
Mt. Scott Creek	0.327	0.337	0.149	0.188	101
Rock Creek	0.715	0.232	0.053	0.000	246
Fields Creek	0.564	0.208	0.178	0.050	101
Coho salmon					
Rock Creek	0.283	0.383	0.117	0.217	60
Trillium Creek	0.268	0.089	0.482	0.161	56
Rainbow/steelhead trout					
Rock Creek	0.043	0.710	0.108	0.140	93

Index of Biotic Integrity

IBI scores for all sampling efforts in fish-bearing streams ranged from 10 to 75 (Table 4). The mean IBI for all sampling efforts per stream reach indicated 10 of 34 fish-bearing reaches were marginally impaired with the balance severely impaired. No mean IBI scores were considered acceptable. Only one of 127 total IBI scores was considered acceptable. In tributaries of the Tualatin River, higher mean scores generally coincided with reaches connected to the Tualatin River. Similarly, the highest scores in the Rock Creek watershed were in the lowest reach of Rock Creek. Individual metric scores used to calculate the IBI scores are presented in Appendix C.

Salmonid Abundance Estimates

We estimated salmonid abundance by species for 7 reaches by season, summer 2002 – spring 2003 (Table 5). Estimated abundance of cutthroat trout was highest in Rock Creek. Although we observed salmonids in other streams, low or irregular catches precluded population estimates in all but Mt. Scott and Fields creeks.

Life History and Population Dynamics

Cutthroat trout in Fields Creek were distributed across a wide range of sizes in most seasons (Figure 2). Successful recruitment is evident by the presence of small fish (< 50mm) in summer

Table 4. Index of Biotic Integrity (IBI) scores by stream reach and season for Clackamas urban streams, summer 2002 – spring 2003. P/A = summer presence/absence surveys. Seasonal surveys: Su = summer, F = fall, W = winter, and Sp = spring.

Watershed, Stream	Reach	2002 P/A	2002 Su	2002 F	2003 W	2003 Sp	Mean	Range
Kellogg Creek								
Kellogg	1	34	43	27	38	44	37	16
	2	65	66	44	64	64	61	22
Mt. Scott	1	52	39	33	30	36	38	22
	2	25	--	--	--	--	25	--
	3	57	41	46	41	41	45	16
	4	47	44	41	52	46	46	11
Dean	1	19	52	48	42	47	42	33
	2	10	--	--	--	--	10	--
Phillips	1	57	68	56	39	62	56	30
	2	34	40	--	--	--	37	6
Rock Creek								
Rock	1	67	59	65	62	67	64	8
	2	63	59	60	47	32	52	31
	3	40	36	51	30	30	37	20
Trillium	1	34	63	72	64	55	57	38
	2	--	17	--	--	--	17	--
	3	17	--	--	--	--	17	--
Tualatin River								
Athey	1	21	--	--	--	--	21	--
	2	34	49	34	36	49	40	16
	3	34	--	--	--	--	34	--
Fields	1	42	34	34	34	57	40	23
	2	42	--	--	--	--	42	--
Pecan	1	34	66	50	59	66	55	33
Saum	1	41	44	40	47	45	44	7
	2	30	49	30	49	49	41	19
Shipley	1	--	--	--	56	53	54	3
Tate	1	34	67	49	57	75	56	41
	2	34	--	--	--	--	34	--
Wilson	1	66	49	34	50	50	50	32
Unnamed 2	1	42	42	42	42	42	42	0
	2	42	42	42	--	42	42	0
Unnamed 5	1	51	51	58	64	70	59	20
	2	34	27	50	34	51	39	24
Unnamed 6	1	50	51	50	68	70	58	20
	2	34	--	--	--	--	34	--

Table 5. Abundance estimates (and 95% confidence intervals) for salmonids within 100-m stream lengths surveyed seasonally by multiple-pass removal, Clackamas County urban streams, summer 2002 – spring 2003. Su = summer, F = fall, W = winter, and Sp = spring.

Watershed, Stream	Reach	2002 Su	2002 F	2003 W	2003 Sp
Cutthroat trout					
Mt Scott Creek	3	--	10 (9-12)	--	--
	4	23 (20-27)	29 (18-39)	14 (14-14)	25 (7-43)
Rock Creek	1	128 (115-141)	26 (23-30)	--	--
	2	84 (79-88)	58 (54-61)	--	--
Fields Creek	1	57 (56-59)	23 (18-27)	19 (16-21)	10 (9-11)
Coho Salmon					
Rock Creek	1	39 (35-42)	59 (56-53)	14 (12-15)	25 (23-27)
	2	23 (19-26)	18 (16-21)	4 (3-6)	--

2002. Growth is indicated by increase in size of the smallest fish from summer 2002 to winter 2003. The largest individuals were similar in size to those from most other streams. The largest cutthroat trout individuals were observed in Mt. Scott Creek (Figure 3). Fish were well distributed across a wide range of sizes. We found no fish < 50 mm; however, fish < 100 mm were relatively abundant in fall and winter. Fish < 80 mm fork length dominated the cutthroat trout population in Rock Creek (Figure 4). Successful recruitment is evident by the presence of small fish (< 60 mm) in summer 2002. Mean length of these fish increased from summer to fall. We found no cutthroat trout in spring 2003.

Length-frequency distribution for rainbow/steelhead trout in Rock Creek varied among seasons (Figure 5). We found few fish in summer 2002; however, small fish (< 60 mm) were present in fall 2002 and winter 2003. Fish > 170 mm were observed only in spring 2003.

Habitat Surveys

Some key habitat parameters have changed significantly since previous surveys (Table 6). In reach 1 of Mt. Scott Creek, the percent of stream categorized as glide has decreased considerably, as has the percentage of substrate consisting of silt. Number of boulders has increased. Silt has also decreased in reach 4 of Mt. Scott Creek, whereas shade has increased. We observed little change to date in Dean Creek. Other than mean depth, Cedar Creek has intermediate values for most habitat parameters.

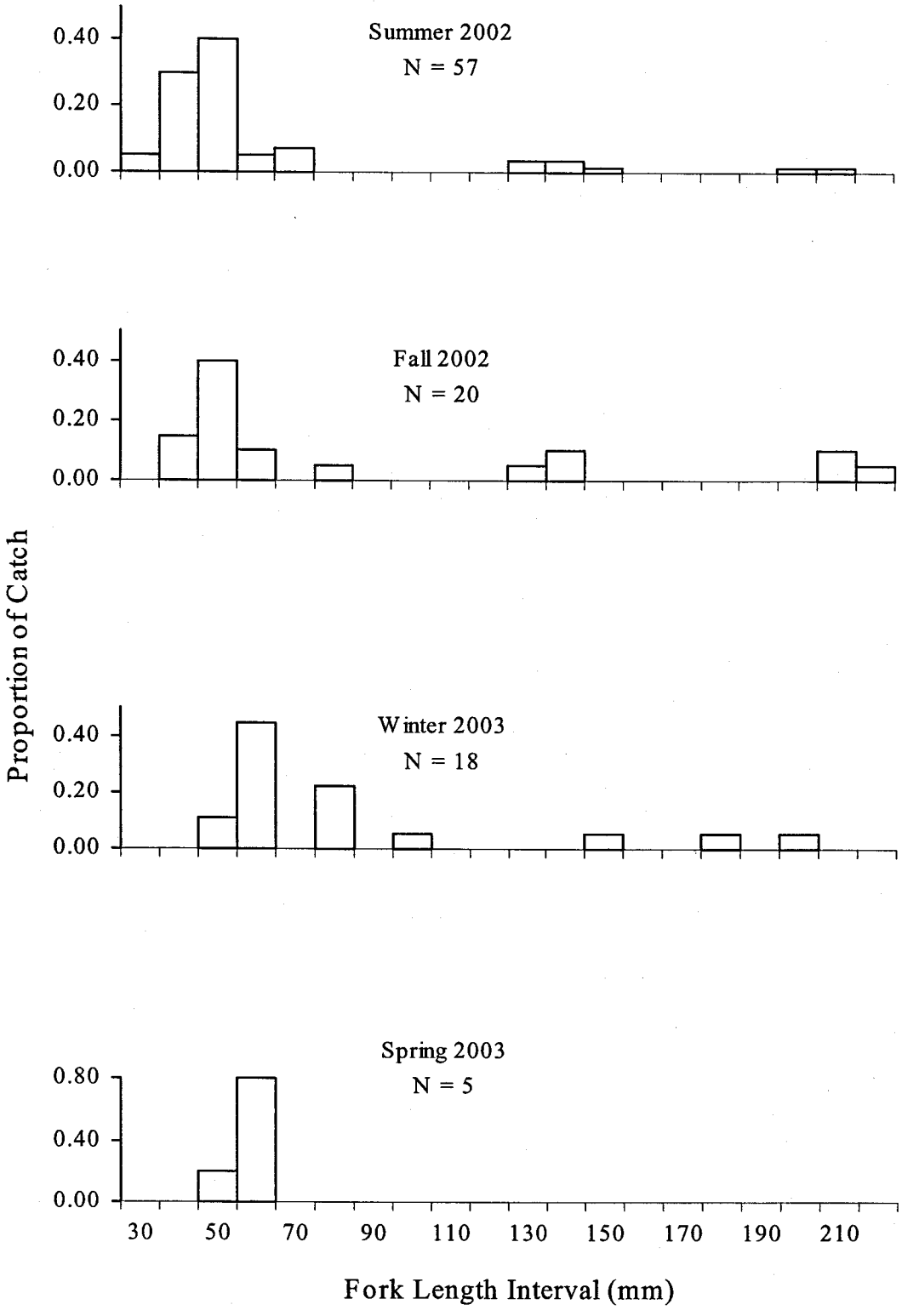

Figure 2. Proportion of catch at length by season for cutthroat trout in Fields Creek, summer 2002 – spring 2003. Note change in scale for spring.

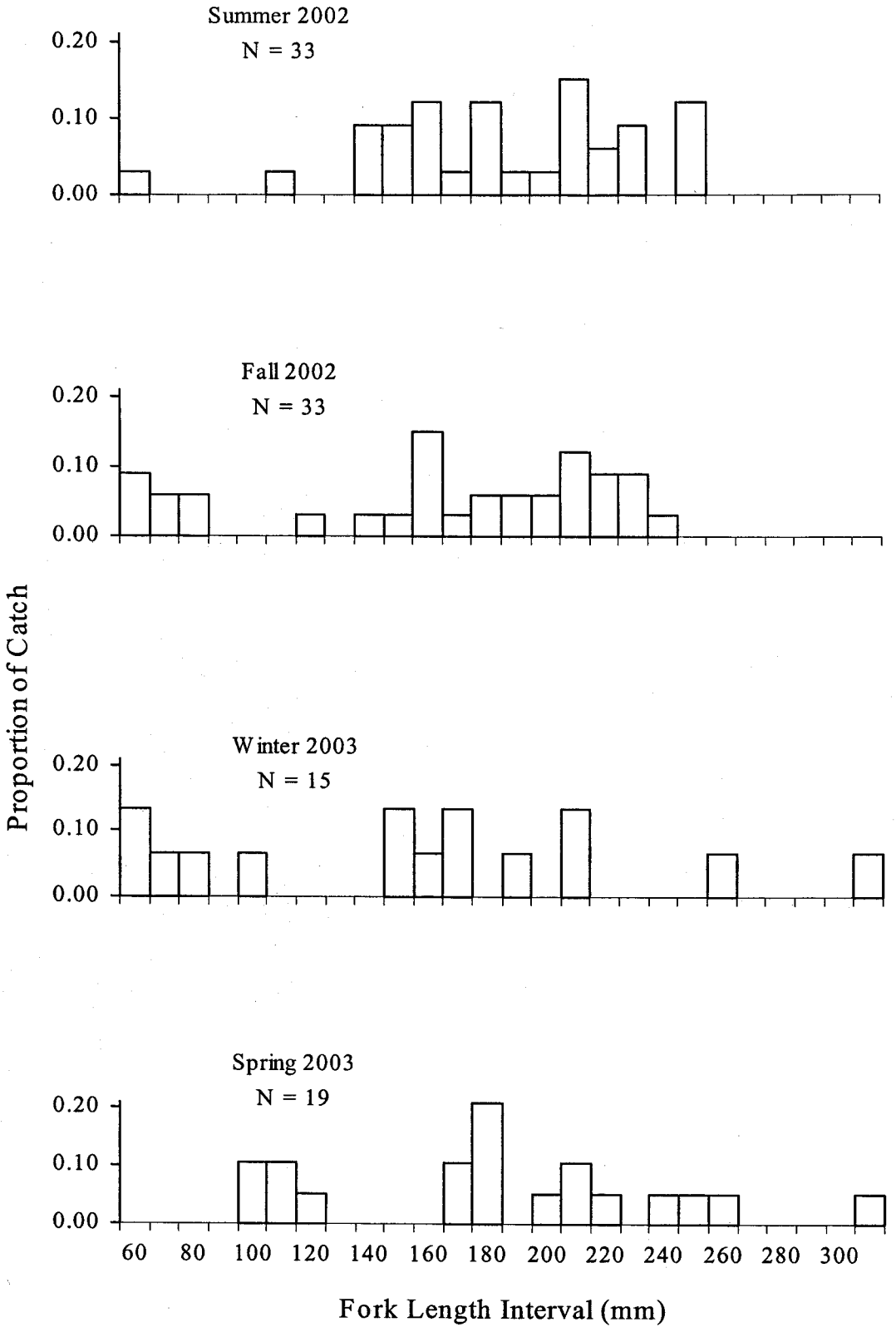

Figure 3. Proportion of catch at length by season for cutthroat trout in Mt. Scott Creek, summer 2002 – spring 2003.

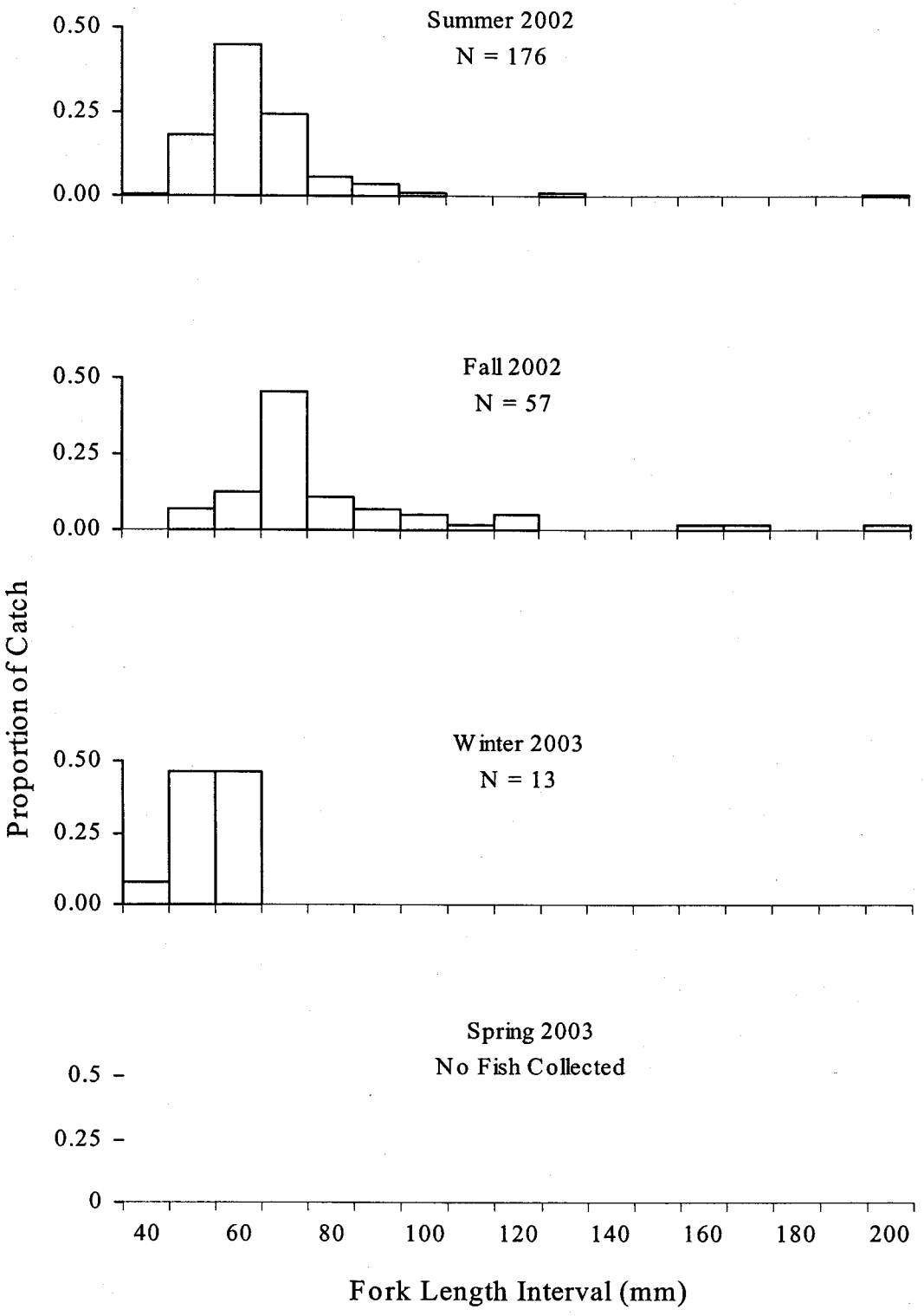

Figure 4. Proportion of catch at length by season for cutthroat trout in Rock Creek, summer 2002 – spring 2003.

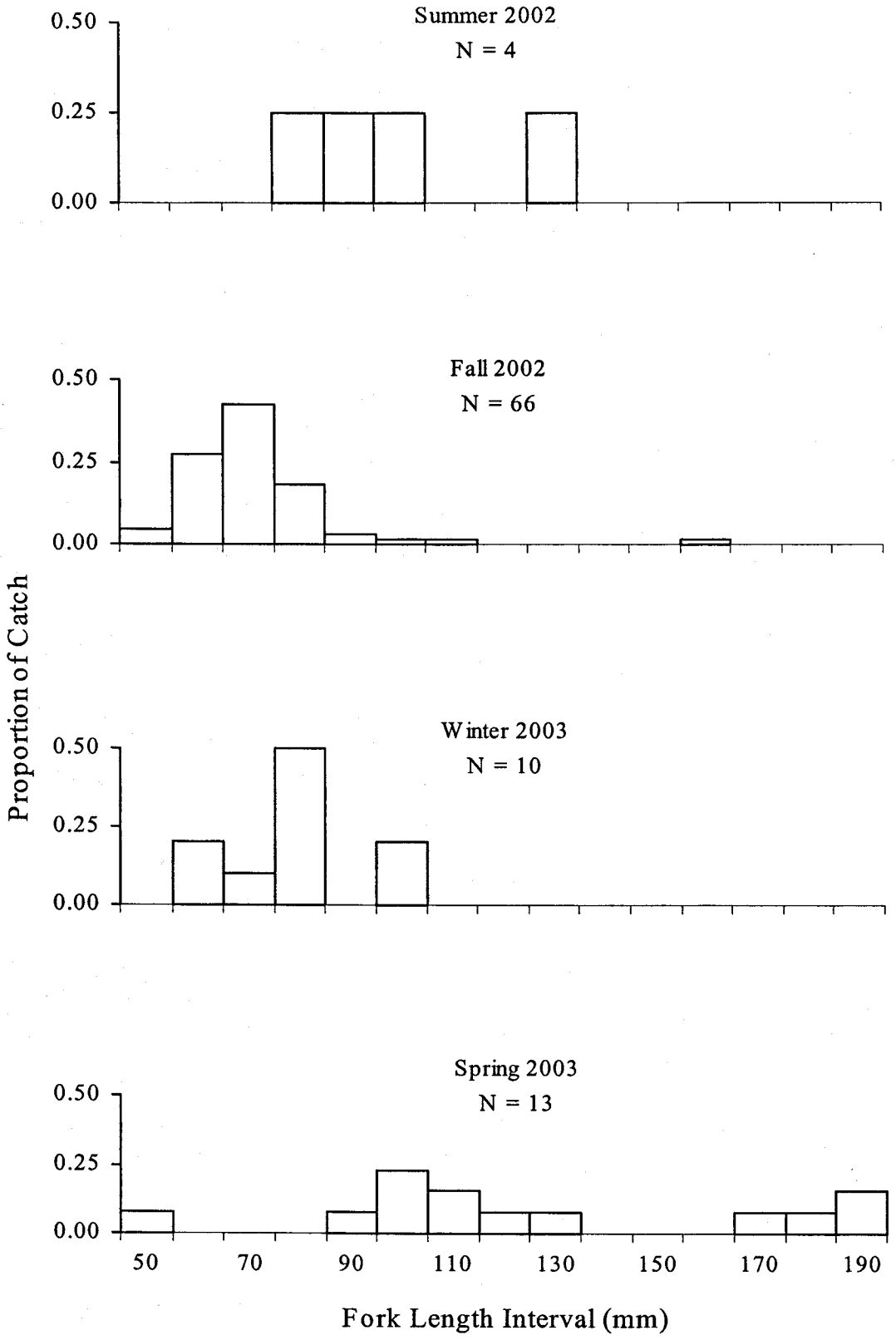

Figure 5. Proportion of catch at length by season for rainbow/steelhead trout in Rock Creek, summer 2002 – spring 2003.

Table 6. Summary of key habitat information collected at five areas in 1997-99, and in 2003. Cedar Creek was not surveyed in 1997-99. Glide = % of area surveyed where habitat unit type was glide. Depth = average; silt = % of substrate; boulders = total count; and shade = average degrees (maximum of 180) for area surveyed.

Stream, reach	Length (m)	Glide (%)	Depth (m)	Silt (%)	Boulders	Shade (°)
Mt. Scott, 1						
1997	472	79	0.2	22	27	91
2003	470	42	0.4	5	107	86
Mt. Scott, 4						
1997	173	0	0.5	55	200	74
2003	156	6	0.3	6	231	108
Dean, 1						
1998	276	58	0.3	65	0	139
2003	266	60	0.2	39	18	132
Phillips, 1						
1998	151	58	0.2	21	0	116
2003	179	18	0.2	9	24	91
Cedar, 1						
2003	81	23	0.3	18	30	106

DISCUSSION

Despite extensive urban development, some Clackamas County streams still contain a relatively diverse assemblage of native fish species, including salmonids. Although relatively widespread, alien species still comprise a small percentage of individuals, with relative abundance decreasing since similar surveys from 1997 through 1999 (Friesen and Zimmerman 1999). Fish assemblages have obviously changed throughout the period of urban development, but persistence of native species, especially those most sensitive to habitat degradation, confirms the potential benefits of habitat protection and restoration.

If actions are taken to protect native fish communities in urban Clackamas County, time is of the essence for Mt. Scott, Rock, and Fields creeks to protect the most productive stream reaches. The highest short-term potential probably exists in larger publicly owned land parcels. The focus species that may persist in order of probability are resident and fluvial or anadromous cutthroat trout, Pacific lamprey, and steelhead.

Within the Kellogg Creek watershed, Mt. Scott Creek appears to be a relative stronghold for cutthroat trout. Fall and winter spawning and migratory behavior of relatively large adult cutthroat trout would be consistent with a fluvial or anadromous life history. Seasonal length distributions and the relatively large size of some cutthroat trout individuals are similar to those in Kelley Creek (Tinus et al. 2003), which may be fluvial or anadromous. Previous surveys also indicated the importance of the upper reaches of Mt. Scott Creek to cutthroat trout (Friesen and

Zimmerman 1999). Further investigation of this population is warranted, especially considering the extensive ongoing development along and nearby the stream.

As found during previous surveys (Friesen and Zimmerman 1999), Rock Creek supports a relatively abundant and diverse population of salmonids, which probably includes both anadromous and resident life histories. Although we found indicators of cutthroat trout production, we found no large fish that would indicate anadromy. It is likely, however, that some fish migrate to the Clackamas River. We also found indications of rainbow/steelhead trout production. No fish > 150 mm were found in summer in 2002, which may indicate outmigration of steelhead smolts prior to sampling. We observed fish over 190 mm in spring 2003. It is unfortunate that the project did not include surveys in summer 2003 to determine if these fish remained in the stream or migrated out. Presence of rainbow/steelhead trout, coho salmon, and Chinook salmon in the lowest reach of Rock Creek indicates juveniles from the Clackamas River probably use the creek for rearing or overwintering habitat. Presence of juveniles further upstream, especially rainbow/steelhead trout and coho salmon, indicate the possibility of production.

We found cutthroat trout in a number of the Tualatin River tributaries; however, Fields Creek appears to be the most important of these streams for cutthroat trout production. The shift in length-frequency suggests successful recruitment in 2002. Along with a few other Tualatin tributaries, Fields Creek supports rainbow/steelhead trout, but only in spring. It is likely these fish are steelhead using the smaller streams as refugia from the Tualatin River.

Lampreys remain relatively widely distributed throughout Clackamas County streams. The presence of a few Pacific lamprey macropthalmia suggests spawning by adult Pacific lamprey. Although we continue to find torrent sculpin in Rock Creek, abundance appears to be lower than during previous surveys (Friesen and Zimmerman 1999). It is unlikely that torrent sculpin exist in other surveyed streams.

Although low IBI scores throughout Clackamas County streams can probably be attributed to barriers and environmental disturbances, some small watersheds may have inherently low IBIs, even when relatively intact (Reynolds et al. 2003). In Fields Creek, IBIs are low and unacceptable, even though the stream supports cutthroat trout. It is possible that small tributaries of the lower Tualatin River might naturally have few fish species and therefore low IBIs.

Seasonally varying IBI scores may be a result of fish behavior. Differential habitat or even whole-stream use may vary by species among seasons (Healy 1998; Sandercock 1998). Such is apparently the case with coho salmon in Rock and Trillium creeks, cutthroat trout in Rock Creek, and rainbow/steelhead trout in Fields Creek.

Seasonal surveys are a snapshot in time taken four days a year over a relatively short distance within each stream reach. Although we believe presence and distribution of most species have been adequately determined, we noted some differences from previous surveys. Relative abundance of common fish has not changed substantially since 1997-99; however, detection of uncommon or rare fish, particularly alien species, is subject to bias associated with minimal effort in each stream. Another difference from previous surveys may relate to difficulties in

correctly identifying some species in the field, particularly sculpins. For example, we did not identify riffle sculpins during previous surveys. Species observed from P/A surveys were generally similar to those of summer MPR surveys. We recognize, however, that relative abundance of species collected may not reflect actual relative abundance because behavior and vulnerability to sampling gear vary among species. For example, benthic species such as sculpins and lampreys can be more difficult to capture than water column species such as salmonids.

It appears that habitat restoration projects have persisted, and some have resulted in obviously improved habitat parameters. Overall complexity of habitat has improved in reach 1 of Mt. Scott Creek, as indicated by the decrease in glide habitat and silt substrate, and increase in the number of boulders. Glides often harbor the lowest numbers of native species. The amount of glide habitat increased slightly in reach 4 of Mt. Scott Creek, but that is because a dam and reservoir formerly occupied the area surveyed. Habitat complexity has greatly increased since removal of the dam. Although the amount of shade has not consistently increased at restoration sites, native shrubs and trees have replaced alien species. Shade will increase as these native species continue to grow. These sites should continue to be monitored in the future.

RECOMMENDATIONS

- Continue to follow recommendations offered as part of the final report of 1997-99 surveys (Friesen and Zimmerman 1999).

- In conjunction with other stakeholders develop priorities for habitat protection and restoration in urban Clackamas County watersheds. Include short term (instream improvements), medium term (habitat protection), and long term (land-use planning) objectives, strategies, and actions.

- Conduct fish and habitat inventories at regular intervals (3-5 years) to evaluate trends and provide information for pre- and post-treatment evaluations.

- Conduct annual surveys in selected streams (i.e., Mt. Scott, Rock, and Fields creeks) to evaluate spawning of salmonids and Pacific lamprey.

- Conduct intensive surveys to evaluate abundance, biomass, spatial structure, habitat use, and movements of salmonids in Rock Creek and within the Kellogg Creek watershed.

- Continue to monitor and evaluate habitat improvement projects, and use results from intensive fish surveys to evaluate relationships between changes in habitat and changes in fish populations.

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APPENDIX A

Fish Collected in Summer Presence/Absence Surveys

Appendix Table A-1. Number of fish collected during summer 2002 presence/absence sampling in Clackamas County streams.

	Stream, reach								
	Athey			Dean		Fields		Kellogg	
Species	1	2	3	1	2	1	2	1	2
Unidentified lamprey	0	0	0	0	0	0	0	0	2
Goldfish	0	0	0	0	0	0	0	0	1
Longnose dace	0	0	0	0	0	0	0	0	0
Speckled dace	0	0	0	0	0	0	0	4	3
Redside shiner	0	0	0	0	0	0	0	13	4
Unidentified sucker	0	0	0	0	0	0	0	0	0
Yellow bullhead	2	0	0	0	0	0	0	0	0
Cutthroat trout	0	0	0	0	0	12	1	0	0
Coho salmon	0	0	0	0	0	0	0	0	0
Rainbow trout/steelhead	0	0	0	0	0	0	0	0	0
Chinook salmon	0	0	0	0	0	0	0	0	0
Unidentified salmonid	0	0	0	0	0	0	0	0	0
Western mosquitofish[a]	0	0	0	2	5	0	0	0	0
Prickly sculpin	0	0	0	0	0	0	0	57	2
Reticulate sculpin	3	23	8	11	0	0	0	31	136
Torrent sculpin	0	0	0	0	0	0	0	0	0
Unidentified cottids	17	11	28	6	0	0	0	118	213
Bluegill[a]	0	0	0	0	0	0	0	0	0
Largemouth bass[a]	0	0	0	0	0	0	0	0	0

Appendix Table A-1 (continued).

	Stream, reach									
	Mt. Scott				Pecan	Phillips		Rock		
Species	1	2	3	4	1	1	2	1	2	3
Unidentified lamprey	1	0	1	3	0	0	0	0	0	1
Goldfish	0	0	0	0	0	0	0	0	0	0
Longnose dace	0	0	0	0	0	0	0	3	0	0
Speckled dace	7	0	2	0	0	4	32	7	0	0
Redside shiner	59	7	15	0	0	19	1	1	0	0
Unidentified sucker	1	1	0	0	0	0	0	2	0	0
Yellow bullhead	2	0	0	0	0	0	0	0	0	0
Cutthroat trout	0	0	16	13	0	1	0	16	23	0
Coho salmon	0	0	0	0	0	0	0	8	8	0
Rainbow trout/steelhead	0	0	0	0	0	0	0	2	10	0
Chinook salmon	0	0	0	0	0	0	0	1	0	0
Unidentified salmonid	0	0	0	0	1	0	0	0	0	0
Western mosquitofish[a]	1	0	0	0	0	0	2	0	0	0
Prickly sculpin	21	0	0	0	0	0	0	0	0	0
Reticulate sculpin	216	10	221	125	27	23	6	34	73	40
Torrent sculpin	0	0	0	0	0	0	0	2	2	0
Unidentified cottids	249	3	143	104	32	17	0	34	20	116
Bluegill[a]	0	0	0	0	0	0	0	0	0	0
Largemouth bass[a]	1	0	2	1	0	0	0	1	0	0

Appendix Table A-1 (continued)

	Stream, reach								
	Saum		Shipley	Tate			Trillium		
Species	1	2	1	1	2	3	1	2	3
Unidentified lamprey	25	0	0	0	0	0	0	0	0
Goldfish	0	0	0	0	0	0	0	0	0
Longnose dace	0	0	0	0	0	0	0	0	0
Speckled dace	0	0	0	0	0	0	0	0	0
Redside shiner	0	0	0	0	0	0	0	0	0
Unidentified sucker	0	0	0	0	0	0	0	0	0
Yellow bullhead	0	0	0	0	0	0	0	0	0
Cutthroat trout	0	0	0	0	0	0	0	0	0
Coho salmon	0	0	0	0	0	0	0	0	0
Rainbow trout/steelhead	0	0	0	0	0	0	0	0	0
Chinook salmon	0	0	0	0	0	0	0	0	0
Unidentified salmonid	0	0	0	0	0	0	0	0	0
Western mosquitofish[a]	0	0	0	0	0	0	0	0	0
Prickly sculpin	0	0	0	0	0	0	0	0	0
Reticulate sculpin	95	7	0	8	2	0	2	0	0
Torrent sculpin	0	0	0	0	0	0	0	0	0
Unidentified cottids	42	5	0	14	20	0	2	0	0
Bluegill[a]	0	0	0	0	0	0	0	0	1
Largemouth bass[a]	0	0	0	0	0	0	0	0	0

Appendix Table A-1 (continued).

	Stream, reach							
	Unnamed 2		Unnamed 4	Unnamed 5		Unnamed 6		Wilson
Species	1	2	1	1	2	1	2	2
Unidentified lamprey	0	0	0	0	0	1	0	1
Goldfish	0	0	0	0	0	0	0	0
Longnose dace	0	0	0	0	0	0	0	0
Speckled dace	0	0	0	0	0	0	0	0
Redside shiner	0	0	0	0	0	0	0	0
Unidentified sucker	0	0	0	0	0	0	0	0
Yellow bullhead	0	0	0	0	0	0	0	0
Cutthroat trout	1	2	0	1	0	0	0	0
Coho salmon	0	0	0	0	0	0	0	0
Rainbow trout/steelhead	0	0	0	0	0	0	0	0
Chinook salmon	0	0	0	0	0	0	0	0
Unidentified salmonid	0	0	0	0	0	0	0	0
Western mosquitofish[a]	0	0	0	0	0	0	0	0
Prickly sculpin	0	0	0	0	0	0	0	0
Reticulate sculpin	0	0	0	5	3	5	3	76
Torrent sculpin	0	0	0	0	0	0	0	0
Unidentified cottids	0	0	0	6	14	3	3	39
Bluegill[a]	0	0	0	0	0	0	0	0
Largemouth bass[a]	0	0	0	0	0	0	0	0

[a]Non-native species

APPENDIX B

Fish Collected in Multiple-Pass Removal Surveys

Appendix Table B-1. Number of fish collected during summer 2002 multiple-pass removal sampling in Clackamas County streams.

	Stream, reach								
	Athey	Dean	Ek	Fields	Kellogg		Mt. Scott		
Species	2	1	2	1	1	2	1	3	4
Unidentified lamprey	2	4	0	0	0	12	0	3	10
Goldfish	0	0	0	0	0	0	0	0	0
Northern pikeminnow									
Longnose dace	0	0	0	0	0	0	0	0	0
Speckled dace	0	4	0	0	43	3	8	0	0
Redside shiner	0	19	0	0	138	3	50	0	0
Unidentified sucker	0	0	0	0	27	0	1	0	0
Cutthroat trout	0	0	0	57	4	6	0	11	22
Coho salmon	0	0	0	0	0	0	0	0	0
Rainbow trout/steelhead	0	0	0	0	0	0	0	0	0
Chinook salmon	0	0	0	0	0	0	0	0	0
Western mosquitofish[a]	0	5	0	0	0	0	0	0	0
Prickly sculpin	0	0	0	0	152	0	6	0	0
Reticulate sculpin	12	54	0	0	75	311	48	118	196
Unidentified cottids	38	104	0	0	290	449	62	227	147
Smallmouth bass[a]	0	0	0	0	0	0	0	0	0
Largemouth bass[a]	0	2	0	0	0	0	0	0	0

Appendix Table B-1 (continued).

	Stream, reach								
	Pecan	Phillips		Rock			Saum		Shipley
Species	1	1	2	1	2	3	1	2	1
Unidentified lamprey	1	8	0	4	3	27	12	5	0
Goldfish	0	2	0	0	0	0	0	0	0
Northern pikeminnow	0	0	0	4	0	0	0	0	0
Longnose dace	0	0	0	18	0	0	0	0	0
Speckled dace	0	47	63	172	18	0	0	0	0
Redside shiner	0	141	29	0	0	0	0	0	0
Unidentified sucker	0	0	0	2	0	0	0	0	0
Cutthroat trout	4	1	0	103	72	1	0	3	0
Coho salmon	0	0	0	10	7	0	0	0	0
Rainbow trout/steelhead	0	0	0	2	2	0	0	0	0
Chinook salmon	0	0	0	1	0	0	0	0	0
Western mosquitofish[a]	0	6	0	0	0	0	1	0	0
Prickly sculpin	0	0	0	0	0	0	0	0	0
Reticulate sculpin	53	108	17	57	106	230	80	79	0
Unidentified cottids	81	203	0	117	28	180	57	34	0
Smallmouth bass[a]	0	0	1	0	0	0	0	0	0
Largemouth bass[a]	0	1	0	0	0	0	0	0	0

Appendix Table B-1 (continued).

	Stream, reach							
	Tate	Trillium		Unnamed 2		Unnamed 4	Unnamed 5	
Species	1	1	2	1	2	1	1	2
Unidentified lamprey	27	0	0	0	0	0	1	0
Goldfish	0	0	0	0	0	0	0	0
Northern pikeminnow	0	0	0	0	0	0	0	0
Longnose dace	0	0	0	0	0	0	0	0
Speckled dace	0	0	0	0	0	0	0	0
Redside shiner	0	0	0	0	0	0	0	0
Unidentified sucker	0	0	0	0	0	0	0	0
Cutthroat trout	3	3	0	5	7	0	4	0
Coho salmon	0	15	0	0	0	0	0	0
Rainbow trout/steelhead	0	0	0	0	0	0	0	0
Chinook salmon	0	1	0	0	0	0	0	0
Western mosquitofish[a]	0	0	0	0	0	0	0	0
Prickly sculpin	0	0	0	0	0	0	0	0
Reticulate sculpin	138	11	0	0	0	0	40	0
Unidentified cottids	114	15	0	0	0	0	127	25
Smallmouth bass[a]	0	0	0	0	0	0	0	0
Largemouth bass[a]	0	0	3	0	0	0	0	0

Appendix Table B-1 (continued).

	Stream, reach	
	Unnamed 6	Wilson
Species	1	1
Unidentified lamprey	22	6
Goldfish	0	0
Northern pikeminnow	0	0
Longnose dace	0	0
Speckled dace	0	0
Redside shiner	0	0
Unidentified sucker	0	0
Cutthroat trout	0	0
Coho salmon	0	0
Rainbow trout/steelhead	0	0
Chinook salmon	0	0
Western mosquitofish[a]	0	0
Prickly sculpin	0	0
Reticulate sculpin	17	116
Unidentified cottids	43	119
Smallmouth bass[a]	0	0
Largemouth bass[a]	0	0

[a]Non-native species

Appendix Table B-2. Number of fish collected during fall 2002 multiple-pass removal intensive sampling in Clackamas County streams.

	Stream, reach								
	Athey	Dean	Ek	Fields	Kellogg		Mt. Scott		
Species	2	1	2	1	1	2	1	3	4
Unidentified lamprey	0	2	0	0	0	4	0	5	4
Goldfish	0	0	0	0	0	0	0	0	0
Northern pikeminnow	0	0	0	0	0	0	0	0	0
Longnose dace	0	0	0	0	0	0	0	0	0
Speckled dace	0	0	0	0	20	0	0	0	0
Redside shiner	0	29	0	0	29	0	20	0	0
Largescale sucker	0	0	0	0	25	0	4	0	0
Cutthroat trout	0	0	0	21	0	5	0	10	24
Coho salmon	0	0	0	0	0	0	0	0	0
Rainbow trout/steelhead	0	0	0	0	0	0	0	0	0
Chinook salmon	0	0	0	0	0	0	0	0	0
Unidentified salmonid	0	0	0	0	0	0	0	0	0
Western mosquitofish[a]	0	2	0	0	0	0	0	0	0
Prickly sculpin	0	0	0	0	38	0	3	0	0
Reticulate sculpin	7	45	0	0	15	37	15	37	38
Riffle sculpin	0	0	0	0	0	0	1	0	0
Torrent scuplin	0	0	0	0	0	0	0	0	0
Unidentified cottids	9	40	0	0	37	22	40	43	17
Pumpkinseed[a]	0	0	0	0	6	0	0	0	0
Largemouth bass[a]	0	0	0	0	0	0	0	0	0

Appendix Table B-2 (continued).

	Stream, reach							
	Pecan	Phillips	Rock			Saum		Shipley
Species	1	1	1	2	3	1	2	1
Unidentified lamprey	2	0	5	3	1	2	0	0
Goldfish	0	1	0	0	0	0	0	0
Northern pikeminnow	0	0	0	1	0	0	0	0
Longnose dace	0	0	18	0	0	0	0	0
Speckled dace	0	26	84	4	0	0	0	0
Redside shiner	0	64	1	0	0	0	0	0
Largescale sucker	0	0	0	0	0	0	0	0
Cutthroat trout	0	1	6	50	1	0	0	0
Coho salmon	0	0	19	4	0	0	0	0
Rainbow trout/steelhead	0	0	66	0	0	0	0	0
Chinook salmon	0	0	5	0	0	0	0	0
Unidentified salmonid	0	0	0	2	0	0	0	0
Western mosquitofish[a]	0	1	0	0	0	0	0	0
Prickly sculpin	0	0	0	0	0	0	0	0
Reticulate sculpin	24	51	23	16	21	25	13	0
Riffle sculpin	0	0	0	0	0	0	0	0
Torrent scuplin	0	0	0	1	0	0	0	0
Unidentified cottids	13	50	25	7	8	2	7	0
Pumpkinseed[a]	0	0	0	0	0	0	0	0
Largemouth bass[a]	0	2	0	0	0	0	0	0

Appendix Table B-2 (continued).

	Stream, reach							
	Tate	Trillium		Unnamed 2		Unnamed 4	Unnamed 5	
Species	1	1	2	1	2	1	1	2
Unidentified lamprey	5	0	0	0	0	0	1	3
Goldfish	0	0	0	0	0	0	0	0
Northern pikeminnow	0	0	0	0	0	0	0	0
Longnose dace	0	0	0	0	0	0	0	0
Speckled dace	0	2	0	0	0	0	0	0
Redside shiner	0	0	0	0	0	0	0	0
Largescale sucker	0	0	0	0	0	0	0	0
Cutthroat trout	0	0	0	3	2	0	1	0
Coho salmon	0	5	0	0	0	0	0	0
Rainbow trout/steelhead	0	4	0	0	0	0	0	0
Chinook salmon	0	0	0	0	0	0	0	0
Unidentified salmonid	0	0	0	0	0	0	0	0
Western mosquitofish[a]	0	0	0	0	0	0	0	0
Prickly sculpin	0	0	0	0	0	0	0	0
Reticulate sculpin	20	1	0	0	0	0	14	3
Riffle sculpin	0	0	0	0	0	0	0	0
Torrent scuplin	0	0	0	0	0	0	0	0
Unidentified cottids	4	2	0	0	0	0	14	10
Pumpkinseed[a]	0	0	0	0	0	0	0	0
Largemouth bass[a]	0	0	0	0	0	0	0	0

Appendix Table B-2 (continued).

	Stream, reach	
	Unnamed 6	Wilson
Species	1	1
Unidentified lamprey	1	0
Goldfish	0	0
Northern pikeminnow	0	0
Longnose dace	0	0
Speckled dace	0	0
Redside shiner	0	0
Largescale sucker	0	0
Cutthroat trout	0	0
Coho salmon	0	0
Rainbow trout/steelhead	0	0
Chinook salmon	0	0
Unidentified salmonid	0	0
Western mosquitofish[a]	0	0
Prickly sculpin	0	0
Reticulate sculpin	6	22
Riffle sculpin	0	0
Torrent scuplin	0	0
Unidentified cottids	2	4
Pumpkinseed[a]	0	0
Largemouth bass[a]	0	0

[a]Non-native species

Appendix Table B-3. Number of fish collected during winter 2003 presence/absence sampling in Clackamas County streams.

	Stream, reach								
	Athey	Dean	Ek	Fields	Kellogg		Mt. Scott		
Species	2	1	2	1	1	2	1	3	4
Brook lamprey	0	0	0	0	0	0	0	0	5
Unidentified lamprey	0	0	0	0	0	0	0	0	4
Goldfish	0	0	0	0	0	1	0	0	0
Northern pikeminnow	0	0	0	0	0	0	0	0	0
Speckled dace	0	0	0	0	4	4	5	0	0
Redside shiner	0	2	0	0	15	0	24	0	0
Largescale sucker	0	0	0	0	5	0	4	0	0
Unidentified sucker	0	0	0	0	0	0	2	0	0
Cutthroat trout	0	0	0	18	0	4	0	1	14
Coho salmon	0	0	0	0	0	0	0	0	0
Rainbow trout/steelhead	0	0	0	0	0	0	0	0	0
Chinook salmon	0	0	0	0	0	0	0	0	0
Unidentified salmonid	0	0	0	0	0	0	0	0	0
Three-spined stickleback	0	0	0	0	0	0	0	0	0
Prickly sculpin	0	0	0	0	9	0	2	0	0
Reticulate sculpin	11	12	0	0	19	69	6	18	15
Torrent sculpin	0	0	0	0	0	0	0	0	0
Unidentified cottids	5	5	0	0	9	57	11	11	5
Pumpkinseed[a]	0	0	0	0	6	0	0	0	0
Smallmouth bass[a]	0	0	0	0	0	0	0	0	0
Largemouth bass[a]	0	0	0	0	0	0	0	0	0

Appendix Table B-3 (continued).

	Stream, reach							
	Pecan	Phillips	Rock			Saum		Shipley
Species	1	1	1	2	3	1	2	1
Brook lamprey	2	0	1	0	0	6	1	4
Unidentified lamprey	0	0	0	0	0	3	0	0
Goldfish	0	0	0	0	0	0	0	0
Northern pikeminnow	0	0	4	0	0	0	0	0
Speckled dace	0	5	47	1	0	0	0	0
Redside shiner	0	28	5	0	0	0	0	0
Largescale sucker	0	0	0	0	0	0	0	0
Unidentified sucker	0	0	0	0	0	0	0	0
Cutthroat trout	1	0	13	0	0	0	0	0
Coho salmon	0	0	5	2	0	0	0	0
Rainbow trout/steelhead	0	0	1	9	0	0	0	0
Chinook salmon	0	0	0	2	0	0	0	0
Unidentified salmonid	0	0	0	0	0	0	0	0
Three-spined stickleback	0	0	0	0	0	2	0	0
Prickly sculpin	0	0	0	0	0	0	0	0
Reticulate sculpin	7	22	31	5	45	40	35	1
Torrent scuplin	0	0	1	0	0	0	0	0
Unidentified cottids	1	16	25	6	7	6	12	0
Pumpkinseed[a]	0	0	0	0	0	1	0	0
Smallmouth bass[a]	0	0	0	0	0	0	0	0
Largemouth bass[a]	0	1	0	0	0	0	0	0

Appendix Table B-3 (continued).

	Stream, reach						
	Tate	Trillium		Unnamed 1	Unnamed 2		Unnamed 4
Species	1	1	2	1	1	2	1
Brook lamprey	2	0	0	0	0	0	0
Unidentified lamprey	1	0	0	0	0	0	0
Goldfish	0	0	0	0	0	0	0
Northern pikeminnow	1	0	0	0	0	0	0
Speckled dace	0	1	0	0	0	0	0
Redside shiner	0	0	0	0	0	0	0
Largescale sucker	0	0	0	0	0	0	0
Unidentified sucker	0	0	0	0	0	0	0
Cutthroat trout	3	0	0	0	2	0	0
Coho salmon	0	27	0	0	0	0	0
Rainbow trout/steelhead	0	14	0	0	0	0	0
Chinook salmon	0	0	0	0	0	0	0
Unidentified salmonid	0	1	0	0	0	0	0
Three-spined stickleback	0	0	0	0	0	0	0
Prickly sculpin	0	0	0	0	0	0	0
Reticulate sculpin	18	3	0	0	0	0	0
Torrent sculpin	0	0	0	0	0	0	0
Unidentified cottids	2	0	0	0	0	0	0
Pumpkinseed[a]	0	0	0	0	0	0	0
Smallmouth bass[a]	0	0	0	0	0	0	0
Largemouth bass[a]	0	0	1	0	0	0	0

Appendix Table B-3 (continued).

	Stream, reach			
	Unnamed 5		Unnamed 6	Wilson
Species	1	2	1	1
Brook lamprey	30	0	8	5
Unidentified lamprey	0	0	0	0
Goldfish	0	0	0	0
Northern pikeminnow	0	0	8	0
Speckled dace	0	0	0	0
Redside shiner	0	0	0	0
Largescale sucker	0	0	0	0
Unidentified sucker	0	0	0	0
Cutthroat trout	0	0	0	0
Coho salmon	0	0	0	0
Rainbow trout/steelhead	0	0	0	0
Chinook salmon	0	0	0	0
Unidentified salmonid	0	0	0	0
Three-spined stickleback	0	0	1	0
Prickly sculpin	2	0	0	0
Reticulate sculpin	9	13	25	44
Torrent scuplin	0	0	0	0
Unidentified cottids	20	10	7	14
Pumpkinseed[a]	0	0	0	0
Smallmouth bass[a]	0	0	1	0
Largemouth bass[a]	0	0	0	0

[a]Non-native species

Appendix Table B-4. Number of fish collected during spring 2003 multiple-pass removal sampling in Clackamas County streams.

	Stream, reach								
	Athey	Dean	Ek	Fields	Kellogg		Mt. Scott		
Species	2	1	2	1	1	2	1	3	4
Brook lamprey	0	0	0	0	0	3	0	0	37
Unidentified lamprey	2	1	0	0	0	1	0	3	5
Northern pikeminnow	0	0	0	0	0	0	0	0	0
Longnose dace	0	0	0	0	0	0	0	0	0
Speckled dace	0	0	0	0	3	1	3	0	0
Redside shiner	0	2	0	0	9	6	46	0	0
Largescale sucker	0	0	0	0	0	0	2	0	0
Cutthroat trout	0	0	0	5	0	5	1	0	18
Coho salmon	0	0	0	0	0	0	0	0	0
Rainbow trout/steelhead	0	0	0	6	0	0	0	0	0
Chinook salmon	0	0	0	0	0	0	0	0	0
Unidentified salmonid	0	0	0	1	0	0	0	0	0
Prickly sculpin	0	0	0	0	1	1	3	0	0
Reticulate sculpin	5	23	0	0	39	56	16	17	26
Riffle sculpin	0	0	0	0	0	0	6	0	0
Unidentified cottids	2	16	0	0	10	42	14	14	19
Pumpkinseed[a]	0	0	0	0	0	1	0	0	0
Largemouth bass[a]	0	1	0	0	0	0	0	0	0

Appendix Table B-4 (continued).

	Stream, reach							
	Pecan	Phillips	Rock			Saum		Shipley
Species	1	1	1	2	3	1	2	1
Brook lamprey	6	0	0	0	1	1	1	3
Unidentified lamprey	0	0	5	0	0	2	3	0
Northern pikeminnow	0	0	5	0	0	0	0	0
Longnose dace	0	0	6	0	0	0	0	0
Speckled dace	0	2	70	1	0	0	0	0
Redside shiner	0	62	7	0	0	0	0	0
Largescale sucker	0	1	1	0	0	0	0	0
Cutthroat trout	1	2	6	50	1	0	0	0
Coho salmon	0	0	13	0	0	0	0	0
Rainbow trout/steelhead	0	0	2	11	0	0	0	0
Chinook salmon	0	0	9	0	0	0	0	0
Unidentified salmonid	0	0	14	0	0	0	0	0
Prickly sculpin	0	0	0	0	0	0	0	0
Reticulate sculpin	19	23	9	9	26	3	4	4
Riffle sculpin	0	0	0	0	0	0	0	0
Unidentified cottids	4	10	4	1	6	2	5	0
Pumpkinseed[a]	0	0	0	0	2	0	0	0
Largemouth bass[a]	0	0	2	0	0	0	0	0

Appendix Table B-4 (continued).

	Stream, reach							
	Tate	Trillium		Unnamed 2		Unnamed 4	Unnamed 5	
Species	1	1	2	1	2	1	1	2
Brook lamprey	1	0	0	0	0	0	27	3
Unidentified lamprey	8	0	0	0	0	0	47	3
Northern pikeminnow	2	2	0	0	0	0	0	0
Longnose dace	0	0	0	0	0	0	0	0
Speckled dace	0	1	0	0	0	0	0	0
Redside shiner	0	0	0	0	0	0	0	0
Largescale sucker	0	0	0	0	0	0	0	0
Cutthroat trout	0	0	0	1	1	4	0	0
Coho salmon	0	9	0	0	0	0	0	0
Rainbow trout/steelhead	1	0	0	0	0	0	0	0
Chinook salmon	0	0	0	0	0	0	0	0
Unidentified salmonid	0	0	0	0	0	0	0	0
Prickly sculpin	0	0	0	0	0	0	0	0
Reticulate sculpin	27	4	0	0	0	0	30	12
Riffle sculpin	0	0	0	0	0	0	0	0
Unidentified cottids	6	5	0	0	0	0	11	7
Pumpkinseed[a]	0	0	0	0	0	0	0	0
Largemouth bass[a]	0	0	0	0	0	0	0	0

Appendix Table B-4 (continued).

	Stream, reach	
	Unnamed 6	Wilson
Species	1	1
Brook lamprey	1	2
Unidentified lamprey	11	1
Northern pikeminnow	0	0
Longnose dace	0	0
Speckled dace	0	0
Redside shiner	0	0
Largescale sucker	0	0
Cutthroat trout	0	0
Coho salmon	0	0
Rainbow trout/steelhead	1	0
Chinook salmon	0	0
Unidentified salmonid	0	0
Prickly sculpin	0	0
Reticulate sculpin	7	29
Riffle sculpin	0	0
Unidentified cottids	1	10
Pumpkinseed[a]	0	0
Largemouth bass[a]	0	0

[a]Non-native species

APPENDIX C

Index of Biotic Integrity Scores

Appendix Table C-1. Data used to calculate Index of Biotic Integrity Scores for reach 1 and 2 of Athey Creek, summer 2002 – spring 2003. Presence/absence (P/A) surveys were conducted in summer.

	Reach 1					Reach 2				
Metric	P/A	Summer	Fall	Winter	Spring	P/A	Summer	Fall	Winter	Spring
Native families	1	--	--	--	--	1	2	1	1	2
Native species	1	--	--	--	--	1	2	1	1	2
Native benthic species	1	--	--	--	--	1	2	1	1	2
Native water column species	0	--	--	--	--	0	0	0	0	0
Hider species	2	--	--	--	--	1	2	1	2	1
Sensitive species	0	--	--	--	--	0	1	0	0	1
Native nonguarding lithophil nester species	0	--	--	--	--	0	1	0	0	1
Percent tolerant individuals	9.1	--	--	--	--	0.0	0.0	0.0	0.0	0.0
Percent filter-feeding individuals	0.0	--	--	--	--	0.0	3.8	0.0	0.0	22.2
Percent omnivores	9.1	--	--	--	--	0.0	0.0	0.0	0.0	0.0
Percent lunkers	0.0	--	--	--	--	0.0	0.0	0.0	0.0	0.0
Percent with anomalies	0.0	--	--	--	--	0.0	0.0	0.0	0.0	0.0

Appendix Table C-1. Data used to calculate Index of Biotic Integrity Scores for Athey Creek, reach 3 and Dean Creek, reach 1, summer 2002 – spring 2003. Presence/absence (P/A) surveys were conducted in summer.

Metric	Stream, reach									
	Athey, 3					Dean, 1				
	P/A	Summer	Fall	Winter	Spring	P/A	Summer	Fall	Winter	Spring
Native families	1	--	--	--	--	1	3	3	2	3
Native species	1	--	--	--	--	1	4	3	2	3
Native benthic species	1	--	--	--	--	1	3	2	1	2
Native water column species	0	--	--	--	--	0	1	1	1	1
Hider species	1	--	--	--	--	2	4	3	1	2
Sensitive species	0	--	--	--	--	0	1	1	0	1
Native nonguarding lithophil nester species	0	--	--	--	--	0	1	1	0	1
Percent tolerant individuals	0.0	--	--	--	--	10.5	3.6	1.7	0.0	2.3
Percent filter-feeding individuals	0.0	--	--	--	--	0.0	2.1	1.7	0.0	2.3
Percent omnivores	0.0	--	--	--	--	10.5	2.6	1.7	0.0	0.0
Percent lunkers	0.0	--	--	--	--	0.0	0.0	0.0	0.0	0.0
Percent with anomalies	0.0	--	--	--	--	0.0	13.8	8.5	0.0	4.7

Appendix Table C-2. Data used to calculate Index of Biotic Integrity Scores for Dean Creek, reach 2 and Ek Creek, reach 2, summer 2002 – spring 2003. Presence/absence (P/A) surveys were conducted in summer.

	Stream, reach									
	Dean, 2					Ek, 2				
Metric	P/A	Summer	Fall	Winter	Spring	P/A	Summer	Fall	Winter	Spring
Native families	0	--	--	--	--	0	0	0	0	0
Native species	0	--	--	--	--	0	0	0	0	0
Native benthic species	1	--	--	--	--	0	0	0	0	0
Native water column species	0	--	--	--	--	0	0	0	0	0
Hider species	1	--	--	--	--	0	0	0	0	0
Sensitive species	0	--	--	--	--	0	0	0	0	0
Native nonguarding lithophil nester species	0	--	--	--	--	0	0	0	0	0
Percent tolerant individuals	100.0	--	--	--	--	0.0	0.0	0.0	0.0	0.0
Percent filter-feeding individuals	0.0	--	--	--	--	0.0	0.0	0.0	0.0	0.0
Percent omnivores	0.0	--	--	--	--	0.0	0.0	0.0	0.0	0.0
Percent lunkers	0.0	--	--	--	--	0.0	0.0	0.0	0.0	0.0
Percent with anomalies	0.0	--	--	--	--	0.0	0.0	0.0	0.0	0.0

Appendix Table C-3. Data used to calculate Index of Biotic Integrity Scores for reaches 1 and 2 of Fields Creek, summer 2002 – spring 2003. Presence/absence (P/A) surveys were conducted in summer.

	Reach 1					Reach 2				
Metric	P/A	Summer	Fall	Winter	Spring	P/A	Summer	Fall	Winter	Spring
Native families	1	1	1	1	1	1	--	--	--	--
Native species	1	1	1	1	2	1	--	--	--	--
Native benthic species	0	0	0	0	0	0	--	--	--	--
Native water column species	1	1	1	1	3	1	--	--	--	--
Hider species	1	1	1	1	2	1	--	--	--	--
Sensitive species	1	1	1	1	2	1	--	--	--	--
Native nonguarding lithophil nester species	1	1	1	1	2	1	--	--	--	--
Percent tolerant individuals	0.0	0.0	0.0	0.0	0.0	0.0	--	--	--	--
Percent filter-feeding individuals	0.0	0.0	0.0	0.0	0.0	0.0	--	--	--	--
Percent omnivores	0.0	0.0	0.0	0.0	0.0	0.0	--	--	--	--
Percent lunkers	0.0	0.0	0.0	0.0	0.0	0.0	--	--	--	--
Percent with anomalies	0.0	4.3	33.3	16.7	0.0	0.0	--	--	--	--

Appendix Table C-4. Data used to calculate Index of Biotic Integrity Scores for reaches 1 and 2 of Kellogg Creek, summer 2002 – spring 2003. Presence/absence (P/A) surveys were conducted in summer.

	Reach 1					Reach 2				
Metric	P/A	Summer	Fall	Winter	Spring	P/A	Summer	Fall	Winter	Spring
Native families	2	4	3	3	2	3	4	2	4	4
Native species	4	6	5	5	4	5	4	2	4	5
Native benthic species	3	4	4	4	3	4	2	1	3	3
Native water column species	1	2	1	1	1	1	2	1	1	2
Hider species	2	3	2	2	2	3	3	2	4	4
Sensitive species	0	1	0	0	2	1	2	1	2	0
Native nonguarding lithophil nester species	0	1	0	2	0	1	2	1	0	2
Percent tolerant individuals	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.8	0.0
Percent filter-feeding individuals	0.0	0.0	0.0	0.0	0.0	0.6	1.5	0.0	1.6	1.8
Percent omnivores	0.0	3.4	14.7	8.2	0.0	0.3	0.0	0.0	0.8	0.0
Percent lunkers	19.3	5.9	9.5	35.7	100.0	100.0	0.0	0.0	50.0	0.0
Percent with anomalies	12.7	16.4	41.2	1.6	22.6	1.9	2.7	1.7	3.7	6.3

Appendix Table C-5. Data used to calculate Index of Biotic Integrity Scores for reaches 1 and 2 of Mount Scott Creek, summer 2002 – spring 2003. Presence/absence (P/A) surveys were conducted in summer.

	Reach 1					Reach 2				
Metric	P/A	Summer	Fall	Winter	Spring	P/A	Summer	Fall	Winter	Spring
Native families	4	3	3	3	3	3	--	--	--	--
Native species	6	5	5	5	5	3	--	--	--	--
Native benthic species	5	4	4	4	4	2	--	--	--	--
Native water column species	1	1	1	1	1	1	--	--	--	--
Hider species	4	2	2	2	3	1	--	--	--	--
Sensitive species	1	0	0	0	0	0	--	--	--	--
Native nonguarding lithophil nester species	1	0	0	0	0	0	--	--	--	--
Percent tolerant individuals	0.4	0.0	0.0	0.0	0.0	0.0	--	--	--	--
Percent filter-feeding individuals	0.2	0.0	0.0	0.0	0.0	0.0	--	--	--	--
Percent omnivores	0.4	0.6	4.8	11.1	1.2	4.8	--	--	--	--
Percent lunkers	63.6	57.1	28.6	37.5	0.0	0.0	--	--	--	--
Percent with anomalies	11.8	21.0	14.5	42.6	60.0	14.3	--	--	--	--

Appendix Table C-6. Data used to calculate Index of Biotic Integrity Scores for reaches 3 and 4 of Mount Scott Creek, summer 2002 – spring 2003. Presence/absence (P/A) surveys were conducted in summer.

	Reach 3					Reach 4				
Metric	P/A	Summer	Fall	Winter	Spring	P/A	Summer	Fall	Winter	Spring
Native families	4	2	3	2	2	3	3	2	3	3
Native species	5	2	3	2	2	3	3	2	3	3
Native benthic species	3	1	2	1	2	2	2	1	2	2
Native water column species	2	1	1	1	0	1	1	1	1	1
Hider species	4	2	3	2	2	3	3	2	3	3
Sensitive species	2	1	2	1	1	2	2	1	2	2
Native nonguarding lithophil nester species	2	1	2	1	1	2	2	1	2	2
Percent tolerant individuals	0.5	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0
Percent filter-feeding individuals	0.3	0.0	1.1	0.0	8.8	1.2	0.9	0.0	3.0	15.9
Percent omnivores	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Percent lunkers	0.0	0.0	0.0	0.0	0.0	0.0	21.4	0.0	16.7	25.0
Percent with anomalies	0.3	0.0	1.1	0.0	0.0	0.8	2.6	0.0	0.0	3.2

Appendix Table C-7. Data used to calculate Index of Biotic Integrity Scores for Pecan Creek, reach 1 and Phillips Creek, reach 1, summer 2002 – spring 2003. Presence/absence (P/A) surveys were conducted in summer.

	Stream, reach									
	Pecan, 1					Phillips, 1				
Metric	P/A	Summer	Fall	Winter	Spring	P/A	Summer	Fall	Winter	Spring
Native families	1	3	2	2	3	3	4	3	2	4
Native species	1	3	2	2	3	4	5	4	3	5
Native benthic species	1	2	2	1	2	2	3	2	2	3
Native water column species	0	1	0	1	1	2	2	2	1	2
Hider species	1	3	2	2	3	3	5	4	2	3
Sensitive species	0	2	1	1	2	1	2	1	0	1
Native nonguarding lithophil nester species	0	2	1	1	2	1	2	1	0	1
Percent tolerant individuals	0.0	0.0	0.0	0.0	0.0	0.0	2.3	2.1	1.4	0.0
Percent filter-feeding individuals	0.0	1.2	5.1	0.0	0.0	0.0	1.3	0.0	0.0	0.0
Percent omnivores	0.0	0.0	0.0	0.0	0.0	0.0	2.3	1.4	0.0	1.0
Percent lunkers	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0
Percent with anomalies	0.0	0.0	0.0	0.0	0.0	4.7	18.2	43.8	6.9	27.3

Appendix Table C-8. Data used to calculate Index of Biotic Integrity Scores for Phillips Creek, reach 2 and Rock Creek, reach 1, summer 2002 – spring 2003. Presence/absence (P/A) surveys were conducted in summer.

	Stream, reach									
	Phillips, 2					Rock, 1				
Metric	P/A	Summer	Fall	Winter	Spring	P/A	Summer	Fall	Winter	Spring
Native families	2	2	--	--	--	4	3	4	3	5
Native species	3	3	--	--	--	10	7	9	8	10
Native benthic species	2	2	--	--	--	5	3	3	3	5
Native water column species	1	1	--	--	--	5	4	6	5	5
Hider species	3	2	--	--	--	6	5	5	5	5
Sensitive species	0	0	--	--	--	5	3	5	4	4
Native nonguarding lithophil nester species	0	0	--	--	--	4	3	5	3	4
Percent tolerant individuals	4.9	0.0	--	--	--	0.9	0.0	0.0	0.0	0.0
Percent filter-feeding individuals	0.0	0.0	--	--	--	0.0	0.0	1.0	0.0	3.1
Percent omnivores	4.9	0.0	--	--	--	1.8	0.0	0.0	0.0	0.8
Percent lunkers	0.0	0.0	--	--	--	9.1	0.0	0.0	0.0	0.0
Percent with anomalies	75.6	12.7	--	--	--	6.3	18.6	28.7	8.7	4.5

Appendix Table C-9. Data used to calculate Index of Biotic Integrity Scores for reaches 2 and 3 of Rock Creek, summer 2002 – spring 2003. Presence/absence (P/A) surveys were conducted in summer.

	Reach 2					Reach 3				
Metric	P/A	Summer	Fall	Winter	Spring	P/A	Summer	Fall	Winter	Spring
Native families	2	4	4	2	2	2	2	3	1	
Native species	5	6	7	4	2	2	2	3	1	1
Native benthic species	2	3	5	1	1	2	2	2	1	1
Native water column species	3	3	2	3	1	0	0	1	0	0
Hider species	4	5	6	2	2	2	2	3	1	1
Sensitive species	4	4	4	3	1	1	1	2	0	0
Native nonguarding lithophil nester species	3	4	3	3	1	1	1	2	0	0
Percent tolerant individuals	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Percent filter-feeding individuals	0.0	1.3	1.5	0.0	0.0	0.6	2.7	3.2	0.0	0.0
Percent omnivores	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Percent lunkers	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Percent with anomalies	0.0	9.5	26.2	5.6	26.3	0.0	0.9	0.0	0.0	0.0

Appendix Table C-10. Data used to calculate Index of Biotic Integrity Scores for reaches 1 and 2 of Saum Creek, summer 2002 – spring 2003. Presence/absence (P/A) surveys were conducted in summer.

	Reach 1					Reach 2				
Metric	P/A	Summer	Fall	Winter	Spring	P/A	Summer	Fall	Winter	Spring
Native families	2	2	2	3	2	1	3	1	2	2
Native species	2	2	2	3	2	1	3	1	2	2
Native benthic species	2	2	2	2	2	1	2	1	2	1
Native water column species	0	1	0	1	1	0	0	0	0	0
Hider species	2	3	2	3	2	1	3	1	2	2
Sensitive species	1	1	1	1	1	0	2	0	1	2
Native nonguarding lithophil nester species	1	1	1	1	1	0	2	0	1	2
Percent tolerant individuals	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Percent filter-feeding individuals	15.4	8.0	6.9	15.3	37.5	0.0	3.8	0.0	2.1	66.7
Percent omnivores	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Percent lunkers	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Percent with anomalies	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Appendix Table C-11. Data used to calculate Index of Biotic Integrity Scores for Shipley Creek, reach 1 and Tate Creek, reach 1, summer 2002 – spring 2003. Presence/absence (P/A) surveys were conducted in summer.

	Stream, reach									
	Shipley, 1					Tate, 1				
Metric	P/A	Summer	Fall	Winter	Spring	P/A	Summer	Fall	Winter	Spring
Native families	--	0	0	2	2	1	3	2	3	4
Native species	--	0	0	2	2	1	3	2	3	4
Native benthic species	--	0	0	2	2	1	2	2	2	2
Native water column species	--	0	0	0	0	0	1	0	1	2
Hider species	--	0	0	2	2	1	3	2	2	3
Sensitive species	--	0	0	1	1	0	2	1	1	2
Native nonguarding lithophil nester species	--	0	0	1	1	0	2	1	1	2
Percent tolerant individuals	--	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Percent filter-feeding individuals	--	0.0	0.0	80.0	42.9	0.0	8.6	0.0	4.5	12.2
Percent omnivores	--	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Percent lunkers	--	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Percent with anomalies	--	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Appendix Table C-12. Data used to calculate Index of Biotic Integrity Scores for Tate Creek, reach 2 and Trillium Creek, reach 1, summer 2002 – spring 2003. Presence/absence (P/A) surveys were conducted in summer.

	Stream, reach									
	Tate, 2					Trillium, 1				
Metric	P/A	Summer	Fall	Winter	Spring	P/A	Summer	Fall	Winter	Spring
Native families	1	--	--	--	--	1	2	3	3	3
Native species	1	--	--	--	--	1	3	4	4	4
Native benthic species	1	--	--	--	--	1	1	2	2	2
Native water column species	0	--	--	--	--	0	2	2	2	2
Hider species	1	--	--	--	--	1	2	3	3	2
Sensitive species	0	--	--	--	--	0	2	2	2	1
Native nonguarding lithophil nester species	0	--	--	--	--	0	2	2	2	1
Percent tolerant individuals	0.0	--	--	--	--	0.0	0.0	0.0	0.0	0.0
Percent filter-feeding individuals	0.0	--	--	--	--	0.0	0.0	0.0	0.0	0.0
Percent omnivores	0.0	--	--	--	--	0.0	0.0	0.0	0.0	0.0
Percent lunkers	0.0	--	--	--	--	0.0	0.0	0.0	0.0	0.0
Percent with anomalies	0.0	--	--	--	--	0.0	0.0	0.0	28.6	14.3

Appendix Table C-13. Data used to calculate Index of Biotic Integrity Scores for reaches 2 and 3 of Trillium Creek, summer 2002 – spring 2003. Presence/absence (P/A) surveys were conducted in summer.

	Reach 2					Reach 3				
Metric	P/A	Summer	Fall	Winter	Spring	P/A	Summer	Fall	Winter	Spring
Native families	--	0	0	--	0	0	--	--	--	--
Native species	--	0	0	--	0	0	--	--	--	--
Native benthic species	--	0	0	--	0	0	--	--	--	--
Native water column species	--	0	0	--	0	0	--	--	--	--
Hider species	--	0	0	--	0	0	--	--	--	--
Sensitive species	--	0	0	--	0	0	--	--	--	--
Native nonguarding lithophil nester species	--	0	0	--	0	0	--	--	--	--
Percent tolerant individuals	--	100.0	0.0	--	0.0	100.0	--	--	--	--
Percent filter-feeding individuals	--	0.0	0.0	--	0.0	0.0	--	--	--	--
Percent omnivores	--	0.0	0.0	--	0.0	0.0	--	--	--	--
Percent lunkers	--	0.0	0.0	--	0.0	0.0	--	--	--	--
Percent with anomalies	--	0.0	0.0	--	0.0	0.0	--	--	--	--

Appendix Table C-14. Data used to calculate Index of Biotic Integrity Scores for Unnamed 1 Creek, reach 1 and Unnamed 2 Creek, reach 1, summer 2002 – spring 2003. Presence/absence (P/A) surveys were conducted in summer.

	Stream, reach									
	Unnamed 1, 1					Unnamed 2, 1				
Metric	P/A	Summer	Fall	Winter	Spring	P/A	Summer	Fall	Winter	Spring
Native families	--	--	--	0	--	1	1	1	1	1
Native species	--	--	--	0	--	1	1	1	1	1
Native benthic species	--	--	--	0	--	0	0	0	0	0
Native water column species	--	--	--	0	--	1	1	1	1	1
Hider species	--	--	--	0	--	1	1	1	1	1
Sensitive species	--	--	--	0	--	1	1	1	1	1
Native nonguarding lithophil nester species	--	--	--	0	--	1	1	1	1	1
Percent tolerant individuals	--	--	--	0.0	--	0.0	0.0	0.0	0.0	0.0
Percent filter-feeding individuals	--	--	--	0.0	--	0.0	0.0	0.0	0.0	0.0
Percent omnivores	--	--	--	0.0	--	0.0	0.0	0.0	0.0	0.0
Percent lunkers	--	--	--	0.0	--	0.0	0.0	0.0	0.0	0.0
Percent with anomalies	--	--	--	0.0	--	0.0	0.0	0.0	0.0	0.0

Appendix Table C-15. Data used to calculate Index of Biotic Integrity Scores for Unnamed 2 Creek, reach 2 and Unnamed 4 Creek, reach 1, summer 2002 – spring 2003. Presence/absence (P/A) surveys were conducted in summer.

	Stream, reach									
	Unnamed 2, 2					Unnamed 4, 1				
Metric	P/A	Summer	Fall	Winter	Spring	P/A	Summer	Fall	Winter	Spring
Native families	1	1	1	0	1	--	0	0	0	0
Native species	1	1	1	0	1	--	0	0	0	0
Native benthic species	0	0	0	0	0	--	0	0	0	0
Native water column species	1	1	1	0	1	--	0	0	0	0
Hider species	1	1	1	0	1	--	0	0	0	0
Sensitive species	1	1	1	0	1	--	0	0	0	0
Native nonguarding lithophil nester species	1	1	1	0	1	--	0	0	0	0
Percent tolerant individuals	0.0	0.0	0.0	0.0	0.0	--	0.0	0.0	0.0	0.0
Percent filter-feeding individuals	0.0	0.0	0.0	0.0	0.0	--	0.0	0.0	0.0	0.0
Percent omnivores	0.0	0.0	0.0	0.0	0.0	--	0.0	0.0	0.0	0.0
Percent lunkers	0.0	0.0	0.0	0.0	0.0	--	0.0	0.0	0.0	0.0
Percent with anomalies	0.0	0.0	0.0	0.0	0.0	--	0.0	0.0	0.0	0.0

Appendix Table C-16. Data used to calculate Index of Biotic Integrity Scores for reaches 1 and 2 of Unnamed 5 Creek, summer 2002 – spring 2003. Presence/absence (P/A) surveys were conducted in summer.

	Reach 1					Reach 2				
Metric	P/A	Summer	Fall	Winter	Spring	P/A	Summer	Fall	Winter	Spring
Native families	2	2	3	3	3	1	1	2	1	2
Native species	2	2	3	4	3	1	0	2	1	2
Native benthic species	1	1	2	3	2	1	0	2	1	2
Native water column species	1	1	1	1	1	0	0	0	0	0
Hider species	2	2	3	3	2	1	0	2	1	2
Sensitive species	1	1	2	2	2	0	0	1	0	1
Native nonguarding lithophil nester species	1	1	2	2	0.0	0	0	1	0	1
Percent tolerant individuals	0.0	0.0	0.0	0.0	48.8	0.0	0.0	0.0	0.0	0.0
Percent filter-feeding individuals	0.0	0.0	3.3	17.9	0.0	0.0	0.0	7.1	0.0	24.0
Percent omnivores	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Percent lunkers	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Percent with anomalies	0.0	0.0	3.3	2.6	0.0	0.0	0.0	0.0	0.0	0.0

Appendix Table C-17. Data used to calculate Index of Biotic Integrity Scores for reaches 1 and 2 of Unnamed 6 Creek, summer 2002 – spring 2003. Presence/absence (P/A) surveys were conducted in summer.

	Reach 1					Reach 2				
Metric	P/A	Summer	Fall	Winter	Spring	P/A	Summer	Fall	Winter	Spring
Native families	2	2	2	4	3	1	--	--	--	--
Native species	2	2	2	4	3	1	--	--	--	--
Native benthic species	2	2	2	2	2	1	--	--	--	--
Native water column species	0	0	0	2	1	0	--	--	--	--
Hider species	2	2	2	1	3	1	--	--	--	--
Sensitive species	1	1	1	1	2	0	--	--	--	--
Native nonguarding lithophil nester species	1	1	1	0.0	2	0	--	--	--	--
Percent tolerant individuals	0.0	0.0	0.0	16.0	0.0	0.0	--	--	--	--
Percent filter-feeding individuals	11.1	26.3	11.1	0.0	50.0	0.0	--	--	--	--
Percent omnivores	0.0	0.0	0.0	0.0	0.0	0.0	--	--	--	--
Percent lunkers	0.0	0.0	0.0	0.0	0.0	0.0	--	--	--	--
Percent with anomalies	0.0	0.0	0.0	0.0	0.0	0.0	--	--	--	--

Appendix Table C-18. Data used to calculate Index of Biotic Integrity Scores for reach 2 of Wilson Creek, summer 2002 – spring 2003. Presence/absence (P/A) surveys were conducted in summer.

	Reach 2				
Metric	P/A	Summer	Fall	Winter	Spring
Native families	2	2	2	4	3
Native species	2	2	2	4	3
Native benthic species	2	2	2	2	2
Native water column species	0	0	0	2	1
Hider species	2	2	2	3	3
Sensitive species	1	1	1	1	2
Native nonguarding lithophil nester species	1	1	1	1	2
Percent tolerant individuals	0.0	0.0	0.0	0.0	0.0
Percent filter-feeding individuals	11.1	26.3	11.1	16.0	50.0
Percent omnivores	0.0	0.0	0.0	0.0	0.0
Percent lunkers	0.0	0.0	0.0	0.0	0.0
Percent with anomalies	0.0	0.0	0.0	0.0	0.0

APPENDIX D

Stream Reach Locations

Appendix Table D-1. Approximate locations of Clackamas County stream reaches surveyed from summer 2002 through spring 2003.

Stream	Reach	Description
Athey	1	Mouth to dam at Schaber Bros. Reservoir then top of reservoir to Borland Rd.
	2	Borland Rd. south to I205 culvert (north side)
	3	I-205 culvert (south side) to Trail Rd.
Dean	1	From mouth at Mt. Scott Creek. Park at McFarlane's at end of Johnson Rd., walk down south side of railroad tracks to just before bridge over Mt. Scott Creek turn south on old road bed. The mouth of Dean Creek is on the south side of the culverts at this location. • Habitat surveys were conducted in habitat improvement areas from the mouth to the bridge at SE 82nd Ave.
Cedar	1	• Habitat surveys were conducted in habitat improvement areas starting ~100m downstream and up to the culvert at SE Mather Rd.
Ek	1	Mouth to Borland Rd. (heavy vegetation restricting access to the creek)
	2	Culvert along I205 to restricted access point above Athey Rd.
Fields	1	Mouth to Elderberry Ln.
	2	Elderberry Ln. to Bosky Dell Ln. is not accessible. Start at native plant nursery at the end of Bosky Dell and go upstream until vegetation gets too dense.
Kellogg	1	Head of Kellogg Lake upstream to mouth of Mt. Scott Creek. Lower access is apartment complex at upper end of the lake (SE Whitcomb Dr.) Start at the eastside of the lawn area behind the main office building. The upper access points include Wilbur Rowe School along Lake Rd. Exit stream before Ryan Ct. area due to lack of access permission but reenter along Kuhn Rd. to Mt. Scott.
	2	Mouth of Mt. Scott Creek upstream to SE Thiessen and SE Aldercrest.

Appendix Table D-1 (continued).

Stream	Reach	Description
Mt. Scott	1	From mouth upstream to railroad tracks at Harmony Rd. then re-enter above sediment pond off of Harmony Rd. • Habitat surveys were conducted in habitat improvement areas starting ~200m downstream and up to reach 2.
	2	Between Phillips and Dean Creeks. Access from Mac Farlane's the end of Johnson Rd. Park along chain link fence and walk NE along Railroad tracks. • Habitat surveys were conducted in habitat improvement areas between the mouths of Phillips and Dean creeks.
	3	From mouth of Dean Creek to mouth of last tributary before Mt. Scott passes under Sunnyside Rd. Access start same as above.
	4	Last tributary before crossing under Sunnyside Rd. to 129th Ave. • Habitat surveys were conducted in habitat improvement areas from starting ~50m downstream of improvements at old dam site near Sunny Wy, and Nella Wy. and through improvement site.
Pecan	1	Mouth to thick vegetation near Ecotopia Ln. Access start from Mossy Brae Rd.
Phillips	1	From mouth at Mt. Scott Creek upstream to Sunnybrook Rd. Park at McFarlane's at end of Johnson Rd. then cross railroad tracks and follow Mt. Scott Creek north to tributary. Suggest shuttle vehicle to parking lot near Sunnybrook Rd. (e.g. Guitar Center or Sheriff's Office). • Habitat surveys were conducted in habitat improvement areas from the mouth to the culvert at SE 84th St.
	2	From Sunnybrook Rd. upstream to waterfall (~50m). Park at Sheriff's Office.
Rock	1	From mouth of creek at Clackamas River to bridge at SR 224. Park along SR 224 at vacant lot (where large culvert pipes say "keep out") and proceed through lot following trails down to creek.
	2	From SR 224 to 40ft. falls (or tall razor wire security fence which ever comes first). Park along SR 224 at vacant lot (where large culvert pipes say "keep out") and proceed through lot following trails down to creek then up to bridge.
	3	From 40ft. falls to Sunnyside Rd. Parking available on roads near intersection of Sunnyside Rd. and Rock Creek culvert.
Saum	1	Mouth to Borland Rd. Access starting point from the end of Tualasaum Rd.
	2	Borland Rd. to restricted access property west of Prosperity Park Rd.

Appendix Table D-1 (continued).

Stream	Reach	Description
Shipley	1	Mouth to area above pump station along Shadow Wood Dr. (parallel with Stafford Rd.)
Tate	1	Begins at mouth to I205 culvert. Park along Johnson Rd. or on Grapevine Rd. under I205.
	2	I205 to old rd. crossing (beaver marsh from I205 to ~1/2 way up Woodbine). Surveyed from above beaver marsh to old rd. bed.
Trillium	1	From mouth of creek at Rock Creek to ~8ft. falls. Park along SR 224 at vacant lot (where large culvert pipes say "keep out") and proceed through lot following trails down to Rock Creek. Proceed upstream to mouth of tributary.
	2	From ~8ft. falls to culvert at SR 224 (south of SR 224/212 intersection and near the corner of the produce market's parking lot). Park along SR 224 at vacant lot (where large culvert pipes say "keep out") and proceed through lot following trails down to Rock Creek. Proceed upstream to mouth of tributary then ~100m to falls.
	3	From east side of culvert at SR 224 (south of SR 224/212 intersection and near the corner of the produce market's parking lot) to north side of housing development. Park at produce market's parking lot (Check with market staff. Let them know you will be parking the for and extended period of time.
Unnamed #1	1	At Turner Rd. and Borland Rd. (Check for water from Borland Rd.)
Unnamed #2	1	Mouth to Borland Rd. Park along Borland Rd. and cross fence to mouth. Park along Riberia Rd.
	2	Borland Rd. to fence above Turner Rd. culvert.
Unnamed #4	1	Mouth to Hilltop Rd. Access from River Run Park easement along rivers edge.
Unnamed #5	1	Mouth to Johnson Rd. Access the start point from I 205 (i.e. park at Johnson Rd. and I205 bridge then walk down edge of I205 to the bridge over the Tualatin River. Mouth of creek is near bridge.)
	2	From Johnson Rd. north. Start above the beaver marsh and go up, stay to the left at the fork and go until the water runs out.

Appendix Table D-1 (continued).

Stream	Reach	Description
Unnamed #6	1	Begins at mouth to I205 culvert. Park on Grapevine Rd. under I205.
	2	Culvert at Grapevine Rd. until water runs out.
Wilson	2	To access starting point...Park a last curve on Johnson Rd. above the I205 bridge then cross the field on west side of the road and drop down into the creek above the Wanker's property line. Start at the fence line.