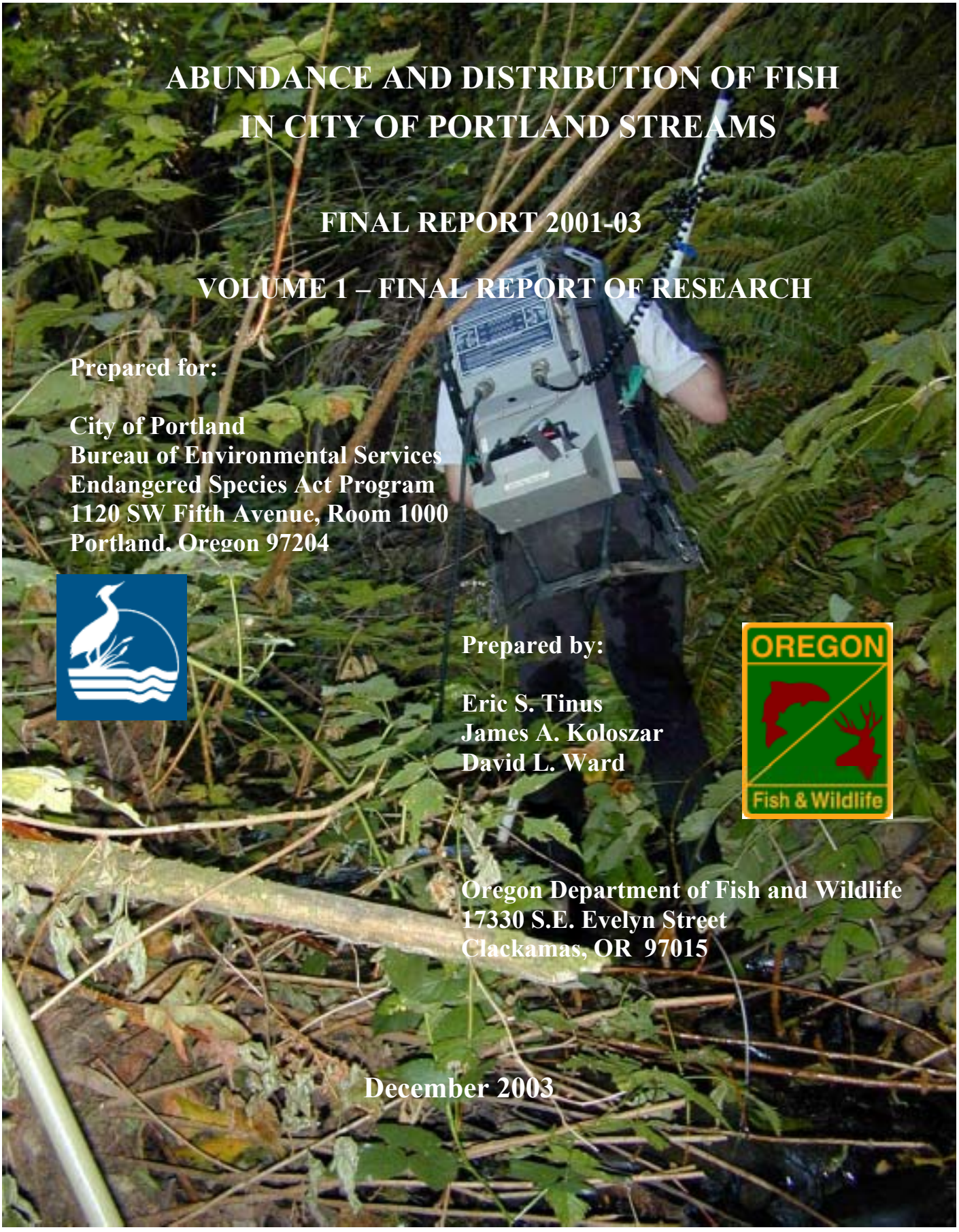

ABUNDANCE AND DISTRIBUTION OF FISH IN CITY OF PORTLAND STREAMS

FINAL REPORT 2001-03

VOLUME 1 – FINAL REPORT OF RESEARCH

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EXECUTIVE SUMMARY

From summer 2001 through spring 2003, the Oregon Department of Fish and Wildlife (ODFW) and the City of Portland's Endangered Species Act Program investigated and inventoried fish communities in Portland streams. We conducted fish surveys in nine Portland streams including Balch, Crystal Springs, Doane, Johnson, Kelley, Miller, Saltzman, Stephens, and Tryon creeks. In summer 2001 and summer 2002 we used a backpack electrofisher to sample 20% of the fast water units (riffles and cascades), glides, and pools within each stream reach. In each season from summer 2001 through spring 2003 we sampled an easily accessible, representative 100-m length of each stream reach. Most streams had been previously surveyed by ODFW crews to quantify aquatic habitat. As per habitat inventory protocols, reaches were delineated by significant landscape changes, major tributaries, or passage barriers. The habitat units used for sampling are described in more detail in ODFW's "Aquatic Inventory Project: Methods for Stream Habitat Surveys (Moore et al. 2002).

We found fish in all streams except Doane and Saltzman creeks. Within the seven fish-bearing streams we conducted 183 reach/time surveys, and collected almost 25,000 fish. Among the fish collected, more than half (55%) were sculpins, 30% were minnow species, 7% were salmon and trout, 5% were lamprey species, 2% were alien species, and 1% were suckers. Native fishes were identified to 16 species in six families, and alien species were identified to 11 species in six families.

Cutthroat trout *Oncorhynchus clarki* were the most common salmonid and were present in all fish-bearing streams except Stephens Creek. We observed rainbow/steelhead trout *O. mykiss* in all reaches of Tryon Creek and throughout the Johnson Creek watershed in very low numbers. All rainbow/steelhead trout other than two adults observed in the lowest reach of Tryon Creek were juveniles, and all coho salmon *O. kisutch* and chinook salmon *O. tshawytscha* observed were juveniles. Coho salmon were observed only in the lower Johnson Creek watershed and in the lowest reaches of Miller, Stephens, and Tryon creeks. Chinook salmon were present in the lowest reaches of Crystal Springs, Johnson, Miller, Stephens, and Tryon creeks.

In Johnson Creek, too few rainbow/steelhead trout were observed to speculate on life history characteristics. Coho salmon and chinook salmon juveniles from the Willamette River appear to use the lower reaches for rearing or overwintering habitat. Johnson Creek is also a potential producer of coho salmon; however, we found no evidence suggesting a viable population exists.

Within the Johnson Creek watershed, Kelley Creek appears to be a relative stronghold for cutthroat trout. The largest cutthroat trout individuals were observed in Kelley Creek in winter 2002, winter 2003 and summer 2002. Fall and winter spawning and migratory behavior of relatively large adult cutthroat trout would be consistent with a fluvial or anadromous life history. We observed cutthroat trout redds in winter 2002. Protection of Kelley Creek should be a high priority.

Recruitment of cutthroat trout in 2002 was also evident in Tryon Creek. Although we found no similar evidence of rainbow/steelhead trout production, the presence in spring 2002 and absence in summer 2002 of fish longer than 115 mm is consistent with juvenile outmigration behavior of

anadromous or fluvial forms. Similar to Johnson Creek, the lowest reach of Tryon Creek appears to be rearing or overwintering habitat for juvenile chinook salmon and coho salmon from the Willamette River.

Fish passage is provided between reaches 1 and 2 of Tryon Creek, but the culvert may not function properly under certain conditions. The old metal baffles trap wood that obstructs flow between baffles. When plugged with woody debris, the water is too shallow during low flows and may be a velocity barrier at high flows. The height between the plunge pool surface and the culvert outflow may be too great for small fish to swim upstream.

Balch Creek has a robust population of resident cutthroat trout, with successful recruitment evident during both years of study. Small size of the largest fish relative to some other streams may be due to the isolation of Balch Creek. Fish have no choice but to be resident, and cannot migrate to the Willamette River. This isolation also increases the vulnerability of the population because no genetic interchange or natural colonization can occur. Recruitment of gravel may also be a limiting factor, and residential land uses may affect the fish population; however, fairly inaccessible portions of the stream exist in sufficient numbers to sustain quiet refugia. These areas should be protected.

Lampreys were observed only in the Johnson Creek watershed, including Kelley Creek, with the exception of one fish observed near the mouth of Stephens Creek. A few lampreys were identified to species: adult western brook lamprey *Lampetra richardsoni* and Pacific lamprey outmigrants (macropthalmia) *Lampetra tridentata*. Relatively high abundance of lampreys further supports making protection of Kelley Creek a high priority. Further study of this tributary should be conducted to understand the conditions that are supporting these sensitive species.

Index of Biotic Integrity (IBI) scores for all sampling efforts in fish-bearing streams ranged from 8 to 87. An IBI is a scoring criteria (maximum possible score = 100) used to assess the ecological condition of a stream as it relates to fish assemblage conditions. The mean IBI for all sampling efforts per stream reach indicates one third of 21 fish bearing reaches are marginally impaired and the balance are severely impaired. No mean IBI scores are considered acceptable. Acceptable IBI scores occurred six times among a total of 183 scores.

Despite approximately 150 years of urban development, many Portland streams still contain a relatively diverse assemblage of native fish species, including salmonids. Alien species still comprise a very small percentage of individuals. Although fish assemblages have undoubtedly changed throughout the period of urban development, 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 Portland, time is of the essence for the Johnson Creek watershed, including Kelley Creek, and for Tryon Creek to protect the most productive stream reaches. The highest short-term potential probably exists in larger publicly owned land parcels: municipal parks in Portland, Tryon Creek State Park, and Metro green spaces.

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

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

- The City should take aggressive steps to upgrade riparian environmental zones and implement innovative stormwater management to restore habitat and improve water quality.

- Conduct fish and habitat inventories at regular intervals (3-5 years) to evaluate trends and provide information for pre- and post-treatment evaluations. More tributaries of Multnomah Channel should be included in these surveys.

- Conduct annual surveys to evaluate spawning of salmonids and Pacific lamprey.

- Conduct intensive surveys to evaluate abundance, biomass, spatial structure, habitat use, and movements of salmonids in Tryon Creek and within the Johnson Creek watershed. This study was designed to provide broad information on distribution and relative abundance of fish in streams throughout the Portland area. More intensive studies in selected streams would allow collection of more detailed information on fish populations and potentially facilitate recommendations for specific habitat restoration actions to meet region-wide salmonid recovery goals.

INTRODUCTION

During summer 2001, the Oregon Department of Fish and Wildlife (ODFW) and the City of Portland's Endangered Species Act Program began to investigate and inventory fish communities in Portland streams. The City of Portland's Framework for Integrated Management of Watershed and River Health requires knowledge of distribution and habitat use of fish, particularly species listed under the federal Endangered Species Act (ESA). Fish surveys provide important baseline information on species distribution and abundance, and may assist managers to set priorities on aquatic habitat protection and restoration work. This final report presents the results of our investigations of fish communities in lower order streams of the Portland metropolitan area. Specifically, we:

1. Identify fish species assemblages and their distribution within selected streams and stream reaches throughout the City of Portland;
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 sensitive species.

Urban stream surveys conducted in Washington and Clackamas counties within the Portland metropolitan area (Ward 1995; Friesen and Ward 1996; Friesen and Zimmerman 1999; Leader 2001a; Leader 2001b; Graham and Ward 2002) 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 to be listed 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) and like salmonids and lampreys, may be sensitive to habitat degradation and pollution.

METHODS

Study Area

We conducted fish surveys in nine Portland streams including Balch, Crystal Springs, Doane, Johnson, Kelley, Miller, Saltzman, Stephens, and Tryon creeks (Figure 1). Balch, Doane, and

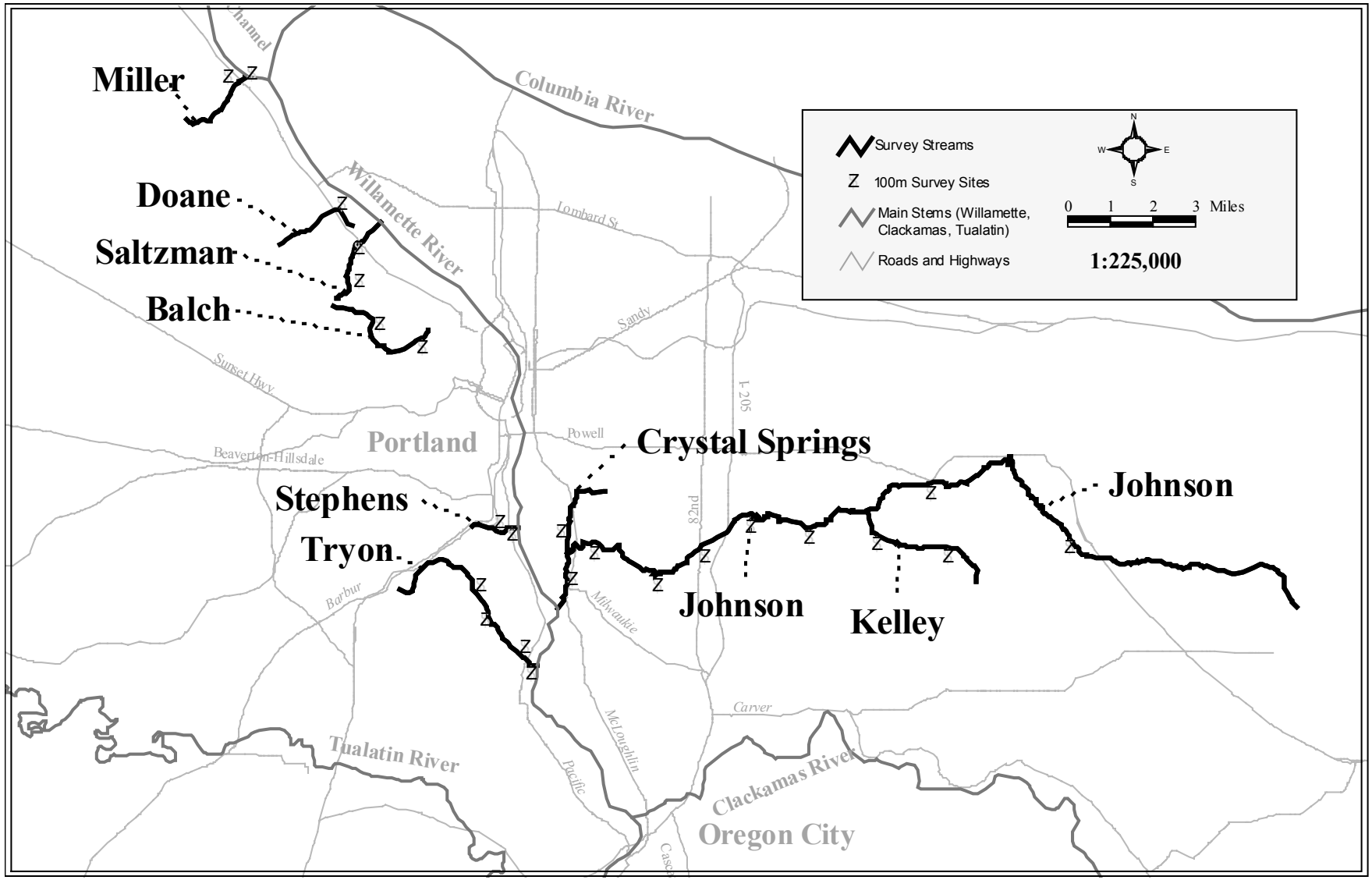

Figure 1. Location of streams and 100-m sites surveyed for fish distribution and abundance in Portland, Oregon, Summer 2001 – Spring 2003.

Saltzman creeks flow through Forest Park in Portland and enter the Willamette River on the west bank. Miller Creek also flows through Forest Park but enters Multnomah Channel, which flows from the Willamette River into the Columbia River to form the Sauvie Island delta. Tryon and Stephens creeks flow east into the Willamette River south of downtown Portland. Johnson Creek flows west into the Willamette River at Milwaukie. Crystal Springs and Kelley Creek are tributaries of Johnson Creek. Crystal Springs flows south near the Sellwood area of Portland and Kelley Creek enters Johnson Creek near Gresham.

Field Sampling

Presence/Absence Sampling

We conducted fish surveys using a backpack electrofisher during summer (2001 and 2002) 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. 2002). 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 2001 – Spring 2003), block nets were placed at the downstream and upstream ends 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 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 in all of the seasonal surveys. Not all reaches were sampled during winter 2002.

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 Portland 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 and for all salmonids combined within each stream reach MPR survey site. Estimates were limited to those stream reaches where the number of salmonids captured decreased with each electrofishing pass. For comparative purposes, we calculated a population density and distribution index for all salmonids combined for each sample site/effort (salmonids per linear meter stream surveyed).

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 by proportion of catch by species and location per sampling effort were plotted graphically and examined visually for ranges of FL values, nodes in distribution, and temporal shifts in distribution.

RESULTS

From summer 2001 through spring 2003, we sampled seven fish bearing streams in 183 reach/time surveys. We collected and examined almost 25,000 individuals. Among the fish collected, more than half (55%) were sculpins, 30% were minnow species, 7% were salmon and trout, 5% were lamprey species, 2% were alien species, and 1% were suckers. Native fishes were identified to 16 species in six families (Table 2). Alien species were identified to 11 species in six families. We conducted P/A and MPR surveys in several reaches in Saltzman and Doane creeks, but found no fish.

Catch of various species differed among habitat types during summer P/A surveys. Forty percent of the fish we collected came from fast water habitat (38% of units sampled), 35% from glides (24% of units), and 26% from pools (38% of units). Catch of salmonids differed, with 29% found in fast water, 15% in glides, and 56% in pools. Salmonids composed 23% of the total catch in pools, but only 8% in fast water and 5% in glides.

Table 1. IBI scoring criteria used for Portland streams, 2001-2003, 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.

	Raw values	
Metric	Stream order 1	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).

Table 2. Fish collected during presence/absence (P/A) and the first pass of multiple-pass removal (MPR) surveys in Portland streams, Summer 2001 – Spring 2003.

Family,	Catch		Proportion of Total	
Species	P/A	MPR	P/A	MPR
Petromyzontidae				
Unidentified lamprey *Lampetra* spp.[a]	26	628	0.006	0.045
Cyprinidae				
Goldfish *Carassius auratus*[b]	0	2	0.000	<0.001
Northern pikeminnow *Ptychocheilus oregonensis*	0	15	0.000	0.001
Longnose dace *Rhinichthys cataractae*	181	238	0.040	0.017
Speckled dace *Rhinichthys osculus*	282	1,423	0.063	0.103
Redside shiner *Richardsonius balteatus*	429	3,187	0.096	0.230
Cobitidae[b]				
Oriental weatherfish *Misgurnus anguillicaudatus*	0	8	0.000	0.001
Catostomidae				
Largescale sucker *Catostomus macrocheilus*	1	206	<0.001	0.015
Ictaluridae[b]				
Brown bullhead *Ameiurus natalis*	0	10	0.000	0.001
Yellow bullhead *Ameiurus nebulosus*	0	5	0.000	<0.001
Unidentifed bullhead *Ameiurus* spp.	1	29	<0.001	0.002
Salmonidae				
Cutthroat trout *Onchorhynchus clarki*	432	593	0.096	0.043
Coho salmon *Onchorhynchus kisutch*	3	104	0.001	0.008
Rainbow trout/steelhead *Onchorhynchus mykiss*	37	50	0.008	0.004
Chinook salmon *Onchorhynchus tshawytscha*	14	56	0.003	0.004
Unidentified salmonids *Salmonidae* spp.	59	32	0.013	0.002
Fundulidae[b]				
Banded killifish *Fundulus diaphanus*	0	9	0.000	0.001
Poeciliidae[b]				
Western mosquitofish *Gambusia affinis*	0	128	0.000	0.009
Gasterosteidae				
Three-spined stickleback *Gasterosteus aculeatus*	13	36	0.003	0.003

Table 2. (continued).

Family, Species	Catch P/A	Catch MPR	Proportion of Total P/A	Proportion of Total MPR
Cottidae				
Prickly sculpin *Cottus asper*	44	113	0.010	0.008
Riffle sculpin *Cottus gulosus*	84	121	0.019	0.009
Reticulate sculpin *Cottus perplexus*	1,911	3,828	0.427	0.277
Torrent sculpin *Cottus rhotheus*	0	7	0.000	0.001
Unidentified sculpins *Cottidae* spp.	954	2,894	0.213	0.209
Centrarchidae[b]				
Pumpkinseed *Lepomis gibbosus*	4	62	0.001	0.004
Bluegill *Lepomis macrochirus*	0	1	0.000	<0.001
Smallmouth bass *Micropterus dolomieu*	0	31	0.000	0.002
Largemouth bass *Micropterus salmoides*	1	2	<0.001	<0.001
White crappie *Pomoxis annularis*	0	10	0.000	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.

Species Assemblages and Distribution

Cutthroat trout were the most common salmonid (Table 2) and were present in all fish-bearing streams except Stephens Creek (Appendices A and B). We observed cutthroat trout throughout the Johnson Creek watershed, except for reaches 2, 8, and 10 of Johnson Creek.

We observed rainbow/steelhead trout in all reaches of Tryon Creek (N = 54) and throughout the Johnson Creek watershed in very low numbers (N = 23). One small fish was observed in lower Miller Creek and several adult adipose fin-clipped steelhead trout were observed near the mouths of Stephens and Tryon creeks.

All coho and chinook salmon observed were juveniles. Coho salmon were observed only in the lower Johnson Creek watershed (Crystals Springs Creek and reaches 2 and 6 of Johnson Creek) and in the lowest reaches of Miller, Stephens, and Tryon creeks. Chinook salmon were present in the lowest reaches of Crystal Springs, Johnson, Miller, Stephens, and Tryon creeks.

Lampreys were observed only in the Johnson Creek watershed with the exception of one fish observed near the mouth of Stephens Creek (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 stream reaches except Balch Creek. The most abundant and widely distributed species was reticulate sculpin. Prickly sculpins were observed throughout the Johnson Creek watershed and in the lowest reaches of Miller, Stephens, and Tryon creeks. Riffle sculpins were observed at a rate slightly greater than prickly sculpins, but distribution was limited to the Johnson Creek watershed and the lowest reach of Tryon Creek. We found five torrent sculpins in the lowest reach of Tryon Creek.

We observed additional native species in most streams (Appendices A and B). Redside shiners and speckled dace were the most common minnows. Minnows were observed in all stream reaches except Balch Creek and reach 2 of Miller Creek. Largescale suckers were the only sucker species observed, and were observed throughout the Johnson Creek watershed. Three-spined sticklebacks were present in low numbers in the lower reaches of the Johnson Creek watershed and in Miller and Stephens creeks.

We found alien species in 15 of 21 fish-bearing reaches, although at relatively low abundance. Bullhead species were observed in reaches 2, 4, and 16 of Johnson Creek and in the lowest reaches of Crystal Springs, Stephens, and Tryon creeks. Sunfish (primarily pumpkinseed) were observed throughout the Johnson Creek watershed (excluding Kelley Creek) and in the lowest reaches of Stephens and Tryon creeks. Western mosquito fish and banded killifish were observed in the lowest reach of Miller and Stephens creeks. Oriental weatherfish were observed in the lowest reach of Crystal Springs, Miller, Stephens, and Tryon creeks. We found one goldfish in reach 8 of Johnson Creek and another one in reach 2 of Stephens Creek (the only fish observed in this reach).

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 least abundant in winter in Balch and Tryon Creeks. In Johnson and Kelley creeks, cutthroat trout were least abundant in spring. Winter abundance in Kelley creek was more than twice as high as in Johnson Creek. Seasonal variability was lowest in Balch and Tryon creeks, and highest in Johnson and Kelley creeks.

Coho salmon were most abundant in winter in Miller Creek and in spring in Stephens Creek. Coho salmon were present in Miller Creek throughout the year in moderate numbers. Coho salmon were also observed all seasons in Stephens Creek, but in low numbers.

Chinook salmon were present in greatest numbers during winter and summer in Stephens Creek. Few chinook salmon were present in fall and spring. Rainbow/steelhead trout were observed in greatest numbers during spring in Tryon Creek. Relatively few were observed during summer.

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					
Balch Creek	0.383	0.230	0.158	0.230	431
Johnson Creek	0.471	0.324	0.118	0.088	34
Kelley Creek	0.382	0.235	0.294	0.088	34
Tryon Creek	0.320	0.292	0.169	0.219	178
Coho salmon					
Miller Creek	0.224	0.143	0.367	0.265	49
Stephens Creek	0.056	0.037	0.019	0.889	54
Chinook salmon					
Stephens Creek	0.214	0.071	0.690	0.024	42
Rainbow/steelhead trout					
Tryon Creek	0.029	0.265	0.176	0.529	34

Index of Biotic Integrity

IBI scores for all sampling efforts in fish-bearing streams ranged from 8 to 87 (Table 4). The mean IBI for all sampling efforts per stream reach indicated one-third of 21 fish bearing reaches were marginally impaired and the balance were severely impaired. No mean IBI scores were considered acceptable. Acceptable IBI scores occurred six times among a total of 183 scores. Higher scores generally coincided with headwater reaches (Kelley, Tryon, and Johnson creeks) or reaches connected to the mainstem Willamette River (Stephens, Tryon, and Miller creeks). Lower scores generally coincided with reaches upstream of passage barriers (Stephens, Balch, and Miller creeks). Individual metric scores used to calculate the IBI scores are presented in Appendix C.

Salmonid Abundance Estimates

We estimated salmonid abundance by species for 17 reaches by season, summer 2002 – spring 2003 (Appendix D). Estimated abundance was highest in Balch, Stephens, and Tryon creeks, and lower in the Johnson Creek watershed. Average estimated abundance of all salmonids combined per linear meter of stream reach surveyed was highest in Balch Creek and lowest in reach 6 of Johnson Creek (Table 5). Estimated abundance was variable across seasons and ranged from 0 to1.090 fish/m within individual stream reaches.

Table 4. Index of Biotic Integrity (IBI) scores by stream reach and season for Portland area streams, summer 2001 – spring 2003. P/A = summer presence/absence surveys. Seasonal surveys are multiple-pass removal surveys: Su = summer, F = fall, W = winter, and Sp = spring. Stream reaches are ordered from highest to lowest mean IBI score. N/S = Not surveyed, N/A = Not applicable.

Stream	Reach	2001 P/A	2001 Su	2001 F	2002 W	2002 Sp	2002 P/A	2002 Su	2002 F	2003 W	2003 Sp	Mean	Range
Kelley	2	N/S	34	72	75	76	58	73	77	87	75	70	53
Stephens	1	55	56	35	75	65	59	68	62	69	33	58	41
Tryon	1	54	71	74	N/S	54	40	65	25	56	66	56	49
Johnson	2	63	47	52	50	63	60	54	50	52	57	55	17
Crystal Springs	1	48	40	42	58	65	65	58	51	47	55	53	26
Tryon	4	42	51	51	N/S	51	48	51	65	51	65	53	23
Miller	1	44	35	34	41	68	68	51	49	58	64	51	34
Johnson	16	52	41	48	N/S	50	50	52	55	42	49	49	14
Kelley	1	41	51	49	49	48	50	52	54	48	40	48	14
Johnson	4	42	40	42	N/S	41	45	59	63	37	46	46	26
Johnson	12	N/S	51	34	N/S	40	30	50	58	31	52	43	28
Tryon	2	41	41	46	N/S	41	38	41	41	50	50	43	12
Tryon	3	50	32	41	N/S	41	46	41	39	40	43	41	18
Johnson	14	52	36	37	N/S	31	40	52	40	37	46	41	21
Johnson	6	45	52	38	N/S	30	43	43	54	32	30	41	24
Johnson	10	42	N/S	N/S	N/S	N/S	47	40	38	43	31	40	16
Miller	2	N/A	34	38	34	51	48	N/A	34	34	34	38	17
Johnson	8	44	44	34	N/S	36	30	44	40	29	40	38	16
Balch	2	36	36	36	36	36	36	36	36	36	36	36	0
Balch	1	32	36	36	36	36	36	36	27	27	36	34	8
Stephens	2	N/A	N/A	N/A	N/S	N/A	N/A	8	N/A	N/A	N/A	8	0

Table 5. Index of distribution and abundance (estimated number of salmonids per linear meter of stream) of salmon and trout by location and season in City of Portland streams, summer 2002 - spring 2003. Su = summer, F = fall, W = winter, and Sp = spring. Indices for each stream reach are ordered from highest to lowest average density. Population estimates with extreme confidence interval bounds are not included. Reaches where values are less than 0.001 and salmonids have been observed are assigned a value of 0.

		Season				
Stream	Reach	Su	F	W	Sp	Mean
Balch	1	0.360	0.230	0.250	0.470	0.328
Stephens	1	1.090	0.030	0.170	0.000	0.323
Balch	2	0.580	0.270	0.100	0.210	0.290
Tryon	3	--	0.410	0.210	0.040	0.220
Tryon	4	0.120	0.180	0.140	0.220	0.165
Tryon	1	0.340	0.000	0.070	0.230	0.160
Johnson	12	0.040	0.020	0.000	0.490	0.138
Miller	1	0.200	0.080	0.150	0.114	0.136
Tryon	2	0.070	0.040	0.060	0.130	0.075
Kelley	1	0.100	0.060	0.070	0.000	0.058
Johnson	16	0.060	0.070	0.040	0.030	0.050
Kelley	2	--	--	0.070	0.030	0.050
Crystal Springs	1	0.010	0.000	0.020	0.080	0.028
Johnson	2	0.000	0.000	0.080	0.030	0.028
Johnson	4	0.060	0.040	0.000	0.000	0.025
Johnson	14	0.010	0.000	0.000	0.020	0.008
Johnson	6	0.000	0.010	0.000	0.000	0.003

Life History and Population Dynamics

Cutthroat trout in Balch Creek were well distributed across sizes from approximately 100 to 200 mm FL in all seasons (Figure 2). Successful recruitment of two consecutive brood years is evident from summer 2001 through spring 2003, with similar trends in catch rate among seasons each year. Mean FL increased slightly from summer to fall both years. The largest individuals were smaller than in other cutthroat trout-bearing streams.

The largest cutthroat trout individuals were observed in Kelley Creek in winter 2002, winter 2003 and summer 2002 (Figure 3). We observed fry in spring 2002 and alevins in winter 2003. We observed redds in winter 2002.

The maximum sizes of cutthroat trout in Tryon Creek were generally similar across seasons (Figure 4). Shifts in length-frequency from spring 2002 through winter 2003 indicate successful recruitment in 2002.

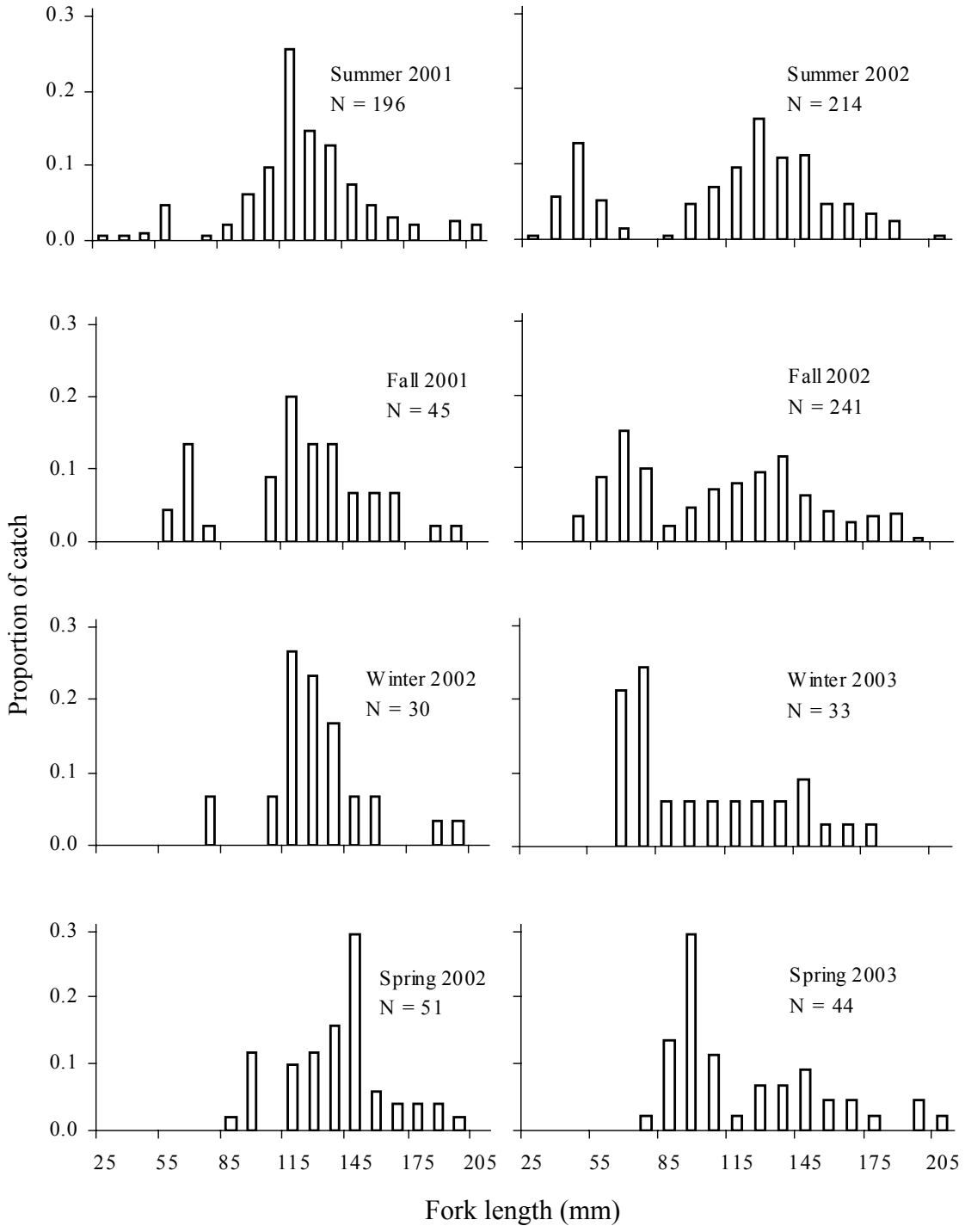

Figure 2. Proportion of catch at length by season for cutthroat trout sampled in Balch Creek, summer 2001 – spring 2003.

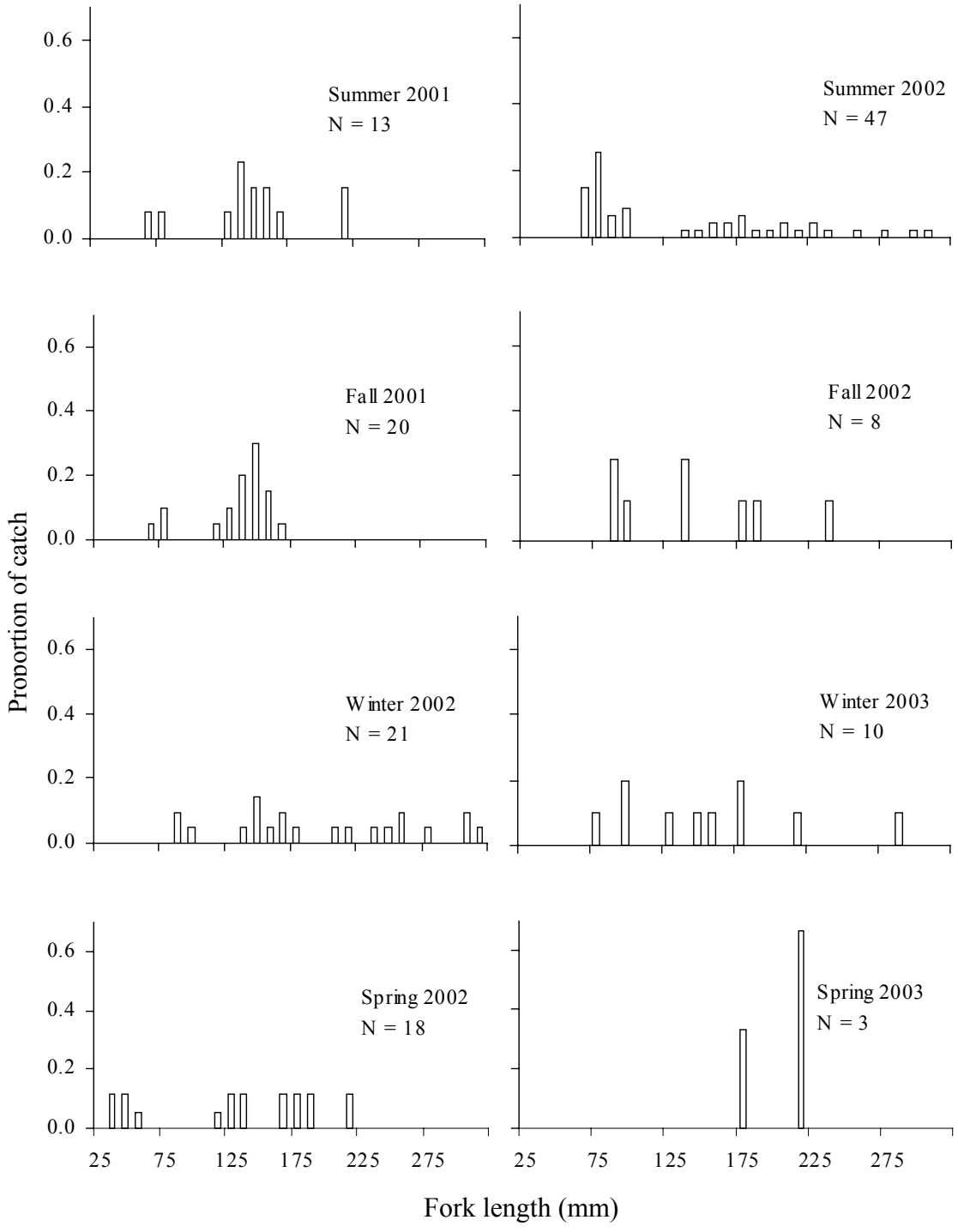

Figure 3. Proportion of catch at length by season for cutthroat trout sampled in Kelley Creek, summer 2001 – spring 2003.

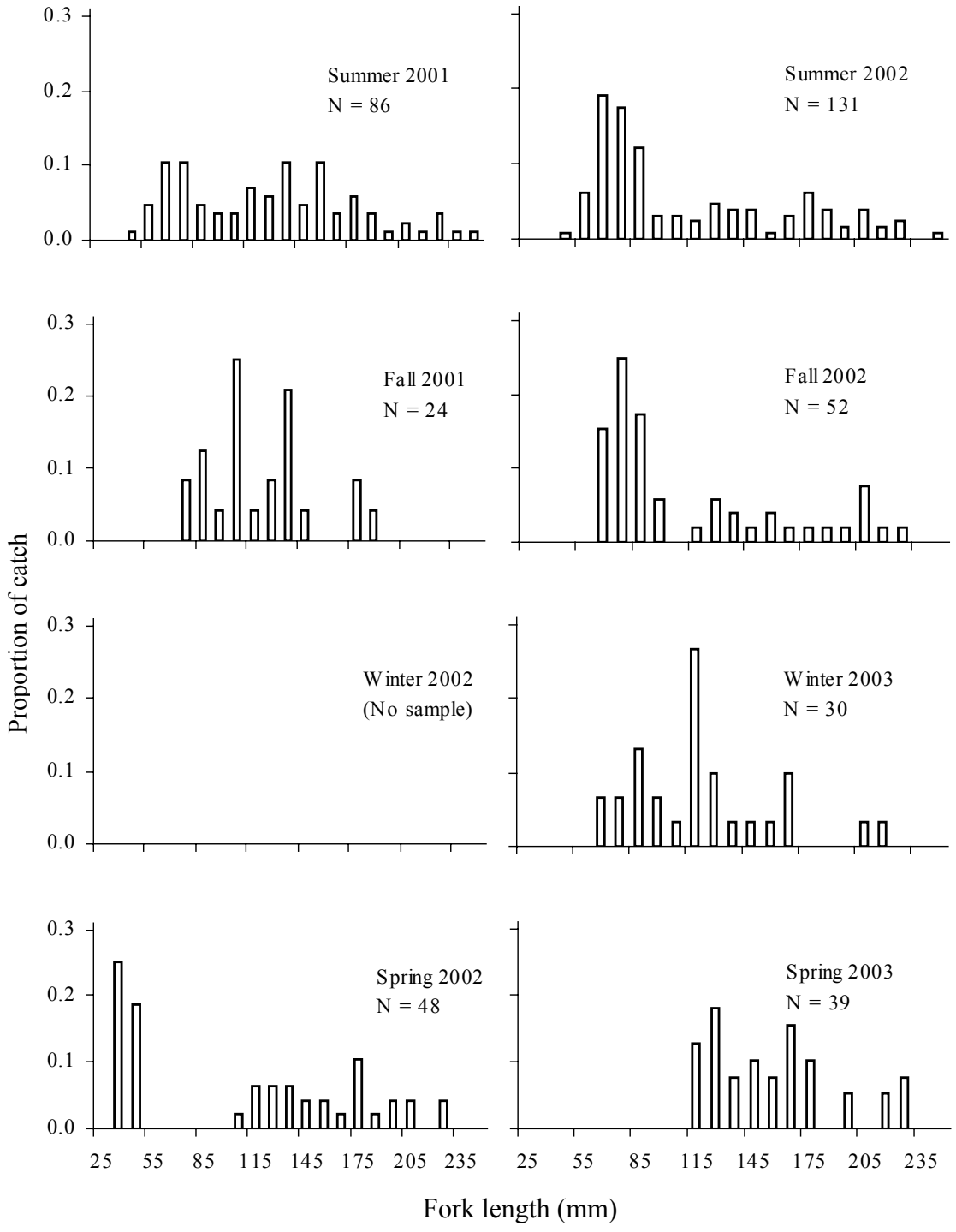

Figure 4. Proportion of catch by fork length interval (mm) for cutthroat trout in Tryon Creek by season, summer 2001 – spring 2003.

Length-frequency distribution by season for rainbow/steelhead trout in Tryon Creek is equivocal to identify age cohorts (Figure 5). No fish were observed at shorter lengths that would suggest recent production within the stream. Fish longer than 115 mm FL were observed in spring 2002 but not in summer 2002. Rainbow/steelhead trout in Tryon Creek did not reach the FL observed among Tryon Creek cutthroat trout.

Coho salmon and chinook salmon varied by size seasonally in Miller and Stephens creeks. In Miller Creek, coho salmon less than 60 mm FL were present only in winter and spring. Fish greater than 60 mm were present during all four seasons. In Stephens Creek, no chinook salmon less than 50 mm FL were observed in summer. The majority of chinook salmon were less than 50 mm FL during winter (69%, N = 29).

DISCUSSION

Despite approximately 150 years of urban development, many Portland streams still contain a relatively diverse assemblage of native fish species, including salmonids. Although relatively widespread, alien species still comprise a very 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.

Although fish were distributed throughout major habitat types (fast water, glides, and pools), salmonids were rarely found in glides. Glides composed 24% of the habitat units sampled during P/A surveys, but held only 5% of the salmonids. Glides actually compose more than 24% of the habitat, because they tend to be longer units than fast water or pools. Because glides in urban streams generally exhibit little habitat complexity, future restoration actions should strive to minimize glide habitat.

If actions are taken to protect native fish communities in Portland, time is of the essence for the Johnson Creek watershed and for Tryon Creek to protect the most productive stream reaches. The highest short-term potential probably exists in larger publicly owned land parcels: municipal parks in Portland, Tryon Creek State Park, and Metro green spaces.

In Johnson Creek, too few rainbow/steelhead trout were observed to speculate on whether they were year-long residents. Coho salmon and chinook salmon juveniles from the Willamette River appear to use the lower reaches for rearing or overwintering habitat. Johnson Creek is also a potential producer of coho salmon; however, we found no evidence suggesting a viable population exists. The presence of a few Pacific lamprey macropthalmia suggests adult Pacific lamprey spawn in the Johnson Creek watershed.

Within the Johnson Creek watershed, Kelley 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, and residents near Kelley Creek have claimed to observe searun cutthroat trout during fall (personal communication, D. Caldwell, ODFW). We observed redds in winter.

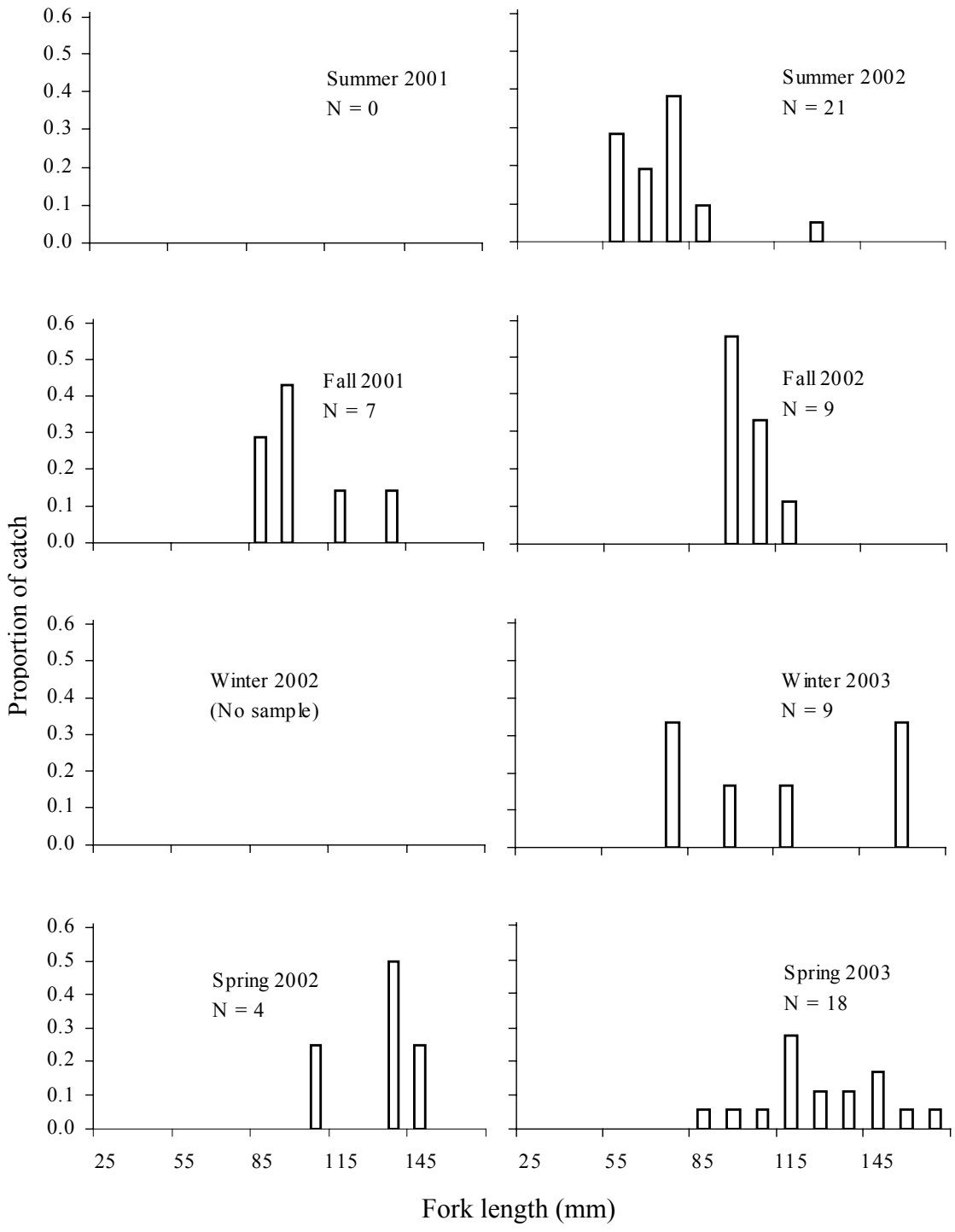

Figure 5. Proportion of catch by fork length interval (mm) for rainbow/steelhead trout in Tryon Creek by season, summer 2001 – spring 2003.

In Tryon Creek the shift in length-frequency suggests successful recruitment of at least one year-class of cutthroat trout. Although we found no similar evidence of rainbow/steelhead trout production, the presence in spring 2002 and absence in summer 2002 of fish longer than 115 mm is consistent with juvenile outmigration behavior of anadromous or fluvial forms. We observed two adult steelhead in the lowest reach of Tryon Creek on the same day in summer 2002 that were adipose fin-clipped. Poor condition of the fish and their presence considerably later than the typical spring spawning period indicate they were probably kelts. The lowest reach of Tryon Creek appears to be rearing or overwintering habitat for juvenile chinook salmon and coho salmon from the Willamette River.

Fish passage is provided between reaches 1 and 2 of Tryon Creek, but the culvert may not function properly under certain conditions. The old metal baffles trap wood that obstructs flow between baffles. When plugged with woody debris, the water is too shallow during low flows and may be a velocity barrier at high flows. The height between the plunge pool surface and the culvert outflow may be too great for small fish to swim upstream.

Balch Creek has a robust population of resident cutthroat trout and length-frequencies suggest growth of cutthroat trout individuals during the optimal feeding season and recruitment of young individuals into the population for at least two consecutive years. Small size of the largest fish relative to some other streams may be due to the isolation of Balch Creek. Fish have no choice but to be resident, and cannot migrate to the Willamette River. This isolation also increases the vulnerability of the population because no genetic interchange or natural colonization can occur. Recruitment of gravel may also be a limiting factor, and residential land uses may affect the fish population; however, fairly inaccessible portions of the stream exist in sufficient numbers to sustain quiet refugia. These areas should be protected.

Partial or complete barriers to fish passage are present in Miller, Doane, Saltzman, and Stephens creeks. Even though reach 2 of Miller Creek is small, it has excellent habitat in terms of canopy cover, diversity of habitat units and substrates, variety of native vegetation, absence of invasive plants, and presence of large woody debris. If it were accessible, Miller Creek might support small populations of cutthroat trout, steelhead, and coho salmon. No fish are present in Doane and Saltzman creeks. Upper reaches in Stephens Creek (no native fish present) may have gradients too high to produce very many fish if passage near its mouth were provided.

Although low IBI scores throughout Portland 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 Balch Creek, IBIs are low and unacceptable. Obviously, Balch Creek cannot be populated with fish from the Willamette River because it is disconnected. It is possible, however, that upper reaches might naturally have few fish species and an IBI would remain low.

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 cutthroat trout in Kelley Creek. Variability in some streams may also occur from changes in habitat caused by the combined effects of hydro-operations, precipitation, and tides. Flow and depth in the lower reach of Stephens Creek often change dramatically

within hours during all seasons depending on tidal effects, in conjunction with precipitation and Willamette Basin reservoir operations.

Seasonal surveys are a snapshot in time taken four days a year over a relatively short distance within each stream reach. By conducting the seasonal surveys over two years, we believe presence and distribution of most species have been determined. Bullheads and goldfish (two individuals) were the only new species observed in the second year of 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.

We further recognize that by limiting sampling to every other reach of Johnson Creek we decrease the likelihood of collecting all species, and we may miss local concentrations of some species. We are confident, however, that because the total area sampled during summer presence/absence sampling is still extensive, the species collected are representative of the species present (Paller 1995).

RECOMMENDATIONS

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

- The City should take aggressive steps to upgrade riparian environmental zones and implement innovative stormwater management to restore habitat and improve water quality.

- Conduct fish and habitat inventories at regular intervals (3-5 years) to evaluate trends and provide information for pre- and post-treatment evaluations. More tributaries of Multnomah Channel should be included in these surveys.

- Conduct annual surveys to evaluate spawning of salmonids and Pacific lamprey.

- Conduct intensive surveys to evaluate abundance, biomass, spatial structure, habitat use, and movements of salmonids in Tryon Creek and within the Johnson Creek watershed. This study was designed to provide broad information on distribution and relative abundance of fish in streams throughout the Portland area. More intensive studies in selected streams would allow collection of more detailed information on fish populations and potentially facilitate recommendations for specific habitat restoration actions to meet region-wide salmonid recovery goals.

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APPENDIX A

Fish Collected in Summer Presence/Absence Surveys

Appendix Table A-1. Number of fish collected during summer 2001 presence/absence sampling in City of Portland streams.

	Stream, reach									
	Balch		Crystal Springs	Johnson						
Species	1	2	1	2	4	6	8	10	14	16
Unidentified lamprey	0	0	0	0	0	0	10	0	3	1
Northern pikeminnow	0	0	0	0	0	0	0	0	0	0
Longnose dace	0	0	0	15	0	102	19	3	1	4
Speckled dace	0	0	1	15	4	17	4	1	15	104
Redside shiner	0	0	16	30	17	81	17	8	47	99
Oriental weatherfish[a]	0	0	0	0	0	0	0	0	0	0
Largescale sucker	0	0	0	0	0	0	0	0	0	0
Cutthroat trout	119	1	1	0	0	0	0	0	0	7
Coho salmon	0	0	0	1	0	0	0	0	0	0
Rainbow trout/steelhead	0	0	0	0	0	3	0	0	0	0
Chinook salmon	0	0	0	0	0	0	0	0	0	0
Unidentified salmonids	0	0	0	0	0	0	0	0	0	0
Banded killifish[a]	0	0	0	0	0	0	0	0	0	0
Western mosquitofish[a]	0	0	0	0	0	0	0	0	0	0
Three-spined stickleback	0	0	0	0	0	0	0	0	0	0
Prickly sculpin	0	0	2	6	0	0	0	0	0	0
Reticulate sculpin	0	0	24	105	62	134	37	3	39	253
Riffle sculpin	0	0	0	28	4	0	0	0	0	0
Torrent sculpin	0	0	0	0	0	0	0	0	0	0
Unidentified cottids	0	0	14	68	53	25	14	2	13	119
Pumpkinseed[a]	0	0	0	0	0	0	0	0	0	0
Bluegill[a]	0	0	0	0	0	0	0	0	0	0
Smallmouth bass[a]	0	0	0	0	0	0	0	0	0	0
Largemouth bass[a]	0	0	0	1	0	0	0	0	0	0
White crappie[a]	0	0	0	0	0	0	0	0	0	0

Appendix Table A-1 (continued).

	Stream, reach								
	Kelley	Miller		Saltzman			Stephens		
Species	1	1	2	2	3	4	1	2	3
Unidentified lamprey	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	0	0	0	0	0
Redside shiner	0	0	0	0	0	0	0	0	0
Oriental weatherfish[a]	0	0	0	0	0	0	0	0	0
Largescale sucker	0	0	0	0	0	0	0	0	0
Cutthroat trout	5	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	6	0	0
Unidentified salmonids	0	0	0	0	0	0	0	0	0
Banded killifish[a]	0	0	0	0	0	0	0	0	0
Western mosquitofish[a]	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	0	0	1	0	0
Reticulate sculpin	26	32	2	0	0	0	0	0	0
Riffle sculpin	0	0	0	0	0	0	0	0	0
Torrent sculpin	0	0	0	0	0	0	0	0	0
Unidentified cottids	17	1	0	0	0	0	0	0	0
Pumpkinseed[a]	0	0	0	0	0	0	0	0	0
Bluegill[a]	0	0	0	0	0	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
White crappie[a]	0	0	0	0	0	0	0	0	0

Appendix Table A-1 (continued).

	Stream, reach			
	Tryon			
Species	1	2	3	4
Unidentified lamprey	0	0	0	0
Northern pikeminnow	0	0	0	0
Longnose dace	0	0	0	0
Speckled dace	0	0	0	0
Redside shiner	0	0	0	0
Oriental weatherfish[a]	0	0	0	0
Largescale sucker	0	0	0	0
Cutthroat trout	1	10	27	12
Coho salmon	0	0	0	0
Rainbow trout/steelhead	0	0	1	0
Chinook salmon	6	0	0	0
Unidentified salmonids	0	0	0	0
Banded killifish[a]	0	0	0	0
Western mosquitofish[a]	0	0	0	0
Three-spined stickleback	0	0	0	0
Prickly sculpin	1	0	0	0
Reticulate sculpin	35	82	196	0
Riffle sculpin	0	0	0	0
Torrent sculpin	0	0	0	0
Unidentified cottids	0	8	27	0
Pumpkinseed[a]	0	0	0	0
Bluegill[a]	0	0	0	0
Smallmouth bass[a]	0	0	0	0
Largemouth bass[a]	0	0	0	0
White crappie[a]	0	0	0	0

[a]Non-native species

Appendix Table A-2. Number of fish collected during summer 2002 presence/absence sampling in City of Portland streams.

	Stream, reach										
	Balch		Crystal Springs	Johnson							
Species	1	2	1	2	4	6	8	10	12	14	16
Unidentified lamprey	0	0	6	0	0	0	0	1	0	4	2
Longnose dace	0	0	5	22	9	0	0	0	0	0	0
Speckled dace	0	0	21	19	11	21	6	0	6	4	26
Redside shiner	0	0	7	25	5	13	5	6	1	15	25
Oriental weatherfish[a]	0	0	0	0	0	0	0	0	0	0	0
Unidentified sucker	0	0	1	0	0	0	0	0	0	0	0
Cutthroat trout	76	50	5	0	0	0	0	0	0	0	2
Coho salmon	0	0	0	0	0	0	0	0	0	0	0
Rainbow trout/steelhead	0	0	0	1	6	2	0	1	0	0	0
Chinook salmon	0	0	0	1	0	0	0	0	0	0	0
Western mosquitofish[a]	0	0	0	0	0	0	0	0	0	0	0
Three-spined stickleback	0	0	11	0	0	0	0	0	0	0	0
Prickly sculpin	0	0	8	15	0	0	0	0	0	0	0
Reticulate sculpin	0	0	243	36	32	49	11	10	28	34	93
Riffle sculpin	0	0	52	0	0	0	0	0	0	0	0
Unidentified cottids	0	0	339	5	27	0	4	1	29	19	47
Pumpkinseed[a]	0	0	3	0	0	0	0	0	0	0	0
Smallmouth bass[a]	0	0	0	0	0	0	0	0	0	0	0

Appendix Table A-2 (continued).

	Stream, reach									
	Kelley		Miller		Saltzman			Stephens		
Species	1	2	1	2	2	3	4	1	2	3
Unidentified lamprey	0	0	0	0	0	0	0	0	0	0
Longnose dace	0	0	0	0	0	0	0	0	0	0
Speckled dace	1	7	0	0	0	0	0	0	0	0
Redside shiner	9	0	0	0	0	0	0	0	0	0
Oriental weatherfish[a]	0	0	0	0	0	0	0	0	0	0
Unidentified sucker	0	0	0	0	0	0	0	0	0	0
Cutthroat trout	21	13	2	1	0	0	0	0	0	0
Coho salmon	0	0	1	0	0	0	0	1	0	0
Rainbow trout/steelhead	1	0	0	0	0	0	0	0	0	0
Chinook salmon	0	0	0	0	0	0	0	2	0	0
Western mosquitofish[a]	0	0	0	0	0	0	0	0	0	0
Three-spined stickleback	0	0	0	0	0	0	0	0	0	0
Prickly sculpin	0	0	0	0	0	0	0	1	0	0
Reticulate sculpin	9	24	5	1	0	0	0	0	0	0
Riffle sculpin	0	0	0	0	0	0	0	0	0	0
Unidentified cottids	12	10	0	1	0	0	0	0	0	0
Pumpkinseed[a]	0	0	0	0	0	0	0	0	0	0
Smallmouth bass[a]	0	0	0	0	0	0	0	0	0	0

Appendix Table A-2 (continued).

	Stream, reach			
	Tryon			
Species	1	2	3	4
Unidentified lamprey	0	0	0	0
Longnose dace	0	0	0	0
Speckled dace	0	0	0	0
Redside shiner	0	0	0	0
Oriental weatherfish[a]	0	0	0	0
Unidentified sucker	0	0	0	0
Cutthroat trout	2	10	33	30
Coho salmon	0	0	0	0
Rainbow trout/steelhead	2	0	18	2
Chinook salmon	0	0	0	0
Western mosquitofish[a]	0	0	0	0
Three-spined stickleback	0	0	0	0
Prickly sculpin	9	0	0	0
Reticulate sculpin	8	105	190	0
Riffle sculpin	0	0	0	0
Unidentified cottids	2	59	71	0
Pumpkinseed[a]	0	0	0	0
Smallmouth bass[a]	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 2001 multiple-pass removal sampling in City of Portland streams.

	Stream, reach									
	Balch		Crystal Springs	Johnson						
Species	1	2	1	2	4	6	8	12	14	16
Unidentified lamprey	0	0	1	0	0	2	1	6	0	0
Northern pikeminnow	0	0	0	0	0	0	0	0	0	0
Longnose dace	0	0	13	6	15	4	11	3	0	0
Speckled dace	0	0	0	17	15	41	30	5	8	4
Redside shiner	0	0	5	19	25	79	46	16	24	35
Oriental weatherfish[a]	0	0	0	0	0	0	0	0	0	0
Largescale sucker	0	0	0	1	0	0	0	0	0	0
Cutthroat trout	44	31	0	0	0	0	0	0	0	1
Coho salmon	0	0	0	1	0	0	0	0	0	0
Rainbow trout/steelhead	0	0	0	0	0	3	0	0	0	0
Chinook salmon	0	0	0	0	0	0	0	0	0	0
Unidentified salmonids	2	2	0	0	0	0	0	0	0	0
Banded killifish[a]	0	0	0	0	0	0	0	0	0	0
Western mosquitofish[a]	0	0	0	0	0	0	0	0	0	0
Three-spined stickleback	0	0	0	0	0	0	0	0	0	0
Prickly sculpin	0	0	0	3	3	0	0	0	0	0
Reticulate sculpin	0	0	70	14	27	45	19	31	20	21
Riffle sculpin	0	0	0	0	0	0	0	0	0	0
Torrent sculpin	0	0	0	0	0	0	0	0	0	0
Unidentified cottids	0	0	159	11	24	16	11	12	6	15
Pumpkinseed[a]	0	0	0	0	0	0	0	0	0	0
Bluegill[a]	0	0	0	0	0	0	0	0	0	0
Smallmouth bass[a]	0	0	0	0	0	0	0	0	0	0
Largemouth bass[a]	0	0	0	0	0	0	0	0	0	0
White crappie[a]	0	0	0	0	0	0	0	0	0	0

Appendix Table B-1 (continued).

	Stream, reach							
	Kelley		Miller		Saltzman		Stephens	
Species	1	2	1	2	2	3	1	2
Unidentified lamprey	7	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	1	0
Oriental weatherfish[a]	0	0	0	0	0	0	0	0
Largescale sucker	0	0	0	0	0	0	0	0
Cutthroat trout	13	0	0	0	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	3	0
Unidentified salmonids	0	0	0	0	0	0	0	0
Banded killifish[a]	0	0	0	0	0	0	0	0
Western mosquitofish[a]	0	0	0	0	0	0	0	0
Three-spined stickleback	0	0	1	0	0	0	0	0
Prickly sculpin	0	0	0	0	0	0	0	0
Reticulate sculpin	95	11	39	2	0	0	2	0
Riffle sculpin	0	0	0	0	0	0	0	0
Torrent sculpin	0	0	0	0	0	0	0	0
Unidentified cottids	15	19	7	7	0	0	1	0
Pumpkinseed[a]	0	0	0	0	0	0	0	0
Bluegill[a]	0	0	0	0	0	0	0	0
Smallmouth bass[a]	0	0	0	0	0	0	0	0
Largemouth bass[a]	0	0	0	0	0	0	0	0
White crappie[a]	0	0	0	0	0	0	0	0

Appendix Table B-1 (continued).

	Stream, reach			
	Tryon			
Species	1	2	3	4
Unidentified lamprey	0	0	0	0
Northern pikeminnow	0	0	0	0
Longnose dace	0	0	0	0
Speckled dace	0	0	0	0
Redside shiner	0	0	0	0
Oriental weatherfish[a]	0	0	0	0
Largescale sucker	0	0	0	0
Cutthroat trout	7	6	5	16
Coho salmon	9	0	0	0
Rainbow trout/steelhead	0	0	0	0
Chinook salmon	1	0	0	0
Unidentified salmonids	0	0	0	0
Banded killifish[a]	0	0	0	0
Western mosquitofish[a]	0	0	0	0
Three-spined stickleback	0	0	0	0
Prickly sculpin	8	0	0	0
Reticulate sculpin	35	134	50	38
Riffle sculpin	3	0	0	0
Torrent sculpin	6	0	0	0
Unidentified cottids	25	10	11	33
Pumpkinseed[a]	0	0	0	0
Bluegill[a]	0	0	0	0
Smallmouth bass[a]	0	0	0	0
Largemouth bass[a]	0	0	0	0
White crappie[a]	0	0	0	0

[a]Non-native species

Appendix Table B-2. Number of fish collected during fall 2001 multiple-pass removal sampling in City of Portland streams.

	Stream, reach									
	Balch		Crystal Springs	Johnson						
Species	1	2	1	2	4	6	8	12	14	16
Unidentified lamprey	0	0	0	0	0	0	0	0	0	0
Northern pikeminnow	0	0	0	0	0	0	0	0	0	0
Longnose dace	0	0	9	3	2	6	4	39	0	28
Speckled dace	0	0	10	4	5	8	43	34	0	5
Redside shiner	0	0	2	0	0	7	29	34	1	24
Oriental weatherfish[a]	0	0	0	0	0	0	0	0	0	0
Largescale sucker	0	0	137	0	0	0	0	5	0	2
Cutthroat trout	38	12	0	0	1	0	0	0	0	8
Coho salmon	0	0	0	0	0	0	0	0	0	0
Rainbow trout/steelhead	0	0	1	0	0	0	0	0	0	1
Chinook salmon	0	0	0	1	0	0	0	0	0	0
Unidentified salmonids	0	0	0	0	0	0	0	0	0	0
Banded killifish[a]	0	0	0	0	0	0	0	0	0	0
Western mosquitofish[a]	0	0	0	0	0	0	0	0	0	0
Three-spined stickleback	0	0	0	0	0	0	0	0	0	0
Prickly sculpin	0	0	0	3	1	0	0	0	0	0
Reticulate sculpin	0	0	103	20	14	6	14	15	4	48
Riffle sculpin	0	0	67	8	0	4	0	0	0	0
Torrent sculpin	0	0	0	0	0	0	0	0	0	0
Unidentified cottids	0	0	13	0	11	2	11	9	2	3
Pumpkinseed[a]	0	0	0	0	0	0	0	0	0	0
Bluegill[a]	0	0	0	0	0	0	0	0	0	0
Smallmouth bass[a]	0	0	0	0	0	0	0	0	0	0
Largemouth bass[a]	0	0	0	0	0	0	0	0	0	0
White crappie[a]	0	0	0	0	0	0	0	0	0	0

Appendix Table B-2 (continued).

	Stream, reach							
	Kelley		Miller		Saltzman		Stephens	
Species	1	2	1	2	2	3	1	2
Unidentified lamprey	3	3	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	2	9	0	0	0	0	0	0
Redside shiner	0	0	0	0	0	0	0	0
Oriental weatherfish[a]	0	0	0	0	0	0	0	0
Largescale sucker	0	0	0	0	0	0	0	0
Cutthroat trout	19	1	0	0	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	2	0
Unidentified salmonids	0	0	0	0	0	0	0	0
Banded killifish[a]	0	0	0	0	0	0	0	0
Western mosquitofish[a]	0	0	0	0	0	0	148	0
Three-spined stickleback	0	0	0	0	0	0	1	0
Prickly sculpin	0	0	0	1	0	0	0	0
Reticulate sculpin	71	67	6	2	0	0	0	0
Riffle sculpin	13	0	0	0	0	0	0	0
Torrent sculpin	0	0	0	0	0	0	0	0
Unidentified cottids	16	30	10	15	0	0	0	0
Pumpkinseed[a]	0	0	0	0	0	0	7	0
Bluegill[a]	0	0	0	0	0	0	0	0
Smallmouth bass[a]	0	0	0	0	0	0	5	0
Largemouth bass[a]	0	0	0	0	0	0	0	0
White crappie[a]	0	0	0	0	0	0	12	0

Appendix Table B-2 (continued).

	Stream, reach			
	Tryon			
Species	1	2	3	4
Unidentified lamprey	0	0	0	0
Northern pikeminnow	0	0	0	0
Longnose dace	0	0	0	0
Speckled dace	0	0	0	0
Redside shiner	0	0	0	0
Oriental weatherfish[a]	0	0	0	0
Largescale sucker	0	0	0	0
Cutthroat trout	4	6	6	8
Coho salmon	3	0	0	0
Rainbow trout/steelhead	3	4	0	0
Chinook salmon	5	0	0	0
Unidentified salmonids	0	0	0	0
Banded killifish[a]	0	0	0	0
Western mosquitofish[a]	0	0	0	0
Three-spined stickleback	0	0	0	0
Prickly sculpin	2	0	0	0
Reticulate sculpin	6	22	23	15
Riffle sculpin	6	7	0	0
Torrent sculpin	2	0	0	0
Unidentified cottids	1	4	1	1
Pumpkinseed[a]	0	0	0	0
Bluegill[a]	0	0	0	0
Smallmouth bass[a]	0	0	0	0
Largemouth bass[a]	0	0	0	0
White crappie[a]	0	0	0	0

[a]Non-native species

Appendix Table B-3. Number of fish collected during winter 2002 multiple-pass removal sampling in City of Portland streams.

	Stream, reach							
	Balch		Crystal Springs	Johnson	Kelley		Miller	
Species	1	2	1	2	1	2	1	2
Unidentified lamprey	0	0	1	0	3	32	1	0
Northern pikeminnow	0	0	0	0	0	0	0	0
Longnose dace	0	0	1	6	0	0	0	0
Speckled dace	0	0	1	1	1	19	0	0
Redside shiner	0	0	76	0	0	0	0	0
Oriental weatherfish[a]	0	0	0	0	0	0	0	0
Largescale sucker	0	0	20	0	0	0	0	0
Cutthroat trout	23	9	1	0	8	14	0	0
Coho salmon	0	0	0	0	0	0	16	0
Rainbow trout/steelhead	0	0	4	1	0	0	0	0
Chinook salmon	0	0	0	0	0	0	0	0
Unidentified salmonids	0	0	0	0	5	2	0	0
Banded killifish[a]	0	0	0	0	0	0	1	0
Western mosquitofish[a]	0	0	0	0	0	0	0	0
Three-spined stickleback	0	0	1	0	0	0	0	0
Prickly sculpin	0	0	1	1	0	0	2	0
Reticulate sculpin	0	0	46	10	7	81	21	2
Riffle sculpin	0	0	19	3	0	0	0	0
Torrent sculpin	0	0	0	0	0	0	0	0
Unidentified cottids	0	0	6	0	0	40	0	0
Pumpkinseed[a]	0	0	0	0	0	0	0	0
Bluegill[a]	0	0	0	0	0	0	0	0
Smallmouth bass[a]	0	0	0	0	0	0	0	0
Largemouth bass[a]	0	0	0	0	0	0	0	0
White crappie[a]	0	0	0	0	0	0	0	0

Appendix Table B-3 (continued).

	Stream, reach		
	Saltzman		Stephens
Species	2	3	1
Unidentified lamprey	0	0	1
Northern pikeminnow	0	0	1
Longnose dace	0	0	0
Speckled dace	0	0	0
Redside shiner	0	0	0
Oriental weatherfish[a]	0	0	0
Largescale sucker	0	0	0
Cutthroat trout	0	0	0
Coho salmon	0	0	1
Rainbow trout/steelhead	0	0	7
Chinook salmon	0	0	29
Unidentified salmonids	0	0	0
Banded killifish[a]	0	0	0
Western mosquitofish[a]	0	0	0
Three-spined stickleback	0	0	0
Prickly sculpin	0	0	6
Reticulate sculpin	0	0	3
Riffle sculpin	0	0	0
Torrent sculpin	0	0	0
Unidentified cottids	0	0	0
Pumpkinseed[a]	0	0	0
Bluegill[a]	0	0	0
Smallmouth bass[a]	0	0	0
Largemouth bass[a]	0	0	0
White crappie[a]	0	0	0

[a]Non-native species

Appendix Table B-4. Number of fish collected during spring 2002 multiple-pass removal sampling in City of Portland streams.

	Stream, reach									
	Balch		Crystal Springs	Johnson						
Species	1	2	1	2	4	6	8	12	14	16
Unidentified lamprey	0	0	10	0	3	0	1	2	0	4
Northern pikeminnow	0	0	0	0	0	0	0	0	0	0
Longnose dace	0	0	5	8	0	0	1	0	0	0
Speckled dace	0	0	24	13	4	9	1	17	1	10
Redside shiner	0	0	134	1	23	7	75	29	28	69
Oriental weatherfish[a]	0	0	0	0	0	0	0	0	0	0
Largescale sucker	0	0	3	1	1	0	1	0	1	4
Cutthroat trout	31	21	0	0	0	0	0	0	0	8
Coho salmon	0	0	3	1	0	0	0	0	0	0
Rainbow trout/steelhead	0	0	0	1	0	0	0	0	0	0
Chinook salmon	0	0	2	8	0	0	0	0	0	0
Unidentified salmonids	0	0	4	1	0	0	0	0	0	0
Banded killifish[a]	0	0	0	0	0	0	0	0	0	0
Western mosquitofish[a]	0	0	0	0	0	0	0	0	0	0
Three-spined stickleback	0	0	0	0	0	0	0	0	0	0
Prickly sculpin	0	0	0	13	0	0	0	0	0	0
Reticulate sculpin	0	0	235	35	8	7	9	8	11	25
Riffle sculpin	0	0	7	1	0	0	0	0	0	0
Torrent sculpin	0	0	0	0	0	0	0	0	0	0
Unidentified cottids	0	0	4	0	1	0	1	3	0	2
Pumpkinseed[a]	0	0	0	0	0	0	0	0	0	0
Bluegill[a]	0	0	0	0	0	0	0	0	0	0
Smallmouth bass[a]	0	0	0	0	0	0	0	0	0	0
Largemouth bass[a]	0	0	0	0	0	0	0	0	0	0
White crappie[a]	0	0	0	0	0	0	0	0	0	0

Appendix Table B-4 (continued).

	Stream, reach							
	Kelley		Miller		Saltzman		Stephens	
Species	1	2	1	2	2	3	1	2
Unidentified lamprey	6	81	0	0	0	0	0	0
Northern pikeminnow	0	0	0	0	0	0	2	0
Longnose dace	0	0	0	0	0	0	0	0
Speckled dace	0	32	0	0	0	0	2	0
Redside shiner	0	0	0	0	0	0	1	0
Oriental weatherfish[a]	0	0	1	0	0	0	0	0
Largescale sucker	0	0	0	0	0	0	0	0
Cutthroat trout	8	11	18	1	0	0	1	0
Coho salmon	0	0	10	0	0	0	129	0
Rainbow trout/steelhead	0	0	0	0	0	0	7	0
Chinook salmon	0	0	0	0	0	0	2	0
Unidentified salmonids	0	0	0	0	0	0	0	0
Banded killifish[a]	0	0	0	0	0	0	1	0
Western mosquitofish[a]	0	0	0	0	0	0	0	0
Three-spined stickleback	0	0	10	0	0	0	0	0
Prickly sculpin	0	0	4	0	0	0	27	0
Reticulate sculpin	65	80	53	3	0	0	1	0
Riffle sculpin	1	0	0	0	0	0	0	0
Torrent sculpin	0	0	0	0	0	0	0	0
Unidentified cottids	4	187	2	0	0	0	1	0
Pumpkinseed[a]	0	0	0	0	0	0	0	0
Bluegill[a]	0	0	1	0	0	0	0	0
Smallmouth bass[a]	0	0	0	0	0	0	2	0
Largemouth bass[a]	0	0	0	0	0	0	1	0
White crappie[a]	0	0	0	0	0	0	0	0

Appendix Table B-4 (continued).

	Stream, reach			
	Tryon			
Species	1	2	3	4
Unidentified lamprey	0	0	0	0
Northern pikeminnow	0	0	0	0
Longnose dace	0	0	0	0
Speckled dace	0	0	0	0
Redside shiner	0	0	0	0
Oriental weatherfish[a]	0	0	0	0
Largescale sucker	0	0	0	0
Cutthroat trout	4	4	31	11
Coho salmon	18	0	0	0
Rainbow trout/steelhead	5	0	0	0
Chinook salmon	0	0	0	0
Unidentified salmonids	0	0	0	0
Banded killifish[a]	0	0	0	0
Western mosquitofish[a]	0	0	0	0
Three-spined stickleback	0	0	0	0
Prickly sculpin	16	0	0	0
Reticulate sculpin	40	28	45	23
Riffle sculpin	0	0	0	0
Torrent sculpin	0	0	0	0
Unidentified cottids	1	0	0	0
Pumpkinseed[a]	0	0	0	0
Bluegill[a]	0	0	0	0
Smallmouth bass[a]	0	0	0	0
Largemouth bass[a]	0	0	0	0
White crappie[a]	0	0	0	0

[a]Non-native species

Appendix Table B-5. Number of fish collected during summer 2002 multiple-pass removal sampling in City of Portland streams

	Stream, reach										
	Balch		Crystal Springs	Johnson							
Species	1	2	1	2	4	6	8	10	12	14	16
Unidentified lamprey	0	0	36	4	122	26	23	25	32	286	34
Goldfish	0	0	0	0	0	0	0	0	0	0	0
Longnose dace	0	0	0	26	20	0	7	0	0	0	0
Speckled dace	0	0	57	32	29	50	103	11	84	107	47
Redside shiner	0	0	30	18	114	77	136	151	129	262	178
Oriental weatherfish[a]	0	0	0	0	0	0	0	0	0	0	0
Largescale sucker	0	0	0	0	0	0	0	0	0	0	0
Unidentified sucker	0	0	0	0	0	1	0	0	0	0	0
Cutthroat trout	34	56	1	0	5	0	0	0	4	1	6
Coho salmon	0	0	0	0	0	0	0	0	0	0	0
Rainbow trout/steelhead	0	0	0	1	6	2	0	1	0	0	0
Chinook salmon	0	0	0	0	0	0	0	0	0	0	0
Unidentified salmonids	0	0	0	0	0	0	0	0	0	0	0
Western mosquitofish[a]	0	0	0	0	0	0	0	0	0	0	0
Three-spined stickleback	0	0	0	0	0	0	0	0	0	0	0
Prickly sculpin	0	0	2	10	1	0	0	0	0	0	0
Reticulate sculpin	0	0	367	73	91	124	93	22	147	193	372
Riffle sculpin	0	0	2	7	4	0	0	0	0	0	0
Unidentified cottids	0	0	397	75	367	57	90	64	288	214	263
Pumpkinseed[a]	0	0	0	0	5	0	0	0	0	0	0
Largemouth bass[a]	0	0	0	0	0	0	0	0	0	0	0
Smallmouth bass[a]	0	0	0	0	0	0	0	0	0	0	0

Appendix Table B-5 (continued).

	Stream, reach						
	Kelley		Miller		Saltzman	Stephens	
Species	1	2	1	2	2	1	2
Unidentified lamprey	25	23	0	0	0	1	0
Goldfish	0	0	0	0	0	0	1
Longnose dace	0	0	0	0	0	0	0
Speckled dace	64	26	0	0	0	0	0
Redside shiner	130	0	0	0	0	0	0
Oriental weatherfish[a]	0	0	2	0	0	0	0
Largescale sucker	0	0	2	0	0	0	0
Unidentified sucker	0	0	0	0	0	0	0
Cutthroat trout	31	16	1	0	0	0	0
Coho salmon	0	0	11	0	0	3	0
Rainbow trout/steelhead	0	0	1	0	0	1	0
Chinook salmon	0	0	4	0	0	6	0
Unidentified salmonids	0	0	0	0	0	0	0
Western mosquitofish[a]	0	0	74	0	0	0	0
Three-spined stickleback	0	0	11	0	0	1	0
Prickly sculpin	0	0	0	0	0	11	0
Reticulate sculpin	130	107	29	0	0	1	0
Riffle sculpin	0	0	0	0	0	1	0
Unidentified cottids	152	108	58	0	0	0	0
Pumpkinseed[a]	0	0	0	0	0	0	0
Largemouth bass[a]	0	0	0	0	0	0	0
Smallmouth bass[a]	0	0	0	0	0	0	0

Appendix Table B-5 (continued).

	Stream, reach			
	Tryon			
Species	1	2	3	4
Unidentified lamprey	0	0	0	0
Goldfish	0	0	0	0
Longnose dace	0	0	0	0
Speckled dace	0	0	0	0
Redside shiner	0	0	0	0
Oriental weatherfish[a]	1	0	0	0
Largescale sucker	0	0	0	0
Unidentified sucker	0	0	0	0
Cutthroat trout	2	6	39	10
Coho salmon	8	0	0	0
Rainbow trout/steelhead	1	0	0	0
Chinook salmon	6	0	0	0
Unidentified salmonids	1	0	0	0
Western mosquitofish[a]	0	0	0	0
Three-spined stickleback	0	0	0	0
Prickly sculpin	16	0	0	0
Reticulate sculpin	36	82	101	4
Riffle sculpin	0	0	0	0
Unidentified cottids	187	185	64	0
Pumpkinseed[a]	0	0	0	0
Largemouth bass[a]	1	0	0	0
Smallmouth bass[a]	1	0	0	0

[a]Non-native species

Appendix Table B-6. Number of fish collected during fall 2002 multiple-pass removal sampling in City of Portland streams.

	Stream, reach										
	Balch		Crystal Springs	Johnson							
Species	1	2	1	2	4	6	8	10	12	14	16
Unidentified lamprey	0	0	16	1	39	24	12	7	12	29	44
Longnose dace	0	0	0	26	24	1	0	0	0	0	0
Speckled dace	0	0	20	29	50	187	155	9	50	38	78
Redside shiner	0	0	35	24	98	433	305	66	51	63	165
Oriental weatherfish[a]	0	0	1	0	0	0	0	0	0	0	0
Largescale sucker	0	0	1	0	0	0	0	0	0	0	0
Unidentified sucker	0	0	0	2	0	7	0	7	0	0	1
Brown bullhead	0	0	3	0	6	0	0	0	0	0	0
Yellow bullhead[a]	0	0	1	1	0	0	0	0	0	0	0
Unidentified catfish	0	0	0	9	0	0	0	0	0	0	0
Cutthroat trout	23	26	0	0	1	1	0	0	2	0	7
Coho salmon	0	0	0	0	0	0	0	0	0	0	0
Rainbow trout/steelhead	0	0	0	0	3	0	0	0	0	0	0
Chinook salmon	0	0	0	0	0	0	0	0	0	0	0
Western mosquitofish[a]	0	0	0	0	0	0	0	0	0	0	0
Threespine stickleback	0	0	0	0	0	0	0	0	0	0	0
Prickly sculpin	0	0	2	9	2	0	0	0	1	0	0
Reticulate sculpin	0	0	176	89	102	183	30	11	37	73	199
Riffle sculpin	0	0	0	2	0	0	0	0	0	0	0
Unidentified cottids	0	0	162	46	165	122	47	22	113	80	159
Pumpkinseed[a]	0	0	27	8	5	0	0	0	0	0	0
Bluegill[a]	0	0	0	0	0	0	0	0	0	0	0
Smallmouth bass[a]	0	0	2	1	0	0	0	0	0	0	0

Appendix Table B-6 (continued).

	Stream, reach						
	Kelley		Miller		Saltzman	Stephens	
Species	1	2	1	2	2	1	2
Unidentified lamprey	45	74	0	0	0	0	0
Longnose dace	0	0	0	0	0	0	0
Speckled dace	66	24	0	0	0	0	0
Redside shiner	143	0	0	0	0	0	0
Oriental weatherfish[a]	0	0	0	0	0	0	0
Largescale sucker	0	0	0	0	0	0	0
Unidentified sucker	1	0	0	0	0	0	0
Brown bullhead	0	0	0	0	0	0	0
Yellow bullhead	0	0	0	0	0	8	0
Unidentified catfish	0	0	0	0	0	26	0
Cutthroat trout	6	2	1	0	0	0	0
Coho salmon	0	0	7	0	0	2	0
Rainbow trout/steelhead	0	0	0	0	0	0	0
Chinook salmon	0	0	0	0	0	1	0
Western mosquitofish[a]	0	0	27	0	0	9	0
Threespine stickleback	0	0	4	0	0	0	0
Prickly sculpin	0	0	0	0	0	1	0
Reticulate sculpin	106	73	19	2	0	4	0
Riffle sculpin	0	0	0	0	0	0	0
Unidentified cottids	95	65	50	3	0	0	0
Pumpkinseed[a]	0	0	0	0	0	6	0
Bluegill[a]	0	0	0	0	0	1	0
Smallmouth bass[a]	0	0	0	0	0	30	0

Appendix Table B-6 (continued).

	Stream, reach			
	Tryon			
Species	1	2	3	4
Unidentified lamprey	0	0	0	0
Longnose dace	0	0	0	0
Speckled dace	0	0	0	0
Redside shiner	0	0	0	0
Oriental weatherfish[a]	4	0	0	0
Largescale sucker	0	0	0	0
Unidentified sucker	0	0	0	0
Brown bullhead	1	0	0	0
Yellow bullhead	0	0	0	0
Unidentified catfish	0	0	0	0
Cutthroat trout	0	2	40	10
Coho salmon	0	0	0	0
Rainbow trout/steelhead	0	1	0	8
Chinook salmon	0	0	0	0
Western mosquitofish[a]	0	0	0	0
Threespine stickleback	0	0	0	0
Prickly sculpin	5	0	0	0
Reticulate sculpin	40	55	70	19
Riffle sculpin	0	0	0	0
Unidentified cottids	22	92	88	0
Pumpkinseed[a]	0	0	0	0
Bluegill[a]	0	0	0	0
Smallmouth bass[a]	0	0	0	0

[a]Non-native species

Appendix Table B-7. Number of fish collected during winter 2003 multiple-pass removal sampling in City of Portland streams.

	Stream, reach										
	Balch		Crystal Springs	Johnson							
Species	1	2	1	2	4	6	8	10	12	14	16
Western brook lamprey	0	0	0	0	0	0	0	2	0	0	0
Pacific lamprey	0	0	3	4	0	0	0	0	0	1	0
Unidentified lamprey	0	0	4	0	0	0	0	3	0	0	0
Goldfish	0	0	0	0	0	0	1	0	0	0	0
Northern pikeminnow	0	0	0	0	1	0	0	0	0	0	0
Longnose dace	0	0	0	5	1	0	0	0	0	0	0
Speckled dace	0	0	8	11	9	18	31	3	9	6	14
Redside shiner	0	0	20	34	149	18	46	138	65	0	57
Largescale sucker	0	0	14	6	7	1	5	6	4	0	0
Unidentified sucker	0	0	0	0	0	0	0	0	0	0	3
Yellow bullhead[a]	0	0	0	2	0	0	0	0	0	0	0
Cutthroat trout	23	10	2	0	0	0	0	0	0	0	4
Coho salmon	0	0	0	3	0	0	0	0	0	0	0
Rainbow trout/steelhead	0	0	0	0	0	0	0	0	0	0	0
Chinook salmon	0	0	0	2	0	0	0	0	0	0	0
Unidentified salmonids	0	0	0	1	0	0	0	0	0	0	0
Banded killifish[a]	0	0	0	0	0	0	0	0	0	0	0
Three-spined stickleback	0	0	1	0	0	0	0	0	0	0	0
Prickly sculpin	0	0	0	2	0	0	0	0	0	0	0
Reticulate sculpin	0	0	45	13	5	8	7	4	3	21	15
Riffle sculpin	0	0	0	2	0	0	0	0	0	0	0
Unidentified cottids	0	0	27	4	11	8	4	11	3	11	11
Pumpkinseed[a]	0	0	3	5	0	0	0	1	0	1	0
Smallmouth bass[a]	0	0	0	0	0	0	0	0	0	0	0
Largemouth bass[a]	0	0	1	0	0	0	0	0	0	0	0

Appendix Table B-7 (continued).

	Stream, reach						
	Kelley		Miller		Saltzman	Stephens	
Species	1	2	1	2	2	1	2
Western brook lamprey	3	13	0	0	0	0	0
Pacific lamprey	0	0	0	0	0	0	0
Unidentified lamprey	1	30	0	0	0	0	0
Goldfish	0	0	0	0	0	0	0
Northern pikeminnow	0	0	7	0	0	5	0
Longnose dace	0	0	0	0	0	0	0
Speckled dace	29	12	0	0	0	1	0
Redside shiner	19	0	0	0	0	0	0
Largescale sucker	0	0	0	0	0	0	0
Unidentified sucker	0	0	0	0	0	0	0
Yellow bullhead	0	0	0	0	0	0	0
Cutthroat trout	4	7	0	0	0	0	0
Coho salmon	0	0	2	0	0	0	0
Rainbow trout/steelhead	0	0	0	0	0	2	0
Chinook salmon	0	0	6	0	0	0	0
Unidentified salmonids	3	0	3	0	0	11	0
Banded killifish[a]	0	0	7	0	0	1	0
Three-spined stickleback	0	0	0	0	0	1	0
Prickly sculpin	0	0	1	0	0	0	0
Reticulate sculpin	33	30	3	1	0	3	0
Riffle sculpin	0	0	0	0	0	0	0
Unidentified cottids	5	13	5	2	0	0	0
Pumpkinseed[a]	0	0	0	0	0	0	0
Smallmouth bass[a]	0	0	0	0	0	2	0
Largemouth bass[a]	0	0	0	0	0	0	0

Appendix Table B-7 (continued).

	Stream, reach			
	Tryon			
Species	1	2	3	4
Western brook lamprey	0	0	0	0
Pacific lamprey	0	0	0	0
Unidentified lamprey	0	0	0	0
Goldfish	0	0	0	0
Northern pikeminnow	0	0	0	0
Longnose dace	0	0	0	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
Yellow bullhead	0	0	0	0
Cutthroat trout	0	4	13	13
Coho salmon	4	0	0	0
Rainbow trout/steelhead	1	2	3	0
Chinook salmon	2	0	0	0
Unidentified salmonids	0	0	0	0
Banded killifish[a]	0	0	0	0
Three-spined stickleback	0	0	0	0
Prickly sculpin	2	0	0	0
Reticulate sculpin	16	3	10	4
Riffle sculpin	0	0	0	0
Unidentified cottids	7	7	23	1
Pumpkinseed[a]	0	0	0	0
Smallmouth bass[a]	0	0	0	0
Largemouth bass[a]	0	0	0	0

[a]Non-native species

Appendix Table B-8. Number of fish collected during spring 2003 multiple-pass removal sampling in City of Portland streams.

	Stream, reach										
	Balch		Crystal Springs	Johnson							
Species	1	2	1	2	4	6	8	10	12	14	16
Western brook lamprey	0	0	0	0	0	0	0	0	22	6	10
Pacific lamprey	0	0	1	0	0	0	0	0	0	0	0
Unidentified lamprey	0	0	21	5	24	0	2	0	5	14	4
Longnose dace	0	0	0	1	2	0	0	0	0	0	0
Speckled dace	0	0	11	14	3	14	12	3	7	4	2
Redside shiner	0	0	30	17	49	27	45	16	70	1	25
Oriental weatherfish[a]	0	0	0	0	0	0	0	0	0	0	0
Largescale sucker	0	0	4	5	0	0	0	0	0	10	1
Unidentified sucker	0	0	0	0	0	0	0	0	0	0	0
Brown bullhead	0	0	2	1	0	0	0	0	0	0	2
Yellow bullhead[a]	0	0	0	0	0	0	0	0	0	0	0
Cutthroat trout	27	20	0	0	0	0	0	0	0	1	3
Coho salmon	0	0	4	0	0	0	0	0	0	0	0
Rainbow trout/steelhead	0	0	0	0	0	0	0	0	0	0	0
Chinook salmon	0	0	0	3	0	0	0	0	0	0	0
Unidentified salmonids	0	0	3	0	0	0	0	0	33	1	0
Three-spined stickleback	0	0	0	3	0	0	0	0	0	0	0
Prickly sculpin	0	0	0	0	0	0	0	0	0	0	0
Reticulate sculpin	0	0	40	20	13	19	16	10	17	30	23
Riffle sculpin	0	0	0	1	0	0	0	0	0	0	0
Unidentified cottids	0	0	11	4	5	10	3	8	8	14	10
Pumpkinseed[a]	0	0	0	2	0	0	0	0	0	2	1
Smallmouth bass[a]	0	0	1	0	0	0	0	0	0	0	0
Largemouth bass[a]	0	0	0	0	0	0	0	0	0	1	0
Unknown species	0	0	0	0	[b]	0	0	0	0	0	0

Appendix Table B-8 (continued).

	Stream, reach						
	Kelley		Miller		Saltzman	Stephens	
Species	1	2	1	2	2	1	2
Western brook lamprey	3	11	0	0	0	0	0
Unidentified lamprey	0	17	0	0	0	0	0
Longnose dace	0	0	0	0	0	2	0
Speckled dace	4	5	0	0	0	0	0
Redside shiner	29	0	0	0	0	1	0
Oriental weatherfish[a]	0	0	0	0	0	1	0
Largescale sucker	0	0	0	0	0	0	0
Unidentified sucker	0	0	0	0	0	1	0
Brown bullhead	0	0	0	0	0	0	0
Yellow bullhead	0	0	0	0	0	1	0
Cutthroat trout	0	3	0	0	0	0	0
Coho salmon	0	0	3	0	0	0	0
Rainbow trout/steelhead	0	0	0	0	0	0	0
Chinook salmon	0	0	2	0	0	0	0
Unidentified salmonids	0	0	0	0	0	0	0
Three-spined stickleback	0	0	21	0	0	0	0
Prickly sculpin	0	0	4	0	0	7	0
Reticulate sculpin	5	20	22	1	0	1	0
Riffle sculpin	0	0	0	0	0	0	0
Unidentified cottids	3	4	3	1	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	0	0	0	0	0
Unknown species	0	0	0	0	0	0	0

Appendix Table B-8 (continued).

	Stream, reach			
	Tryon			
Species	1	2	3	4
Western brook lamprey	0	0	0	0
Unidentified lamprey	0	0	0	0
Longnose dace	0	0	0	0
Speckled dace	0	0	0	0
Redside shiner	0	0	0	0
Oriental weatherfish[a]	0	0	0	0
Largescale sucker	0	0	0	0
Unidentified sucker	0	0	0	0
Brown bullhead	0	0	0	0
Yellow bullhead	0	0	0	0
Cutthroat trout	12	10	2	15
Coho salmon	1	0	0	0
Rainbow trout/steelhead	8	1	3	6
Chinook salmon	1	0	0	0
Unidentified salmonids	1	0	0	0
Three-spined stickleback	0	0	0	0
Prickly sculpin	5	0	0	0
Reticulate sculpin	26	12	15	4
Riffle sculpin	0	0	0	0
Unidentified cottids	10	3	18	0
Pumpkinseed[a]	0	0	0	0
Smallmouth bass[a]	0	0	0	0
Largemouth bass[a]	0	0	0	0

[a] Non-native species

[b] Large numbers of unidentified fry observed but not identified or enumerated

APPENDIX C

Index of Biotic Integrity Data

Appendix Table C-1. Data used to calculate Index of Biotic Integrity Scores for reach 1 of Balch Creek, summer 2001 – spring 2003. Presence/absence surveys were conducted in summer.

			Multiple pass removal							
	Presence/absence		2001-02				2002-03			
Metric	2001	2002	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring
Native families	1	1	1	1	1	1	1	1	1	1
Native species	1	1	1	1	1	1	1	1	1	1
Native benthic species	0	0	0	0	0	0	0	0	0	0
Native water column species	1	1	1	1	1	1	1	1	1	1
Hider species	1	1	1	1	1	1	1	1	1	1
Sensitive species	1	1	1	1	1	1	1	1	1	1
Native nonguarding lithophil nester species	1	1	1	1	1	1	1	1	1	1
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	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	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	0.8	0.0	0.0	0.0	0.0	0.0	0.0	5.0	7.1	0.0

Appendix Table C-2. Data used to calculate Index of Biotic Integrity Scores for reach 2 of Balch Creek, summer 2001 – spring 2003. Presence/absence surveys were conducted in summer.

			Multiple pass removal							
	Presence/absence		2001-02				2002-03			
Metric	2001	2002	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring
Native families	1	1	1	1	1	1	1	1	1	1
Native species	1	1	1	1	1	1	1	1	1	1
Native benthic species	0	0	0	0	0	0	0	0	0	0
Native water column species	1	1	1	1	1	1	1	1	1	1
Hider species			1	1	1	1	1	1	1	1
Sensitive species	1	1	1	1	1	1	1	1	1	1
Native nonguarding lithophil nester species	1	1	1	1	1	1	1	1	1	1
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	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	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-3. Data used to calculate Index of Biotic Integrity Scores for Crystal Springs Creek, summer 2001 – spring 2003. Presence/absence surveys were conducted in summer.

			Multiple pass removal							
	Presence/absence		2001-02				2002-03			
Metric	2001	2002	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring
Native families	3	6	3	4	5	5	4	4	6	5
Native species	5	10	4	7	10	8	7	6	7	6
Native benthic species	3	7	3	5	7	6	5	5	4	4
Native water column species	2	3	1	2	3	3	2	1	2	2
Hider species	3	7	3	5	7	6	6	4	5	5
Sensitive species	1	2	1	1	3	3	2	1	2	3
Native nonguarding lithophil nester species	1	2	1	1	3	3	2	1	2	2
Percent tolerant individuals	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	0.8	1.9
Percent filter-feeding individuals	0.0	0.9	0.7	0.0	0.7	2.1	1.7	3.6	5.5	3.8
Percent omnivores	0.0	0.1	0.0	39.9	11.8	1.1	0.0	1.3	11.0	3.8
Percent lunkers	66.7	21.4	0.0	0.0	0.0	0.0	50.0	66.7	0.0	50.0
Percent with anomalies	6.9	2.6	4.7	1.8	2.6	1.4	17.6	11.4	3.9	11.4

Appendix Table C-4. Data used to calculate Index of Biotic Integrity Scores for reach 2 of Johnson Creek, summer 2001 – spring 2003. Presence/absence surveys were conducted in summer.

			Multiple pass removal							
	Presence/absence		2001-02				2002-03			
Metric	2001	2002	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring
Native families	3	3	3	3	3	4	3	4	5	6
Native species	7	7	6	6	6	8	7	8	9	9
Native benthic species	5	4	5	5	5	5	5	7	7	6
Native water column species	2	3	1	1	1	3	1	1	2	3
Hider species	4	5	3	3	5	4	6	7	7	7
Sensitive species	1	2	0	1	1	2	1	1	2	2
Native nonguarding lithophil nester species	1	2	0	1	1	2	1	1	2	2
Percent tolerant individuals	0.4	0.8	0.0	0.0	0.0	0.0	0.0	4.0	2.3	1.4
Percent filter-feeding individuals	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.4	3.4	5.6
Percent omnivores	0.0	0.8	1.4	0.0	0.0	2.1	0.0	4.9	9.1	6.9
Percent lunkers	83.3	93.8	75.0	100.0	50.0	100.0	90.0	81.8	28.6	25.0
Percent with anomalies	0.0	26.2	1.4	17.4	36.4	25.5	20.3	35.2	29.5	31.9

Appendix Table C-5. Data used to calculate Index of Biotic Integrity Scores for reach 4 of Johnson Creek, summer 2001 – spring 2003. Presence/absence surveys were conducted in summer.

			Multiple pass removal							
	Presence/absence		2001-02				2002-03			
Metric	2001	2002	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring
Native families	2	3	2	3	--	4	4	4	3	3
Native species	4	5	5	4	--	5	8	7	6	5
Native benthic species	3	3	3	3	--	4	6	5	4	4
Native water column species	1	2	1	1	--	1	2	3	2	1
Hider species	3	3	3	4	--	3	6	6	3	4
Sensitive species	0	1	0	1	--	1	2	3	0	1
Native nonguarding lithophil nester species	0	1	0	1	--	1	2	3	0	1
Percent tolerant individuals	0.0	0.0	0.0	0.0	--	0.0	0.0	0.6	0.0	0.0
Percent filter-feeding individuals	0.0	0.0	0.0	0.0	--	7.5	7.6	5.8	0.0	25.0
Percent omnivores	0.0	0.0	0.0	0.0	--	2.5	0.0	0.6	3.9	0.0
Percent lunkers	0.0	0.0	66.7	0.0	--	0.0	2.5	33.3	0.0	0.0
Percent with anomalies	0.0	19.8	44.0	17.2	--	67.5	8.2	34.7	54.7	54.2

Appendix Table C-6. Data used to calculate Index of Biotic Integrity Scores for reach 6 of Johnson Creek, summer 2001 – spring 2003. Presence/absence surveys were conducted in summer.

			Multiple pass removal							
	Presence/absence		2001-02				2002-03			
Metric	2001	2002	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring
Native families	3	3	4	2	--	2	4	5	3	2
Native species	5	4	6	5	--	3	5	8	4	3
Native benthic species	3	1	4	4	--	2	4	4	3	2
Native water column species	2	2	2	1	--	1	1	2	1	1
Hider species	4	3	4	4	--	2	3	4	2	2
Sensitive species	1	1	2	0	--	0	1	2	0	0
Native nonguarding lithophil nester species	1	1	2	0	--	0	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
Percent filter-feeding individuals	0.0	0.0	1.6	0.0	--	0.0	7.8	202	0.0	0.0
Percent omnivores	0.0	0.0	0.0	0.0	--	0.0	0.3	0.8	1.9	0.0
Percent lunkers	0.0	50.0	0.0	0.0	--	0.0	0.0	0.0	0.0	0.0
Percent with anomalies	14.9	29.1	37.7	39.4	--	60.9	25.5	31.9	9.4	57.1

Appendix Table C-7. Data used to calculate Index of Biotic Integrity Scores for reach 8 of Johnson Creek, summer 2001 – spring 2003. Presence/absence surveys were conducted in summer.

			Multiple pass removal							
	Presence/absence		2001-02				2002-03			
Metric	2001	2002	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring
Native families	3	2	3	2	--	3	3	3	3	3
Native species	5	3	5	4	--	5	5	4	4	4
Native benthic species	4	2	4	3	--	4	4	3	3	3
Native water column species	1	1	1	1	--	1	1	1	1	1
Hider species	4	2	4	3	--	3	4	3	2	3
Sensitive species	1	0	1	0	--	0	1	1	1	1
Native nonguarding lithophil nester species	1	0	1	0	--	0	1	1	1	1
Percent tolerant individuals	0.0	0.0	0.0	0.0	--	0.0	0.0	0.0	1.1	0.0
Percent filter-feeding individuals	9.5	0.0	0.8	0.0	--	0.0	5.1	2.2	0.0	2.6
Percent omnivores	0.0	0.0	0.0	0.0	--	1.1	0.0	0.0	6.4	0.0
Percent lunkers	0.0	0.0	0.0	0.0	--	0.0	0.0	0.0	20.0	0.0
Percent with anomalies	8.6	38.5	76.3	52.5	--	83.0	26.7	52.9	34.0	50.0

Appendix Table C-8. Data used to calculate Index of Biotic Integrity Scores for reach 10 of Johnson Creek, summer 2001 – spring 2003. Presence/absence surveys were conducted in summer.

			Multiple pass removal							
	Presence/absence		2001-02				2002-03			
Metric	2001	2002	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring
Native families	2	4	--	--	--	--	3	4	4	2
Native species	4	4	--	--	--	--	4	5	5	4
Native benthic species	3	2	--	--	--	--	3	4	4	2
Native water column species	1	2	--	--	--	--	1	1	2	1
Hider species	3	3	--	--	--	--	3	3	3	2
Sensitive species	0	2	--	--	--	--	1	1	1	0
Native nonguarding lithophil nester species	0	2	--	--	--	--	1	1	1	0
Percent tolerant individuals	0.0	0.0	--	--	--	--	0.0	0.0	0.0	0.0
Percent filter-feeding individuals	0.0	5.3	--	--	--	--	9.2	5.7	3.0	0.0
Percent omnivores	0.0	0.0	--	--	--	--	0.0	5.7	3.0	0.0
Percent lunkers	0.0	0.0	--	--	--	--	0.0	0.0	0.0	0.0
Percent with anomalies	0.0	10.5	--	--	--	--	35.4	62.7	6.3	8.1

Appendix Table C-9. Data used to calculate Index of Biotic Integrity Scores for reach 12 of Johnson Creek, summer 2001 – spring 2003. Presence/absence surveys were conducted in summer.

			Multiple pass removal							
	Presence/absence		2001-02				2002-03			
Metric	2001	2002	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring
Native families	--	2	3	3	--	3	4	4	3	5
Native species	--	3	5	5	--	4	5	6	4	6
Native benthic species	--	2	3	4	--	3	3	4	3	4
Native water column species	--	1	1	1	--	1	2	2	1	1
Hider species	--	2	4	3	--	3	4	4	2	4
Sensitive species	--	0	1	0	--	1	2	2	0	2
Native nonguarding lithophil nester species	--	0	1	0	--	1	2	2	0	2
Percent tolerant individuals	--	0.0	0.0	0.0	--	0.0	0.0	0.0	0.0	0.0
Percent filter-feeding individuals	--	0.0	8.2	0.0	--	3.4	3.4	2.7	0.0	4.4
Percent omnivores	--	0.0	0.0	3.7	--	0.0	0.0	0.0	4.8	7.4
Percent lunkers	--	0.0	0.0	0.0	--	0.0	0.0	66.7	25.0	80.0
Percent with anomalies	--	6.3	0.0	23.5	--	33.9	45.0	28.3	4.3	22.6

Appendix Table C-10. Data used to calculate Index of Biotic Integrity Scores for reach 14 of Johnson Creek, summer 2001 – spring 2003. Presence/absence surveys were conducted in summer.

			Multiple pass removal							
	Presence/absence		2001-02				2002-03			
Metric	2001	2002	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring
Native families	3	3	2	2	--	3	4	3	3	4
Native species	5	4	3	2	--	4	5	4	3	4
Native benthic species	4	3	2	1	--	3	3	3	3	3
Native water column species	1	1	1	1	--	1	2	1	0	1
Hider species	4	3	2	1	--	2	4	3	3	4
Sensitive species	1	1	0	0	--	0	2	1	1	2
Native nonguarding lithophil nester species	1	1	2	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	1.9
Percent filter-feeding individuals	2.5	5.3	0.0	0.0	--	0.0	25.2	10.2	2.5	1.9
Percent omnivores	0.0	0.0	0.0	0.0	--	2.4	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	7.5	41.4	0.0	--	56.1	39.5	40.1	5.0	5.7

Appendix Table C-11. Data used to calculate Index of Biotic Integrity Scores for reach 16 of Johnson Creek, summer 2001 – spring 2003. Presence/absence surveys were conducted in summer.

			Multiple pass removal							
	Presence/absence		2001-02				2002-03			
Metric	2001	2002	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring
Native families	4	4	3	4	--	5	4	5	4	4
Native species	6	5	4	6	--	6	5	6	5	5
Native benthic species	4	3	2	4	--	4	3	4	3	4
Native water column species	2	2	2	2	--	2	2	2	2	2
Hider species	5	4	3	4	--	4	4	4	3	5
Sensitive species	2	2	1	1	--	2	2	2	1	2
Native nonguarding lithophil nester species	2	2	1	1	--	2	2	2	1	2
Percent tolerant individuals	0.0	0.0	0.0	0.0	--	0.0	0.0	0.0	0.0	1.5
Percent filter-feeding individuals	0.2	1.0	0.0	0.0	--	3.0	2.8	3.9	0.0	4.5
Percent omnivores	0.0	0.0	0.0	2.4	--	4.0	0.0	0.3	1.9	1.5
Percent lunkers	0.0	0.0	0.0	25.0	--	0.0	25.0	16.7	0.0	0.0
Percent with anomalies	26.3	17.3	68.2	34.1	--	60.0	33.7	43.0	17.2	26.9

Appendix Table C-12. Data used to calculate Index of Biotic Integrity Scores for reach 1 of Kelley Creek, summer 2001 – spring 2003. Presence/absence surveys were conducted in summer.

			Multiple pass removal							
	Presence/absence		2001-02				2002-03			
Metric	2001	2002	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring
Native families	2	3	3	4	4	4	4	5	3	3
Native species	2	5	3	5	4	4	4	6	4	4
Native benthic species	1	2	2	4	3	3	3	4	2	3
Native water column species	1	3	1	1	1	1	2	2	2	1
Hider species	2	4	3	4	4	4	4	4	3	3
Sensitive species	1	2	2	2	2	2	2	2	2	1
Native nonguarding lithophil nester species	1	2	2	2	2	2	2	2	2	1
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	0.0	7.2	1.3	18.2	5.8	1.7	8.3	0.0	6.8
Percent omnivores	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0
Percent lunkers	0.0	0.0	0.0	0.0	0.0	0.0	25.0	0.0	33.3	0.0
Percent with anomalies	0.0	15.1	0.0	2.5	9.1	5.8	43.1	42.1	2.6	68.2

Appendix Table C-13. Data used to calculate Index of Biotic Integrity Scores for reach 2 of Kelley Creek, summer 2001 – spring 2003. Presence/absence surveys were conducted in summer.

			Multiple pass removal							
	Presence/absence		2001-02				2002-03			
Metric	2001	2002	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring
Native families	--	3	1	4	4	4	4	4	4	4
Native species	--	5	1	4	4	4	4	4	4	4
Native benthic species	--	2	1	3	3	3	3	3	3	3
Native water column species	--	1	0	1	1	1	1	1	1	1
Hider species	--	4	1	4	4	4	3	4	4	4
Sensitive species	--	1	0	2	2	2	2	2	2	2
Native nonguarding lithophil nester species	--	1	0	1	2	2	2	2	2	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	2.6	7.7	20.3	2.3	32.5	41.6	3.1
Percent omnivores	--	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Percent lunkers	--	15.4	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0
Percent with anomalies	--	11.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Appendix Table C-14. Data used to calculate Index of Biotic Integrity Scores for reach 1 of Miller Creek, summer 2001 – spring 2003. Presence/absence surveys were conducted in summer.

			Multiple pass removal							
	Presence/absence		2001-02				2002-03			
Metric	2001	2002	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring
Native families	2	8	2	1	2	3	3	2	3	3
Native species	2	3	2	1	3	5	5	3	5	5
Native benthic species	1	1	1	1	2	2	1	1	2	2
Native water column species	1	2	1	0	1	3	4	2	3	3
Hider species	2	2	2	1	1	3	4	3	3	2
Sensitive species	0	2	0	0	1	2	3	2	2	2
Native nonguarding lithophil nester species	0	2	0	0	1	2	3	2	2	2
Percent tolerant individuals	0.0	0.0	0.0	0.0	4.0	0.0	29.3	26.8	25.0	0.0
Percent filter-feeding individuals	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Percent omnivores	0.0	0.0	0.0	0.0	0.0	0.0	29.3	26.8	0.0	0.0
Percent lunkers	0.0	0.0	0.0	0.0	0.0	12.5	0.0	0.0	12.5	0.0
Percent with anomalies	0.0	0.0	2.4	0.0	12.0	1.7	2.4	0.0	3.6	1.9

Appendix Table C-15. Data used to calculate Index of Biotic Integrity Scores for reach 2 of Miller Creek, summer 2001 – spring 2003. Presence/absence surveys were conducted in summer.

			Multiple pass removal							
	Presence/absence		2001-02				2002-03			
Metric	2001	2002	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring
Native families	--	1	1	1	1	2	--	1	1	1
Native species	--	2	1	2	1	2	--	1	1	1
Native benthic species	--	1	1	2	1	1	--	1	1	1
Native water column species	--	1	0	0	0	1	--	0	0	0
Hider species	--	2	1	1	1	2	--	1	1	1
Sensitive species	--	1	0	0	0	1	--	0	0	0
Native nonguarding lithophil nester species	--	1	0	0	0	1	--	0	0	0
Percent tolerant individuals	--	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
Percent omnivores	--	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
Percent with anomalies	--	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 reach 1 of Stephens Creek, summer 2001 – spring 2003. Presence/absence surveys were conducted in summer.

			Multiple pass removal							
	Presence/absence		2001-02				2002-03			
Metric	2001	2002	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring
Native families	2	2	3	3	3	3	4	2	4	3
Native species	2	3	3	2	5	8	4	4	6	5
Native benthic species	1	1	1	0	2	2	2	2	2	4
Native water column species	1	2	2	2	3	5	2	2	4	1
Hider species	0	0	1	2	2	3	2	3	4	3
Sensitive species	1	2	1	1	2	4	2	2	1	0
Native nonguarding lithophil nester species	1	2	1	1	2	4	2	2	2	0
Percent tolerant individuals	0.0	0.0	0.0	88.5	0.0	2.0	0.0	50.9	5.3	14.3
Percent filter-feeding individuals	0.0	0.0	0.0	0.0	0.0	0.0	11.1	0.0	0.0	0.0
Percent omnivores	0.0	0.0	0.0	79.6	0.0	0.0	0.0	49.1	0.0	21.4
Percent lunkers	100.0	0.0	0.0	0.0	37.5	43.8	40.0	100.0	0.0	0.0
Percent with anomalies	0.0	0.0	0.0	0.0	0.0	8.8	11.1	0.0	0.0	21.4

Appendix Table C-17. Data used to calculate Index of Biotic Integrity Scores for reach 1 of Tryon Creek, summer 2001 – spring 2003. Presence/absence surveys were conducted in summer.

			Multiple pass removal							
	Presence/absence		2001-02				2002-03			
Metric	2001	2002	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring
Native families	2	2	2	2	--	2	2	1	2	2
Native species	4	3	7	8	--	5	5	2	4	6
Native benthic species	2	2	4	4	--	2	2	2	2	2
Native water column species	2	1	3	4	--	3	3	0	2	4
Hider species	2	2	4	5	--	2	3	2	1	3
Sensitive species	2	1	4	5	--	3	3	0	2	4
Native nonguarding lithophil nester species	2	1	3	4	--	3	3	0	2	4
Percent tolerant individuals	0.0	0.0	0.0	0.0	--	0.0	0.7	6.8	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	0.7	6.8	0.0	0.0
Percent lunkers	50.0	63.6	50.0	28.6	--	41.2	80.0	20.0	100.0	25.0
Percent with anomalies	0.0	9.5	0.0	0.0	--	1.6	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 Tryon Creek, summer 2001 – spring 2003. Presence/absence surveys were conducted in summer.

			Multiple pass removal							
	Presence/absence		2001-02				2002-03			
Metric	2001	2002	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring
Native families	2	2	2	2	--	2	2	2	2	2
Native species	2	2	2	4	--	2	2	2	3	3
Native benthic species	1	1	1	2	--	1	1	1	1	1
Native water column species	1	1	1	2	--	1	1	1	2	2
Hider species	2	2	2	4	--	2	2	2	3	3
Sensitive species	1	1	1	2	--	1	1	1	2	2
Native nonguarding lithophil nester species	1	1	1	2	--	1	1	1	2	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	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	0.6	0.0	3.0	--	0.0	0.0	0.0	0.0	0.0

Appendix Table C-19. Data used to calculate Index of Biotic Integrity Scores for reach 3 of Tryon Creek, summer 2001 – spring 2003. Presence/absence surveys were conducted in summer.

			Multiple pass removal							
	Presence/absence		2001-02				2002-03			
Metric	2001	2002	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring
Native families	2	2	2	2	--	2	2	2	2	2
Native species	3	3	2	2	--	2	2	2	3	2
Native benthic species	1	1	1	1	--	1	1	1	1	1
Native water column species	2	2	1	1	--	1	1	2	1	2
Hider species	3	3	2	2	--	2	2	2	3	2
Sensitive species	2	2	1	1	--	1	1	1	2	1
Native nonguarding lithophil nester species	2	2	1	1	--	1	1	1	2	1
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	1.0	2.6	0.0	--	0.0	0.0	0.8	5.0	0.0

Appendix Table C-20. Data used to calculate Index of Biotic Integrity Scores for reach 4 of Tryon Creek, summer 2001 – spring 2003. Presence/absence surveys were conducted in summer.

			Multiple pass removal							
	Presence/absence		2001-02				2002-03			
Metric	2001	2002	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring
Native families	1	1	2	2	--	2	2	2	2	2
Native species	1	2	2	2	--	2	2	3	2	3
Native benthic species	0	0	1	1	--	1	1	1	1	1
Native water column species	1	2	1	1	--	1	1	2	1	2
Hider species	1	2	2	2	--	2	2	3	2	3
Sensitive species	1	2	1	1	--	1	1	2	1	2
Native nonguarding lithophil nester species	1	2	1	1	--	1	1	2	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	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	3.1	0.0	0.0	--	0.0	0.0	0.0	0.0	0.0

APPENDIX D

Salmonid Abundance Estimates

Appendix Table D-1. Estimated number of salmonids (and 95% confidence limits) per 100-m sampling sites in Portland streams, summer 2001 through spring 2003. Rainbow trout include fish that are potentially anadromous steelhead. No salmonids were collected in reaches 8 and 10 of Johnson Creek, or in reach 2 of Stephens Creek.

		Species			
Stream, reach	Season	Cutthroat trout	Rainbow trout	Coho salmon	Chinook salmon
Balch 1	Summer 2001	50 (43-57)	0	0	0
	Fall 2001	39 (36-42)	0	0	0
	Winter 2002	52 (0-152)	0	0	0
	Spring 2002	32 (29-35)	0	0	0
	Summer 2002	36 (31-42)	0	0	0
	Fall 2002	23 (22-24)	0	0	0
	Winter 2003	25 (20-31)	0	0	0
	Spring 2003	47 (0-100)	0	0	0
Balch 2	Summer 2001	34 (31-36)	0	0	0
	Fall 2001	12 (12-12)	0	0	0
	Winter 2002	9 (8-10)	0	0	0
	Spring 2002	21 (20-22)	0	0	0
	Summer 2002	58 (54-63)	0	0	0
	Fall 2002	27 (24-30)	0	0	0
	Winter 2003	10 (10-11)	0	0	0
	Spring 2003	21 (18-24)	0	0	0
Crystal Springs 1	Summer 2001	0	0	0	0
	Fall 2001	0	1 (1-1)	0	0
	Winter 2002	2 (1-3)	5[a]	0	0
	Spring 2002	0	0	5 (4-6)	4 (3-5)
	Summer 2002	1 (1-1)	0	0	0
	Fall 2002	0	0	0	0
	Winter 2003	2 (2-2)	0	0	0
	Spring 2003	0	0	7[a]	0
Johnson 2	Summer 2001	0	0	0	0
	Fall 2001	0	0	0	1 (1-1)
	Winter 2002	0	1 (1-1)	0	0
	Spring 2002	0	6 (4-7)	3 (2-4)	13 (6-21)
	Summer 2002	0	0	0	0
	Fall 2002	0	0	0	0
	Winter 2003	0	0	6 (5-7)	6[a]
	Spring 2003	0	0	0	3 (3-3)

Appendix Table D-1 (continued).

Stream, reach	Season	Species			
		Cutthroat trout	Rainbow trout	Coho salmon	Chinook salmon
Johnson 4	Summer 2001	0	0	0	0
	Fall 2001	1 (1-1)	0	0	0
	Winter 2002	--	--	--	--
	Spring 2002	0	0	0	0
	Summer 2002	6 (2-10)	0	0	0
	Fall 2002	2 (1-3)	4[a]	0	0
	Winter 2003	0	0	0	0
	Spring 2003	0	0	0	0
Johnson 6	Summer 2001	0	0	6 (0-17)	0
	Fall 2001	0	0	0	0
	Winter 2002	--	--	--	--
	Spring 2002	0	0	0	0
	Summer 2002	0	0	0	0
	Fall 2002	1 (1-1)	0	0	0
	Winter 2003	0	0	0	0
	Spring 2003	0	0	0	0
Johnson 12	Summer 2001	0	0	0	0
	Fall 2001	0	0	0	0
	Winter 2002	--	--	--	--
	Spring 2002	0	0	0	0
	Summer 2002	4 (4-5)	0	0	0
	Fall 2002	2 (2-2)	0	0	0
	Winter 2003	0	0	0	0
	Spring 2003	0	0	0	0
Johnson 14	Summer 2001	0	0	0	0
	Fall 2001	0	0	0	0
	Winter 2002	--	--	--	--
	Spring 2002	0	0	0	0
	Summer 2002	1 (1-1)	0	0	0
	Fall 2002	0	0	0	0
	Winter 2003	0	0	0	0
	Spring 2003	2 (2-2)	0	0	0

Appendix Table D-1 (continued).

Stream, reach	Season	Species			
		Cutthroat trout	Rainbow trout	Coho salmon	Chinook salmon
Johnson 16	Summer 2001	1 (1-1)	0	0	0
	Fall 2001	9 (9-9)	3 (4-5)	0	0
	Winter 2002	--	--	--	--
	Spring 2002	8 (7-10)	0	0	0
	Summer 2002	6 (5-7)	0	0	0
	Fall 2002	7 (6-8)	0	0	0
	Winter 2003	4 (4-4)	0	0	0
	Spring 2003	3 (2-4)	0	0	0
Kelley 1	Summer 2001	8 (8-8)	0	0	0
	Fall 2001	19 (18-21)	0	0	0
	Winter 2002	13 (13-13)	0	0	0
	Spring 2002	8 (7-9)	0	0	0
	Summer 2002	10 (10-11)	0	0	0
	Fall 2002	6 (5-7)	0	0	0
	Winter 2003	7 (5-8)	0	0	0
	Spring 2003	0	0	0	0
Kelley 2	Summer 2001	0	0	0	0
	Fall 2001	1 (1-1)	0	0	0
	Winter 2002	16 (15-17)	0	0	0
	Spring 2002	[a]	0	0	0
	Summer 2002	[a]	0	0	0
	Fall 2002	[a]	0	0	0
	Winter 2003	7 (6-9)	0	0	0
	Spring 2003	3 (2-4)	0	0	0
Miller 1	Summer 2001	0	0	0	0
	Fall 2001	0	0	0	0
	Winter 2002	0	0	17 (13-22)	0
	Spring 2002	28[a]	0	0	0
	Summer 2002	5 (4-7)	4 (3-6)	17 (16-18)	8 (6-9)
	Fall 2002	2 (1-3)	0	8 (8-8)	0
	Winter 2003	0	0	4 (3-5)	11 (11-12)
	Spring 2003	0	0	5 (5-5)	5[a]

Appendix Table D-1 (continued).

Stream, reach	Season	Species			
		Cutthroat trout	Rainbow trout	Coho salmon	Chinook salmon
Miller 2	Summer 2001	0	0	0	0
	Fall 2001	0	0	0	0
	Winter 2002	0	0	0	0
	Spring 2002	1 (1-1)	0	0	0
	Summer 2002	0	0	0	0
	Fall 2002	0	0	0	0
	Winter 2003	0	0	0	0
	Spring 2003	0	0	0	0
Stephens 1	Summer 2001	0	0	0	3 (3-3)
	Fall 2001	0	0	0	2 (2-2)
	Winter 2002	0	19 (17-21)	9 (6-11)	37[a]
	Spring 2002	0	10 (8-13)	51 (49-53)	11 (9-14)
	Summer 2002	0	4 (3-5)	10 (8-11)	10 (10-11)
	Fall 2002	0	0	3 (3-3)	2 (1-2)
	Winter 2003	0	4 (3-6)	0	0
	Spring 2003	0	0	0	0
Tryon 1	Summer 2001	16 (14-17)	0	17 (17-17)	4 (3-6)
	Fall 2001	11 (9-12)	9 (8-10)	9 (8-10)	13 (12-14)
	Winter 2002	--	--	--	--
	Spring 2002	10 (8-12)	13 (11-15)	27[a]	0
	Summer 2002	9 (8-11)	4 (3-6)	18[a]	16 (14-17)
	Fall 2002	0	0	0	0
	Winter 2003	0	4 (3-5)	6 (5-7)	4 (3-5)
	Spring 2003	23[a]	16 (14-18)	5 (3-7)	5 (3-7)
Tryon 2	Summer 2001	7 (4-9)	0	0	0
	Fall 2001	10[a]	9 (8-10)	0	0
	Winter 2002	--	--	--	--
	Spring 2002	4 (4-4)	0	0	0
	Summer 2002	7 (4-9)	0	0	0
	Fall 2002	3 (2-4)	3 (3-3)	0	0
	Winter 2003	6[a]	5 (4-6)	0	0
	Spring 2003	12 (8-17)	3 (2-4)	0	0

Appendix Table D-1 (continued).

Stream, reach	Season	Species			
		Cutthroat trout	Rainbow trout	Coho salmon	Chinook salmon
Tryon 3	Summer 2001	5 (5-5)	0	0	0
	Fall 2001	6 (5-7)	0	0	0
	Winter 2002	--	--	--	--
	Spring 2002	34 (28-40)	0	0	0
	Summer 2002	[a]	0	0	0
	Fall 2002	41 (38-43)	0	0	0
	Winter 2003	17 (13-22)	6 (5-8)	0	0
	Spring 2003	5 (5-5)	5 (5-5)	0	0
Tryon 4	Summer 2001	17 (14-20)	0	0	0
	Fall 2001	8 (8-8)	0	0	0
	Winter 2002	--	--	--	--
	Spring 2002	11 (10-12)	0	0	0
	Summer 2002	12 (6-18)	0	0	0
	Fall 2002	17 (15-18)	16 (14-17)	0	0
	Winter 2003	14 (10-19)	0	0	0
	Spring 2003	21 (21-21)	14 (13-16)	0	0

[a] Fish collected, but distribution of catch among passes precluded estimates of abundance and confidence limits.

APPENDIX E

Stream Reach Locations

Appendix Table E-1. Approximate locations of Portland stream reaches surveyed from summer 2001 through spring 2003.

Stream	Reach	Location
Balch	1	Lower Macleay Park to NW Cornell Road culvert crossing
	2	NW Cornell Road culvert crossing to NW Cornell Road crossing near Thompson Road
Crystal Springs	1	Confluence with Johnson Creek to headwaters upstream of Reed College lake
Johnson	2	Highway 224 overpass to Crystal Springs tributary junction
	4	Old Tacoma Bridge crossing at East Moreland golf course to Tideman-Johnson rail and footbridges
	6	Johnson Creek Boulevard bridge to Linwood Avenue bridge
	8	82nd Avenue bridge to I-205 bridges
	10	106th Avenue bridge to 110th Avenue bridge
	12	Brookside restoration project site to 132nd Avenue bridge
	14	Kelley Creek to 190th Avenue bridge
	16	Springwater corridor bridge to Palmblad Road bridge
Kelley	1	Confluence with Johnson Creek to Mitchell Creek
	2	Mitchell Creek to 190th Avenue culvert
Miller	1	Confluence with Multnomah Channel at Fred's Marina to west end of U.S. Highway 30 culvert
	2	West end of U.S.Highway 30 culvert to unmarked tributary entrance
Saltzman	2	East side of Saltzman Road at brush guarded culvert to first tributary entrance
	3	First tributary entrance to second tributary entrance
	4	Second tributary entrance to Leif Erickson Road

Appendix Table E-1 (continued).

Stephens	1	Confluence with Willamette River to Macadam Avenue culvert
	2	Macadam Avenue culvert to first tributary entrance in River View Cemetery
	3	First tributary entrance inside River View Cemetery to Burlingame Avenue
Tryon	1	Willamette River confluence to east side of State Highway 43 culvert
	2	West side of State Highway 43 culvert to tributary entrance downstream of Iron Mountain Bridge
	3	Tributary entrance downstream of Iron Mountain Bridge to Arnold Creek tributary junction
	4	Arnold Creek to Southwest Lancaster Road