ABUNDANCE AND DISTRIBUTION OF FISH SPECIES IN CITY OF PORTLAND STREAMS

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ABSTRACT

This investigation represented a continued partnership between Oregon Department of Fish and Wildlife and the City of Portland identifying fish distribution and abundance, and monitoring stream condition using an index of biotic integrity. From April 2008 through February 2009, we used backpack electrofishing techniques in the four City of Portland drainages Fanno Creek, Johnson Creek Watershed, Miller and Stephens creeks. Over 95% of the total aquatic animals identified in our catch were from three families, sculpin (family Cottidae; 55.2%), minnows (family Cyprinidae; 35.0%), and Pacific salmon and trout (family Salmonidae; 4.8%). Catch was predominated by sculpin during spring (64.8%) and summer (68.4%) while minnows predominated in fall (58.1%) and winter (47.1%). Salmon and trout were present every season with 3.5% to 5.1% spring through fall, and 9.7% during winter. Numbers of animals captured decreased spring to winter in three of the four drainages. Most of the fish captured were small (<100 mm; <3.9 inches fork length) in length. Sculpin appeared to use pooled and fast water hydrologic unit types (49% and 47%, respectively). Minnows preferred pools (82%) over the other two hydrologic unit types. Salmonids had a higher overall percentage capture in pools than fast water and glide habitats (66, 27, and 7%, respectively). Calculations of fish per estimated hydrologic units available in the entire reach contradicted the percentage findings for both sculpin and Pacific salmon and trout thus suggesting different pattern in distribution among hydrologic unit types, especially glides. On average, stream conditions in City of Portland were marginally impaired, and no reach achieved the highest ranking of acceptable impairment. Future monitoring in the region could be enhanced by focusing on assessing at a watershed level. Improving the power to detect slow recovery could require increasing the number of sites sampled, and by decreasing the duration between sampling events. A continued commitment to evaluate aquatic assemblages should inform our understanding of aquatic ecosystem condition in urban streams while assuring effective management of fish and wildlife in the region.

INTRODUCTION

Understanding seasonal use and distribution of single species or a community of animals is of interest in managing aquatic resources. In order for ecological descriptors to be relevant they should include comprehensive seasonal coverage across the entire ecosystem of interest (Kwak and Peterson 2007). However, seasonal variation can profoundly influence an assemblage in open water bodies (e.g., streams, sloughs, estuaries) where animals move freely among habitats. With this in mind, variation may be more pronounced when collecting a mix of animals that exhibit different life history characteristics, growth, and survival. Characterizing an assemblage both seasonally and spatially may lead to a better understanding of the dynamics of the measured group of animals, and guide managers in implementing effective policy in a region.

Many efforts to restore aquatic ecosystems in the Columbia River ecoregion revolve around recovering distinct populations of Pacific salmon *Oncorhynchus spp.* and steelhead *O. mykiss* that are managed by Endangered Species Act (ESA) legislation. Of the six anadromous species of Pacific salmon and steelhead known to use streams in the Columbia River ecoregion (NOAA Fisheries 2009), four have been regularly observed in sampling activities in the Portland Metropolitan area (Farr and Ward 1993; Friesen et al. 2007). Characterizing the distribution and habitat associations of each species involves accurate measurement of their presence in localized habitats. Although there is little doubt that all six ESA listed species utilize the lower Columbia River as a migratory corridor, both as adults returning to spawn (FPC 2009a) and as juveniles moving seaward (FPC 2009b), rigorous sampling is needed to fully understand the ecological importance of this system for Pacific salmon and steelhead.

The Federal Water Pollution Act of 1972 (Clean Water Act; 33 U.S.C. § 1251 et seq.) identified a need to restore and maintain the chemical, physical, and biologic integrity of the Nation's water. In response to this legislation, Karr (1981) developed a method for indicating stream condition using fish metrics. Continued testing found that this approach could be applied broadly, and worked best when seasonal variation was reduced by conducting sampling during summer flow conditions (Karr et al. 1987). Additionally, modifications that accounted for regional differences in species composition and that vigorously test the reliability and repeatability of metrics enhanced the dependability for use as a long term monitoring tool (Hughes et al 1998; Fore 2003; Hughes et al. 2004). Continued monitoring by regularly measuring responses related to aquatic disturbance requires an understanding of a minimally disturbed condition (Hughes 1995; Mebane et al. 2003). This information establishes a standard (baseline or reference condition) for what should be expected in an ecosystem if left to function undisturbed. This idea of integrating ecological consideration based on each species found in a population has been broadly applied in regular monitoring and managing aquatic resources (EPA 2007; OWEB 2007; ODFW 2009a). Understanding the composition of the aquatic assemblage can provide the insight needed for constructing a multi-dimensional assessment of stream condition, and formulating actions for restoring functionality of aquatic resources in disturbed areas.

The City of Portland, in continued partnership with Oregon Department of Fish and Wildlife (ODFW), looked to add to existing fish distribution and abundance information in streams that flow through city boundaries which are part of the Columbia River ecoregion. This investigation, in part, responded to policies outlined in the City of Portland Watershed Management Plan (City of Portland 2005), the federal Endangered Species Act of 1973 (ESA; 16 U.S.C. § 1531 et seq.), and the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA-Superfund; 42 U.S.C. § 9601 et seq.). The goal of our study was to expand on existing knowledge related to the origin, distribution, and habitat associations of fish populations in streams within the Portland city boundaries. The primary objective of this effort was to identify and evaluate the relative abundance, distribution, and use of hydrological unit types by fish species in Portland area streams. Paramount to this effort was a description of the extent of use of Portland streams by ESA listed Pacific salmon species. Information obtained through this work should enhance coordination between jurisdictions involved in the protection of ESA listed and Oregon sensitive species while providing insight for restoring stream condition throughout the area.

STUDY AREA

The City of Portland encompasses 376.5 km^2 (145 $miles^2$) in Northwest Oregon including the area around the confluence of the Willamette and Columbia rivers. Since the naming of the clearing after the best 2 out of 3 flips of Francis Pettygrove's penny around 1843, Portland has grown to become the largest city in the state containing an estimated 575,930 people (Proehl, 2009). The City is in the Marine west coast climate zone; characterized by mild–cold and very moist winters generally between 3–8° C (37–46 F) in January, and warm summers averaging 14–27° C (58–81°F) in July. Atmospheric temperatures are generally warmest during July–August (record high 1981, 42°C; 107°F), and coldest during December–February (record low 1950, -19°C; -3°F). Average annual precipitation, primarily in the form of rain, is 922 mm (36.3 inches), which typically is measurable over 152 days each year (NOAA 2009). Water makes up approximately 8% of the total surface area that continue to provide important habitats for many of the aquatic animals known to occur in the State. The City of Portland is part of the larger Oregon Department of Fish and Wildlife North Willamette Watershed District that encompasses lower Willamette River tributaries that flow from the east facing slopes of the Coast Range and the west facing slopes of the Cascade Range through eight counties. Although the number of streams that sustain fish in the North Willamette Watershed District is large, this effort focused on four primary drainages within the City of Portland boundaries; Fanno Creek, Johnson Creek Watershed, Miller Creek and Stephens Creek (Figure 1).

Fanno Creek is located, in part, within the City of Portland boundaries and drains south southwest to the Tualatin River. Fanno Creek drainage originates from the southern end of the Tualatin Mountains near Council Crest 323 m (1,061 ft) above sea level (a.s.1.), and is composed of an area just over 81.6 km^2 (31.5 mi^2; USGS 2009a). Annual daily mean discharge for the period of record 1994, 1995, and 2001–2008 was between 1.0 and 1.8 m^3/s (33.7 and 63.4 cfs) with maximum discharge of 30.9 m^3/s (1,090 cfs) and minimum of 0.03 m^3/s (1 cfs). Fanno Creek headwater originates from the southwest slope of Sentinel Peak 180 m (590 ft) a.s.1., and flows westward adjacent to Beaverton-Hillsdale highway. The drainage area above 56^{th} Avenue is comprised of 6.14 km^2 (2.37 mi^2), with an annual daily mean discharge for the period of record 1990–2007 between 0.06 and 0.19 m^3/s (2.0 and 6.7 cfs) with maximum discharge of 20.8 m^3/s (733 cfs) and minimum of <0.01 m^3/s (0.01 cfs). The headwaters of Vermont Creek are near Gabriel Park with a peak elevation 143 m (470 ft) a.s.l., and Woods Creek originates in the

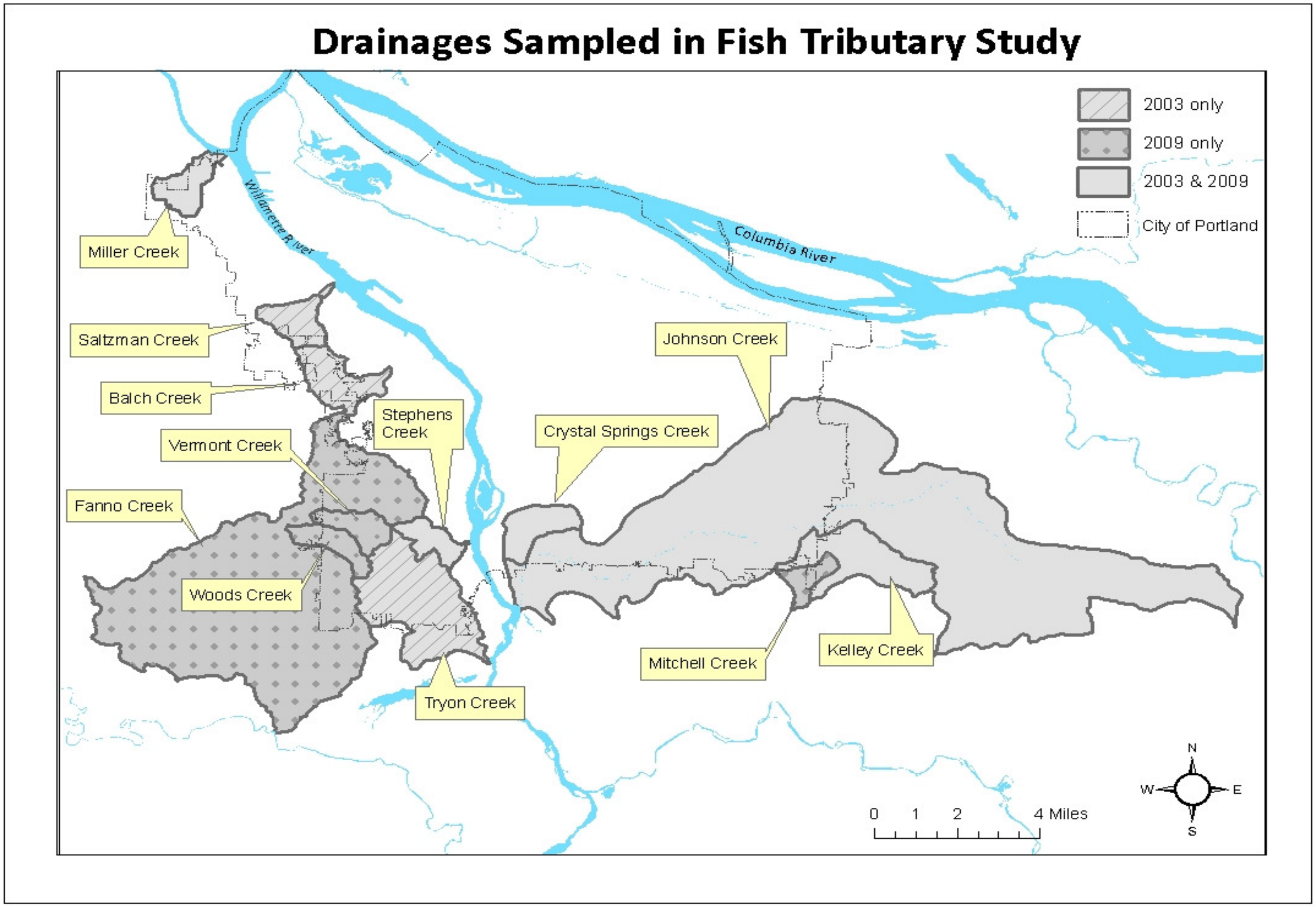

Figure 1. Map showing an overview of stream drainages in the City of Portland boundaries where backpack electrofishing surveys were conducted to identify seasonal fish abundance, fish composition, fish distribution, and an assessment of overall stream condition during 2008–2009.

area of Woods Park with a peak elevation of 187 m (613 ft.) a.s.l. Land uses around these creeks are primarily urban residential and light commercial. Fish passage in upper Fanno Creek is hampered downstream of the Portland City boundary by a culvert structure that has an unknown blockage status to anadromous fishes (ODFW 2009b).

Johnson Creek Watershed is found, in part, within the City of Portland boundaries and drains west to its confluence with the Willamette River through the cities of Gresham, Portland, and Milwaukie and parts of Clackamas and Multnomah counties. Johnson Creek originates near the town of Cottrell (229 m; 750 ft a.s.l.), and is composed of an area just over 135.5 km^2 (52.3 mi^2; USGS 2009c). Annual daily mean discharge at the Milport road bridge for the period of record (1990–2007) was between 1.5 and 4.2 m^3/s (54.5 and 149.1 cfs) with maximum discharge of 61.4 m^3/s (2,170 cfs) and minimum of 0.3 m^3/s (10 cfs). The areas of Johnson Creek watershed that this investigation focused on included Crystal Springs, Johnson, Kelley, and Mitchell creeks (Figure 1). Crystal Springs Creek originates just upstream of Reed College Lake (54.9 m; 180 ft a.s.l.) and descends 3.4 km (2.1 miles) to its confluence with Johnson Creek near Johnson Creek Park. We sampled the main stem of Johnson Creek from the mouth upstream 20.7 km (11.9 miles) to the 190th street bridge crossing (87.2 m; 286 ft a.s.l.). Kelley Creek originates at 229.8 m (754 ft. a.s.l.) near Pleasant Valley, and terminates approximately 6.2 km (3.8 miles) downstream at the foot of Powell Butte near Sycamore. Mitchell Creek, a tributary to Kelley Creek, originates in the foothills east of Happy Valley (160.6 m; 527 ft a.s.l.) and flows 2.5 km (1.6 miles) through Pleasant Valley to its mouth. Land use in this watershed includes urban industrial, agricultural, urban and rural residential settings. Fish passage in Johnson Creek Watershed may be impeded by a falls at Tideman Johnson Natural Area as well as culverts and dams with unknown blockage status within the study area (ODFW 2009b).

Miller Creek flows from the eastern facing slopes of the Tualatin Mountains 3.1 km (1.9 miles) to it's confluence with Multnomah Channel. Miller Creek headwaters are over 246.8m (810 ft) a.s.l. with an additional tributary originating at 280.1 m (919 ft) a.s.l. and adding an additional 1.7 km (1.1 miles) of wetted linear length to the drainage. Steep terrain characterizes most of the drainage. A culvert at the railroad crossing is considered a barrier with unknown status to fish passage (ODFW 2009b).

Stephens Creek flows 3 km (1.9 miles) east from the Southeastern slopes of the Tualatin Mountains, and is a relatively small drainage which drops from 146.3 m (480 ft) a.s.l. at the headwaters near Wilson High School to its mouth with the Willamette River. The stream has been fragmented by a road system with a culvert barrier at Macadam Avenue and again where it intersects with Interstate 5. In addition there are two unnamed tributaries that add another 1.5 km (0.9 miles) of wetted linear length to the creek from relatively steep terrain. The culvert at Macadam Avenue is defined as being a barrier with unknown status to fish passage (ODFW 2009b).

Several native fish families of interest are known to inhabit the survey areas. Salmonid species at risk include Chinook salmon *Oncorhynchus tshawytscha*, coho salmon *O. kisutch*, anadromous and resident cutthroat trout *O. clarki clarki*, and steelhead (anadromous) or rainbow trout (resident) *O. mykiss*. Previous studies have indicated that these salmonids use many of the streams in the Portland Metropolitan Area (Ward 1995; Friesen and Zimmerman 1999; Tinus et al. 2003), and still may be present in many Portland streams. In addition, chum salmon O. keta may have occupied at least some areas in the lower Willamette River, but their overall use of Portland area streams have not been well documented (personal communication Todd Alsbury; ODFW Willamette Watershed District Biologist). Torrent sculpin *Cottus rhotheus*, a native cottid, is a highly responsive indicator of degraded conditions. In the greater Portland area, they have only been found in relatively undisturbed reaches of a few streams.

Between 2001 and 2003, ODFW conducted fish surveys in nine City of Portland streams (Tinus et al. 2003) of which seven (Balch, Crystal Springs, Johnson, Kelley, Miller, Stephens, and Tyron creeks) contained fish representing 12 families and two (Doane and Saltzman creeks) contained no fish. Data from this work were used to create an index of biotic integrity following methods developed for Willamette River ecoregion (Hughes et al. 1998). To supplement data collected during the earlier investigation, we conducted sampling within similar areas of Johnson Creek Watershed (Crystal Springs, Johnson and Kelley creeks), Miller Creek, and Stephens Creek. Not all study streams in the earlier study were revisited; either because they did not contain fish or they had passage issues that impacted fish composition in unknown ways. In addition, new information was collected in Fanno Creek drainage (Fanno, Vermont, Woods creeks), and Mitchell Creek, a smaller order tributary in Johnson Creek watershed. Data collected will be used to help inform and prioritize habitat restoration work while determining the suitability level of these urban streams for supporting listed salmonids.

METHODS

This work was designed to complement earlier investigations in urban streams of the lower Willamette River drainage (Ward 1995; Friesen and Zimmerman 1999; Tinus et al. 2003). Modifications to the earlier study approach (Tinus et al. 2003) were requested by City of Portland Bureau of Environmental Services (BES) staff prior to sampling. These changes involved 1) not sampling in streams that did not contain fish in the earlier study, 2) eliminating streams that were thought to have passage barriers that may introduce unknown bias related to fish composition, 3) increasing the number and length of reaches surveyed in Johnson Creek drainage to parallel Tyron Creek study (Hudson et al. 2008), and 4) introducing new streams to the study. Given these changes, we only described relationships between and among these other studies findings when the sites sampled did not differ in location or length (e.g. reaches used for Index of Biotic Integrity).

We used electrofishing techniques (Reynolds 1996) to collect fish in Portland area streams. Collections generally occurred between 8 am and 5 pm Monday through Friday. Upon our first visit to a reach, we marked downstream (start) and upstream (end) locations with GPS coordinates and flagging to assure consistency in sampling coverage through the course of the investigation. Water temperature (to the nearest 1° C) and conductivity (µS/cm) were measured daily upon arrival at each site. This information was used by field personnel to assure conformity with scientific collection permits and guidelines in waters containing salmonids listed under the Endangered Species Act (NOAA Fisheries 2000). Block nets were secured at the downstream and upstream ends of the reach prior to entering the stream to sample. We avoided surveying a reach when 1) water temperatures were high >18° C (64° F), 2) during high flow events, or 3) when visibility was hindered by turbid water conditions. Electrofishing equipment was set on direct current (DC) with the lowest possible voltage needed to effectively immobilize fish (most often 200 volts). Voltage adjustments were generally completed within the first 10 meters of the first pass of each reach, and were retained for subsequent passes in the reach.

Catch was enumerated by species and rearing type following each pass. For non-salmonid species, we measured the fork length (nearest 1 mm) of up to 20 fish per species captured. Salmonids were anesthetized in a bath of sodium bicarbonate (525mg/10 L water; 0.02 ounces/2.6 gal) to minimize handling stress. We measured the fork length (nearest 1 mm) of each salmonid captured. In addition, a tissue sample (partial fin clip) was collected from a subset of fish captured during each season (not to exceed 50), and preserved in a vial containing 70% denatured alcohol (v/v) for delivery to City of Portland staff for future genetic analysis. Anesthetized fish were allowed to recover in an aerated container before being released.

Given the difficulty surrounding visually distinguishing juvenile steelhead (anadromous) and rainbow trout (resident) we refer to both life history types out of convenience using the common name "steelhead". We do not mean to imply that we presume every observation of this species represented the anadromous life history. The same is true for cutthroat trout, hereafter referred to using the common name "cutthroat", and should not be interpreted to mean that every observation of this species represented the resident life history.

Seasonal Fish Assemblage and Abundance

Multiple pass electrofishing catch from continuous stream reaches was used to characterize fish assemblage by drainage (Appendix Figures A-1 through A-12), and to estimate fish abundance during spring, summer, fall, and winter, 2008-2009. We defined each season using equinox or solstice dates (USNO 2008). We sampled 100m (328.1 ft.) reach lengths in Fanno (Fanno, Vermont and Woods creeks), Miller, and Stephens drainages; while 200 m (656.2 ft.) reach lengths were used in Johnson Creek drainage (Crystal Springs, main-stem Johnson, Kelley, and Mitchell creeks). Upon our first visit to each reach we measured the specified meter distance using a Rolatape® 400 series measuring wheel. GPS coordinates were recorded and flagging was secured in plain view at the start and end points of each reach (Appendix Table 1). This was done to assure the consistency of sampling among seasons. Reaches in Fanno Creek drainage covered only the area within the City of Portland boundaries, and did not encompass the entire stream length. Every third reach was sampled in Johnson Creek drainage. Stephens Creek only covered the lower 75 meters while Miller Creek consisted of the two reaches in the lower 200 meters of the stream. We revisited all reaches, sampling continuous lengths of each during all four seasons of the investigation. In order to avoid spatial and temporal bias, we randomly selected the order that we surveyed reaches during a season.

We conducted up to three electrofishing passes in a reach (Armour et al. 1983). Subsequent passes were conducted whenever we captured either Chinook salmon, coho salmon, cutthroat, steelhead. One or two-passes were used only if zero of the four salmonids were captured during the sampling event. Fish were examined for anomalies, and released downstream of the lower block net prior to making additional passes.

We estimated the species specific population sizes in a reach during spring, summer, fall and winter using the depletion method described by Zippin (1956). Estimates were calculated for each species encountered using the equation (Van Den Avyle and Hayward 1999)

$$\hat{N} = \frac{C}{\left(1 - \hat{p}^{s}\right)}, \tag{1}$$

where

$\hat{N}$ = estimated population size per reach of stream,
C = the total catch in sequence of catches i,
$\hat{p}$ = the probability fish escape capture, and
s = number of consecutive sample periods.

In order to calculate $\hat{N}$, we calculated $\hat{p}$ using the equation

$$\frac{\hat{p}}{\hat{q}} - \frac{s\hat{p}^{s}}{\left(1 - \hat{p}^{s}\right)} = \frac{\sum_{t=1}^{s}(t-1)C_t}{C}, \tag{2}$$

where

$\hat{q}$ = catchability coefficient estimated from linear relationship of the catches,
t = sample period.

A 95% confidence interval was calculated as $\hat{N} \pm 1.96\sqrt{V\left(\hat{N}\right)}$ where variance was calculated using the equation

$$V\left(\hat{N}\right) = \frac{\hat{N}\left(1 - \hat{p}^{s}\right)\hat{p}^{s}}{\left(1 - \hat{p}\right)^{2} - \left(\hat{q}s\right)^{2}\hat{p}^{s-1}}. \tag{3}$$

We assumed that the proportion of the population we sampled was relatively large, and that our sampling did not reduce the population to a size too small for capture during subsequent passes.

To characterize fish composition in each drainage, we standardized $\hat{N}$ (calculated in equation 1) as a percentage for each species using the equation

$$\%\hat{N}_{ijk} = \left(\frac{x_{ijk}}{\sum_{i=1,\,j=1}^{n} x_{ijk}}\right) \bullet 100, \tag{4}$$

where

$\%\hat{N}_{ijk}$ = standardized percent population abundance for species i captured at reach j during season k, and
x_{ijk} = population abundance for species i captured at reach j during season k.

We used this information to graphically display the composition in the catch, and to portray seasonal and site specific distribution within the drainage. A generalized description of native and non-native origin was used to identify species composition in drainages each season. Fork lengths measured from known species were used to calculate descriptive statistics, which were summarized by drainage for each season.

Fish Presence in Summer Habitat Units

We conducted single pass electrofishing surveys to determine fish presences at or near summer base flow in Fanno Creek, Johnson Creek Watershed (Crystal Springs, Johnson, Kelley, and Mitchell creeks), Miller Creek, and Stephens Creek. Reaches were delineated by significant landscape changes, major tributaries, or passage barriers (Moore et al. 2002). We chose to designate reaches by areas of similar land use rather than fixed lengths (Appendix Table 2). This provided a means to survey throughout an area characterized by specific land use activities while achieving adequate coverage in three different hydrologic unit types; fast water (e.g. riffles, rapids, and cascades), glide, and pool. For this reason, reach lengths and hydrologic unit sizes varied. Within each stream reach, we sampled 20% of each hydrologic unit type (Hankin and Reeves 1988). For each hydrologic unit type in a reach, we randomly selected one of the first five units to serve as a starting point, and then surveyed every fifth unit through the remainder of the reach. No additional measurements of habitat features in hydrologic units were collected. In cases when there were fewer than five of a specific hydrologic unit type in a reach we chose to sample at least one unit. Whenever applicable we used the unit number we selected originally, however if fewer units were found in the reach we sampled the unit closest to the initially selected number. Electrofishing was limited to one pass through each designated hydrologic unit. Block nets were stretched across the upstream and downstream end of each unit prior to sampling to stop fish from moving in or out of the hydrologic unit during sampling. Fish were handled as described previously and released following recovery downstream of the lower block net.

Catch was summarized by family for all City of Portland streams combined, and their distribution among the three different hydrologic unit types was summarized as a percentage of the total individuals in a family identified in each type. In addition we estimated the number of individuals per hydrologic unit type for each family by dividing the combined count of individuals in a family by the total number of hydrologic unit types sampled in all the creeks in which the family was encountered. Fish composition in each of the seven creeks was also characterized. Although we sampled 20% of each hydrologic unit type we did not quantify total units of each type within a reach. Thus these data were not used to identify actual pool to fast water ratios in each reach, drainage, or watershed. To identify the presence of species-specific differences in encounter frequencies among hydrologic unit types, reaches, or combinations of the two variables, we conducted a two-way analysis of variance (ANOVA) with hydrologic unit type and reach as the main factors, and species as a blocking variable. Additionally, the presence of statistically significant differences in encounter frequencies among species, land use, or factor combinations were assessed by conducting a two-way ANOVA where species and land use were incorporated as independent variables. Prior to analyses responses were ranked transformed to stabilize variances (Conover and Iman 1981). All tests were considered statistically significant at $\alpha = 0.05$.

Index of Biotic Integrity

We applied an index of biotic integrity to assess stream conditions related to anthropogenic disturbances within City of Portland streams. We used catch data collected during single-pass summer electrofishing surveys to generate scores for 12 metrics (Table 1) that reliably predicted stream condition to three impairment levels (Hughes et al. 1998). Only summer base flow data were applied to the index, because stream conditions during the period conformed to reference criteria used in the development of the method (Karr et al. 1987; Hughes and Gammon 1997). We did not calculate seasonal index of biotic integrity scores, as was done in 2001 and 2002 (Tinus et al. 2003), because of inherent problems associated with variability among seasons (Karr et al. 1987). Doing so would have led to uncertainties with repeatability and reliability, and would have assumed an unrealistic reference condition for other seasons (Hughes et al. 2005; Mebane et al. 2003).

Index scores were calculated using linear interpolation. A maximum expected score for each metric was identified. The actual count or percentage for a metric was divided by the

Table 1. Index of biotic integrity metrics used to score stream condition to three impairment levels (Hughes 1998).

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

a) Species that create nests in gravel or smaller substrates to spawn.
b) Lunkers are relatively large individuals of the following species and sizes: prickly sculpin (100 mm), torrent sculpin (100 mm), steelhead (300 mm), cutthroat (250 mm), chiselmouth (300 mm), northern pikeminnow (300 mm), and largescale sucker (300 mm).

maximum score to generate a rate, and multiplied by 10. Individual metric scores were summed and the result was multiplied by a correction factor (10/12 metrics = 0.8333) to assure the score did not exceed 100. The final score was categorized based on one of three qualitative impairment levels that were derived from Hughes et al. (1998). A score $\leq$50 was classified as severely impaired, a score between 51 and 74 was considered marginally impaired, and a score $\geq$75 indicated an acceptable level of impairment. Impairment levels calculated for each reach were thus directly comparable to impairment levels calculated during summer base flow in the same reaches during 2001 and 2002, which provided for a cursory assessment of stream condition in these reaches among years.

RESULTS

During the course of the investigation we conducted 252 of the 256 scheduled multiple pass electrofishing surveys, and 17 of the 19 planned single pass surveys (Appendix Table 3). We were not able to conduct four multiple pass surveys in Johnson Creek (reaches 4, 19, 43, and 73) during winter, because of high turbid flow conditions. We were not able to conduct two single pass surveys in Johnson Creek (reaches 10 and 16) during summer base flow, due to sampling restrictions associated with scientific permitting requirements. As a result, comparisons with previous years could not be generated for these two reaches in 2008. Information specific to each survey event can be found in Appendix Table 3. We did not measure the fork lengths of salmonid species captured during fall to minimize handling stress and to conform to modified scientific permitting requirements.

Seasonal Fish Assemblage and Abundance

We identified 14 aquatic families in City of Portland streams. Overall catch was composed of one crustacean, three amphibians, and 10 fish families that were made up of 1, 3, 30 species, respectively (Table 2). Sculpin (family Cottidae), minnows (family Cyprinidae), and Pacific salmon and trout made up 95.0% of all aquatic animals identified in our catch (N = 39,313). Non-native aquatic animals (Table 2) accounted for 0.5% (N = 186) of the total individuals identified. Sculpin represented 55.2% (N = 21,707) of all aquatic animals captured, with reticulate sculpin *C. perplexus* comprising 60.2% of the individuals encountered in the family. We did not capture torrent sculpin in any of the streams we sampled during 2008-2009. Minnows represented 35.0% (N = 13,775) of the total aquatic animals captured with redside shiner *Richardsonius balteatus* comprising 64.6% of the individuals encountered in the family. Salmon and trout represented 4.8% (N = 1,874) of the total aquatic animals captured, with cutthroat comprising 68.6% of the individuals encountered in the family. We did not capture chum salmon in any of the streams we sampled during 2008-2009.

Sculpin, minnow, and Pacific salmon and trout families predominated in each of the four seasons we sampled with sculpin making up the highest percentage of the total seasonal catch in spring and summer. Minnows made up the highest percentage of the total seasonal catch in fall and winter. Sculpin comprised 64.8, 68.4, 31.6 and 33.9% of the total aquatic animals sampled in spring, summer, fall and winter, respectively. Reticulate sculpin comprised 63.0, 67.2, 60.2, and 66.9% of all sculpins identified in the four seasons, respectively. Minnows comprised 27.9, 23.8, 58.1 and 47.1% of the total aquatic animals sampled in spring, summer, fall and winter,

Table 2. Combined fish assemblage found in Fanno Creek drainage, Johnson Creek watershed, Miller Creek, and Stephens Creek of City of Portland boundaries during 2008-2009.

Municipality, Common group	Family	Genus species	Common name	Origin
City of Portland				
Amphibian	Dicamptodontidae	*Dicamptodon tenebrosus*	Pacific giant salamander	Native
	Ranidae	*Rana catesbeana*	Bullfrog	Non-native
	Salamandridae	*Taricha granulosa*	Rough skinned newt	Native
Crustacean	Astacoidea	*Pacifastacus*	Crayfish	—
Fish	Catostomidae	*Catostomus macrocheilus*	Largescale sucker	Native
	Centrarchidae	*Lepomis cyanellus*	Green sunfish	Non-native
		Lepomis gibbosus	Pumpkinseed	Non-native
		Lepomis macrochirus	Bluegill	Non-native
		Micropterus dolomieu	Smallmouth bass	Non-native
		Micropterus salmoides	Largemouth bass	Non-native
	Cobitidae	*Misgrunus anguillicaudatus*	Oriental weatherfish	Non-native
	Cottidae	*Cottus asper*	Prickly sculpin	Native
		Cottus gulosus	Riffle sculpin	Native
		Cottus perplexus	Reticulate sculpin	Native
	Cyprinidae	*Acrocheilus alutaceus*	Chiselmouth	Native
		Carassius auratus	Goldfish	Non-native
		Ctenopharyngodon idella	Fathead minnow	Non-native
		Cyprinus carpio	Common carp	Non-native
		Mylocheilus caurinus	Peamouth	Native
		Notemigonus crysoleucas	Golden shiner	Non-native
		Ptychocheilus oregonensis	Northern pikeminnow	Native
		Richardsonius balteatus	Redside shiner	Native
		Rhinichthys cataractae	Longnose dace	Native
		Rhinichthys cataractae	Speckled dace	Native
	Fundulidae	*Fundulus diaphanus*	Banded killifish	Non-native
	Gasterosteidae	*Gasterosteus aculeatus*	Threespine stickleback	Native
	Ictaluridae	*Ameiurus nebulosus*	Brown bullhead	Non-native
	Petromyzontidae	*Lampetra richardsoni*	Western brook lamprey	Native
		Lampetra tridentata	Pacific lamprey	Native
	Poeciliidae	*Gambusia affinis*	Western mosquitofish	Non-native
	Salmonidae	*Oncorhynchus clarki*	Cutthroat	Native
		Oncorhynchus kisutch	Coho salmon	Native
		Oncorhynchus mykiss	Steelhead	Native
		Oncorhynchus tshawytscha	Chinook salmon	Native

respectively. Redside shiner comprised 72.4, 57.0, 63.3, and 74.7% of all minnows identified in the four seasons, respectively. In addition, speckled dace *Rhinichthys osculus* were identified making up a noticeable percentage from spring to winter, when they comprised 27.3, 40.0, and 35.4, and 24.2% of the total minnows during all four seasons. Salmon and trout comprised 5.1, 3.5, 5.0 and 9.7% of the total aquatic animals sampled in spring, summer, fall and winter, respectively. Cutthroat comprised 69.0, 83.1, 62.4, and 49.8% of all salmon and trout identified in each season, respectively. Length frequencies for Chinook salmon, coho salmon, cutthroat and steelhead are provided in Appendix Figures B-1 through B-4, respectively. Fish of hatchery origin (adipose fin clipped) were only identified for Chinook salmon in spring, and again in winter when a group participating in Salmon and Trout Enhancement Program released fish (not adipose fin clipped) into Crystal Springs Creek from the Reed College campus (personal communication Todd Alsbury; ODFW Willamette Watershed District Biologist).

Fanno Creek Drainage

In Fanno Creek drainage, fish abundances were estimated in reaches 1 and 2 of Fanno Creek, and both reaches of Vermont Creek. We did not catch any fish in reach 3 of Fanno Creek, or reaches 1 and 2 of Woods Creek during any season that we sampled. We captured four families of fish during the course of our investigation (Figure 2). Overall, standardized percent abundance was 93, 4, 2, and 1% for sculpin, minnows, salmonids, and lamprey *Petromyzontidae spp.*, respectively. We were unable to identify 35% of the sculpin, and <1% of the lamprey and salmonids to species due to 1) their small size, 2) they escaped before being identified, or 3) their development was not advanced enough to show noticeable characteristics without sacrificing the animal. Standardized percent abundance was 41, 28, 26 and 5% for spring, summer, fall, and winter, respectively (Figure 3).

Estimated abundance for species identified in Fanno Creek drainage are available in Appendix Table 4. Half of the reach estimates calculated in Fanno Creek drainage were ≤1 with a pattern of decreasing values from spring to winter in many of the reaches for each species. Abundances for reticulate and unidentified sculpin species combined were estimated to be >150 in reaches 1 and 2 of Fanno Creek during each season but winter when estimates dropped noticeably to <10. Estimates of taxa abundance for reticulate and unidentified species of sculpin in reaches of Vermont Creek were also higher than all other species found there. Combined estimates for sculpin captured in reach 1 of Vermont Creek were between 61 and 119 among seasons. Reach 2 of Vermont Creek followed the pattern described for reaches 1 and 2 of Fanno Creek; where combined sculpin abundance estimates were higher in spring, summer, and fall than they were in winter. Although redside shiners were the 2nd highest estimated species in Fanno Creek drainage, they were primarily found in reach 1 of Fanno Creek in spring. Redside shiners sparsely occupied reach 1 of Vermont Creek in spring, and were present in reach 1 of Fanno Creek in summer and fall. Western brook lamprey *Lampetra richardsoni* were found in both Vermont (1 per reach in spring) and Fanno (1 to 5.8 per reach in summer, fall and winter) creeks, and Pacific lamprey *L. tridentata* were found in Vermont Creek in winter only (1 per reach). In spring we estimated 6.5 and 22.8 cutthroat in reaches 1 and 2 of Fanno Creek, respectively (Appendix Table 4). Cutthroat estimates decreased as the seasons progressed, with zero fish being observed in either reach during winter. No other salmonid species were

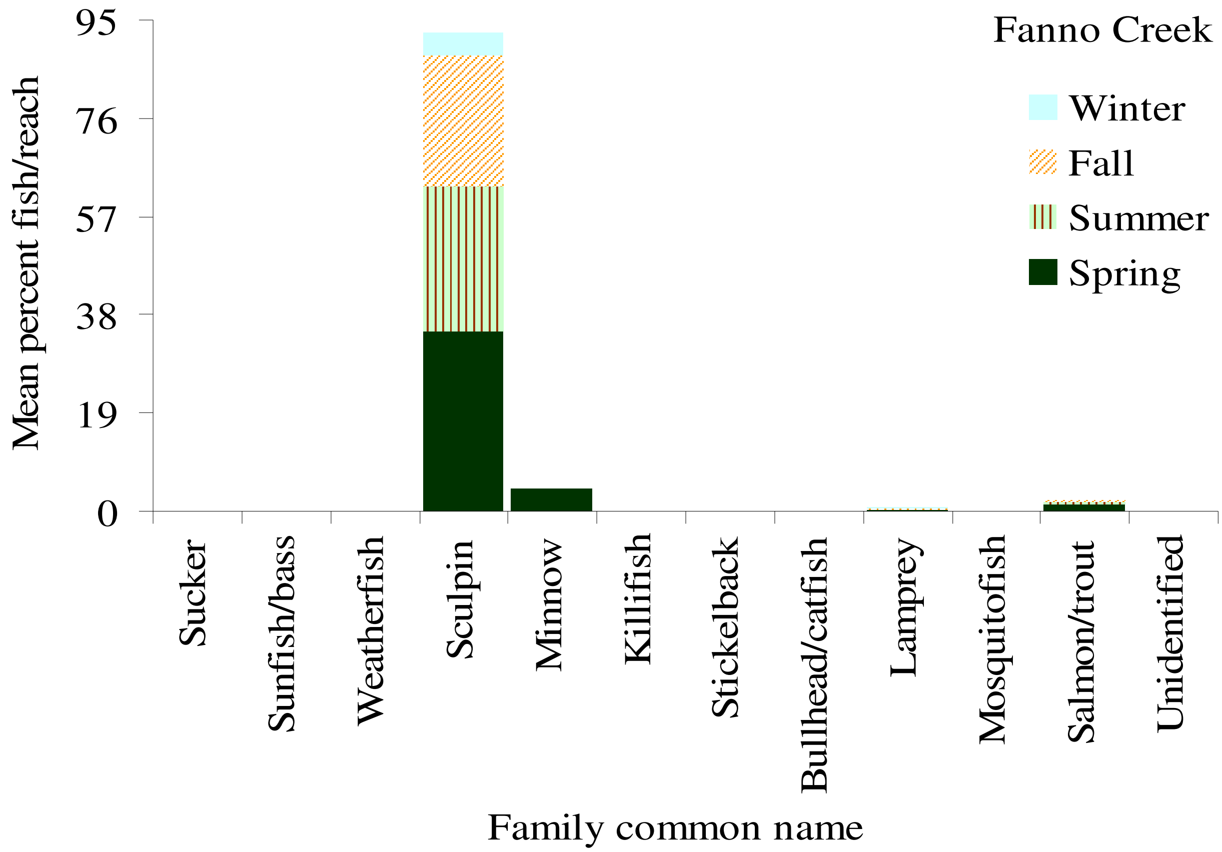

Figure 2. Standardized percentage of fish per reach for all families of fish encountered in Fanno Creek drainage during 2008–2009.

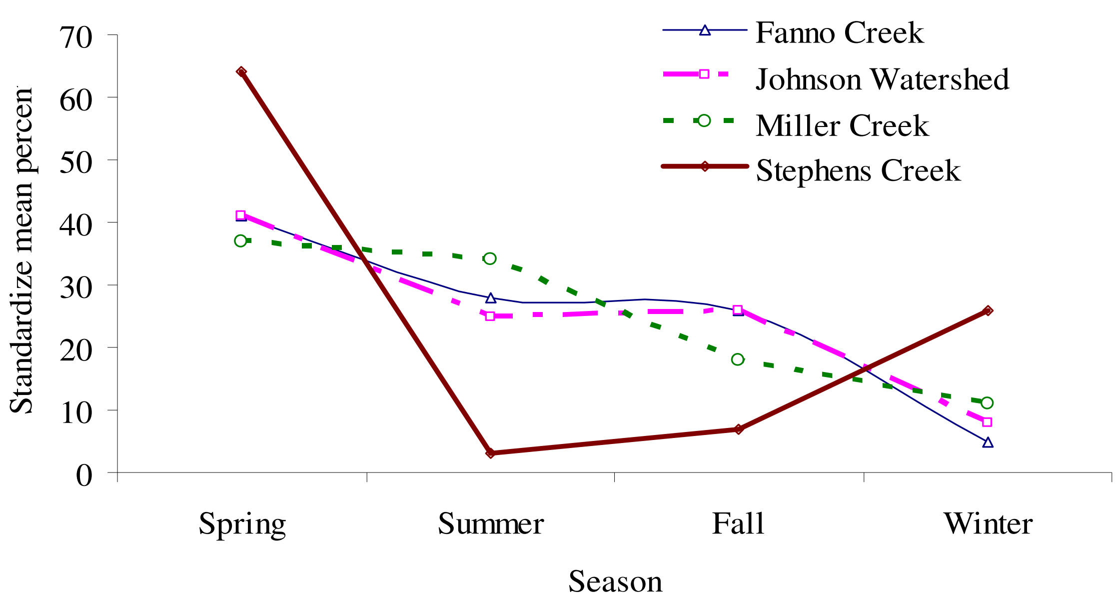

Figure 3. Trends in standardized percentage of the annual total fish by season in Fanno Creek, Johnson Creek Watershed, Miller Creek, and Stephens Creek during 2008–2009.

identified in reaches of Fanno Creek drainage during any season sampled. All but one fish (western mosquitofish) identified in Fanno Creek drainage were native species.

Descriptive statistics for fork length of all taxa identified to species in Fanno Creek drainage are available in Appendix Table 5. Seasonal mean fork lengths of reticulate sculpin were between 68.4 and 75.7 mm (2.7 and 3.0 inches). Seasonal mean fork lengths of redside shiner were between 32.3 and 96.0 mm (1.3 and 3.8 inches). Seasonal mean fork lengths of western brook lamprey were between 112.0 and 133.5 mm (4.4 and 5.3 inches); while the one Pacific lamprey identified was 161.0 mm (6.3 inches). Seasonal mean fork lengths of cutthroat were between 118.2 and 136.4 mm (4.7 and 5.4 inches).

Johnson Creek Watershed

In Johnson Creek watershed, fish were captured in every reach except reach 32 of Kelley Creek, and reach 14 of Mitchell Creek where no fish were captured during any season. Both of these reaches were the furthest upstream that we sampled. We captured eleven families of fish during the course of our investigation (Figure 4). Overall, standardized percent abundance was 51, 43, and 3% for sculpin, minnows, and salmonids, respectively. Suckers Catostomidae, threespine stickleback *Gasterosteidae aculeatus,* and lamprey comprised <1% of the standardized percent abundance, while non-native sunfish and bass (family Centrarchidae), oriental weatherfish *Misgrunus anguillicaudatus*, banded killifish *Fundulus diaphanus*, and western mosquitofish *Gambusia affinis* comprised <0.01%. We were unable to identify 19% of the fish captured to species due to their small size, they escaped before being identified, or their development was not advanced enough to show noticeable characteristics without sacrificing the animal. Seasonal catch decreased from spring to winter with 41, 25, 26 and 8% of the standardized percent abundance occurring in spring, summer, fall, and winter, respectively (Figure 3).

Estimated abundance for species identified in Johnson Creek watershed are available in Appendix Table 4. A fifth of the reach estimates calculated in Johnson Creek watershed were ≤1. Mean fish per reach for combined reticulate, prickly *C. asper* and unidentified sculpin species were 67.2, 64.0, 28.2 and 6.7 during spring, summer, fall, and winter, respectively. Reticulate sculpin were found throughout all of Johnson Creek watershed with 45, 58, and 62% estimated fish occupying Johnson Creek during spring, summer, and fall, respectively. Reticulate sculpin in Johnson Creek accounted for 5% of the total fish estimated in the watershed during winter, having increased occurrence in Crystal Springs and Kelley creeks (50% and 38%, respectively) during that season. Prickly sculpin were primarily estimated to be <3 in reaches in this watershed with 98, 92, 100, and 66.7% of the total estimated fish occurring in Johnson Creek during spring, summer, fall, and winter, respectively. There were zero prickly sculpin identified in Kelley or Mitchell creeks during any season. Mean fish per reach for combined native minnow species of chiselmouth *Acrocheilus alutaceus*, northern pikeminnow *Ptychocheilus oregonensis*, redside shiner, speckled and longnose dace *R. cataractae* species were 20.5, 19.5, 37.6 and 6.4 during spring, summer, fall, and winter, respectively. Redside shiner and speckled dace were the most prevalent native minnow species in Johnson Creek watershed, with 92, 96, 83 and 88% of the estimated redside shiner residing in Johnson Creek during spring, summer, fall, and winter respectively. Speckled dace occupied both

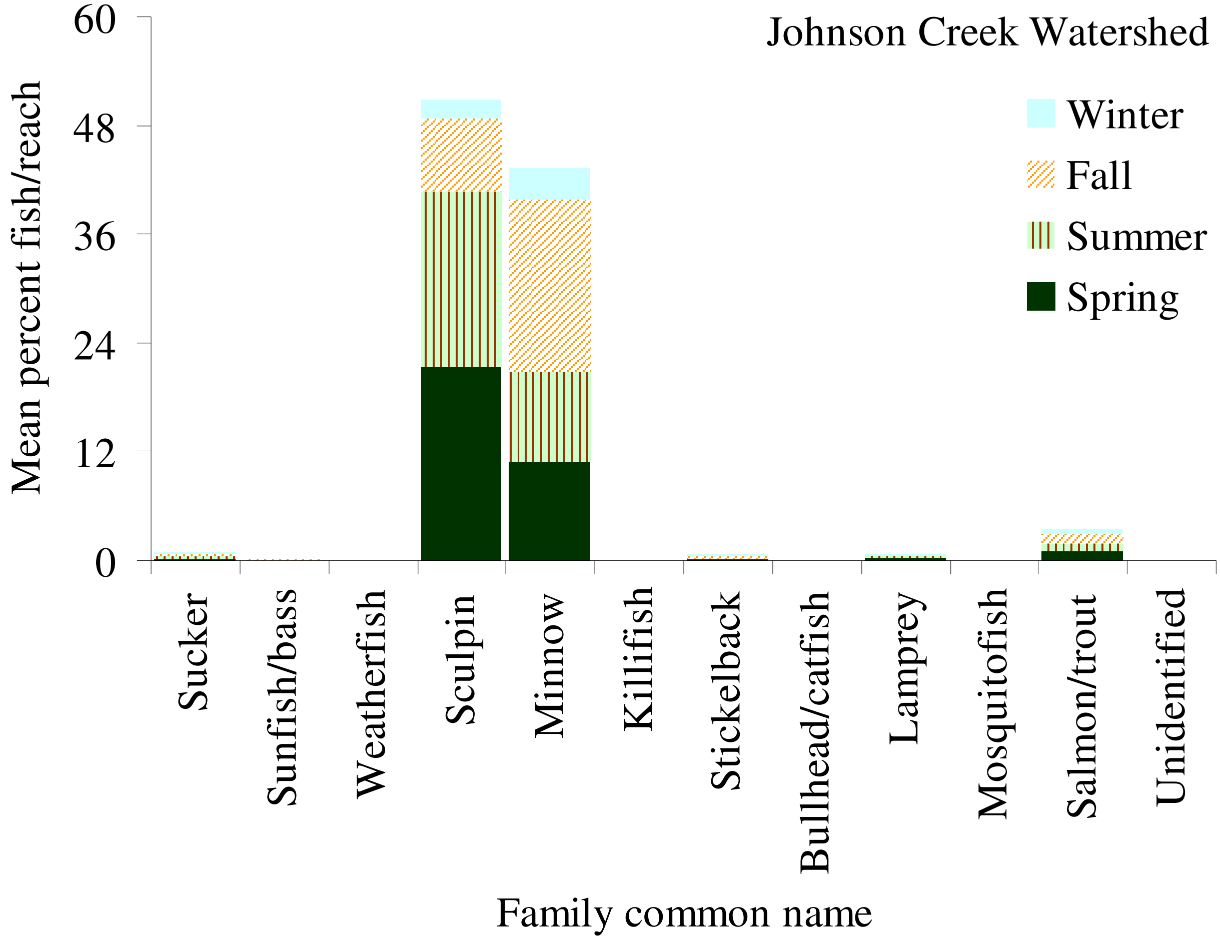

Figure 4. Standardize percentage of fish per reach for all families of fish encountered in Johnson Creek Watershed during 2008–2009.

Johnson and Kelley creeks with >45% of the estimated fish per reach in spring. Speckled dace estimates prevailed in Johnson creek during summer (72%) and fall (78%), while winter estimates had speckled dace predominately in Crystal Springs Creek (42%). Chiselmouth were found primarily in Crystal Springs Creek with 100, 79, and 100% of the estimated fish being identified during spring, fall and winter, respectively.

Mean fish per reach for combined Chinook salmon, coho salmon, cutthroat and steelhead was 2.0, 1.7, 1.8 and 0.9 during spring, summer, fall, and winter respectively. Chinook salmon were identified in reaches of Crystal Springs and Johnson creeks in all four seasons, and were not identified in Kelley or Mitchell creeks during any season. Coho salmon were identified in reaches of Johnson and Kelley creeks in all four seasons; were in Crystal Springs Creek in spring and winter, and were not identified in Mitchell Creek during any season. Cutthroat were most prevalent in Kelley and Mitchell creeks during all four seasons. Cutthroat were also identified in Johnson Creek at low percentages during spring, fall, and winter with a noticeably higher percentage during summer. Cutthroat were only identified in Crystal Springs Creek during summer at a very low percentage. Steelhead were most prevalent in Johnson Creek during all four seasons. Steelhead were identified in Crystal Springs Creek in spring, fall and winter.

Steelhead were present in Kelley Creek during spring only, and no steelhead were identified in Mitchell Creek during any of the four seasons. Mean fish per reach for combined native largescale sucker *Catostomus macrocheilus* and unidentified sucker were 2.2, 2.9, 2.4 and 1.7 during spring, summer, fall, and winter, respectively. Only reach 17 of Crystal Springs Creek did not have sucker species identified, and at least one reach has sucker identified during each of the four seasons. Similarly, suckers were identified in 28 reaches of Johnson Creek, and were identified in at least one reach during each of the four seasons. Only reach 2 of Kelley Creek contained suckers during spring and fall. No suckers were identified in Mitchell Creeks during any of the four seasons. Mean fish per reach for threespine stickleback were 11.9, 3.5, 13.3 and 12.2 during spring, summer, fall, and winter, respectively. Threespine stickleback were identified in all reaches in Crystal Springs Creek during all four seasons, and the lowest three reaches of Johnson Creek during spring, summer, and fall. No threespine stickleback were identified in Johnson Creek during winter, and were not identified in any reach of Kelley or Mitchell creeks. Western brook lamprey were estimated in reach 11 and 14 of Crystal Springs Creek (3 to 27.5 per reach during spring, summer and winter, respectively). In Johnson Creek, western brook lamprey were estimated primarily during spring (1 to 20.9 per reach) between reaches 49 and 94; with sparser estimates of 4.5 per reach during summer, and 1 per reach during fall and winter. We estimated 1 Pacific lamprey in reach 19 of Johnson Creek during spring and reach 14 of Crystal Springs Creek during winter. Native species represented 99.7% of the standardized mean percentage of the species composition in Johnson Creek Watershed. Seasonal estimates of non-native species were primarily <2 in Johnson Creek watershed, with the highest estimates being identified during fall (1 to 16.7 per reach). Estimates calculated for spring were between 1 and 3 per reach, and did not exceed 1 per reach during summer or winter.

Descriptive statistics for fork length of all taxa identified to species in Johnson Creek Watershed are available in Appendix Table 5. Seasonal mean fork lengths for reticulate, riffle *C. gulosus*, and prickly sculpin were between 54.7 and 66.2 mm (2.2 and 2.6 inches), 60.5 and 77.0 mm (2.4 and 3.0 inches), and 59.0 and 136.0 mm (2.3 and 5.4 inches), respectively. Seasonal mean fork lengths for the native minnows of chiselmouth, northern pikeminnow, peamouth *Mylochelilus caurinus*, redside shiner, speckled and longnose dace were between 77.7 and 82.0 mm (3.1 and 3.2 inches), 56.7 and 99.0 mm (2.2 and 3.9 inches), 89.0 mm (3.5 inches), 48.3 and 74.7 mm (1.9 and 2.9 inches), 48.7 and 71.5 mm (1.9 and 2.8 inches), and between 73.4 and 123 mm (2.9 and 4.8 inches), respectively. Seasonal mean fork lengths of Chinook salmon, coho salmon, cutthroat, and steelhead were between 46.0 and 115.6 (1.8 and 4.6 inches), 47.3 and 101.5 (1.9 and 4.0 inches), 51.0 and 174.0 (2.0 and 6.9 inches), and 57.7 and 147.8 (2.3 and 5.8 inches), respectively. Seasonal mean fork lengths for suckers and threespine stickleback, were between 60.0 and 470.0 mm (2.4 and 18.5 inches), and 37.0 and 50.0 mm (1.5 and 2.0 inches), respectively. Seasonal mean fork lengths for ammocoetes, and adult Pacific and western brook lamprey were between 41.0 and 109.2 mm (1.6 and 4.3 inches), 100.7 and 150.0 mm (4.0 and 5.9 inches), and 92.5 and 130.0 mm (3.6 and 5.1 inches), respectively. Seasonal fork lengths for the five non-native families of sunfish and bass, oriental weatherfish, banded killifish, brown bullhead *Ameiurus nebulosus*, and western mosquitofish were means between 48.5 and 177.5 mm (1.9 and 7.0 inches), 186.0 mm (7.3 inches), 69.0 mm (2.7 inches), means between 65.6 and 211.0 mm (2.6 and 8.3 inches), and 34.0 mm (1.3 inches), respectively.

Miller Creek Drainage

Fish were captured in both reaches of Miller Creek. We identified ten families of fish during the course of our investigation (Figure 5). Overall, standardized percent abundance was 75, 16, 5, and 3% for sculpin, threespine stickleback, salmon and trout, and minnows, respectively. Non-native western mosquitofish and oriental weatherfish had standardized mean percent of <1%. Although we captured suckers, sunfish and bass, speckled dace, banded killifish, and lamprey in Miller Creek, we were not able to generate estimates for any of these fish. We were unable to identify 16% of the sculpin and 9% of the salmonids to species. Seasonal catch decreased from spring to winter with 37, 34, 18 and 11% of the standardized percent abundance occurring in spring, summer, fall, and winter, respectively (Figure 3).

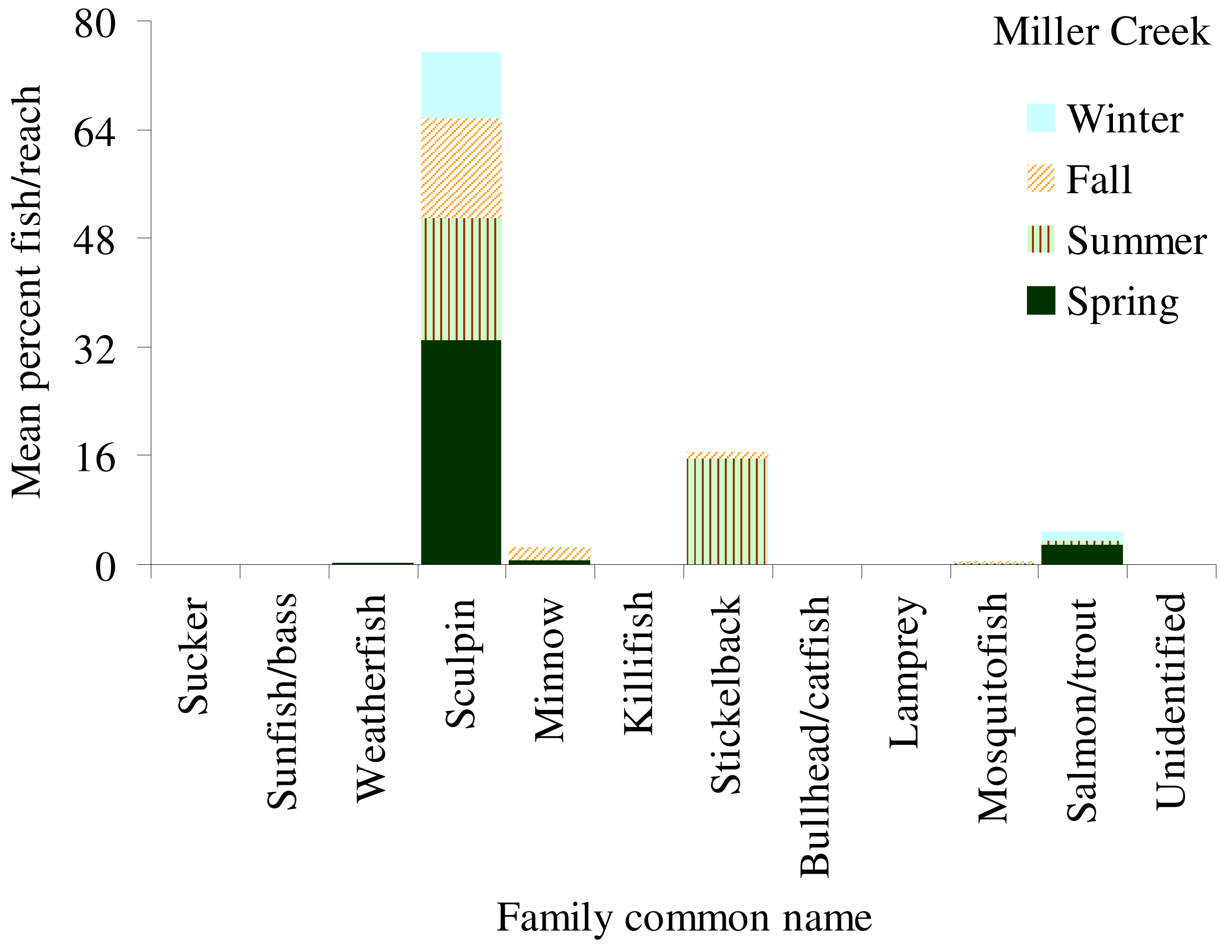

Figure 5. Standardized percentage of fish per reach for all families of fish encountered in Miller Creek drainage during 2008–2009.

Estimated fish per reach for species identified in Miller Creek drainage are available in Appendix Table 4. Slightly over two thirds of the reach estimates calculated in Miller Creek were ≤1 per reach with no strong seasonal pattern emerging among estimates for each species. Combined reticulate, prickly and unidentified sculpin species were estimated to be >230 in reaches 1 of Miller Creek during spring and steadily decreased to <75 in winter; while reach 2 sculpin was noticeably less with <20 in spring, summer and fall, and 1 during winter. Although threespine stickleback were the 2nd highest estimated species in Miller Creek they were primarily found in reach 1 during summer (118 per reach) and decreased to <7 fall through winter. There were three native minnow species found in reach 1 of Miller Creek. Northern pikeminnow were captured in spring and winter, and chiselmouth and redside shiners were identified in fall. Estimates did not exceed 5 per reach for any of these species. Coho salmon were found in reach 1 every season with the highest estimate occurring in spring (22.6 per reach), and we were not able to generate an estimate for fall. We estimated 2 coho salmon in reach 2 of Miller Creek during winter, and zero coho were captured in reach 2 during spring, summer, or fall. Chinook salmon were identified in reach 1 during spring, but we were not able to generate an estimate. No other salmonid species were identified in reaches of Miller Creek drainage during any season sampled. Native species represented 99% of the standardized mean percentage of the species composition in Miller Creek. Seasonal estimates of non-native species did not exceed 2 per reach and were comprised of a single species during each of the four seasons.

Descriptive statistics for fork length of all taxa identified to species in Miller Creek drainage are available in Appendix Table 5. Seasonal mean fork lengths for reticulate, prickly and riffle sculpin were between 64.8 and 68.7 mm (2.6 and 2.7 inches), 55.0 and 65.3 mm (2.2 and 2.6 inches), and 67.7 and 70.4 mm (2.7 and 2.8 inches), respectively. Seasonal mean fork lengths of threespine stickleback were between 36.9 and 52.0 mm (1.5 and 2.0 inches). Seasonal mean fork lengths of coho salmon were between 76.3 and 94.0 mm (3.0 and 3.7 inches) while Chinook salmon had a mean fork length of 51.8 mm during spring (2.0 inches). Seasonal mean fork lengths of northern pikeminnow, chiselmouth, redside shiner and speckled dace were between 30.0 and 54.0 mm (1.2 and 2.1 inches), 45.7 mm, 38.2 mm, and 28 mm, respectively. One western brook lamprey was identified in Miller Creek that was 160.0mm (6.3 inches).

Stephens Creek Drainage

We captured eight families of fish in the only reach we sampled in Stephens Creek during the course of our investigation (Figure 6). Overall, standardized percent abundance was 36, 30, 25, 3, 2, 2, 1, and 1% for minnows, salmon and trout, sculpin, smallmouth bass *Micropterus dolomieu*, brown bullhead, banded killifish, western mosquitofish, and oriental weatherfish, respectively. Although we identified Chinook salmon, and common carp *Cyprinus carpio* in Stephens Creek, we were not able to generate estimates for these species of fish. Seasonal catch was higher during spring than summer and fall with 64, 3, and 7% of the standardized percent abundance, respectively (Figure 3). Standardized percent abundance increased again in winter to 26%.

Estimated fish per reach for species identified in Stephens Creek drainage are available in Appendix Table 4. Over one third of the reach estimates calculated in Stephens Creek drainage were ≤1. Spring and winter seasons had a higher diversity of species (9 and 7, respectively) and larger estimates (between 1 and 31 per reach and between 1 and 19.7 per reach) than did summer and fall seasons (1 and 3; 3 per reach and between 1 and 2 per reach, respectively). Seasonal patterns may have been influenced by screening devices that were placed at the mouth of Stephens Creek during a fish restoration project. There were three native minnow species found

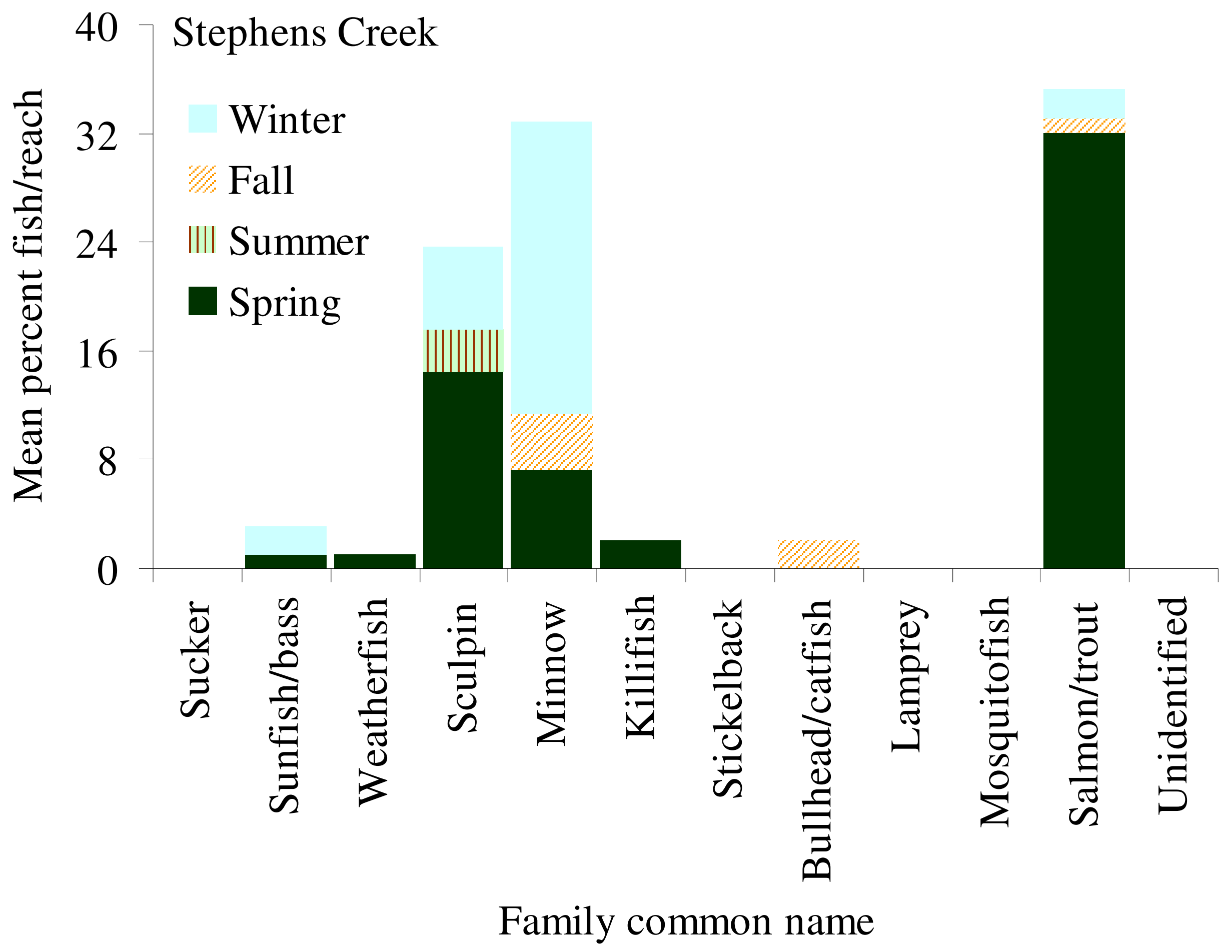

Figure 6. Standardize percentage of fish per reach for all families of fish encountered in Stephens Creek drainage during 2008–2009.

in reach 1 of Stephens Creek, with speckled and longnose dace being captured in spring and winter 3 and 19.7 per reach; 1 and 1 per reach, respectively), and northern pikeminnow being captured in spring (3 per reach). Coho salmon were found in reach 1 in spring (31 per reach) and fall (1 per reach), and were not identified using reach 1 of Stephens Creek in summer or winter seasons. We estimated 2 *O. mykiss* in reach 1 of Stephens Creek during winter, and zero steelhead were captured in reach 1 during spring, summer, or fall. No other salmonid species were identified in reaches of Stephens Creek drainage during any season sampled. Combined reticulate, and prickly sculpin species were estimated to between 12 and 2 in reach 1 of Stephens Creek during spring, summer, and winter. We identified zero sculpin in reach 1 of Stephens Creek during fall. Native species represented 92% of the standardized mean percentage of the species composition in Stephens Creek. Seasonal estimates of non-native species did not exceed 2 per reach and were comprised of 3, 2, and 1 species during spring, fall, and winter respectively. There were zero non-native species identified during summer.

Descriptive statistics for fork length of all taxa identified to species in Stephens Creek are available in Appendix Table 5. Seasonal mean fork lengths of northern pikeminnow, peamouth, speckled and longnose dace were 39.3 (1.5 inches), 55.7 mm (2.2 inches), between 31.8 and 32.0

mm (1.3 and 1.3 inches), and 38 and 56 mm (1.5 and 2.2 inches), respectively. Seasonal mean fork lengths of coho salmon, steelhead, and Chinook salmon were 41.4, 92.5, and 50.0 mm (1.6, 3.6, and 2.0 inches), respectively. Coho were identified in spring only, while steelhead and Chinook salmon were found in winter only. Seasonal mean fork lengths for reticulate, and prickly sculpin were between 50.0 and 65.3 mm (2.0 and 2.6 inches), and 55.8 and 68.9 mm (2.2 and 2.7 inches), respectively. Seasonal mean fork lengths for the five non-native families of fish were <68.0mm (2.7 inches) for all except one oriental weatherfish (170.0 mm; 6.7 inches).

Fish Presence in Summer Hydrologic Units

Table 3 shows the number of the hydrologic units sampled in each reach during summer base flow in 2008. A conglomeration of all City of Portland reaches consisted of eight families of fish. Families identified in fast water, glide, and pool hydrologic unit types varied (Table 4). Sculpin was the predominate family identified (N = 7,563), with 42, 9, and 49% of the total fish captured being in fast water, glide, and pooled hydrologic unit types, respectively. Combining all individuals by hydrologic unit type for all systems that sculpin were identified in, showed there were 4.8, 5.5, and 5.2 sculpin per fast water, glide, and pool unit, respectively. Salmonids followed sculpin in prominence among all the families identified (N = 418), with 27, 7, and 66% of the total fish captured being in fast water, glide, and pooled hydrologic unit types, respectively. Combining all individuals per hydrologic unit type for only those systems where salmonids were identified in, showed there were 0.2, 0.3, and 0.4 salmonids per fast water, glide, and pool unit, respectively. Minnows were third most predominate family identified (N = 219), with 17, 9, and 82% of the total fish captured being in fast water, glide, and pooled hydrologic unit types, respectively. Combining all individuals per hydrologic unit type for those systems that minnows were identified in showed there were <0.1 minnows in both fast water and glide units, while we estimated there were 0.3 minnows per pooled unit.

Fanno Creek Drainage

In the three reaches of Fanno Creek, we sampled 6 fast water, 1 glide, and 7 pooled units. There was an increase in the number of fast water and pooled units in each reach as we moved upstream (Table 3). At a minimum there were 30, 1, and 35 fast water, glide, and pools, respectively. Of the four families of fish identified in Fanno Creek, sculpin were the only family of fish found in both fast water and glide units. Pools contained sculpin, redside shiner, lamprey and cutthroat.

Johnson Creek Watershed

In the single reach of Crystal Springs Creek, we sampled 3 fast water, 3 glide, and 2 pooled units (Table 3). We were not able to describe a pattern for hydrologic unit types available in upstream reaches of Crystal Springs Creek. Of the five families of fish identified in Crystal Springs Creek, sculpin and minnows were found in all three unit types. Threespine stickleback were identified in fast water and pooled units. Suckers were found in glide and pools. Steelhead were identified in fast water habitat units only.

Table 3. Summary of single pass electrofishing sampling during summer base flow 2008. Information on stream reach, date sampled and the number of hydrologic units sampled is provided.

Drainage, Stream, Reach number (length)	Date sampled	Fast water units	Glide units	Pooled units	Total units sampled
Fanno Drainage,					
Fanno Creek,					
1 (100 m)	8/29/2008	6	1	7	14
2 (100 m)	9/4/2008	7	0	10	17
3 (100 m)	9/10/2008	12	0	11	23
Johnson Drainage,					
Crystal Springs Creek					
1 (2,743 m)	9/3/2008	3	3	2	8
Johnson Creek					
2 (1,199 m)	8/26/2008	2	1	2	5
4 (815 m)	8/22/2008	2	1	2	5
6 (1,909 m)	9/2/2008	7	2	6	15
8 (1,252 m)	8/27/2008	1	1	2	4
12 (1,761 m)	8/12/2008	5	2	8	15
14 (3,219 m)	8/28/2008	7	1	8	16
Kelley Creek					
1 (1,023 m)	8/7/2008	9	3	10	22
2 (1,905 m)	8/20/2008	11	0	13	24
Mitchell Creek					
2 (610 m)	8/15/2008	7	0	8	15
4 (609 m)	8/11/2008	2	0	7	9
Miller Drainage,					
Miller Creek					
1 (100 m)	8/8/2008	5	1	4	10
2 (100 m)	8/14/2008	20	0	25	45
Stephens Drainage,					
Stephens Creek					
1 (75 m)	8/13/2008	1	0	1	2

Table 4. Catch summary by fish family identified in three different hydrologic unit types among all creeks sampled in City of Portland boundaries during summer base flow 2008. Total number (*N*) of fish captured in each hydrologic unit and the percent of the total individuals identified in the family among the three unit types is provided in parentheses. Fish per hydrologic unit type sampled with the minimum estimate (count) for each unit type is shown in parentheses.

	Fast water unit types		Glide unit types		Pooled unit types	
Common name (Creek count)	*N* fish (percent)	Fish/unit (count)	*N* fish (percent)	Fish/unit (count)	*N* fish (percent)	Fish/unit (count)
Suckers (2)	1 (7.7)	0.002 (502)	1 (7.7)	0.010 (96)	11 (84.6)	0.034 (326)
Sunfish/bass (2)	7 (24.1)	0.013 (526)	1 (3.4)	0.009 (107)	21 (72.4)	0.052 (403)
Sculpin (7)	3,153 (41.7)	4.785 (659)	704 (9.3)	5.457 (129)	3,706 (49.0)	5.212 (711)
Minnows (4)	38 (17.4)	0.061 (618)	2 (0.9)	0.017 (116)	179 (81.7)	0.302 (593)
Stickleback (1)	1 (—)	0.015 (65)	0 (—)	0.000 (8)	0 (—)	0.000 (48)
Lamprey (3)	23 (33.8)	0.042 (553)	0 (—)	0.000 (108)	45 (66.2)	0.083 (545)
Mosquitofish (1)	1 (—)	0.002 (437)	0 (—)	0.000 (88)	0 (—)	0.000 (278)
Salmon/trout (5)	112 (26.8)	0.177 (631)	30 (7.2)	0.259 (116)	276 (66.0)	0.433 (638)

In the eleven reaches of Johnson Creek, we sampled 24 fast water, 8 glide, and 28 pooled habitat units (Table 3). We could not identify a consistent pattern of change for any of the three hydrologic unit quantities as we moved upstream. Of the eight families of fish identified in Johnson Creek, only mosquitofish, were not identified in fast water or pooled units. Sucker, sculpin, minnow, and mosquitofish were identified in glide units. Of the two salmonids identified, 20 and 22 cutthroat, and 13 and 3 steelhead were identified in fast water and pooled habitat units, respectively.

In the two reaches of Kelley Creek, we sampled 20 fast water, 3 glide, and 23 pooled units (Table 3). There was a slight increase in the number of fast water and pooled units between the two reaches as we moved upstream. Glide units decreased in number between the two reaches as we moved upstream. Of the five fish families identified in Kelley Creek, sculpin were identified in all three hydrologic unit types. Minnows, lamprey, and salmonids were found in fast water and pooled units. Sunfish were in pooled habitat units only.

In the two reaches of Mitchell Creek, we sampled 9 fast water, 0 glide, and 15 pooled units (Table 3). There was a decrease in the number of fast water units between the two reaches as we moved upstream, while pooled units were similar in number as we moved upstream. Of the three families of fish identified in Mitchell Creek, sculpin and salmonids were identified in both fast water and pooled units, and lamprey were only identified in pooled units.

Miller Creek Drainage

In the two reaches of Miller Creek, we sampled 25 fast water, 1 glide, and 29 pooled units (Table 3). There was an increase in the number of fast water and pooled units in the two reaches as we moved upstream. Sculpin were the only family of fish identified in the two reaches sampled during summer. Prickly and riffle sculpin were identified in fast water and pool hydrologic units but not glides. Reticulate sculpin were identified in all three unit types.

Stephens Creek Drainage

In the single reach of Stephens Creek, we sampled 1 fast water, 0 glide, and 1 pooled hydrologic units (Table 3). We were not able to describe a pattern of change for hydrologic unit types available in upstream reaches of Stephens Creek. Sculpin were the only family of fish identified in the single reach sampled, and was comprised entirely of reticulate sculpin which were found in the pooled unit only. As mentioned earlier, activities associated with the fish restoration project in the reach may have biased the results.

The full model incorporating hydrologic unit type and reach as main factors and species as a blocking variable was found to be significant (model 1; F = 16.76, d.f. = 29, P <0.0001), indicating within a species, ranked frequencies of encounter differed significantly among hydrologic unit types, reaches, or combinations of the two (i.e., interactions). Similarly, the overall model incorporating species and land use as independent variables was found to be significant (model 2; F = 10.71, d.f. = 38, P <0.0001), indicating statistically significant differences existed in ranked frequencies among species, land use, or the interactions. Although these analyses revealed the presence of statistically significant differences among main factors or combinations of independent variables, unexplained errors were large (model 1 CV = 28.83; model 2 CV = 30.86). As these models were unable to partition appreciable proportions of the variability, the differences identified may be misleading.

Index of Biotic Integrity

Stream condition in the surveyed reaches of City of Portland streams showed 11 reaches that were marginally impaired, and six reaches that were severely impaired during 2008 (Figure 7). No stream reach scored within the highest possible impairment level of acceptable. Fanno Creek, Johnson Creek Watershed, and Miller Creek had ≥50% of the reaches ranked as marginally impaired, while the only site in Stephens Creek ranked as severely impaired. The upper reach in both Fanno and Mitchell creeks scored the lowest of all reaches.

Table 5 shows impairment levels for 12 reaches sampled both during 2001 and 2002, and again during 2008. Stream conditions improved from severe impairment to moderate impairment in six of 12 reaches between 2001, 2002, and 2008. There were four impairment levels that remained static between periods, and two that drop from marginal to severe impairment. A combination of all reaches in the City of Portland show stream condition has a weak trend toward improved impairment from the earlier indexes to 2008 (Figure 8).

DISCUSSION

Fanno Creek, Johnson Creek Watershed, Miller Creek and Stephens Creek all contained native species of fish, and thus remain important for sustaining fish in the region. Multiple species of sculpin, minnow, lamprey, salmon and trout continued to persist in streams found within the city boundaries. The prevalence of these fish species merits our continued

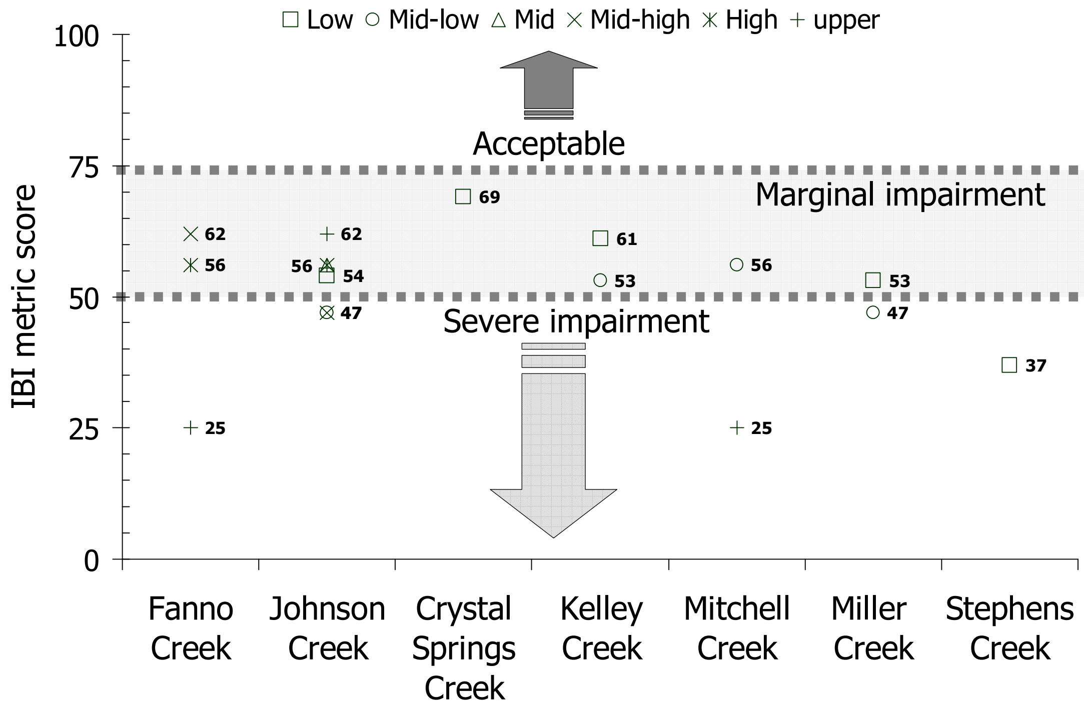

Figure 7. Index of biotic integrity metric scores for each reach sampled during summer base flow 2008. Scores that fall within the gray zone represents marginal impairment levels, while white zones below and above represent severe and acceptable impairment levels, respectively. The legend uses a distinguishing mark relative to the distance from the mouth of the specified creek.

commitment to supporting in-stream enhancement and restoration efforts in these drainages. Although it is not likely that streams within the City of Portland boundaries will be restored to pre-European settlement conditions, striving to enhance stream conditions across a watershed could aid in reestablishing a more productive fish community. Treating City of Portland streams as river continuums (Vannote et al. 1980) that strive to link available resources could prove effective at increasing productivity for fish in the ecoregion. However, knowing how restoration projects influence fish communities in a stream will require a continued commitment to monitoring responses exhibited by fish populations in the watershed.

Seasonal abundance estimates for the three most prevalent native families of fish showed different patterns. Overall standardized percent population abundance showed that sculpin increased in prevalence from spring to summer, but decreased noticeably thereafter. The opposite was observed for minnows; where estimates were noticeably smaller in spring and summer, yet greater than all other families in fall and winter. Although salmonids were identified during every season of the year, the percentage they contributed remained relatively static spring through fall, with a slight increase in overall prevalence during winter. Our investigation sought to measure seasonal distribution in City of Portland streams, but our effort

Table 5. Impairment levels determined from Indexes of Biotic Integrity that uses fish metrics assembled from fish captured in three different hydrologic unit types at summer base flow in Johnson, Miller, and Stephens drainages during 2001, 2002 and 2008.

	Index of biotic integrity impairment levels		
Drainage, Stream reach (number)	Base flow 2001	Base flow 2002	Base flow 2008
Johnson Creek Watershed,			
Crystal Springs Creek (1)	Severe	Marginal	Marginal
Johnson Creek (2)	Marginal	Marginal	Marginal
Johnson Creek (4)	Severe	Severe	Severe
Johnson Creek (6)	Marginal	Marginal	Marginal
Johnson Creek (8)	Marginal	Severe	Severe
Johnson Creek (12)	—	Severe	Marginal
Johnson Creek (14)	Marginal	Severe	Marginal
Kelley Creek (1)	Severe	Severe	Marginal
Kelley Creek (2)	Severe	Severe	Marginal
Miller Creek Drainage,			
Miller Creek (1)	Severe	Marginal	Marginal
Miller Creek (2)	—	Severe	Severe
Stephens Creek Drainage,			
Stephens Creek (1)	Marginal	Marginal	Severe

was not designed to determine interaction among species. Therefore, interpreting seasonal differences among these native species falls outside the scope of our sampling design. Identifying whether these observed differences are related to species interactions or simply attributable to differences among life histories of these species would require a focused look at interactions within the aquatic community. This level of effort would require more intensive sampling; collecting data to quantify parameters such as habitat and diet (Baltz 1990; Crowder 1990). The expense and effort associated with these types of sampling activities may be cost prohibitive, especially given the low abundance of many of the species of interest in these streams (e.g., Chinook salmon). Continuing to employ less costly measures to monitor relative trends in a watershed better fit the current conditions of City of Portland streams, and should continue to provide the types of data needed to effectively inform improvement measures.

Standardized percent abundance estimates that combined all taxa showed a decreasing trend in three of the four drainages from spring to winter. This provides initial support to the idea that fish numbers changed seasonally. Angermeier and Karr (1986) found that assessments of stream condition varied relative to the number of young fish present in sampled reaches, and attributed variation to stochastic processes. They concluded that spatial and temporal standardization of sampling activities helped to reduce unexplained variability and enhanced repeatability when monitoring fish populations across time. The pattern of a steep decrease in standardized percent abundances in Stephens Creek may be directly associated with in-water work in and just upstream of the end of the reach. A sediment capture device was placed across

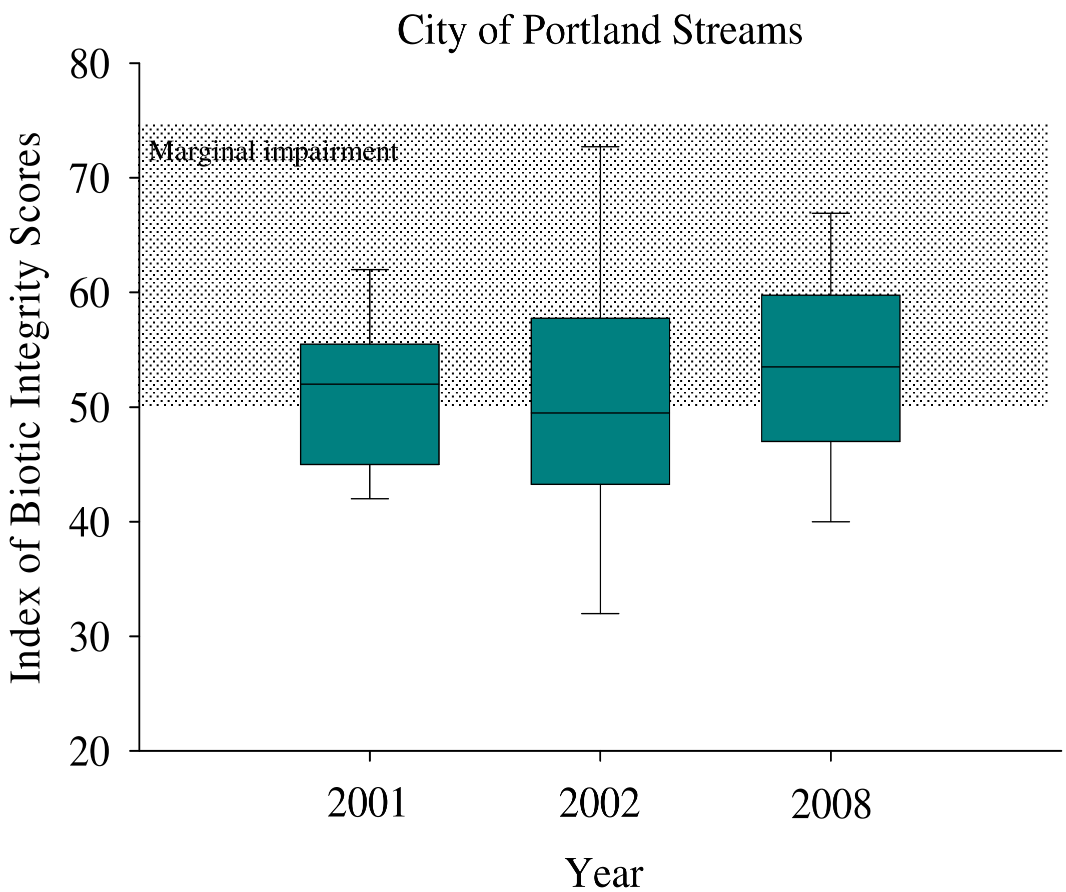

Figure 8. Box plot describing index of biotic integrity from 12 repeated stream reaches surveyed at summer base flow during 2001, 2002, and 2008 within City of Portland boundaries. The gray zone in the chart represents marginal impairment levels, while white zones below and above represent severe and acceptable impairment levels, respectively.

the mouth of the creek, which may have inhibited the natural use of the reach by fish. Elucidating causes of this pattern would, in part, require returning to Stephens Creek in subsequent seasons to identify if the pattern persists without the sediment capture device in place. Given the proximity of the reach to the main stem Willamette River it is possible that fish utilize the lower 75 meters of the creek intermittently. Scrivener et al. (1994) showed that juvenile Chinook salmon used non-natal tributaries for short periods of time. Identifying this behavior for fish in the lower 75 m of Stephens Creek may provide information relative to short term use and dispersal by salmonids and other fish. This kind of information could help verify the importance of small tributaries as necessary habitats for fish in the ecoregion.

Regardless of season, many of the fish we captured were small in size. Although we generated length frequency histograms for each of the four salmonid species, there were too few fish captured to sufficiently characterize size distributions during each season. Devries and Frie (1996) describe that fish lengths provided a valuable tool for separating age-groups in a population of fish, but that even the most basic distribution require a large sample to identify clear dispersion around peak values (modes). We collected lengths from every Chinook salmon, coho salmon, and steelhead, as well as the majority of the cutthroat we captured each season. Yet, most histograms were sparsely populated. The sizes of Chinook salmon and coho salmon captured during the investigation represented what would be expected when sampling juvenile fish only. Although the larger of the fish sampled for these two species fit sizes of residualized or precocious fish (Van Dyke et al. 2008), we did not observe any visual traits expected in maturing fish during any of the seasons we sampled. Steelhead and cutthroat, potentially representing both resident and anadromous life histories, appeared to be comprised of multiple cohorts with smaller sized fish predominating. Cutthroat, the most prevalent of the salmonid species in the study area, showed some semblance of distinct modes in spring; however the pattern began to erode summer to winter. Devries and Frie (1996) caution that bias associated with variable growth may obscure the interpretation of length frequency distributions when used alone to describe different age-groups. Collecting hard tissues from cutthroat in future sampling might enhance our understanding of cutthroat age structure. Such an effort would be valuable in better characterizing this native population, and may help to infer benefits associated with restoration efforts.

It seems apparent that City of Portland streams are being used by rearing juvenile fish of anadromous life histories (e.g. Chinook salmon and coho salmon). However, it remains unclear if the origin of these fish is the stream of their capture. Juvenile Chinook salmon have been shown to disperse 15 km or more upstream in non-natal creeks in the lower Fraser River (Murray and Rosenau 1989); while coho salmon have been found in off channel habitats in winter (Nickelson et al. 1992; Quinn and Peterson 1996) and shown a propensity to move among streams habitats (Nielson 1992). Teel et al. (2009) recently published work describing juvenile Chinook salmon moving into wetland rearing habitats of the lower Willamette River that included the Columbia Slough. Collections in the main stem of the Columbia Slough found Chinook salmon and coho salmon as far upstream as 8.4 km (Van Dyke et al. 2009). Although there have been observations of larger steelhead in Johnson Creek Watershed, the magnitude of successful reproduction in the watershed by adult anadromous salmonids remains anecdotal. Even systems with depressed naturally spawning populations typically contain offspring in larger groups in better quality hydrologic units throughout the freshwater rearing period (Van Dyke 2008 and 2009). Yet our collections in Johnson Creek Watershed rarely included greater than one juvenile salmonid per 200 m reach. We did not collect or observe a single adult Chinook salmon, coho salmon or steelhead during sampling even though our coverage of the watershed was extensive both temporally and spatially. Although electrofishing introduces some size selective bias, it is generally represented by reduced capture efficiencies for smaller fish (Reynolds 1996). Therefore, our catches should have been less biased for larger fish, even if they were less abundant. Recognizing the current use of the watershed by multiple aged fish could help to prioritize restoration projects that benefit the primary functional use of the watershed (e.g., connectivity to migratory corridors), and allow natural processes to work less stringently at restoring components of the habitat that are not in as high demand (e.g., site specific reintroduction of spawning complexes).

Native species were more prevalent than non-native species in all drainages. This parallels earlier findings on species composition in City of Portland streams (Tinus et al. 2003). In addition to sculpin, minnow, and salmon and trout, we identified ammocoetes, and western brook and Pacific lamprey macropthalmia in every drainage we sampled but Stephens Creek.

Smaller numbers of large scale suckers were encountered in Crystal Springs, Johnson, Kelley, and Miller creeks. Threespine stickleback were found throughout Crystal Springs Creek, and in the lower reaches of Johnson (from reach 10 downstream), and Miller creeks. The presence of these three families of fish in City of Portland streams indicate these drainages continue to play a role in sustaining these fish in the region. Of the 23 non-native fish species documented in the Columbia River ecoregion (Wydoski and Whitney 2003, Sytsma et al 2004), we found 13 in streams within the City of Portland boundaries. Although this count describes a rich species composition, the percentage of estimated non-native species in City of Portland streams was 0.2%. Understanding native and non-native species interaction in the region will continue to be a topic of interest, but at least in the wadeable streams we surveyed native fish species continue to predominate. Efforts like this should continue to monitor and describe fish composition in wadeable streams in the region.

Although we were able to identify the relative ratio of pools to fast water units in a reach, we were not able to quantify their overall representation in each reach, drainage or watershed because we did not measure the linear length of each unit. Elucidating the relative importance of hydrologic unit types could generate insight on the productivity expected in a drainage. However, addressing this and related questions would require a more quantitative approach. Habitat inventories have been conducted in City of Portland sections of Johnson Creek Watershed (ODFW 1999-2000, personal communication Isaac Sanders), yet characterizing the dynamic nature of this system may require repeated efforts of shorter duration. Understanding the roles of different hydrologic unit types in supporting fish communities will continue to be important if we are to effectively manage and restore productive aquatic systems in Portland area drainages. Monitoring the effects of habitat restoration should remain a priority of management in the ecoregion.

This investigation found cutthroat to be more prevalent in Kelley and Mitchell creeks than in Crystal Springs and Johnson creeks. Tinus et al. (2003) also reported cutthroat being a large component of the fish assemblage in Kelley Creek with fluvial or anadromous forms potentially being responsible for redds observed during surveys in winter. We did not observe any redds or handle large fish that had the characteristics common to anadromous cutthroat, so we are unable to confirm spawning activity in Johnson Creek Watershed. Additional sampling may reveal a more comprehensive use by salmonids in the drainage, but increases in fish numbers may be needed to regularly observe them each season in Johnson Creek Watershed.

Juvenile Chinook salmon, coho salmon, and steelhead continue to use segments of each of the streams that we sampled in Portland city boundaries. Yet, even at the watershed level these species were encountered too infrequently to conduct reliable tests of statistical difference. Rahel and Jackson (2007) associated these problems with trying to quantify species specific differences in watersheds where abundance is low. Although cutthroat were more prevalent, they were generally isolated to upstream reaches and were not encountered in many of the streams we sampled. This effectively limited our ability to adhere to the assumptions of statistical models, and consequently to conduct reliable tests of hypotheses. Overall Chinook salmon yielded estimates <1 fish per reach over 90% of the time; while for cutthroat this occurred over 85% of the time. For this reason, exploring alternative methods that measure the responses of more prevalent native species may provide more dependable information that can be used for assessing the effectiveness of enhancement projects. This could improve our ability to detect differences resulting from the enhancement or restoration of streams in the area. For example, dace exhibit many of the dispersal behaviors that we expect from juvenile salmonids (Clough and Beaumont 1998), and thus require the same connectivity among stream habitats (Poulet 2008). Where dace are present, focusing attention on measuring their dispersal behavior in streams subject to culvert removal activities may provide better chance of elucidating the effects of the work, and translate to highlight benefits for juvenile salmonids as well. Effecting positive change by successfully showing changes related to restoration measures could result in the creation of successful and viable methods to improve stream conditions for these and other native species in the region.

The index of biotic integrity showed that conditions in City of Portland streams are on average marginally impaired. Although there may have been a slight trend toward improved median impairment ranking for the ecoregion, no reach was defined as acceptable; the highest impairment level achievable for our index. Despite our hope that an ecosystem's ability to support viable aquatic communities can rebound rapidly following disturbance, animal abundances may decline (e.g. due to stochastic events) before the community responds to enhancement efforts. Davis (1995) described that effort to restore clean water quality in Soar River, England led to the natural repopulation of an extirpated fish community; a response requiring 20 years to observe. Little to no change in median stream condition from 2001 to 2008 underscores the need for long term monitoring in the region. In addition, our ability to detect a difference when the changes are small in size or gradual in duration may depend on continued and regular sampling efforts in the ecoregion. Fore (2003) showed that fish based indexes of biotic integrity should be capable of detecting a two percent change annually after about five years of sampling in 30 to 50 sites. We sampled fewer sites and did not repeat sites annually. By increasing the number of sites we sample, and decreasing the time between sampling events, our approach would likely become more effective at detecting small changes.

The headwater reach in both Fanno and Mitchell creeks contained large stretches characterized by an intermittent wetted or puddled channel during base flow conditions, and probably did not provide conditions suitable for a resident fish population even during wetter seasons of the year. Given that our assessment was designed to classify stream condition in fish bearing streams, the use of these reaches may have introduced bias as observed stream conditions differed from the theoretical unperturbed state (Hughes et al. 1998; Whittier et al. 2007). Replacing these two sites may reduce unexplained variability and thus better represent the area of interest.

The index of biotic integrity is an effective tool for assessing stream condition in urban ecosystems. However, long term monitoring efforts require clearly defined spatial scopes for sampling designs to effectively describe responses (Fore 2003; Meador et al. 2008). Our approach was based on a large ecoregion, but some have focused on scores to scale down their interpretation to a single reach or to describe a specific creek. Using a single reach isolated in a specific creek that was randomly selected from reaches throughout a larger ecoregion conforms to the assumption of this index of biotic integrity (Fausch et al. 1984; Hughes et al. 1998; Whittier et al. 2007). However, applying information from a single reach that is representative of a single isolated condition which differs from complex or fragmented conditions found in the majority of the drainage could be fundamentally flawed. Whittier et al. 2007 found that direct substitution of metrics used in one index of biotic integrity could strain the efficacy of another if metrics were applied broadly without thorough consideration of regional differences. If single creek or drainage assessments are desired, we should consider distributing sampling effort equally across all segments of the stream of interest. In the case of Miller and Stephens creeks, this would require identifying additional reaches that occur throughout the entire wetted area of these drainages. However, we do not recommend narrowing this assessment to a finer scale because doing so would require a novel assessment that tests conformity of responsiveness to a suite of metrics that are free from redundancies, and pertain to a suitable reference collection specific to each stream indexed. We do believe that adding reaches to our monitoring effort will better account for small increments of change over time, and feel that it would be appropriate to include additional reaches in all of the current drainages sampled. Future assessments should sample comprehensively in all these drainages if we hope to achieve broad acceptance of impairment levels measured by our index. A finer resolution on the spatial level should lead to improved monitoring of aquatic resources in the region.

We did not complete a seasonal assessment of stream condition using the index of biotic integrity (Tinus et al. 2003). Using an index of biotic integrity to compare seasonal differences is biased by unexplained variability among seasons (Angermeier and Karr 1986; Karr et al. 1987). This bias can be magnified when a reference condition is used interchangeably among seasons (Hughes et al. 2005; Mebane et al. 2003). Gatz et al. (1993) cautioned against lumping different seasonal collections into a single index of biotic integrity because doing so would make between year comparisons less meaningful. Rankin and Yoder (1990) looked at sources of variability and concluded that standardizing data collection methods were important in increasing the accuracy of an assessment. Fore et al. (1994) showed that sites sampled during fall had much higher variability when compared to collections from the same sites in summer. Hughes et al. (1998) suggested that sources of variability associated with sampling too few sites, or sampling when conditions change widely should be eliminated whenever possible to minimize variability. By following these guidelines, one retains a standard of consistency that assures the degree a score changes will accurately portray the impairment level measured. Our commitment to such a standardized approach strengthens our comparisons by minimizing unexplained variability and enhancing dependability of results. Therefore, future comparisons should refrain from attempting to identify seasonal differences in stream conditions using this method. However, this method when consistently applied using summer base flow collections that parallel those used in past work should dependably and efficiently provide multiple year comparisons of stream condition in the region.

RECOMMENDATIONS

We recommend continued monitoring of seasonal fish use of urban streams to identify trends in abundance and distribution of native species. This effort should include monitoring for changes in the overall presence of non-native fish in the area.

We recommend considering evaluations that utilize other native species (e.g. speckled dace) as surrogates for less abundant species (e.g. Chinook salmon) to test for changes associated with habitat improvement projects. Continued emphasis on reestablishing habitat connectivity by clearing stream migratory corridors of blockages such as culverts, could make for a promising demonstration project.

We believe conducting fish monitoring and habitat inventory studies at more regular intervals (1-3 years) could help to evaluate trends that monitor relative changes for pre- and post-treatment evaluations.

We recommend continuing to assess stream condition using the index of biotic integrity used in this study and designed for the Willamette River ecoregion. Future efforts should identify sources of unexplained variability and assess the need to incorporate more sites (such as in Miller and Stephens creeks) into the sampling design. This may add a better characterization of stream condition at the ecoregion level. In addition, reducing the duration between sampling events from 3–5 to 1–2 years may enhance our ability to detect small changes. Implementing assessments more frequently and detecting changes in stream condition at this scale may provide a segue for establishing a watershed level monitoring approach that could be of mutual interest to other municipalities and stakeholders in the greater Portland Metropolitan area.

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APPENDIX TABLES

Sampling Summaries

Appendix Table 1. Location and description of multiple pass survey reaches sampled in City of Portland streams during 2008-2009. Global positioning system coordinates are WGS 84 datum formatted in decimal degree units (hddd:mm:ss).

Stream, Reach	WGS 84	Description of the downstream and upstream boundaries
Fanno Creek,		
1	N45 29 17.6 W122 44 15.6 N45 29 17.1 W122 44 10.7	Start at tributary adjacent to 59th Avenue and end 100 m upstream; past apartments parallel to creek.
2	N45 29 10.7 W122 43 09.8 —	Start adjacent to red deck and end 100 m upstream at tributary reach; downstream of 39th avenue culvert north of Beaverton-Hillsdale Highway.
3	N45 28 56.9 W122 42 26.4 N45 28 57.5 W122 42 23.0	Start upstream of culvert for Christian Center parking lot Road and end 100 m upstream; adjacent to corner of Neva Shalom temple off SW Dosch Road.
Vermont Creek,		
1	N45 28 35.9 W122 44 09.4 N45 28 35.6 W122 44 05.5	Start at foot path culvert north of Vermont Street and end at chain link fence post close to creek.
2	N45 28 24.2 W122 43 33.7 N45 28 26.1 W122 43 36.0	Start 20 m into blackberry covered area near the northwest corner of Caldew Street Condos, and end at the overhanging cedar tree.
Woods Creek,		
1	N45 28 10.3 W122 44 11.1 N45 28 10.1 W122 44 06.4	Start at tributary downstream form April Park trail and end at concrete ring on bank.
2	N45 27 50.6 W122 43 39.5 N45 27 49.4 W122 43 36.4	Start ~100m downstream from Garden Home road culvert and end below culvert pool.
Crystal Springs Creek		
2	N45 27 44.0 W122 38 31.9 N45 27 44.0 W122 38 31.9	Start adjacent to Harney Street between 21st and 23rd Avenues, and end at Tenino Street culvert.
5	— —	Start at apartments and the vacant lot property line, and end at Lambert Street.
8	N45 28 10.7 W122 38 30.4 N45 28 17.0 W122 38 31.2	Start adjacent to middle of the concrete casting pond, and end just downstream of the Westmoreland Park lake.
11	N45 28 38.0 W122 38 24.3 N45 28 43.8 W122 38 20.7	Start upstream of railroad culvert and end 200 m upstream (~50m downstream of pond).
14	N45 28 47.9 W122 38 20.5 N45 28 53.7 W122 38 19.5	Start at upstream mouth of pond and end at golf course property line.

Appendix Table 1. Continued.

Stream, Reach WGS 84	Description of the downstream and upstream boundaries
Crystal Springs (continued)	
17 N45 28 55.4 W122 38 10.8 N45 28 56.0 W122 38 03.1	Start at tree with No Trespassing sign downstream of tree line, and end past the stilted Reed College Campus building along Botsford drive.
Johnson Creek	
1 N45 26 44.8 W122 38 37.3 N45 26 47.0 W122 38 36.6	Start between two concrete retaining walls and adjacent to manhole, and end just downstream (~15m) of 17th Avenue bridge.
4 N45 26 53.4 W122 38 34.2 N45 26 59.4 W122 38 33.4	Start adjacent to Bus stop on 17th Avenue, and end ~50 m past 2nd bridge.
7 N45 27 11.6 W122 38 36.2 N45 27 18.1 W122 38 35.0	Start at Milport road bridge, and end adjacent to pallet pile and corner of building.
10 N45 27 31.3 W122 38 31.3 N45 27 35.6 W122 38 33.4	Start at Ochoco bridge, and end below confluence with Crystal Springs in Johnson Creek Park.
13 N45 27 45.5 W122 38 21.7 N45 27 50.5 W122 38 20.1	Start downstream of Umatilla bridge (Adjacent to Acropolis), and end in the bend downstream of McLoughlin bridge.
16 N45 27 52.2 W122 38 00.6 N45 27 53.1 W122 37 53.2	Start near first white condo on SE Berkley, and end at cul-de-sac.
19 N45 27 53.8 W122 37 43.7 N45 27 48.8 W122 37 36.2	Start adjacent to clay tennis court, and end 200 m upstream past back tennis court.
22 N45 27 44.1 W122 37 29.3 N45 27 44.9 W122 37 20.0	Start downstream of empty restored backwater, and end just downstream of restored instream structure.
25 N45 27 46.9 W122 37 04.7 N45 27 42.6 W122 37 00.8	Start at SE Harney bridge, and end at SE 45th avenue bridge.
28 N45 27 31.5 W122 36 42.0 N45 27 28.2 W122 36 33.4	Start at property line of Blue Split level house (4925 Brookside), and end between Grey and Beige houses (5135 Brookside).
31 N45 27 26.0 W122 36 27.2 N45 27 21.9 W122 36 20.7	Start at 55th avenue bridge, and end in the middle of creek bend toward the east.
34 N45 27 20.9 W122 36 04.8 N45 27 18.2 W122 36 01.4	Start downstream of Wichita avenue bridge, and ends approximately midway to second big bend.

Appendix Table 1. Continued.

Stream, Reach WGS 84		Description of the downstream and upstream boundaries
Johnson Creek (continued)		
37	N45 27 18.9 W122 35 45.0 N45 27 18.9 W122 35 38.4	Start at east property line of house on corner of 65th and May, and end after creek moves away from May.
40	N45 27 24.5 W122 35 24.3 N45 27 28.4 W122 35 19.3	Start downstream of where Label lane would cross creek, and end where creek bends to east.
43	N45 27 32.2 W122 35 04.4 N45 27 37.5 W122 35 05.5	Start upstream of railroad car bridge, and end after creek becomes parallel to Springwater Trail.
46	N45 27 44.9 W122 34 52.6 N45 27 47.8 W122 34 45.2	Start behind old house at 79th and Luther, and end at 82nd avenue bridge.
49	N45 27 55.9 W122 34 30.5 N45 27 59.8 W122 34 25.7	Start at remains of old bridge, and end at Lambert bridge.
55	N45 28 16.6 W122 33 49.4 N45 28 22.6 W122 33 45.0	Start downstream 92nd avenue bridge, and end at the beginning of the concrete bank before MAX bridge.
58	N45 28 27.3 W122 33 35.2 N45 28 30.8 W122 33 27.3	Start adjacent to forested area on northwest side of the creek, and end 200m upstream.
61	N45 28 32.3 W122 33 19.1 N45 28 30.9 W122 33 11.7	Start where creek is parallel to 101st avenue, and end upstream of 103rd avenue property line.
64	N45 28 26.1 W122 33 04.9 N45 28 26.1 W122 32 59.2	Start downstream of 106th avenue bridge, and end at upstream end of long pool past tunnel.
67	N45 28 30.1 W122 32 46.6 N45 28 34.5 W122 32 44.5	Start behind house on 108th avenue, and end past 110th avenue bridge.
70	N45 28 30.5 W122 32 29.8 N45 28 28.0 W122 32 25.9	Start at upstream root wad on bend, and end around tunnel parallel to Foster.
73	N45 28 25.8 W122 32 12.7 N45 28 24.5 W122 32 04.8	Start adjacent to downstream end of blue house property, and end before open replanted bank.
76	N45 28 16.8 W122 31 37.2 N45 28 17.2 W122 31 24.0	Start downstream of 122nd avenue bridge near property line, and end upstream 200 m.
82	N45 28 25.1 W122 31 05.6 N45 28 27.1 W122 30 59.7	Start ~30 m downstream of tributary, and end at 134th and Deardorf avenue covered bridge.

Appendix Table 1. Continued.

Stream, Reach WGS 84		Description of the downstream and upstream boundaries
Johnson Creek (continued)		
85	N45 28 40.5 W122 30 32.2 —	Start just upstream of 134th and Deardorf avenue covered bridge, and end 200 m upstream.
88	N45 28 38.4 W122 30 26.9 N45 28 39.2 W122 30 18.7	Start downstream of the 142nd avenue bridge, and end before the bend upstream of the bridge.
91	N45 28 38.1 W122 30 00.7 N45 28 42.0 W122 29 52.8	Start ~30 m downstream of horse farm driveway bridge, and end where creek is close to Foster road.
94	N45 28 43.2 W122 29 44.9 N45 28 46.8 W122 29 42.2	Start where creek is closest to Foster road, and end at second bridge (private driveway).
Kelley Creek,		
2	N45 28 36.7 W122 29 52.9 N45 28 32.7 W122 29 53.0	Start at slight bend upstream of 159th avenue bridge, and end at first instream terrace.
5	N45 28 12.8 W122 29 44.5 N45 28 12.2 W122 29 36.5	Start downstream of tributary, and end at pond pipe.
8	N45 28 11.7 W122 29 36.1 N45 28 06.7 W122 29 30.1	Start at Kelley Creek Ranch driveway bridge, and end just into treed area.
11	N45 28 03.8 W122 29 08.9 N45 28 01.6 W122 29 06.5	Start behind church along fence line, and end near property line/yard of house on Foster road.
14	N45 27 57.7 W122 28 34.2 N45 27 56.9 W122 28 26.3	Start upstream of Richey road culvert, and end ~50m into restored channel adjacent to Bradshaw house and pond.
17	N45 27 56.8 W122 28 08.3 N45 27 57.2 W122 28 00.7	Start at foot bridge upstream of driveway culvert off Richey road, and end at structure below 190th avenue culvert.
23	N45 27 58.4 W122 27 35.3 N45 27 57.5 W122 27 29.0	Start ~20m upstream of 190th avenue culvert, and end 200m upstream.
26	N45 27 58.1 W122 27 15.0 N45 27 51.5 W122 27 07.3	Start adjacent to Binford avenue, and end adjacent to Eleven Mile Avenue.
29	N45 27 41.2 W122 26 54.5 N45 27 37.4 W122 26 48.7	Start at culvert on private driveway (green mailbox 8015), and end upstream at pink flagging.

Appendix Table 1. Continued.

Stream, Reach	WGS 84	Description of the downstream and upstream boundaries
Kelley Creek (continued)		
32	N45 27 33.1 W122 26 42.4 N45 27 27.2 W122 26 41.2	Starts adjacent to metal pipe on Rodlun road, and end at logs by tributary confluence.
Mitchell Creek,		
2	— —	Start at top of pool above "race track" culvert, and end in blackberries adjacent to horse stable property.
5	N45 27 48.2 W122 29 25.5 N45 27 43.2 W122 29 27.7	Start near downstream edge of property line, and end at Baxter road culvert.
8	N45 27 36.8 W122 29 49.8 N45 27 33.2 W122 29 50.9	Start at 162nd avenue culvert, and end 200m upstream.
11	N45 27 32.5 W122 30 01.6 N45 27 30.3 W122 30 08.6	Start ~50 m downstream of tributary, and end at trailer park culvert.
14	N45 27 24.8 W122 30 26.4 N45 27 22.0 W122 30 33.2	Start ~50m upstream of fence line, and end at small culvert adjacent to Spyglass road.
Miller Creek		
2	N45 37 05.6 W122 48 14.2 —	Start at confluence with Willamette River, and end 100 m upstream.
5	N45 37 03.1 W122 48 24.8 N45 37 01.4 W122 48 28.5	Start upstream of highway 30 bridge, and end 100 m upstream.
Stephens Creek		
1	N45 28 07.7 W122 40 10.0 —	Start at confluence with Willamette River, and end at culvert at Macadam Avenue.

Appendix Table 2. Location and description of single pass survey reaches sampled in City of Portland streams during 2008. Global positioning system coordinates are WGS 84 datum formatted in decimal degree units (hddd:mm:ss).

Stream, Reach WGS 84	Reach Length meters (miles)	Description of the downstream and upstream boundaries
Fanno Creek,		
1 N45 29 17.6 W122 44 15.6 N45 29 17.1 W122 44 10.7	100 (0.06)	Start at tributary that is adjacent to 59th avenue, and end just past apartments parallel to creek.
2 N45 29 10.7 W122 43 09.8 —	100 (0.06)	Start downstream of 39th street culvert (north of Beaverton-Hillsdale Highway) adjacent to a red deck, and end 100 m upstream at tributary.
3 N45 28 56.9 W122 42 26.4 N45 28 57.5 W122 42 23.0	100 (0.06)	Start upstream of culvert for Christian Center parking, and end adjacent to corner of Neva Shalom temple.
Crystal Springs Creek,		
1 — —	2,743 (1.71)	Start at mouth of Crystal Springs Creek and end at Reed College Lake.
Johnson Creek,		
2 — —	1,199 (0.75)	Start at highway 224 overpass, and end at mouth of Crystal Springs Creek.
4 — —	815 (0.51)	Start at the old Tacoma street bridge crossing, and end at Tideman-Johnson rail and foot bridge.
6 — —	1,909 (1.20)	Start at Johnson Creek boulevard, and end at Linwood avenue.
8 — —	1,252 (0.78)	Start at 82nd avenue bridge crossing and end at I-205 bridges.
10 — —	1,062 (0.66)	Start at 106th avenue, and end at 110th avenue bridge crossing.
12 — —	2,743 (1.71)	Start at upper end of the Brookside Restoration site, and end at SE 134th avenue bridge crossing.
14 — —	2,743 (1.71)	Start at Kelley Creek tributary, and end at 190th avenue bridge crossing

Appendix Table 2. Continued

Stream, Reach WGS 84	Reach Length meters (miles)	Description of the downstream and upstream boundaries
Johnson Creek (continued)		
16 — —	2,743 (1.71)	Start at Springwater corridor bridge, and end at Palmblad road bridge crossing.
Kelley Creek,		
2 — —		Start at slight bend upstream of 159th avenue bridge, and end at first instream terrace.
4 — —		Start downstream of tributary and end at pond pipe.
Mitchell Creek,		
1 — —		Start at confluence with Kelley Creek, and end at Baxter road.
2 — —		Start at Baxter road, and end at 162nd Avenue.
3 — —		Start at 162nd avenue, and end at unnamed road.
4 — —		Start at unnamed road, and end at headwaters.
Miller Creek,		
2 N45 37 05.6 W122 48 14.2 —	100 (0.06)	Start at confluence with Willamette River, and end 100 m upstream.
5 N45 37 03.1 W122 48 24.8 N45 37 01.4 W122 48 28.5	100 (0.06)	Start upstream of highway 30 bridge, and end 100 m upstream.
Stephens Creek,		
1 N45 28 07.7 W122 40 10.0 —	75 (0.05)	Start at confluence with Willamette River, and end at Macadam avenue culvert.

Appendix Table 3. Individual electrofishing survey with specific information relative to each sampling event in City of Portland reaches during 2008-2009.

Season (method), Drainage, Stream	Reach (length)	Date	Time	Pass count (seconds)	DC at Volts. H^2O temp. conductivity
Spring (Multiple pass),					
Fanno Drainage,					
Fanno Creek	1 (100)	6/16/2008	9:24	3 (2,527)	100. 14. —
	2 (100)	6/16/2008	12:32	3 (2,930)	—. 14. —
	3 (100)	6/17/2008	10:02	1 (679)	—. 12. —
Vermont Creek	1 (100)	6/17/2008	10:54	1 (957)	—. 13. —
	2 (100)	6/17/2008	12:40	1 (811)	—. 12. —
Woods Creek	1 (100)	6/18/2008	10:38	1 (607)	—. 12. —
	2 (100)	6/18/2008	9:44	1 (804)	—. 12. —
Johnson Drainage,					
Crystal Springs Creek	2 (200)	4/24/2008	10:15	3 (—)	—. 12. —
	5 (200)	4/30/2008	9:10	1 (—)	—. 12. —
	8 (200)	4/24/2008	14:05	1 (—)	—. 13. —
	11 (200)	4/30/2008	12:15	2 (—)	—. 15. —
	14 (200)	5/1/2008	9:40	3 (—)	—. 13. —
	17 (200)	5/19/2008	12:57	3 (—)	—. 19. —
Johnson Creek	1 (200)	5/14/2008	10:06	3 (—)	—. 15. —
	4 (200)	5/15/2008	9:14	1 (—)	—. 16. —
	7 (200)	4/28/2008	9:35	3 (—)	—. 14. —
	10 (200)	4/28/2008	13:25	1 (—)	—. 16. —
	13 (200)	5/2/2008	10:15	1 (—)	—. 12. —
	16 (200)	4/25/2008	9:25	1 (—)	—. 10. —
	19 (200)	5/5/2008	9:30	2 (—)	—. 14. —
	22 (200)	4/17/2008	11:30	2 (—)	—. 11. —
	25 (200)	4/21/2008	9:51	3 (—)	—. 8. —
	28 (200)	4/21/2008	13:29	1 (—)	—. 9. —
	31 (200)	4/22/2008	9:28	1 (—)	—. 9. —
	34 (200)	4/22/2008	10:48	1 (—)	—. 9. —
	37 (200)	5/15/2008	10:58	1 (—)	—. 16. —
	40 (200)	4/22/2008	12:49	1 (—)	—. —. —
	43 (200)	4/22/2008	14:00	1 (—)	—. 9. —
	46 (200)	5/6/2008	10:35	1 (—)	—. 14. —
	49 (200)	5/5/2008	12:45	3 (—)	—. 16. —
	52 (200)	5/6/2008	14:00	2 (—)	—. 14. —
	55 (200)	5/7/2008	9:10	1 (—)	—. 13. —
	58 (200)	5/7/2008	10:45	3 (—)	—. 13. —

Appendix Table 3. Continued.

Season (method), Drainage, Stream	Reach (length)	Date	Time	Pass count (seconds)	DC at Volts. H^2O temp. conductivity
Spring (Multiple pass) cont.,					
Johnson Drainage cont.,					
Johnson Creek cont.	61 (200)	5/8/2008	9:25	1 (—)	—. 11. —
	64 (200)	5/8/2008	11:15	2 (—)	—. 12. —
	67 (200)	5/8/2008	14:05	3 (—)	—. 13. —
	70 (200)	5/16/2008	11:50	2 (—)	—. 18. —
	73 (200)	5/9/2008	9:05	3 (—)	—. 12. —
	76 (200)	5/13/2008	9:00	3 (—)	—. 12. —
	79 (200)	5/12/2008	10:20	1 (—)	—. 11. —
	82 (200)	5/16/2008	9:26	2 (—)	—. 17. —
	85 (200)	5/15/2008	13:05	1 (—)	—. 17. —
	88 (200)	4/29/2008	9:45	1 (—)	—. 12. —
	91 (200)	4/29/2008	11:05	2 (—)	—. 12. —
	94 (200)	4/29/2008	14:45	1 (—)	—. 12. —
Kelley Creek	2 (200)	5/20/2008	10:38	3 (—)	—. 16. —
	5 (200)	5/27/2008	10:00	3 (—)	—. 14. —
	8 (200)	5/28/2008	10:20	3 (—)	—. 15. —
	11 (200)	5/21/2008	9:52	3 (—)	—. 15. —
	14 (200)	6/13/2008	11:28	3 (5,716)	—. 12. —
	17 (200)	5/22/2008	10:22	3 (—)	—. 11. —
	20 (200)	6/5/2008	10:45	2 (—)	—. 11. —
	23 (200)	6/2/2008	11:30	3 (—)	—. 12. —
	26 (200)	5/29/2008	11:00	1 (—)	—. 12. —
	29 (200)	5/23/2008	11:56	1 (—)	—. 11. —
	32 (200)	5/29/2008	12:45	1 (—)	—. 12. —
Mitchell Creek	2 (200)	6/9/2008	12:14	3 (4,383)	—. 12. 102
	5 (200)	6/12/2008	9:29	3 (5,489)	—. 11. —
	8 (200)	6/6/2008	10:03	3 (3,829)[a]	—. 11. —
	11 (200)	6/10/2008	10:10	3 (4,961)	—. 10. 100
	14 (200)	6/11/2008	12:20	1 (848)	—. 13. 124
Miller Drainage,					
Miller Creek	1 (100)	4/18/2008	9:55	3 (—)	—. 9. —
	2 (100)	5/19/2008	10:17	1 (—)	—. 14. —
Stephen Drainage,					
Stephens Creek	1 (75)	4/14/2008	12:10	1 (—)	—. 11. —

a) Seconds during one of the pass was not recorded prior to resetting the timer

Appendix Table 3. Continued.

Season (method), Drainage, Stream	Reach (length)	Date	Time	Pass count (seconds)	DC at Volts. H^2O temp. conductivity
Summer (Multiple pass),					
Fanno Drainage,					
Fanno Creek	1 (100)	7/29/2008	8:30	2 (2,652)	—. 15. 244
	2 (100)	7/29/2008	10:15	3 (2,639)	—. 15. 220
	3 (100)	7/29/2008	11:40	1 (514)	—. 14. 220
Vermont Creek	1 (100)	8/4/2008	8:45	1 (750)	—. 13. 128
	2 (100)	8/4/2008	10:27	1 (1,219)	—. 13. 120
Woods Creek	1 (100)	8/4/2008	9:46	1 (537)	—. 13. —
	2 (100)	8/4/2008	10:34	1 (560)	—. 14. —
Johnson Drainage,					
Crystal Springs Creek	2 (200)	7/16/2008	9:14	2 (1,892)	—. 18. —
	5 (200)	7/16/2008	11:55	1 (1,103)	—. 20. —
	8 (200)	7/15/2008	11:50	2 (1,650)	—. 17. 194
	11 (200)	7/16/2008	9:45	b (—)	—. 15. 182
	11 (200)	7/18/2008	9:32	2 (4,256)	—. 14. 222
	14 (200)	7/18/2008	8:15	1 (—)	—. 14. 184
	17 (200)	7/17/2008	9:06	2 (3,399)	—. 17. —
Johnson Creek	1 (200)	7/28/2008	8:54	1 (3,387)	—. 16. —
	4 (200)	6/30/2008	9:46	1 (2,725)	—. 19. 192
	7 (200)	7/1/2008	9:21	1 (1,927)	—. 19. 198
	10 (200)	7/1/2008	12:15	2 (3,895)	—. 21. 175
	13 (200)	7/2/2008	9:45	3 (5,497)	—. 19. 177
	16 (200)	7/2/2008	13:43	2 (3,347)	—. 20. 181
	19 (200)	7/3/2008	9:27	1 (2,333)	—. 19. 155
	22 (200)	7/8/2008	9:13	3 (5,955)	—. 18. 185
	25 (200)	7/9/2008	8:43	2 (3,038)	—. 20. 172
	28 (200)	7/9/2008	11:19	2 (3,000)	—. 20. —
	31 (200)	7/10/2008	8:38	3 (5,377)	—. 19. 180
	37 (200)	7/14/2008	10:19	1 (3,904)	—. 19. —
	40 (200)	7/15/2008	7:50	3 (4,367)	—. 18. 153
	43 (200)	7/15/2008	8:30	1 (1,897)	—. 18. —
	46 (200)	7/25/2008	8:35	3 (5,580)	—. 18. —
	49 (200)	7/21/2008	8:20	3 (4,411)	—. 17. 142
	52 (200)	7/21/2008	8:22	2 (3,693)	—. 18. —
	55 (200)	7/22/2008	9:00	1 (2,111)	—. 18. —

b) Electrofisher malfunctioned 10 m into initial run, so ended sampling event

Appendix Table 3. Continued.

Season (method), Drainage, Stream	Reach (length)	Date	Time	Pass count (seconds)	DC at Volts. H^2O temp. conductivity
Summer (Multiple pass) cont.,					
Johnson Drainage cont.,					
Johnson Creek cont.	58 (200)	7/22/2008	9:05	3 (4,929)	—. 16. 154
	61 (200)	7/23/2008	8:25	1 (1,782)	—. 17. —
	64 (200)	7/23/2008	8:50	2 (8,514)	—. 15. 163
	67 (200)	7/23/2008	10:00	1 (1,637)	—. 17. —
	70 (200)	7/23/2008	11:33	1 (2,025)	—. 16. —
	73 (200)	7/24/2008	8:30	3 (6,334)	—. 12. 165
	76 (200)	7/24/2008	8:25	3 (3,528)	—. 15. —
	79 (200)	7/24/2008	11:13	1 (1,694)	—. 16. —
	82 (200)	7/24/2008	12:29	3 (6,497)	—. 14. 142
	85 (200)	7/25/2008	7:40	3 (3,073)	—. 14. 151
	88 (200)	7/25/2008	9:28	3 (4,229)	—. 14. —
	91 (200)	7/25/2008	11:37	1 (1,777)	—. 17. —
	94 (200)	7/28/2008	8:20	2 (4,213)	—. 14. 168
Kelley Creek	2 (200)	7/28/2008	11:33	3 (4,018)	—. 13. 189
	5 (200)	7/31/2008	9:00	3 (6,312)	—. 14. —
	8 (200)	7/31/2008	9:00	3 (4,903)	—. 14. 199
	11 (200)	7/10/2008	13:15	3 (3,340)	—. —. 170
	14 (200)	8/1/2008	9:28	2 (4,408)	—. 18. 150
	17 (200)	7/28/2008	11:32	3 (4,569)	—. 14. —
	20 (200)	8/1/2008	9:28	2 (2,160)	—. 14. —
	23 (200)	7/29/2008	8:45	1 (992)	—. 13. —
	26 (200)	7/29/2008	10:14	1 (1,939)	—. 13. —
	29 (200)	7/29/2008	11:57	1 (1,206)	—. 13. —
	32 (200)	8/1/2008	12:26	1 (302)	—. 15. 115
Mitchell Creek	2 (200)	7/30/2008	10:15	3 (5,653)	—. 15. —
	5 (200)	7/22/2008	11:47	3 (2,589)	—. 14. —
	8 (200)	7/18/2008	8:57	3 (4,119)	—. 13. —
	11 (200)	7/30/2008	9:00	3 (3,066)	—. 12. 104
	14 (200)	7/30/2008	13:30	1 (18)	—. 21. 199
Miller Drainage,					
Miller Creek	1 (100)	7/14/2008	13:26	3 (1,969)[a]	—. 15. —
	2 (100)	7/14/2008	13:20	1 (1,211)	—. —. 215
Stephens Drainage,					
Stephens Creek	1 (100)	7/15/2008	9:54	1 (749)	—. 18. —

Appendix Table 3. Continued.

Season (method), Drainage, Stream	Reach (length)	Date	Time	Pass count (seconds)	DC at Volts. H^2O temp. conductivity
Summer (Single pass),					
Fanno Drainage,					
Fanno Creek	1 (100)	8/29/2008	8:15	1 (1,855)	—. 17. 186
	2 (100)	9/4/2008	8:40	1 (1,913)	—. 13. 220
	3 (100)	10/1/2008	9:00	1 (434)	100. 14. 249
Johnson Drainage,					
Crystal Springs Creek	1 (2,743)	9/3/2008	9:00	1 (1,733)	—. 14. 229
Johnson Creek	2 (1,199)	8/26/2008	8:29	1 (4,054)	—. 16. 204
	4 (815)	8/22/2008	8:10	1 (1,437)	—. 17. 167
	6 (1,909)	9/2/2008	10:00	1 (5,151)	—. 14. 177
	8 (1,252)	8/27/2008	8:20	1 (1,152)	—. 18. 158
	10 (1,062)	—	—	—	—. —. —
	12 (1,761)	8/12/2008	8:00	1 (3,231)	—. 18. 152
	14 (3,219)	8/28/2008	9:30	1 (3,942)	—. 17. 134
	16 (4,087)	—	—	—	—. —. —
Kelley Creek	2 (1,023)	8/7/2008	8:30	1 (3,650)	—. 17. 191
	4 (1,905)	8/20/2008	8:42	1 (2,768)	—. 18. 198
Mitchell Creek	2 (610)	8/15/2008	8:30	1 (1,284)	—. 17. 119
	4 (609)	8/11/2008	8:38	1 (104)	—. 16. —
Miller Drainage,					
Miller Creek	1 (100)	8/8/2008	9:44	1 (596)	—. 15. 198
	2 (100)	8/14/2008	9:45	1 (1,080)	—. 14. 229
Stephens Drainage,					
Stephens Creek	1 (100)	8/13/2008	9:58	1 (102)	—. 16. 231
Fall (Multiple pass),					
Fanno Drainage,					
Fanno Creek	1 (100)	12/10/2008	12:40	3 (2,135)	200. 7. 143
	2 (100)	12/9/2008	8:40	3 (2,586)	200. 6. 121
	3 (100)	10/22/2008	8:50	1 (382)	100. 9. 174
Vermont Creek	1 (100)	11/5/2008	14:09	1 (1,354)	200. 9. 106
	2 (100)	11/25/2008	12:55	1 (673)	200. 7. 165
Woods Creek	1 (100)	10/24/2008	8:55	1 (464)	200. 7. 180
	2 (100)	11/4/2008	9:20	1 (762)	200. 10. 131
Johnson Drainage,					
Crystal Springs Creek	2 (200)	10/29/2008	8:50	3 (3,554)	100. 11. 206
	5 (200)	12/4/2008	12:30	1 (1,055)	200. 10. 182

Appendix Table 3. Continued.

Season (method), Drainage, Stream	Reach (length)	Date	Time	Pass count (seconds)	DC at Volts. H^2O temp. conductivity
Fall (Multiple pass) cont.,					
Johnson Drainage cont.,					
Crystal Springs cont.	8 (200)	12/15/2008	11:25	1 (1,193)	100. 4. 176
	11 (200)	11/3/2008	8:55	1 (1,319)	200. 12. 202
	14 (200)	11/3/2008	10:35	1 (1,406)	200. 12. 178
	17 (200)	12/16/2008	11:55	2 (2,321)	100. 3. 177
Johnson Creek	1 (200)	11/10/2008	8:45	2 (3,602)	200. 11. 146
	4 (200)	12/4/2008	9:00	3 (4,205)	200. 8. 146
	7 (200)	11/20/2008	8:40	3 (3,613)	200. 9. 96
	10 (200)	12/2/2008	12:25	3 (4,157)	200. 11. 138
	13 (200)	11/18/2008	8:50	3 (3,632)	200. 8. 110
	16 (200)	10/30/2008	10:42	3 (3,203)	200. 11. 210
	19 (200)	11/20/2008	14:02	3 (3,585)	200. 10. 92
	22 (200)	10/21/2008	10:15	3 (4,534)	200. 10. 154
	25 (200)	10/20/2008	10:24	3 (2,479)	200. 11. 192
	28 (200)	11/18/2008	13:45	3 (2,435)	200. 9. 102
	31 (200)	11/19/2008	8:55	3 (4,545)	200. 9. 102
	34 (200)	10/22/2008	10:14	3 (5,870)	200. 9. 122
	37 (200)	10/27/2008	14:09	3 (3,933)	200. 10. 110
	40 (200)	11/24/2008	12:30	2 (2,077)	200. 7. 94
	43 (200)	12/11/2008	8:55	3 (4,302)	200. 7. 88
	46 (200)	10/29/2008	13:05	3 (4,324)	200. 11. 115
	49 (200)	11/26/2008	8:48	1 (1,589)	200. 6. 95
	52 (200)	12/1/2008	11:50	1 (996)	200. 9. 91
	55 (200)	11/25/2008	11:00	1 (1,157)	200. 6. 97
	58 (200)	12/3/2008	12:20	1 (1,558)	200. 9. 88
	61 (200)	10/28/2008	11:00	1 (1,457)	200. 9. 98
	64 (200)	11/25/2008	8:40	2 (1,984)	200. 6. 95
	67 (200)	11/18/2008	12:10	1 (980)	200. 9. 93
	70 (200)	10/30/2008	8:45	1 (1,492)	200. 9. 122
	73 (200)	10/23/2008	8:57	3 (4,738)	200. 9. 102
	76 (200)	10/27/2008	10:44	3 (3,294)	200. 9. 115
	79 (200)	12/3/2008	14:00	1 (1,162)	200. 10. 91
	82 (200)	12/3/2008	8:55	3 (3,555)	200. 9. 91
	85 (200)	11/17/2008	13:45	2 (1,385)	200. 10. 92
	88 (200)	10/23/2008	13:00	3 (2,678)	250. 9. 103

Appendix Table 3. Continued.

Season (method), Drainage, Stream	Reach (length)	Date	Time	Pass count (seconds)	DC at Volts. H^2O temp. conductivity
Fall (Multiple pass) cont.,					
Johnson Drainage cont.,					
Johnson Creek cont.	91 (200)	10/28/2008	9:20	1 (1,388)	200. 9. 129
	94 (200)	12/2/2008	9:15	1 (1,300)	200. 10. 75
Kelley Creek	2 (200)	12/12/2008	8:40	3 (3,107)	200. 6. 126
	5 (200)	11/14/2008	9:10	3 (4,607)	200. 9. 125
	8 (200)	11/17/2008	8:45	3 (5,666)	200. 8. 136
	11 (200)	11/24/2008	9:40	3 (4,255)	200. 7. 129
	14 (200)	11/26/2008	10:10	3 (3,799)	200. 6. 109
	17 (200)	11/19/2008	12:45	3 (3,425)	100. 9. 122
	20 (200)	12/1/2008	8:50	1 (1,638)	200. 9. 109
	23 (200)	10/28/2008	13:40	3 (1,700)	100. 10. 115
	26 (200)	12/10/2008	9:05	2 (2,597)	200. 6. 91
	29 (200)	11/5/2008	12:12	1 (855)	100. 8. 76
	32 (200)	11/4/2008	11:06	1 (557)	200. 10. 99
Mitchell Creek	2 (200)	12/1/2008	12:20	3 (3,697)	200. 9. 138
	5 (200)	11/12/2008	9:25	3 (3,166)[a]	200. 12. 114
	8 (200)	10/24/2008	10:55	3 (3,737)	200. 7. 126
	11 (200)	11/5/2008	9:15	3 (3,214)	100. 9. 128
	14 (200)	11/3/2008	13:35	1 (352)	100. 11. 111
Miller Drainage,					
Miller Creek	1 (100)	12/11/2008	12:55	3 (2,164)	100. 8. 138
	2 (100)	11/20/2008	11:30	1 (797)	200. 9. 125
Stephens Drainage,					
Stephens Creek	1 (100)	10/27/2008	8:45	2 (1,248)	100. 10. 218
Winter (Multiple pass),					
Fanno Drainage,					
Fanno Creek	1 (100)	1/26/2009	12:02	1 (601)	200. 4. 85
	2 (100)	3/9/2009	10:22	1 (930)	100. 5. 157
	3 (100)	2/2/2009	8:45	1 (389)	200. 4. 166
Vermont Creek	1 (100)	3/11/2009	12:17	1 (984)	100. 5. 135
	2 (100)	1/27/2009	8:39	1 (633)	—. 3. 138
Woods Creek	1 (100)	3/11/2009	11:41	1 (458)	100. 4. 141
	2 (100)	2/3/2009	9:11	1 (1,077)	100. 3. 179
Johnson Drainage,					
Crystal Springs Creek	2 (200)	3/9/2009	11:25	3 (3,370)	150. 8. 193

Appendix Table 3. Continued.

Season (method), Drainage, Stream	Reach (length)	Date	Time	Pass count (seconds)	DC at Volts. H^2O temp. conductivity
Winter (Multiple pass) cont.,					
Johnson Drainage cont.,					
Crystal Springs cont.	5 (200)	3/9/2009	14:51	1 (1,438)	100. 10. 184
	8 (200)	3/11/2009	13:42	1 (1,420)	150. 10. 179
	11 (200)	2/4/2009	16:00	1 (882)	150. 11. 179
	14 (200)	2/23/2009	11:42	2 (2,685)	150. 11. 180
	17 (200)	2/4/2009	14:40	2 (1,821)	100. 9. 162
Johnson Creek	1 (200)	1/29/2009	8:53	3 (3,039)	200. 5. 139
	4 (200)	—	—	—	—. —. —
	7 (200)	1/21/2009	8:45	3 (3,553)	200. 3. —
	10 (200)	1/28/2009	9:25	2 (2,265)	200. 4. 104
	13 (200)	2/23/2009	8:43	3 (3,506)	200. 6. 104
	16 (200)	2/18/2009	13:29	1 (1,457)	150. 7. 99
	19 (200)	—	—	—	—. —. —
	22 (200)	2/9/2009	8:35	3 (3,895)	150. 5. 113
	25 (200)	1/28/2009	11:19	3 (2,830)	200. 4. 89
	28 (200)	2/10/2009	13:10	3 (4,003)	150. 5. 101
	31 (200)	2/4/2009	11:57	3 (3,815)	200. 6. 90
	34 (200)	2/9/2009	10:58	3 (3,695)	150. 6. 93
	37 (200)	1/26/2009	10:02	3 (2,995)	200. 2. 90
	40 (200)	1/21/2009	12:00	3 (2,947)	200. 3. 78
	43 (200)	—	—	—	—. —. —
	46 (200)	2/2/2009	9:42	3 (2,923)	200. 3. 84
	49 (200)	2/18/2009	11:30	1 (1,524)	100. 5. 81
	52 (200)	1/22/2009	12:20	1 (882)	200. 3. 93
	55 (200)	2/3/2009	11:21	1 (1,174)	200. 4. 74
	58 (200)	2/3/2009	12:36	1 (1,109)	200. 4. 79
	61 (200)	3/12/2009	9:03	1 (1,595)	100. 4. 71
	64 (200)	2/9/2009	14:37	1 (1,133)	150. 5. 91
	67 (200)	1/22/2009	13:15	2 (1,805)	200. 4. 89
	70 (200)	3/12/2009	10:11	1 (817)	100. 4. 70
	73 (200)	—	—	—	—. —. —
	76 (200)	1/29/2009	13:21	3 (2,811)	200. 4. 82
	79 (200)	1/26/2009	8:40	1 (1,606)	200. 2. 83
	82 (200)	2/9/2009	13:01	2 (2,273)	150. 5. 86
	85 (200)	2/10/2009	8:40	3 (2,770)	150. 4. 86

Appendix Table 3. Continued.

Season (method), Drainage, Stream	Reach (length)	Date	Time	Pass count (seconds)	DC at Volts. H^2O temp. conductivity
Winter (Multiple pass) cont.,					
Johnson Drainage cont.,					
Johnson Creek cont.	88 (200)	2/3/2009	14:06	1 (1,211)	200. 5. 80
	91 (200)	2/2/2009	12:55	2 (1,871)	200. 5. 81
	94 (200)	1/29/2009	11:50	1 (1,178)	200. 4. 79
Kelley Creek	2 (200)	3/2/2009	8:34	3 (2,439)	200. 7. 69
	5 (200)	3/18/2009	9:23	1 (1,144)	200. 7. 71
	8 (200)	2/19/2009	9:29	2 (3,163)	100. 4. 81
	11 (200)	2/18/2009	9:00	2 (1,850)	100. 5. 91
	14 (200)	1/26/2009	13:32	3 (2,429)[a]	200. 2. 74
	17 (200)	1/27/2009	10:50	3 (4,273)	200. 2. 79
	20 (200)	2/19/2009	12:30	2 (2,311)	100. 6. 70
	23 (200)	2/12/2009	12:31	3 (2,597)	150. 4. 71
	26 (200)	2/12/2009	14:24	1 (1,495)	100. 4. 80
	29 (200)	1/28/2009	14:28	1 (738)	100. 6. 57
	32 (200)	2/4/2009	10:48	1 (397)	100. 6. 56
Mitchell Creek	2 (200)	1/22/2009	8:57	3 (2,930)	200. 4. 103
	5 (200)	2/10/2009	10:21	3 (2,309)	150. 4. 86
	8 (200)	3/2/2009	12:57	3 (3,793)	100. 8. 85
	11 (200)	2/5/2009	11:37	3 (2,494)	100. 7. 88
	14 (200)	2/3/2009	10:21	1 (204)	100. 3. 84
Miller Drainage,					
Miller Creek	1 (100)	2/5/2009	9:15	3 (1,595)	100. 5. 96
	2 (100)	2/4/2009	8:54	2 (1,196)	100. 4. 78
Stephens Drainage,					
Stephens Creek	1 (75)	2/11/2009	9:17	3 (2,337)	150. 6. 157

Appendix Table 4. Estimated fish for each reach sampled in City of Portland streams during spring, summer, fall and winter 2008-2009. Reach length in Fanno and Miller creeks were 100 m, while Stephens Creek was 75 m. All the reaches in Johnson Creek Watershed were 200 m in length.

Drainage, Stream (Reach)	Family	Common name	Spring fish/reach (SE)	Summer fish/reach (SE)	Fall fish/reach (SE)	Winter fish/reach (SE)
Fanno Drainage,						
Fanno Creek (1)	Cottidae	Reticulate sculpin	167.5 (16.0)	121.0 (15.0)	108.7 (51.6)	8.0 (a)
		Unidentified sculpin	169.3 (180.8)	128.4 (80.6)	136.2 (131.2)	1.0 (a)
	Cyprinidae	Redside shiner	94.8 (29.8)	b	c	0.0 (—)
	Petromyzontidae	Western Brook lamprey	2.2 (1.8)	0.0 (—)	c	0.0 (—)
		Pacific lamprey	0.0 (—)	1.0 (a)	5.8 (9.2)	0.0 (—)
	Salmonidae	Cutthroat	6.5 (2.4)	1.0 (a)	c	
Fanno Creek (2)	Cottidae	Reticulate sculpin	211.0 (55.4)	170.9 (31.4)	59.2 (4.2)	3.0 (a)
		Unidentified sculpin	37.9 (15.6)	13.4 (8.0)	100.9 (167.8)	4.0 (a)
	Petromyzontidae	Pacific lamprey	0.0 (—)	0.0 (—)	0.0 (—)	5.8 (9.2)
	Salmonidae	Cutthroat	22.8 (89.4)	5.8 (9.2)	5.9 (4.8)	
Fanno Creek (3)	no fish identified		—	—	—	—
Vermont Creek (1)	Cottidae	Reticulate sculpin	79.0 (a)	74.0 (a)	28.0 (a)	60.0 (a)
		Unidentified sculpin	20.0 (a)	45.0 (a)	50.0 (a)	1.0 (a)
	Cyprinidae	Redside shiner	1.0 (a)	0.0 (—)	0.0 (—)	0.0 (—)
	Poeciliidae	Western mosquitofish	0.0 (—)	0.0 (—)	0.0 (—)	1.0 (a)
Vermont Creek (2)	Cottidae	Reticulate sculpin	63.0 (a)	34.0 (a)	29.0 (a)	6.0 (a)
		Unidentified sculpin	1.0 (a)	12.0 (a)	35.0 (a)	10.0 (a)
	Petromyzontidae	Western Brook lamprey	1.0 (a)	1.0 (a)	0.0 (—)	0.0 (—)
		Pacific lamprey	1.0 (a)	0.0 (—)	0.0 (—)	0.0 (—)
Woods Creek (1)	no fish identified		—	—	—	—
Woods Creek (2)	no fish identified		—	—	—	—

a) Not able to calculate standard error

b) Negative estimate is due to a violation in depletion where catch value(s) did not decrease linearly with each subsequent pass

c) Species encountered during a later pass, not able to estimate species abundance

Appendix Table 4. Continued.

Drainage, Stream (Reach)	Family	Common name	Spring fish/reach (SE)	Summer fish/reach (SE)	Fall fish/reach (SE)	Winter fish/reach (SE)
Johnson Watershed,						
Crystal Springs Cr (2)	Catostomidae	Largescale sucker	1.0 (a)	2.0 (a)	b	11.0 (a)
		Unidentified sucker	16.6 (2.2)	0.0 (—)	0.0 (—)	17.5 (17.8)
	Centrarchidae	Bluegill	1.0 (a)	c	16.7 (27.8)	1.0 (a)
		Largemouth bass	0.0 (—)	0.0 (—)	c	0.0 (—)
		Pumpkinseed	0.0 (—)	0.0 (—)	8.7 (2.8)	0.0 (—)
	Cottidae	Reticulate sculpin	142.0 (34.4)	541.4 (57.6)	212.9 (348.0)	47.7 (87.2)
		Unidentified sculpin	30.8 (47.4)	47.0 (a)	5.0 (a)	2.0 (a)
	Cyprinidae	Chiselmouth	3.8 (5.2)	0.0 (—)	3.8 (5.2)	3.8 (5.2)
		Common carp	1.0 (a)	0.0 (—)	c	0.0 (—)
		Northern pikeminnow	1.0 (a)	0.0 (—)	c	6.0 (a)
		Redside shiner	92.8 (12.0)	48.1 (13.5)	472.8 (5,083.8)	74.2 (29.0)
		Speckled dace	c	37.6 (3.7)	63.1 (16.4)	46.4 (12.8)
		Longnose Dace	0.0 (—)	1.0 (a)	0.0 (—)	0.0 (—)
		Goldfish	0.0 (—)	0.0 (—)	c	0.0 (—)
	Fundulidae	Banded killifish	0.0 (—)	0.0 (—)	0.0 (—)	1.0 (a)
	Gasterosteidae	Threespine stickleback	b	0.0 (—)	3.0 (a)	1.0 (a)
	Ictaluridae	Brown bullhead	0.0 (—)	0.0 (—)	c	0.0 (—)
	Petromyzontidae	Western Brook lamprey	0.0 (—)	0.0 (—)	0.0 (—)	c
	Salmonidae	Chinook salmon	3.1 (1.0)	1.0 (a)	3.8 (5.2)	0.0 (—)
		Coho salmon	2.0 (a)	0.0 (—)	0.0 (—)	6.1 (0.8)
		Steelhead	0.0 (—)	0.0 (—)	7.1 (0.8)	3.1 (1.0)
Crystal Springs Cr (5)	Catostomidae	Largescale sucker	22.0 (a)	0.0 (—)	0.0 (—)	0.0 (—)
		Unidentified sucker	0.0 (—)	0.0 (—)	2.0 (a)	0.0 (—)
	Centrarchidae	Smallmouth bass	2.0 (a)	0.0 (—)	0.0 (—)	0.0 (—)
	Cottidae	Prickly sculpin	0.0 (—)	1.0 (a)	0.0 (—)	0.0 (—)

Appendix Table 4. Continued.

Drainage, Stream (Reach)	Family	Common name	Spring fish/reach (SE)	Summer fish/reach (SE)	Fall fish/reach (SE)	Winter fish/reach (SE)
Johnson Watershed cont.,						
Crystal Springs Cr (5) cont.	Cottidae cont.	Reticulate sculpin	170.0 (a)	143.0 (a)	94.0 (a)	55.0 (a)
		Unidentified sculpin	2.0 (a)	14.0 (a)	11.0 (a)	3.0 (a)
	Cyprinidae	Common carp	2.0 (a)	0.0 (—)	0.0 (—)	0.0 (—)
		Redside shiner	68.0 (a)	8.0 (a)	282.0 (a)	1.0 (a)
		Speckled dace	34.0 (a)	5.0 (a)	23.0 (a)	15.0 (a)
	Gasterosteidae	Threespine stickleback	9.0 (a)	1.0 (a)	83.0 (a)	53.0 (a)
Crystal Springs Cr (8)	Catostomidae	Unidentified sucker	0.0 (—)	0.0 (—)	0.0 (—)	1.0 (a)
	Cottidae	Prickly sculpin	0.0 (—)	2.0 (a)	0.0 (—)	0.0 (—)
		Reticulate sculpin	126.0 (a)	231.0 (a)	8.0 (a)	83.0 (a)
		Unidentified sculpin	0.0 (—)	17.0 (a)	0.0 (—)	0.0 (—)
	Cyprinidae	Redside shiner	0.0 (—)	4.0 (a)	10.0 (a)	1.0 (a)
		Speckled dace	0.0 (—)	5.0 (a)	0.0 (—)	15.0 (a)
	Gasterosteidae	Threespine stickleback	24.0 (a)	12.0 (a)	0.0 (—)	36.0 (a)
Crystal Springs Cr (11)	Catostomidae	Largescale sucker	18.0 (19.0)	1.0 (a)	4.0 (a)	0.0 (—)
		Unidentified sucker	0.0 (—)	0.0 (—)	3.0 (a)	0.0 (—)
	Centrarchidae	Bluegill	0.0 (—)	0.0 (—)	1.0 (a)	0.0 (—)
	Cottidae	Reticulate sculpin	243.4 (75.7)	b	20.0 (a)	9.0 (a)
		Unidentified sculpin	25.0 (60.0)	32.0 (9.8)	11.0 (a)	5.0 (a)
	Cyprinidae	Redside shiner	104.0 (4.7)	b	15.0 (a)	0.0 (—)
		Speckled dace	14.3 (3.5)	144.5 (360.6)	4.0 (a)	2.0 (a)
	Gasterosteidae	Threespine stickleback	7.2 (0.6)	0.0 (—)	3.0 (a)	4.0 (a)
	Petromyzontidae	Ammocoetes	0.0 (—)	1.0 (a)	0.0 (—)	0.0 (—)
		Western Brook lamprey	c	0.0 (—)	0.0 (—)	3.0 (a)
	Salmonidae	Steelhead	2.0 (a)	0.0 (—)	0.0 (—)	0.0 (—)
		Cutthroat	0.0 (—)	1.0 (a)	0.0 (—)	0.0 (—)

Appendix Table 4. Continued.

Drainage, Stream (Reach)	Family	Common name	Spring fish/reach (SE)	Summer fish/reach (SE)	Fall fish/reach (SE)	Winter fish/reach (SE)
Johnson Watershed cont.,						
Crystal Springs Cr (14)	Catostomidae	Largescale sucker	c	0.0 (—)	0.0 (—)	0.0 (—)
		Unidentified sucker	0.0 (—)	0.0 (—)	0.0 (—)	1.0 (a)
	Cottidae	Prickly sculpin	1.0 (a)	0.0 (—)	0.0 (—)	1.0 (a)
		Reticulate sculpin	425.4 (40.2)	89.0 (a)	21.0 (a)	139.1 (13.7)
		Unidentified sculpin	155.9 (82.4)	97.0 (a)	22.0 (a)	83.8 (24.4)
	Cyprinidae	Redside shiner	0.0 (—)	2.0 (a)	21.0 (a)	56.9 (3.5)
		Speckled dace	14.1 (21.6)	13.0 (a)	21.0 (a)	56.5 (10.1)
	Gasterosteidae	Threespine stickleback	48.2 (28.2)	0.0 (—)	8.0 (a)	16.0 (6.9)
	Petromyzontidae	Ammocoetes	15.3 (14.2)	7.0 (a)	0.0 (—)	b
		Western Brook lamprey	27.5 (108.8)	3.0 (a)	0.0 (—)	9.0 (13.4)
		Pacific lamprey	0.0 (—)	0.0 (—)	0.0 (—)	1.0 (a)
	Salmonidae	Chinook salmon	0.0 (—)	0.0 (—)	0.0 (—)	2.0 (a)
		Coho salmon	1.0 (a)	0.0 (—)	0.0 (—)	0.0 (—)
		Steelhead	11.7 (15.4)	0.0 (—)	0.0 (—)	1.0 (a)
Crystal Springs Cr (17)	Cottidae	Reticulate sculpin	38.0 (a)	113.1 (5.6)	c	24.2 (10.9)
		Unidentified sculpin	0.0 (—)	b	c	0.0 (—)
	Cyprinidae	Speckled dace	0.0 (—)	11.6 (1.2)	c	c
	Gasterosteidae	Threespine stickleback	5.0 (a)	4.0 (3.5)	b	0.0 (—)
	Salmonidae	Chinook salmon	0.0 (—)	1.0 (a)	1.0 (a)	1.0 (a)
Johnson Creek (1)	Catostomidae	Largescale sucker	1.0 (a)	0.0 (—)	c	0.0 (—)
		Unidentified sucker	1.0 (a)	2.0 (a)	15.1 (1.9)	0.0 (—)
	Centrarchidae	Bluegill	1.0 (a)	0.0 (—)	1.0 (a)	0.0 (—)
		Smallmouth bass	0.0 (—)	0.0 (—)	4.0 (3.5)	0.0 (—)
	Cobitidae	Oriental weatherfish	0.0 (—)	1.0 (a)	0.0 (—)	0.0 (—)
	Cottidae	Prickly sculpin	24.8 (4.6)	8.0 (a)	9.0 (13.4)	1.0 (a)

Appendix Table 4. Continued.

Drainage, Stream (Reach)	Family	Common name	Spring fish/reach (SE)	Summer fish/reach (SE)	Fall fish/reach (SE)	Winter fish/reach (SE)
Johnson Watershed cont.,						
Johnson Creek (1) cont.	Cottidae cont.	Reticulate sculpin	c	4.0 (a)	29.4 (2.9)	1.0 (a)
		Unidentified sculpin	15.1 (0.8)	33.0 (a)	c	0.0 (—)
	Cyprinidae	Common carp	0.0 (—)	0.0 (—)	3.0 (a)	0.0 (—)
		Northern pikeminnow	0.0 (—)	0.0 (—)	1.0 (a)	0.0 (—)
		Redside shiner	0.0 (—)	12.0 (a)	c	1.0 (a)
		Speckled dace	5.0 (a)	16.0 (a)	5.3 (1.0)	0.0 (—)
		Longnose Dace	0.0 (—)	18.0 (a)	b	0.0 (—)
	Gasterosteidae	Threespine stickleback	0.0 (—)	3.0 (a)	c	0.0 (—)
	Ictaluridae	Brown bullhead	0.0 (—)	0.0 (—)	16.2 (5.2)	0.0 (—)
	Petromyzontidae	Ammocoetes	0.0 (—)	1.0 (a)	1.0 (a)	0.0 (—)
	Salmonidae	Chinook salmon	3.0 (a)	0.0 (—)	1.0 (a)	0.0 (—)
		Coho salmon	0.0 (—)	0.0 (—)	0.0 (—)	c
		Steelhead	4.4 (2.6)	0.0 (—)	0.0 (—)	3.8 (5.2)
		Unidentified salmonid	5.2 (1.2)	0.0 (—)	0.0 (—)	0.0 (—)
Johnson Creek (4)	Catostomidae	Largescale sucker	0.0 (—)	0.0 (—)	3.8 (5.2)	—
		Unidentified sucker	0.0 (—)	0.0 (—)	b	—
	Centrarchidae	Bluegill	1.0 (a)	0.0 (—)	1.0 (a)	—
		Smallmouth bass	0.0 (—)	1.0 (a)	b	—
		Largemouth bass	0.0 (—)	0.0 (—)	1.0 (a)	—
		Pumpkinseed	0.0 (—)	0.0 (—)	1.0 (a)	—
	Cottidae	Prickly sculpin	6.0 (a)	2.0 (a)	c	—
		Reticulate sculpin	34.0 (a)	60.0 (a)	111.1 (159.6)	—
		Unidentified sculpin	14.0 (a)	19.0 (a)	b	—
	Cyprinidae	Common carp	0.0 (—)	0.0 (—)	5.9 (4.8)	—
		Redside shiner	10.0 (a)	3.0 (a)	b	—

Appendix Table 4. Continued.

Drainage, Stream (Reach)	Family	Common name	Spring fish/reach (SE)	Summer fish/reach (SE)	Fall fish/reach (SE)	Winter fish/reach (SE)
Johnson Watershed cont.,						
Johnson Creek (4) cont.	Cyprinidae cont.	Speckled dace	46.0 (a)	16.0 (a)	b	—
		Longnose Dace	0.0 (—)	1.0 (a)	0.0 (—)	—
	Gasterosteidae	Threespine stickleback	1.0 (a)	8.0 (a)	5.9 (4.8)	—
	Ictaluridae	Brown bullhead	0.0 (—)	0.0 (—)	6.1 (0.8)	—
	Petromyzontidae	Ammocoetes	0.0 (—)	0.0 (—)	c	—
	Salmonidae	Chinook salmon	0.0 (—)	0.0 (—)	b	—
		Steelhead	0.0 (—)	0.0 (—)	3.1 (1.0)	—
		Unidentified salmonid	0.0 (—)	0.0 (—)	c	—
Johnson Creek (7)	Catostomidae	Largescale sucker	c	0.0 (—)	0.0 (—)	0.0 (—)
		Unidentified sucker	0.0 (—)	0.0 (—)	c	c
	Centrarchidae	Smallmouth bass	0.0 (—)	0.0 (—)	c	0.0 (—)
	Cottidae	Prickly sculpin	c	4.0 (a)	0.0 (—)	0.0 (—)
		Reticulate sculpin	291.9 (538.4)	88.0 (a)	b	b
		Unidentified sculpin	397.4 (810.8)	26.0 (a)	b	5.2 (1.2)
	Cyprinidae	Common carp	0.0 (—)	0.0 (—)	c	0.0 (—)
		Redside shiner	c	0.0 (—)	c	0.0 (—)
		Speckled dace	18.5 (61.8)	10.0 (a)	b	c
		Longnose Dace	c	0.0 (—)	1.0 (a)	0.0 (—)
	Ictaluridae	Brown bullhead	0.0 (—)	0.0 (—)	c	0.0 (—)
	Petromyzontidae	Ammocoetes	c	0.0 (—)	0.0 (—)	0.0 (—)
	Salmonidae	Chinook salmon	0.0 (—)	0.0 (—)	0.0 (—)	2.0 (a)
		Coho salmon	c	0.0 (—)	2.0 (a)	11.0 (a)
		Steelhead	1.0 (a)	0.0 (—)	c	6.0 (a)
		Cutthroat	0.0 (—)	0.0 (—)	0.0 (—)	1.0 (a)
		Unidentified salmonid	0.0 (—)	0.0 (—)	0.0 (—)	1.0 (a)

Appendix Table 4. Continued.

Drainage, Stream (Reach)	Family	Common name	Spring fish/reach (SE)	Summer fish/reach (SE)	Fall fish/reach (SE)	Winter fish/reach (SE)
Johnson Watershed cont.,						
Johnson Creek (10)	Catostomidae	Largescale sucker	3.0 (a)	0.0 (—)	1.0 (a)	0.0 (—)
		Unidentified sucker	0.0 (—)	c	3.8 (5.2)	1.0 (a)
	Centrarchidae	Bluegill	0.0 (—)	1.0 (a)	1.0 (a)	0.0 (—)
		Smallmouth bass	3.0 (a)	0.0 (—)	b	0.0 (—)
		Pumpkinseed	0.0 (—)	0.0 (—)	c	0.0 (—)
	Cottidae	Prickly sculpin	2.0 (a)	5.0 (a)	c	0.0 (—)
		Reticulate sculpin	15.0 (a)	64.0 (1.3)	17.5 (17.8)	1.0 (a)
		Unidentified sculpin	18.0 (a)	19.6 (2.4)	33.9 (55.2)	0.0 (—)
	Cyprinidae	Common carp	0.0 (—)	0.0 (—)	4.4 (2.6)	0.0 (—)
		Northern pikeminnow	0.0 (—)	0.0 (—)	c	0.0 (—)
		Redside shiner	37.0 (a)	40.5 (63.0)	c	0.0 (—)
		Speckled dace	2.0 (a)	13.4 (1.0)	1.0 (a)	c
		Longnose Dace	0.0 (—)	1.0 (a)	0.0 (—)	0.0 (—)
	Gasterosteidae	Threespine stickleback	1.0 (a)	b	3.8 (5.2)	0.0 (—)
	Ictaluridae	Brown bullhead	0.0 (—)	0.0 (—)	1.0 (a)	0.0 (—)
	Petromyzontidae	Ammocoetes	0.0 (—)	0.0 (—)	b	0.0 (—)
		Pacific lamprey	0.0 (—)	0.0 (—)	0.0 (—)	c
	Poeciliidae	Western mosquitofish	0.0 (—)	1.0 (a)	0.0 (—)	0.0 (—)
	Salmonidae	Coho salmon	0.0 (—)	0.0 (—)	b	0.0 (—)
		Steelhead	0.0 (—)	0.0 (—)	c	2.0 (a)
		Cutthroat	0.0 (—)	3.0 (a)	0.0 (—)	0.0 (—)
Johnson Creek (13)	Catostomidae	Largescale sucker	10.0 (a)	0.0 (—)	c	0.0 (—)
		Unidentified sucker	0.0 (—)	0.0 (—)	0.0 (—)	1.0 (a)
	Cottidae	Prickly sculpin	0.0 (—)	11.7 (2.6)	c	1.0 (a)
		Reticulate sculpin	17.0 (a)	94.1 (0.6)	b	b

Appendix Table 4. Continued.

Drainage, Stream (Reach)	Family	Common name	Spring fish/reach (SE)	Summer fish/reach (SE)	Fall fish/reach (SE)	Winter fish/reach (SE)
Johnson Watershed cont.,						
Johnson Creek (13) cont.	Cottidae cont.	Unidentified sculpin	27.0 (a)	70.1 (0.6)	20.4 (3.8)	c
	Cyprinidae	Common carp	0.0 (—)	0.0 (—)	c	0.0 (—)
		Redside shiner	37.0 (a)	22.0 (a)	106.7 (90.8)	32.5 (1.8)
		Speckled dace	3.0 (a)	15.0 (a)	163.5 (1,200.6)	5.9 (4.8)
		Longnose Dace	1.0 (a)	29.1 (3.0)	c	c
	Petromyzontidae	Pacific lamprey	0.0 (—)	0.0 (—)	0.0 (—)	b
	Salmonidae	Chinook salmon	0.0 (—)	1.0 (a)	0.0 (—)	2.0 (a)
		Coho salmon	0.0 (—)	0.0 (—)	0.0 (—)	2.2 (1.8)
		Steelhead	0.0 (—)	0.0 (—)	c	5.2 (1.2)
		Cutthroat	0.0 (—)	2.2 (1.8)	0.0 (—)	0.0 (—)
Johnson Creek (16)	Catostomidae	Largescale sucker	0.0 (—)	0.0 (—)	1.0 (a)	1.0 (a)
	Centrarchidae	Bluegill	0.0 (—)	0.0 (—)	5.8 (9.2)	0.0 (—)
		Pumpkinseed	0.0 (—)	0.0 (—)	2.2 (1.8)	0.0 (—)
	Cottidae	Prickly sculpin	0.0 (—)	3.0 (a)	c	0.0 (—)
		Reticulate sculpin	3.0 (a)	37.1 (0.4)	32.3 (13.4)	1.0 (a)
		Unidentified sculpin	7.0 (a)	24.0 (0.2)	23.0 (10.0)	0.0 (—)
	Cyprinidae	Golden shiner	0.0 (—)	0.0 (—)	c	0.0 (—)
		Redside shiner	40.0 (a)	c	b	11.0 (a)
		Speckled dace	1.0 (a)	b	70.2 (20.6)	1.0 (a)
		Longnose Dace	0.0 (—)	16.0 (31.7)	18.2 (6.2)	0.0 (—)
	Petromyzontidae	Ammocoetes	0.0 (—)	1.0 (a)	0.0 (—)	0.0 (—)
		Western Brook lamprey	0.0 (—)	c	0.0 (—)	0.0 (—)
	Salmonidae	Chinook salmon	0.0 (—)	0.0 (—)	2.2 (1.8)	0.0 (—)
		Steelhead	0.0 (—)	0.0 (—)	5.2 (1.2)	0.0 (—)
		Cutthroat	0.0 (—)	2.0 (a)	0.0 (—)	0.0 (—)

Appendix Table 4. Continued.

Drainage, Stream (Reach)	Family	Common name	Spring fish/reach (SE)	Summer fish/reach (SE)	Fall fish/reach (SE)	Winter fish/reach (SE)
Johnson Watershed cont.,						
Johnson Creek (19)	Catostomidae	Largescale sucker	1.0 (a)	0.0 (—)	c	—
		Unidentified sucker	0.0 (—)	0.0 (—)	2.2 (1.8)	—
	Cottidae	Reticulate sculpin	96.4 (20.3)	47.0 (a)	42.1 (57.8)	—
		Unidentified sculpin	313.6 (260.2)	49.0 (a)	b	—
	Cyprinidae	Northern pikeminnow	c	0.0 (—)	1.0 (a)	—
		Redside shiner	75.6 (46.9)	6.0 (a)	506.7 (1,756.8)	—
		Speckled dace	32.0 (42.9)	7.0 (a)	b	—
		Longnose Dace	8.0 (4.9)	3.0 (a)	0.0 (—)	—
	Petromyzontidae	Ammocoetes	c	0.0 (—)	c	—
		Western Brook lamprey	c	0.0 (—)	0.0 (—)	—
		Pacific lamprey	1.0 (a)	0.0 (—)	0.0 (—)	—
	Salmonidae	Chinook salmon	0.0 (—)	0.0 (—)	b	—
		Coho salmon	0.0 (—)	0.0 (—)	c	—
		Steelhead	1.0 (a)	0.0 (—)	c	—
Johnson Creek (22)	Catostomidae	Largescale sucker	4.0 (a)	1.0 (a)	5.8 (9.2)	c
	Centrarchidae	Unidentified sunfish/bass	0.0 (—)	c	0.0 (—)	0.0 (—)
	Cottidae	Prickly sculpin	0.0 (—)	0.0 (—)	1.0 (a)	0.0 (—)
		Reticulate sculpin	84.0 (0.1)	534.1 (168.8)	231.3 (180.2)	c
		Unidentified sculpin	0.0 (—)	579.9 (128.8)	b	0.0 (—)
	Cyprinidae	Chiselmouth	0.0 (—)	0.0 (—)	1.0 (a)	0.0 (—)
		Redside shiner	60.1 (0.3)	49.2 (19.6)	98.9 (22.8)	17.3 (1.4)
		Speckled dace	32.0 (0.2)	125.4 (274.8)	b	3.8 (5.2)
		Longnose Dace	0.0 (—)	51.6 (105.0)	15.2 (10.4)	0.0 (—)

Appendix Table 4. Continued.

Drainage, Stream (Reach)	Family	Common name	Spring fish/reach (SE)	Summer fish/reach (SE)	Fall fish/reach (SE)	Winter fish/reach (SE)
Johnson Watershed cont.,						
Johnson Creek (22) cont.	Ictaluridae	Brown bullhead	1.0 (a)	0.0 (—)	0.0 (—)	0.0 (—)
	Petromyzontidae	Ammocoetes	0.0 (—)	b	c	0.0 (—)
		Western Brook lamprey	0.0 (—)	0.0 (—)	c	0.0 (—)
	Salmonidae	Chinook salmon	0.0 (—)	c	1.0 (a)	0.0 (—)
		Coho salmon	0.0 (—)	c	0.0 (—)	0.0 (—)
		Steelhead	2.0 (a)	0.0 (—)	12.6 (2.4)	27.5 (108.8)
		Cutthroat	0.0 (—)	42.2 (35.0)	0.0 (—)	0.0 (—)
Johnson Creek (25)	Catostomidae	Largescale sucker	2.2 (1.8)	0.0 (—)	7.4 (2.0)	0.0 (—)
	Cottidae	Prickly sculpin	0.0 (—)	c	0.0 (—)	0.0 (—)
		Reticulate sculpin	35.1 (26.8)	b	37.2 (1.0)	1.0 (a)
		Unidentified sculpin	42.2 (9.6)	544.5 (2,046.0)	40.0 (9.2)	0.0 (—)
	Cyprinidae	Northern pikeminnow	1.0 (a)	0.0 (—)	0.0 (—)	0.0 (—)
		Redside shiner	98.6 (11.6)	24.1 (1.6)	130.4 (557.4)	30.3 (13.8)
		Speckled dace	13.3 (1.4)	b	23.9 (2.6)	0.0 (—)
	Petromyzontidae	Western Brook lamprey	0.0 (—)	0.0 (—)	c	0.0 (—)
	Salmonidae	Coho salmon	0.0 (—)	0.0 (—)	0.0 (—)	2.0 (a)
		Steelhead	2.2 (1.8)	0.0 (—)	8.3 (16.8)	c
		Cutthroat	0.0 (—)	1.0 (a)	0.0 (—)	0.0 (—)
Johnson Creek (28)	Catostomidae	Unidentified sucker	0.0 (—)	0.0 (—)	0.0 (—)	c
	Cottidae	Reticulate sculpin	17.0 (a)	b	b	5.8 (9.2)
		Unidentified sculpin	9.0 (a)	b	32.7 (153.8)	5.2 (1.2)
	Cyprinidae	Redside shiner	70.0 (a)	b	12.0 (a)	31.1 (0.8)
		Speckled dace	14.0 (a)	160.2 (161.1)	11.4 (9.0)	11.7 (2.6)
		Longnose Dace	0.0 (—)	0.0 (—)	1.0 (a)	0.0 (—)
	Salmonidae	Steelhead	0.0 (—)	0.0 (—)	b	6.5 (2.4)

Appendix Table 4. Continued.

Drainage, Stream (Reach)	Family	Common name	Spring fish/reach (SE)	Summer fish/reach (SE)	Fall fish/reach (SE)	Winter fish/reach (SE)
Johnson Watershed cont.,						
Johnson Creek (28) cont.	Salmonidae cont.	Cutthroat	0.0 (—)	c	0.0 (—)	0.0 (—)
Johnson Creek (31)	Catostomidae	Largescale sucker	0.0 (—)	0.0 (—)	0.0 (—)	c
	Cottidae	Reticulate sculpin	10.0 (a)	b	c	3.8 (5.2)
		Unidentified sculpin	3.0 (a)	150.2 (1.0)	b	c
	Cyprinidae	Redside shiner	5.0 (a)	158.8 (15.8)	b	1.0 (a)
		Speckled dace	5.0 (a)	60.3 (45.0)	100.4 (201.2)	19.1 (3.4)
		Longnose Dace	0.0 (—)	2.0 (a)	0.0 (—)	0.0 (—)
	Petromyzontidae	Ammocoetes	0.0 (—)	c	c	0.0 (—)
	Salmonidae	Chinook salmon	0.0 (—)	3.1 (1.0)	0.0 (—)	0.0 (—)
		Steelhead	0.0 (—)	c	38.3 (184.6)	15.5 (7.6)
		Cutthroat	0.0 (—)	c	c	0.0 (—)
Johnson Creek (34)	Catostomidae	Largescale sucker	0.0 (—)	0.0 (—)	3.0 (a)	1.0 (a)
		Unidentified sucker	0.0 (—)	0.0 (—)	c	c
	Cottidae	Prickly sculpin	0.0 (—)	0.0 (—)	3.0 (a)	0.0 (—)
		Reticulate sculpin	13.0 (a)	317.3 (64.8)	197.7 (106.6)	2.2 (1.8)
		Unidentified sculpin	4.0 (a)	c	b	0.0 (—)
	Cyprinidae	Redside shiner	24.0 (a)	128.5 (130.6)	647.7 (559.2)	43.5 (8.2)
		Speckled dace	18.0 (a)	b	319.8 (127.8)	5.0 (a)
		Longnose Dace	0.0 (—)	5.9 (4.8)	0.0 (—)	0.0 (—)
	Salmonidae	Steelhead	0.0 (—)	0.0 (—)	10.2 (4.6)	8.7 (2.8)
		Cutthroat	0.0 (—)	c	0.0 (—)	0.0 (—)
Johnson Creek (37)	Catostomidae	Largescale sucker	3.0 (a)	1.0 (a)	c	0.0 (—)
		Unidentified sucker	0.0 (—)	0.0 (—)	0.0 (—)	c
	Cottidae	Prickly sculpin	9.0 (a)	0.0 (—)	0.0 (—)	0.0 (—)
		Reticulate sculpin	20.0 (a)	95.0 (a)	97.9 (59.4)	c

Appendix Table 4. Continued.

Drainage, Stream (Reach)	Family	Common name	Spring fish/reach (SE)	Summer fish/reach (SE)	Fall fish/reach (SE)	Winter fish/reach (SE)
Johnson Watershed cont.,						
Johnson Creek (37) cont.	Cottidae cont.	Unidentified sculpin	17.0 (a)	20.0 (a)	b	c
	Cyprinidae	Peamouth chub	0.0 (—)	0.0 (—)	1.0 (a)	0.0 (—)
		Redside shiner	27.0 (a)	48.0 (a)	290.5 (72.0)	26.8 (6.4)
		Speckled dace	36.0 (a)	56.0 (a)	910.4 (735.6)	8.0 (4.2)
		Longnose Dace	0.0 (—)	0.0 (—)	c	0.0 (—)
	Petromyzontidae	Ammocoetes	0.0 (—)	0.0 (—)	c	0.0 (—)
	Salmonidae	Chinook salmon	0.0 (—)	0.0 (—)	0.0 (—)	1.0 (a)
		Coho salmon	0.0 (—)	3.0 (a)	0.0 (—)	0.0 (—)
		Steelhead	0.0 (—)	0.0 (—)	6.1 (0.8)	c
		Cutthroat	0.0 (—)	1.0 (a)	c	0.0 (—)
Johnson Creek (40)	Catostomidae	Largescale sucker	0.0 (—)	0.0 (—)	c	8.1 (0.8)
		Unidentified sucker	0.0 (—)	0.0 (—)	c	0.0 (—)
	Cottidae	Reticulate sculpin	14.0 (a)	127.3 (5.8)	4.0 (3.5)	c
		Unidentified sculpin	12.0 (a)	b	1.0 (a)	0.0 (—)
	Cyprinidae	Redside shiner	4.0 (a)	1,805.0 (22,981.6)	304.2 (22.1)	6.0 (a)
		Speckled dace	8.0 (a)	84.2 (9.6)	81.0 (296.9)	4.4 (2.6)
	Petromyzontidae	Western Brook lamprey	0.0 (—)	0.0 (—)	0.0 (—)	c
	Salmonidae	Chinook salmon	0.0 (—)	0.0 (—)	1.0 (a)	0.0 (—)
		Steelhead	0.0 (—)	0.0 (—)	2.0 (a)	3.1 (1.0)
		Cutthroat	0.0 (—)	14.7 (49.2)	0.0 (—)	0.0 (—)
Johnson Creek (43)	Catostomidae	Unidentified sucker	0.0 (—)	1.0 (a)	c	—
	Cottidae	Reticulate sculpin	17.0 (a)	50.0 (a)	b	—
		Unidentified sculpin	6.0 (a)	28.0 (a)	16.7 (27.8)	—
	Cyprinidae	Northern pikeminnow	0.0 (—)	1.0 (a)	0.0 (—)	—
		Redside shiner	36.0 (a)	5.0 (a)	114.2 (81.6)	—

Appendix Table 4. Continued.

Drainage, Stream (Reach)	Family	Common name	Spring fish/reach (SE)	Summer fish/reach (SE)	Fall fish/reach (SE)	Winter fish/reach (SE)
Johnson Watershed cont.,						
Johnson Creek (43) cont.	Cyprinidae cont.	Speckled dace	6.0 (a)	24.0 (a)	b	—
	Salmonidae	Chinook salmon	0.0 (—)	0.0 (—)	c	—
		Steelhead	0.0 (—)	0.0 (—)	c	—
Johnson Creek (46)	Catostomidae	Largescale sucker	1.0 (a)	0.0 (—)	4.0 (a)	0.0 (—)
		Unidentified sucker	0.0 (—)	1.0 (a)	16.7 (27.8)	0.0 (—)
	Cottidae	Reticulate sculpin	150.0 (36.7)	304.8 (18.0)	1,145.9 (6,475.0)	0.0 (—)
		Unidentified sculpin	45.6 (7.2)	63.8 (10.0)	47.3 (18.2)	0.0 (—)
	Cyprinidae	Northern pikeminnow	0.0 (—)	0.0 (—)	1.0 (a)	0.0 (—)
		Redside shiner	780.2 (107.0)	51.5 (15.8)	307.7 (57.0)	23.4 (21.8)
		Speckled dace	b	99.4 (5.2)	528.5158.2	5.2 (1.2)
	Petromyzontidae	Ammocoetes	2.0 (a)	4.0 (a)	0.0 (—)	0.0 (—)
		Pacific lamprey	0.0 (—)	0.0 (—)	c	0.0 (—)
	Salmonidae	Coho salmon	0.0 (—)	0.0 (—)	0.0 (—)	1.0 (a)
		Steelhead	1.0 (a)	7.6 (7.4)	13.1 (3.8)	5.9 (4.8)
Johnson Creek (49)	Catostomidae	Largescale sucker	c	1.0 (a)	0.0 (—)	0.0 (—)
		Unidentified sucker	c	0.0 (—)	1.0 (a)	0.0 (—)
	Cottidae	Reticulate sculpin	50.1 (7.0)	192.7 (56.0)	1.0 (a)	0.0 (—)
		Unidentified sculpin	15.2 (10.4)	17.8 (2.6)	1.0 (a)	0.0 (—)
	Cyprinidae	Redside shiner	222.3 (9.6)	57.7 (30.0)	162.0 (a)	0.0 (—)
		Speckled dace	53.1 (18.8)	108.8 (751.2)	29.0 (a)	9.0 (a)
	Petromyzontidae	Ammocoetes	0.0 (—)	2.0 (a)	0.0 (—)	0.0 (—)
		Western Brook lamprey	4.4 (2.6)	0.0 (—)	0.0 (—)	0.0 (—)
		Unidentified lamprey	c	0.0 (—)	0.0 (—)	0.0 (—)
	Salmonidae	Steelhead	1.0 (a)	0.0 (—)	0.0 (—)	0.0 (—)
		Cutthroat	0.0 (—)	c	0.0 (—)	0.0 (—)

Appendix Table 4. Continued.

Drainage, Stream (Reach)	Family	Common name	Spring fish/reach (SE)	Summer fish/reach (SE)	Fall fish/reach (SE)	Winter fish/reach (SE)
Johnson Watershed cont.,						
Johnson Creek (49) cont.	Salmonidae cont.	Unidentified salmonid	c	0.0 (—)	0.0 (—)	0.0 (—)
Johnson Creek (52)	Catostomidae	Largescale sucker	2.0 (a)	0.0 (—)	0.0 (—)	0.0 (—)
		Unidentified sucker	1.0 (a)	0.0 (—)	5.0 (a)	2.0 (a)
	Centrarchidae	Bluegill	1.0 (a)	0.0 (—)	0.0 (—)	0.0 (—)
		Largemouth bass	c	0.0 (—)	0.0 (—)	0.0 (—)
		Pumpkinseed	c	1.0 (a)	0.0 (—)	0.0 (—)
	Cottidae	Reticulate sculpin	101.9 (25.3)	71.3 (26.4)	3.0 (a)	0.0 (—)
		Unidentified sculpin	301.8 (182.2)	8.3 (2.9)	6.0 (a)	0.0 (—)
		Redside shiner	203.1 (90.4)	36.0 (99.5)	21.0 (a)	121.0 (a)
		Speckled dace	8.0 (4.9)	3.0 (a)	6.0 (a)	0.0 (—)
	Petromyzontidae	Ammocoetes	42.3 (6.1)	0.0 (—)	0.0 (—)	0.0 (—)
		Western Brook lamprey	1.0 (a)	0.0 (—)	1.0 (a)	0.0 (—)
	Salmonidae	Steelhead	1.0 (a)	0.0 (—)	0.0 (—)	0.0 (—)
		Unidentified salmonid	0.0 (—)	1.0 (a)	0.0 (—)	0.0 (—)
Johnson Creek (55)	Catostomidae	Largescale sucker	0.0 (—)	0.0 (—)	0.0 (—)	1.0 (a)
		Unidentified sucker	7.0 (a)	0.0 (—)	4.0 (a)	4.0 (a)
	Cottidae	Reticulate sculpin	36.0 (a)	25.0 (a)	5.0 (a)	1.0 (a)
		Unidentified sculpin	24.0 (a)	28.0 (a)	6.0 (a)	1.0 (a)
	Cyprinidae	Redside shiner	47.0 (a)	20.0 (a)	38.0 (a)	18.0 (a)
		Speckled dace	32.0 (a)	8.0 (a)	3.0 (a)	0.0 (—)
	Petromyzontidae	Ammocoetes	0.0 (—)	0.0 (—)	0.0 (—)	1.0 (a)
		Western Brook lamprey	1.0 (a)	0.0 (—)	0.0 (—)	0.0 (—)
Johnson Creek (58)	Catostomidae	Largescale sucker	c	0.0 (—)	0.0 (—)	0.0 (—)
		Unidentified sucker	2.2 (1.8)	0.0 (—)	5.0 (a)	1.0 (a)

Appendix Table 4. Continued.

Drainage, Stream (Reach)	Family	Common name	Spring fish/reach (SE)	Summer fish/reach (SE)	Fall fish/reach (SE)	Winter fish/reach (SE)
Johnson Watershed cont.,						
Johnson Creek (58) cont.	Centrarchidae	Largemouth bass	0.0 (—)	1.0 (a)	0.0 (—)	0.0 (—)
		Green sunfish	0.0 (—)	1.0 (a)	0.0 (—)	0.0 (—)
	Cottidae	Reticulate sculpin	137.2 (119.6)	b	6.0 (a)	2.0 (a)
		Unidentified sculpin	b	115.1 (250.4)	3.0 (a)	3.0 (a)
	Cyprinidae	Redside shiner	111.9 (26.4)	164.8 (214.8)	129.0 (a)	51.0 (a)
		Speckled dace	40.5 (7.0)	b	4.0 (a)	0.0 (—)
	Petromyzontidae	Ammocoetes	c	b	0.0 (—)	0.0 (—)
		Western Brook lamprey	1.0 (a)	0.0 (—)	0.0 (—)	0.0 (—)
	Salmonidae	Steelhead	b	0.0 (—)	0.0 (—)	0.0 (—)
		Cutthroat	0.0 (—)	16.7 (27.8)	0.0 (—)	0.0 (—)
		Unidentified salmonid	c	0.0 (—)	0.0 (—)	0.0 (—)
Johnson Creek (61)	Catostomidae	Largescale sucker	0.0 (—)	0.0 (—)	1.0 (a)	0.0 (—)
		Unidentified sucker	6.0 (a)	0.0 (—)	5.0 (a)	0.0 (—)
	Centrarchidae	Bluegill	1.0 (a)	0.0 (—)	0.0 (—)	0.0 (—)
		Pumpkinseed	3.0 (a)	0.0 (—)	1.0 (a)	0.0 (—)
	Cottidae	Reticulate sculpin	41.0 (a)	18.0 (a)	3.0 (a)	0.0 (—)
		Unidentified sculpin	20.0 (a)	12.0 (a)	7.0 (a)	0.0 (—)
	Cyprinidae	Redside shiner	160.0 (a)	12.0 (a)	119.0 (a)	2.0 (a)
		Speckled dace	23.0 (a)	15.0 (a)	31.0 (a)	0.0 (—)
	Petromyzontidae	Ammocoetes	1.0 (a)	1.0 (a)	0.0 (—)	0.0 (—)
		Western Brook lamprey	12.0 (a)	0.0 (—)	0.0 (—)	0.0 (—)
Johnson Creek (64)	Catostomidae	Largescale sucker	0.0 (—)	1.0 (a)	0.0 (—)	3.0 (a)
		Unidentified sucker	c	9.0 (13.4)	b	0.0 (—)
	Centrarchidae	Bluegill	b	0.0 (—)	0.0 (—)	0.0 (—)
		Smallmouth bass	0.0 (—)	0.0 (—)	0.0 (—)	0.0 (—)

Appendix Table 4. Continued.

Drainage, Stream (Reach)	Family	Common name	Spring fish/reach (SE)	Summer fish/reach (SE)	Fall fish/reach (SE)	Winter fish/reach (SE)
Johnson Watershed cont.,						
Johnson Creek (64) cont.	Centrarchidae cont.	Largemouth bass	1.0 (a)	0.0 (—)	0.0 (—)	0.0 (—)
	Cottidae	Prickly sculpin	0.0 (—)	c	0.0 (—)	0.0 (—)
		Reticulate sculpin	73.0 (7.4)	424.0 (160.6)	c	0.0 (—)
		Unidentified sculpin	48.1 (10.8)	c	4.0 (3.5)	0.0 (—)
	Cyprinidae	Northern pikeminnow	0.0 (—)	1.0 (a)	0.0 (—)	0.0 (—)
		Redside shiner	1,190.3 (3,244.9)	176.0 (47.6)	b	0.0 (—)
		Speckled dace	12.5 (10.6)	b	c	0.0 (—)
	Petromyzontidae	Ammocoetes	3.0 (a)	59.1 (2.1)	0.0 (—)	0.0 (—)
		Western Brook lamprey	c	0.0 (—)	0.0 (—)	1.0 (a)
	Salmonidae	Steelhead	0.0 (—)	0.0 (—)	2.0 (a)	0.0 (—)
		Cutthroat	1.0 (a)	1.0 (a)	0.0 (—)	0.0 (—)
Johnson Creek (67)	Catostomidae	Unidentified sucker	0.0 (—)	0.0 (—)	0.0 (—)	b
	Centrarchidae	Bluegill	1.0 (a)	0.0 (—)	1.0 (a)	0.0 (—)
		Pumpkinseed	c	0.0 (—)	0.0 (—)	0.0 (—)
	Cottidae	Reticulate sculpin	925.2 (6,761.2)	21.0 (a)	3.0 (a)	1.0 (a)
		Unidentified sculpin	1,001.3 (13,421.2)	0.0 (—)	0.0 (—)	4.0 (3.5)
	Cyprinidae	Redside shiner	725.2 (8,838.6)	17.0 (a)	77.0 (a)	b
		Speckled dace	c	1.0 (a)	11.0 (a)	4.0 (a)
	Petromyzontidae	Ammocoetes	c	2.0 (a)	0.0 (—)	0.0 (—)
		Western Brook lamprey	c	0.0 (—)	0.0 (—)	0.0 (—)
		Unidentified lamprey	0.0 (—)	0.0 (—)	0.0 (—)	c
	Salmonidae	Chinook salmon	0.0 (—)	0.0 (—)	0.0 (—)	1.0 (a)
		Coho salmon	2.2 (1.8)	0.0 (—)	0.0 (—)	0.0 (—)
		Steelhead	0.0 (—)	0.0 (—)	0.0 (—)	2.0 (a)
Johnson Creek (70)	Catostomidae	Unidentified sucker	0.0 (—)	2.0 (a)	11.0 (a)	0.0 (—)

Appendix Table 4. Continued.

Drainage, Stream (Reach)	Family	Common name	Spring fish/reach (SE)	Summer fish/reach (SE)	Fall fish/reach (SE)	Winter fish/reach (SE)
Johnson Watershed cont.,						
Johnson Creek (70) cont.	Cottidae	Prickly sculpin	1.0 (a)	0.0 (—)	0.0 (—)	0.0 (—)
		Reticulate sculpin	140.2 (133.6)	27.0 (a)	17.0 (a)	0.0 (—)
		Unidentified sculpin	64.7 (6.8)	32.0 (a)	19.0 (a)	0.0 (—)
	Cyprinidae	Redside shiner	28.0 (9.2)	3.0 (a)	55.0 (a)	10.0 (a)
		Speckled dace	c	10.0 (a)	35.0 (a)	2.0 (a)
	Petromyzontidae	Western Brook lamprey	4.0 (a)	0.0 (—)	0.0 (—)	0.0 (—)
	Salmonidae	Coho salmon	1.0 (a)	0.0 (—)	0.0 (—)	0.0 (—)
Johnson Creek (73)	Catostomidae	Largescale sucker	b	1.0 (a)	c	—
		Unidentified sucker	0.0 (—)	0.0 (—)	b	—
	Cottidae	Reticulate sculpin	b	229.1 (70.4)	44.0 (76.2)	—
		Unidentified sculpin	241.6 (480.0)	33.1 (79.6)	95.7 (183.2)	—
	Cyprinidae	Redside shiner	111.4 (16.0)	40.0 (9.2)	1,805.0 (22,981.6)	—
		Speckled dace	15.3 (14.2)	43.7 (16.0)	101.1 (57.4)	—
	Petromyzontidae	Ammocoetes	c	c	0.0 (—)	—
		Western Brook lamprey	4.0 (a)	0.0 (—)	0.0 (—)	—
		Unidentified lamprey	1.0 (a)	0.0 (—)	0.0 (—)	—
	Salmonidae	Coho salmon	11.4 (9.0)	0.0 (—)	0.0 (—)	—
		Steelhead	c	c	c	—
		Cutthroat	0.0 (—)	13.3 (11.8)	c	—
		Unidentified salmonid	0.0 (—)	0.0 (—)	1.0 (a)	—
Johnson Creek (76)	Catostomidae	Largescale sucker	0.0 (—)	0.0 (—)	0.0 (—)	c
		Unidentified sucker	1.0 (a)	0.0 (—)	c	0.0 (—)
	Cottidae	Reticulate sculpin	337.5 (163.6)	158.6 (27.2)	30.7 (33.2)	c
		Unidentified sculpin	311.9 (214.0)	65.2 (9.2)	b	8.3 (16.8)
	Cyprinidae	Northern pikeminnow	0.0 (—)	c	0.0 (—)	0.0 (—)

Appendix Table 4. Continued.

Drainage, Stream (Reach)	Family	Common name	Spring fish/reach (SE)	Summer fish/reach (SE)	Fall fish/reach (SE)	Winter fish/reach (SE)
Johnson Watershed cont.,						
Johnson Creek (76) cont.	Cyprinidae cont.	Redside shiner	74.8 (41.8)	84.5 (105.4)	b	167.0 (96.8)
		Speckled dace	b	19.1 (15.8)	61.4 (15.6)	1.0 (a)
	Petromyzontidae	Ammocoetes	b	0.0 (—)	0.0 (—)	0.0 (—)
		Western Brook lamprey	20.9 (10.0)	0.0 (—)	c	0.0 (—)
		Unidentified lamprey	c	0.0 (—)	0.0 (—)	0.0 (—)
	Salmonidae	Coho salmon	0.0 (—)	1.0 (a)	0.0 (—)	0.0 (—)
		Steelhead	19.5 (33.6)	1.0 (a)	5.2 (1.2)	b
		Cutthroat	2.0 (a)	7.4 (2.0)	6.0 (a)	1.0 (a)
Johnson Creek (79)	Catostomidae	Largescale sucker	2.0 (a)	1.0 (a)	3.0 (a)	5.0 (a)
		Unidentified sucker	2.0 (a)	1.0 (a)	4.0 (a)	0.0 (—)
	Cottidae	Reticulate sculpin	19.0 (a)	21.0 (a)	6.0 (a)	0.0 (—)
		Unidentified sculpin	9.0 (a)	11.0 (a)	11.0 (a)	0.0 (—)
	Cyprinidae	Redside shiner	30.0 (a)	13.0 (a)	33.0 (a)	4.0 (a)
		Speckled dace	0.0 (—)	5.0 (a)	6.0 (a)	2.0 (a)
Johnson Creek (82)	Catostomidae	Largescale sucker	1.0 (a)	0.0 (—)	c	c
		Unidentified sucker	0.0 (—)	0.0 (—)	4.0 (a)	0.0 (—)
	Centrarchidae	Largemouth bass	0.0 (—)	0.0 (—)	1.0 (a)	0.0 (—)
	Cottidae	Prickly sculpin	3.0 (a)	0.0 (—)	0.0 (—)	0.0 (—)
		Reticulate sculpin	40.0 (2.3)	177.3 (74.6)	c	12.5 (10.6)
		Unidentified sculpin	42.9 (3.8)	b	15.2 (10.4)	c
	Cyprinidae	Redside shiner	37.9 (1.3)	98.9 (22.8)	174.4 (362.4)	1.0 (a)
		Speckled dace	c	42.1 (57.8)	84.6 (124.0)	c
	Petromyzontidae	Western Brook lamprey	1.0 (a)	0.0 (—)	0.0 (—)	0.0 (—)
	Salmonidae	Coho salmon	3.0 (a)	0.0 (—)	0.0 (—)	0.0 (—)
		Steelhead	0.0 (—)	8.3 (16.8)	b	1.0 (a)

Appendix Table 4. Continued.

Drainage, Stream (Reach)	Family	Common name	Spring fish/reach (SE)	Summer fish/reach (SE)	Fall fish/reach (SE)	Winter fish/reach (SE)
Johnson Watershed cont.,						
Johnson Creek (82) cont.	Salmonidae cont.	Cutthroat	0.0 (—)	7.1 (0.8)	3.8 (5.2)	0.0 (—)
Johnson Creek (85)	Catostomidae	Largescale sucker	0.0 (—)	0.0 (—)	0.0 (—)	5.2 (1.2)
		Unidentified sucker	0.0 (—)	0.0 (—)	c	0.0 (—)
	Cottidae	Prickly sculpin	3.0 (a)	0.0 (—)	0.0 (—)	0.0 (—)
		Reticulate sculpin	14.0 (a)	55.1 (24.4)	4.0 (3.5)	1.0 (a)
		Unidentified sculpin	12.0 (a)	61.4 (47.0)	b	c
	Cyprinidae	Redside shiner	9.0 (a)	260.7 (727.8)	27.0 (23.2)	11.0 (a)
		Speckled dace	0.0 (—)	3.1 (1.0)	b	2.0 (a)
	Petromyzontidae	Ammocoetes	2.0 (a)	c	0.0 (—)	0.0 (—)
		Western Brook lamprey	8.0 (a)	0.0 (—)	0.0 (—)	0.0 (—)
	Salmonidae	Coho salmon	0.0 (—)	2.0 (a)	0.0 (—)	c
		Steelhead	0.0 (—)	0.0 (—)	1.0 (a)	1.0 (a)
		Cutthroat	0.0 (—)	3.8 (5.2)	0.0 (—)	0.0 (—)
Johnson Creek (88)	Catostomidae	Largescale sucker	0.0 (—)	0.0 (—)	c	3.0 (a)
		Unidentified sucker	0.0 (—)	0.0 (—)	c	1.0 (a)
	Cottidae	Reticulate sculpin	13.0 (a)	559.3 (872.4)	28.3 (7.2)	0.0 (—)
		Unidentified sculpin	13.0 (a)	50.8 (233.0)	28.8 (10.4)	0.0 (—)
	Cyprinidae	Redside shiner	6.0 (a)	126.7 (23.0)	240.3 (358.4)	1.0 (a)
		Speckled dace	1.0 (a)	11.7 (5.8)	13.4 (8.0)	3.0 (a)
	Petromyzontidae	Ammocoetes	3.0 (a)	c	0.0 (—)	0.0 (—)
	Salmonidae	Coho salmon	0.0 (—)	c	0.0 (—)	0.0 (—)
		Steelhead	0.0 (—)	0.0 (—)	c	0.0 (—)
		Cutthroat	0.0 (—)	c	2.0 (a)	0.0 (—)
Johnson Creek (91)	Catostomidae	Largescale sucker	0.0 (—)	1.0 (a)	0.0 (—)	1.0 (a)
		Unidentified sucker	0.0 (—)	1.0 (a)	1.0 (a)	16.0 (31.7)

Appendix Table 4. Continued.

Drainage, Stream (Reach)	Family	Common name	Spring fish/reach (SE)	Summer fish/reach (SE)	Fall fish/reach (SE)	Winter fish/reach (SE)
Johnson Watershed cont.,						
Johnson Creek (91) cont.	Cottidae	Reticulate sculpin	48.1 (10.8)	31.0 (a)	1.0 (a)	b
		Unidentified sculpin	32.1 (8.4)	9.0 (a)	0.0 (—)	b
	Cyprinidae	Redside shiner	48.8 (5.2)	6.0 (a)	4.0 (a)	625.0 (4,200.0)
		Speckled dace	1.0 (a)	1.0 (a)	0.0 (—)	0.0 (—)
		Fathead minnow	1.0 (a)	0.0 (—)	0.0 (—)	0.0 (—)
	Petromyzontidae	Ammocoetes	c	0.0 (—)	0.0 (—)	c
	Salmonidae	Steelhead	1.0 (a)	0.0 (—)	0.0 (—)	0.0 (—)
		Cutthroat	0.0 (—)	0.0 (—)	0.0 (—)	1.0 (a)
Johnson Creek (94)	Catostomidae	Largescale sucker	3.0 (a)	120.5 (2.7)	0.0 (—)	0.0 (—)
		Unidentified sucker	0.0 (—)	c	1.0 (a)	2.0 (a)
	Centrarchidae	Smallmouth bass	0.0 (—)	c	0.0 (—)	0.0 (—)
		Green sunfish	0.0 (—)	0.0 (—)	1.0 (a)	0.0 (—)
	Cottidae	Reticulate sculpin	13.0 (a)	146.8 (5.9)	3.0 (a)	6.0 (a)
		Unidentified sculpin	2.0 (a)	b	4.0 (a)	13.0 (a)
	Cyprinidae	Redside shiner	19.0 (a)	b	5.0 (a)	24.0 (a)
		Speckled dace	4.0 (a)	75.6 (46.9)	3.0 (a)	5.0 (a)
	Petromyzontidae	Ammocoetes	0.0 (—)	4.5 (1.5)	0.0 (—)	0.0 (—)
		Western Brook lamprey	0.0 (—)	4.5 (1.5)	0.0 (—)	0.0 (—)
	Poeciliidae	Western mosquitofish	0.0 (—)	0.0 (—)	1.0 (a)	0.0 (—)
	Salmonidae	Cutthroat	0.0 (—)	1.0 (a)	0.0 (—)	0.0 (—)
Kelley Creek (2)	Cottidae	Reticulate sculpin	158.6 (27.2)	138.6 (10.2)	58.7 (90.4)	b
		Unidentified sculpin	94.6 (6.4)	0.0 (—)	b	c
	Cyprinidae	Redside shiner	47.4 (6.2)	33.6 (2.0)	300.2 (917.8)	34.3 (12.8)
		Speckled dace	3.0 (a)	8.1 (0.8)	16.7 (27.8)	0.0 (—)
	Salmonidae	Coho salmon	15.7 (2.6)	c	1.0 (a)	1.0 (a)

Appendix Table 4. Continued.

Drainage, Stream (Reach)	Family	Common name	Spring fish/reach (SE)	Summer fish/reach (SE)	Fall fish/reach (SE)	Winter fish/reach (SE)
Johnson Watershed cont.,						
Kelley Creek (2) cont.	Salmonidae cont.	Steelhead	14.0 (a)	0.0 (—)	c	0.0 (—)
		Cutthroat	b	45.2 (3.0)	30.8 (47.4)	b
Kelley Creek (5)	Cottidae	Reticulate sculpin	260.9 (23.2)	311.5 (123.4)	110.1 (235.2)	1.0 (a)
		Unidentified sculpin	119.5 (21.0)	130.7 (283.8)	b	0.0 (—)
	Cyprinidae	Redside shiner	26.1 (5.0)	28.3 (5.2)	29.4 (69.6)	0.0 (—)
		Speckled dace	20.9 (2.8)	36.5 (5.2)	66.4 (25.6)	2.0 (a)
	Salmonidae	Coho salmon	1.0 (a)	b	b	0.0 (—)
		Cutthroat	53.8 (5.2)	68.9 (8.6)	69.3 (33.0)	0.0 (—)
Kelley Creek (8)	Centrarchidae	Bluegill	0.0 (—)	1.0 (a)	0.0 (—)	0.0 (—)
		Green sunfish	2.0 (a)	0.0 (—)	0.0 (—)	0.0 (—)
	Cottidae	Reticulate sculpin	147.9 (15.4)	375.0 (220.0)	140.5 (104.0)	9.1 (0.5)
		Unidentified sculpin	81.5 (2.4)	b	25.6 (4.0)	c
	Cyprinidae	Redside shiner	26.5 (1.8)	8.0 (a)	c	0.0 (—)
		Speckled dace	28.6 (2.0)	40.3 (4.8)	40.2 (13.6)	4.0 (a)
	Salmonidae	Coho salmon	3.0 (a)	20.3 (6.0)	11.7 (5.8)	1.0 (a)
		Cutthroat	24.9 (2.8)	37.3 (10.2)	23.4 (3.8)	6.0 (a)
Kelley Creek (11)	Cottidae	Reticulate sculpin	113.5 (10.0)	45.8 (10.0)	b	c
		Unidentified sculpin	306.3 (2,885.4)	25.0 (a)	c	4.0 (3.5)
	Cyprinidae	Speckled dace	38.3 (1.2)	10.4 (1.8)	125.6 (165.2)	21.8 (3.8)
	Salmonidae	Cutthroat	13.9 (3.2)	7.4 (2.0)	4.4 (2.6)	2.0 (a)
Kelley Creek (14)		Reticulate sculpin	367.3 (128.8)	92.3 (14.1)	180.2 (153.4)	198.4 (975.4)
		Unidentified sculpin	b	273.4 (17.5)	b	38.3 (184.6)
	Cyprinidae	Speckled dace	202.6 (320.6)	b	281.7 (77.4)	43.0 (2.6)
	Salmonidae	Cutthroat	21.8 (6.8)	3.0 (a)	19.9 (23.4)	10.4 (1.8)
Kelley Creek (17)	Cottidae	Reticulate sculpin	278.2 (82.0)	205.4 (33.0)	114.9 (319.6)	11.7 (2.6)

Appendix Table 4. Continued.

Drainage, Stream (Reach)	Family	Common name	Spring fish/reach (SE)	Summer fish/reach (SE)	Fall fish/reach (SE)	Winter fish/reach (SE)
Johnson Watershed cont.,						
Kelley Creek (17) cont.	Cottidae cont.	Unidentified sculpin	159.3 (75.8)	131.4 (94.8)	11.3 (32.0)	51.6 (105.0)
	Cyprinidae	Speckled dace	75.5 (11.6)	83.0 (8.2)	50.2 (10.4)	15.2 (1.0)
	Salmonidae	Cutthroat	41.2 (3.0)	8.3 (1.6)	b	10.2 (4.6)
		Unidentified salmonid	1.0 (a)	0.0 (—)	0.0 (—)	0.0 (—)
Kelley Creek (20)	Cottidae	Reticulate sculpin	284.2 (31.6)	116.3 (31.6)	60 (a)	32.0 (9.8)
		Unidentified sculpin	150.0 (8.3)	14.1 (0.3)	52.0 (a)	36.0 (99.5)
	Cyprinidae	Speckled dace	36.4 (8.0)	16.3 (0.8)	8.0 (a)	9.0 (2.1)
	Salmonidae	Cutthroat	1.0 (a)	1.0 (a)	0.0 (—)	1.0 (a)
Kelley Creek (23)	Cottidae	Reticulate sculpin	23.0 (3.0)	17.0 (a)	0.0 (—)	24.0 (7.2)
		Unidentified sculpin	33.5 (1.8)	3.0 (a)	0.0 (—)	8.1 (0.8)
	Salmonidae	Cutthroat	7.4 (2.0)	0.0 (—)	b	15.7 (2.6)
		Unidentified salmonid	8.0 (4.2)	0.0 (—)	0.0 (—)	0.0 (—)
Kelley Creek (26)	Cottidae	Reticulate sculpin	14.0 (a)	4.0 (a)	36.0 (99.5)	1.0 (a)
		Unidentified sculpin	36.0 (a)	17.0 (a)	b	1.0 (a)
	Salmonidae	Cutthroat	0.0 (—)	0.0 (—)	1.0 (a)	0.0 (—)
Kelley Creek (29)	Cottidae	Reticulate sculpin	11.0 (a)	26.0 (a)	2.0 (a)	0.0 (—)
		Unidentified sculpin	45.0 (a)	32.0 (a)	4.0 (a)	2.0 (a)
Kelley Creek (32)	No fish identified		—	—	—	—
Mitchell Creek (2)	Cottidae	Reticulate sculpin	158.2 (43.8)	197.7 (28.4)	b	18.2 (3.6)
		Unidentified sculpin	194.5 (171.6)	178.1 (39.8)	86.2 (34.8)	36.5 (35.8)
	Cyprinidae	Speckled dace	0.0 (—)	0.0 (—)	5.8 (9.2)	0.0 (—)
	Petromyzontidae	Ammocoetes	c	b	c	0.0 (—)
		Western Brook lamprey	c	0.0 (—)	c	c
	Salmonidae	Cutthroat	45.3 (11.0)	22.6 (4.2)	46.4 (4.8)	23.4 (8.2)
Mitchell Creek (5)	Cottidae	Reticulate sculpin	257.6 (47.4)	108.9 (37.6)	180.6 (566.6)	16.9 (2.8)

Appendix Table 4. Continued.

Drainage, Stream (Reach)	Family	Common name	Spring fish/reach (SE)	Summer fish/reach (SE)	Fall fish/reach (SE)	Winter fish/reach (SE)
Johnson Watershed cont.,						
Mitchell Creek (5) cont.	Cottidae cont.	Unidentified sculpin	123.6 (186.0)	c	105.2 (218.8)	51.3 (17.6)
	Cyprinidae	Common carp	1.0 (a)	0.0 (—)	0.0 (—)	0.0 (—)
	Petromyzontidae	Ammocoetes	11.4 (9.0)	c	b	c
		Western Brook lamprey	0.0 (—)	0.0 (—)	c	0.0 (—)
		Pacific lamprey	0.0 (—)	0.0 (—)	0.0 (—)	
	Salmonidae	Cutthroat	50.4 (3.2)	13.0 (a)	36.3 (8.4)	10.0 (a)
		Unidentified salmonid	1.0 (a)	0.0 (—)	0.0 (—)	0.0 (—)
Mitchell Creek (8)	Cottidae	Reticulate sculpin	184.6 (64.2)	75.5 (6.8)	32.0 (8.4)	11.7 (2.6)
		Unidentified sculpin	156.7 (73.6)	46.5 (9.6)	33.0 (10.2)	4.4 (2.6)
	Petromyzontidae	Ammocoetes	b	41.2 (107.4)	b	c
		Western Brook lamprey	0.0 (—)	1.0 (a)	0.0 (—)	b
	Salmonidae	Cutthroat	91.5 (33.4)	45.0 (2.6)	46.4 (12.8)	25.6 (4.0)
		Unidentified salmonid	b	0.0 (—)	0.0 (—)	0.0 (—)
Mitchell Creek (11)	Cottidae	Reticulate sculpin	30.7 (21.4)	49.4 (22.8)	8.1 (0.8)	2.2 (1.8)
		Unidentified sculpin	17.8 (2.6)	14.7 (49.2)	7.6 (7.4)	2.2 (1.8)
	Petromyzontidae	Western Brook lamprey	c	0.0 (—)	0.0 (—)	0.0 (—)
	Salmonidae	Cutthroat	66.6 (18.4)	45.2 (6.0)	55.5 (107.2)	25.6 (8.4)
		Unidentified salmonid	0.0 (—)	7.6 (7.4)	0.0 (—)	0.0 (—)
Mitchell Creek (14)	No fish identified		—	—	—	—
Miller Drainage,						
Miller Creek (1)	Cobitidae	Oriental weatherfish	1.0 (a)	0.0 (—)	0.0 (—)	0.0 (—)
	Cottidae	Prickly sculpin	8.3 (16.8)	79.0 (80.4)	1.0 (a)	3.1 (1.0)
		Reticulate sculpin	223.4 (368.4)	35.7 (5.6)	54.4 (13.6)	33.1 (79.6)
		Unidentified sculpin	c	2.0 (a)	39.7 (2.4)	36.2 (45.4)
	Cyprinidae	Chiselmouth	0.0 (—)	0.0 (—)	3.8 (5.2)	0.0 (—)

Appendix Table 4. Continued.

Drainage, Stream (Reach)	Family	Common name	Spring fish/reach (SE)	Summer fish/reach (SE)	Fall fish/reach (SE)	Winter fish/reach (SE)
Miller Drainage cont.,						
Miller Creek (1) cont.	Cyprinidae cont.	Common carp	0.0 (—)	0.0 (—)	0.0 (—)	1.0 (a)
		Northern pikeminnow	4.4 (2.6)	0.0 (—)	c	b
		Redside shiner	0.0 (—)	0.0 (—)	5.0 (a)	0.0 (—)
		Speckled dace	0.0 (—)	0.0 (—)	0.0 (—)	c
	Gasterosteidae	Threespine stickleback	c	118.2 (1.0)	6.5 (2.4)	b
	Petromyzontidae	Western Brook lamprey	c	0.0 (—)	0.0 (—)	0.0 (—)
	Poeciliidae	Western mosquitofish	0.0 (—)	1.0 (a)	2.0 (a)	0.0 (—)
	Salmonidae	Chinook salmon	b	0.0 (—)	0.0 (—)	0.0 (—)
		Coho salmon	22.6 (45.2)	4.0 (a)	b	5.8 (9.2)
		Unidentified salmonid	0.0 (—)	0.0 (—)	0.0 (—)	2.2 (1.8)
Miller Creek (2)	Cottidae	Prickly sculpin	8.0 (a)	8.0 (a)	0.0 (—)	0.0 (—)
		Reticulate sculpin	9.0 (a)	8.0 (a)	8.0 (a)	1.0 (a)
		Unidentified sculpin	0.0 (—)	4.0 (a)	7.0 (a)	0.0 (—)
	Salmonidae	Coho salmon	0.0 (—)	0.0 (—)	0.0 (—)	2.0 (a)
Stephens Drainage,						
Stephens Creek (1)	Centrarchidae	Smallmouth bass	1.0 (a)	0.0 (—)	0.0 (—)	2.0 (a)
	Cobitidae	Oriental weatherfish	1.0 (a)	0.0 (—)	0.0 (—)	0.0 (—)
	Cottidae	Prickly sculpin	2.0 (a)	3.0 (a)	0.0 (—)	b
		Reticulate sculpin	12.0 (a)	0.0 (—)	0.0 (—)	5.8 (9.2)
		Unidentified sculpin	0.0 (—)	0.0 (—)	0.0 (—)	c
	Cyprinidae	Common carp	0.0 (—)	0.0 (—)	c	0.0 (—)
		Northern pikeminnow	3.0 (a)	0.0 (—)	0.0 (—)	0.0 (—)
		Peamouth	0.0 (—)	0.0 (—)	4.0 (3.5)	0.0 (—)
		Speckled dace	3.0 (a)	0.0 (—)	0.0 (—)	19.7 (7.2)
		Longnose Dace	1.0 (a)	0.0 (—)	0.0 (—)	1.0 (a)

Appendix Table 4. Continued.

Drainage, Stream (Reach)	Family	Common name	Spring fish/reach (SE)	Summer fish/reach (SE)	Fall fish/reach (SE)	Winter fish/reach (SE)
Stephens Drainage cont.,						
Stephens Creek (1) cont.	Fundulidae	Banded killifish	2.0 (a)	0.0 (—)	0.0 (—)	c
	Ictaluridae	Brown bullhead	0.0 (—)	0.0 (—)	2.0 (a)	0.0 (—)
	Poeciliidae	Western mosquitofish	0.0 (—)	0.0 (—)	b	0.0 (—)
	Salmonidae	Chinook salmon	0.0 (—)	0.0 (—)	0.0 (—)	c
		Coho salmon	31.0 (a)	0.0 (—)	1.0 (a)	0.0 (—)
		Steelhead	0.0 (—)	0.0 (—)	0.0 (—)	2.0 (a)
		Unidentified salmonid	0.0 (—)	0.0 (—)	0.0 (—)	b

Appendix Table 5. Descriptive statistics for fork length by season of fish measured in City of Portland Streams 2008-2009.

Season, Drainage, Stream	Family	Genus species	Common name	Count	Mean (Std)	Min/Max
Spring,						
Fanno Drainage,						
Fanno Creek	Cottidae	*Cottus perplexus*	Reticulate sculpin	42	69.3 (18.0)	47/115
	Cyprinidae	*Richardsonius balteatus*	Redside shiner	20	84.1 (8.9)	72/103
	Petromyzontidae	*Lampetra*	Ammocoetes	2	139.0 (12.7)	130/148
	Salmonidae	*Oncorhynchus clarki*	Cutthroat	15	136.4 (64.7)	49/215
Vermont Creek	Cottidae	*Cottus perplexus*	Reticulate sculpin	40	71.9 (14.2)	49/102
	Cyprinidae	*Richardsonius balteatus*	Redside shiner	1	96.0 (—)	—
	Petromyzontidae	*Lampetra*	Ammocoetes	1	145.0 (—)	—
		Lampetra richardsoni	Western Brook lamprey	1	112.0 (—)	—
Johnson Watershed,						
Crystal Springs Creek	Catostomidae	*Catostomus macrocheilus*	Largescale sucker	32	128.9 (128.6)	44/520
	Centrarchidae	*Lepomis macrochirus*	Bluegill	1	65.0 (—)	—
		Micropterus dolomieu	Smallmouth bass	2	75.5 (6.4)	71/80
	Cottidae	*Cottus Asper*	Prickly sculpin	1	106.0 (—)	—
		Cottus perplexus	Reticulate sculpin	227	64.0 (10.6)	47/100
	Cyprinidae	*Acrocheilus alutaceus*	Chiselmouth	3	77.7 (11.7)	69/91
		Cyprinus carpio	Common carp	3	106.3 (22.1)	81/122
		Richardsonius balteatus	Redside shiner	111	74.7 (18.5)	35/116
		Rhinichthys osculus	Speckled dace	68	55.6 (13.8)	37/95
	Gasterosteidae	*Gasterosteus aculeatus*	Threespine stickleback	77	41.1 (6.7)	24/55
	Petromyzontidae	*Lampetra*	Ammocoetes	11	52.2 (30.8)	25/135
		Lampetra richardsoni	Western Brook lamprey	11	119.0 (8.2)	105/130
	Salmonidae	*Oncorhynchus tshawytscha*	Chinook salmon	3	84.7 (4.2)	80/88
		Oncorhynchus kisutch	Coho salmon	3	84.0 (11.8)	74/97

Appendix Table 5. Continued.

Season, Drainage, Stream	Family	Genus species	Common name	Count	Mean (Std)	Min/Max
Spring cont.,						
Johnson Watershed cont.,						
Crystal Springs cont.	Salmonidae cont.	*Oncorhynchus mykiss*	Steelhead	10	75.1 (76.2)	35/220
Johnson Creek	Catostomidae	*Catostomus macrocheilus*	Largescale sucker	42	278.1 (142.5)	56/467
	Centrarchidae	*Lepomis macrochirus*	Bluegill	8	48.5 (23.1)	27/94
		Micropterus salmoides	Largemouth bass	3	82.3 (48.0)	47/137
		Lepomis gibbosus	Pumpkinseed	5	77.4 (18.8)	62/110
		Micropterus dolomieu	Smallmouth bass	3	72.3 (7.0)	65/79
	Cottidae	*Cottus Asper*	Prickly sculpin	50	77.5 (30.2)	46/179
		Cottus perplexus	Reticulate sculpin	974	57.3 (9.5)	30/102
	Cyprinidae	*Pimephales promelas*	Fathead minnow	1	45.0 (—)	—
		Rhinichthys cataractae	Longnose dace	9	80.4 (18.7)	58/122
		Ptychocheilus oregonensis	Northern pikeminnow	2	99.0 (19.8)	85/113
		Richardsonius balteatus	Redside shiner	856	56.4 (20.1)	19/116
		Rhinichthys osculus	Speckled dace	393	48.7 (12.4)	21/81
	Gasterosteidae	*Gasterosteus aculeatus*	Threespine stickleback	2	50.0 (14.1)	40/60
	Ictaluridae	*Ameiurus nebulosus*	Brown bullhead	1	114.0 (—)	—
	Petromyzontidae	*Lampetra*	Ammocoetes	69	106.3 (27.7)	40/147
		Lampetra richardsoni	Western Brook lamprey	75	109.2 (8.5)	93/130
	Salmonidae	*Oncorhynchus tshawytscha*	Chinook salmon	3	46.0 (3.5)	44/50
		Oncorhynchus kisutch	Coho salmon	19	47.3 (6.1)	39/61
		Oncorhynchus clarki	Cutthroat	3	174.0 (112.0)	94/302
		Oncorhynchus mykiss	Steelhead	30	58.8 (47.2)	30/181
Kelley Creek	Centrarchidae	*Lepomis cyanellus*	Green sunfish	2	75.5 (9.2)	69/82
	Cottidae	*Cottus perplexus*	Reticulate sculpin	417	61.2 (10.0)	43/96

Appendix Table 5. Continued.

Season, Drainage, Stream	Family	Genus species	Common name	Count	Mean (Std)	Min/Max
Spring cont.,						
Johnson Watershed cont.,						
Kelley Creek cont.	Cyprinidae	*Richardsonius balteatus*	Redside shiner	87	68.5 (12.1)	42/97
		Rhinichthys osculus	Speckled dace	173	53.1 (12.6)	28/89
	Petromyzontidae	*Lampetra*	Ammocoetes	35	86.6 (26.8)	35/150
		Lampetra richardsoni	Western Brook lamprey	15	113.7 (12.0)	96/140
	Salmonidae	*Oncorhynchus kisutch*	Coho salmon	19	56.3 (5.3)	47/66
		Oncorhynchus clarki	Cutthroat	167	75.8 (43.8)	31/231
		Oncorhynchus mykiss	Steelhead	14	57.7 (32.3)	34/140
Mitchell Creek	Cottidae	*Cottus perplexus*	Reticulate sculpin	83	60.6 (10.8)	46/97
	Cyprinidae	*Cyprinus carpio*	Common carp	1	122.0 (—)	—
	Petromyzontidae	*Lampetra*	Ammocoetes	28	66.9 (25.1)	29/115
		Lampetra richardsoni	Western Brook lamprey	2	92.5 (10.6)	85/100
	Salmonidae	*Oncorhynchus clarki*	Cutthroat	209	64.4 (33.5)	30/210
Miller Drainage,						
Miller Creek	Cobitidae	*Misgrunus anguillicaudatus*	Oriental weatherfish	1	127.0 (—)	—
	Cottidae	*Cottus Asper*	Prickly sculpin	13	62.4 (14.7)	46/102
		Cottus perplexus	Reticulate sculpin	75	65.5 (11.5)	42/100
		Cottus gulosus	Riffle sculpin	7	70.4 (4.9)	61/77
	Cyprinidae	*Ptychocheilus oregonensis*	Northern pikeminnow	4	44.0 (3.9)	40/49
	Gasterosteidae	*Gasterosteus aculeatus*	Threespine stickleback	1	52.0 (—)	—
	Petromyzontidae	*Lampetra richardsoni*	Western Brook lamprey	1	160.0 (—)	—
	Salmonidae	*Oncorhynchus tshawytscha*	Chinook salmon	11	51.8 (11.4)	42/74
		Oncorhynchus kisutch	Coho salmon	12	94.0 (26.5)	44/116

Appendix Table 5. Continued.

Season, Drainage, Stream	Family	Genus species	Common name	Count	Mean (Std)	Min/Max
Spring cont.,						
Stephens Drainage,						
Stephens Creek	Centrarchidae	*Micropterus dolomieu*	Smallmouth bass	1	62.0 (—)	—
	Cottidae	*Cottus Asper*	Prickly sculpin	2	50.0 (5.7)	46/54
		Cottus perplexus	Reticulate sculpin	12	68.9 (15.0)	55/97
	Cyprinidae	*Rhinichthys cataractae*	Longnose dace	1	38.0 (—)	—
		Ptychocheilus oregonensis	Northern pikeminnow	3	39.3 (0.6)	39/40
		Rhinichthys osculus	Speckled dace	3	32.0 (3.5)	28/34
	Fundulidae	*Fundulus diaphanous*	Banded killifish	2	53.5 (0.7)	53/54
	Salmonidae	*Oncorhynchus kisutch*	Coho salmon	31	41.4 (3.2)	38/52
Summer,						
Fanno Drainage,						
Fanno Creek	Cottidae	*Cottus perplexus*	Reticulate sculpin	81	70.3 (14.2)	41/100
	Cyprinidae	*Richardsonius balteatus*	Redside shiner	27	85.5 (10.9)	66/105
	Petromyzontidae	*Lampetra*	Ammocoetes	2	108.5 (61.5)	66/105
	Petromyzontidae	*Lampetra richardsoni*	Western Brook lamprey	1	116.0 (—)	—
	Salmonidae	*Oncorhynchus clarki*	Cutthroat	14	118.2 (61.7)	55/245
Vermont Creek	Cottidae	*Cottus perplexus*	Reticulate sculpin	40	68.4 (13.3)	50/105
	Petromyzontidae	*Lampetra*	Ammocoetes	1	98.0 (—)	—
Johnson Watershed,						
Crystal Springs Creek	Catostomidae	*Catostomus macrocheilus*	Largescale sucker	13	99.3 (27.4)	64/140
	Centrarchidae	*Lepomis macrochirus*	Bluegill	2	98.0 (19.8)	84/112
	Cottidae	*Cottus Asper*	Prickly sculpin	3	114.0 (83.2)	62/210
		Cottus perplexus	Reticulate sculpin	141	66.2 (8.8)	47/95
		Cottus gulosus	Riffle sculpin	4	60.5 (5.2)	53/65

Appendix Table 5. Continued.

Season, Drainage, Stream	Family	Genus species	Common name	Count	Mean (Std)	Min/Max
Summer cont.,						
Johnson Watershed cont.,						
Crystal Springs cont.	Cyprinidae	*Rhinichthys cataractae*	Longnose dace	1	123.0 (—)	—
		Richardsonius balteatus	Redside shiner	76	72.4 (20.1)	23/104
		Rhinichthys osculus	Speckled dace	95	62.3 (18.1)	16/107
	Gasterosteidae	*Gasterosteus aculeatus*	Threespine stickleback	23	38.2 (15.2)	15/59
	Petromyzontidae	*Lampetra*	Ammocoetes	8	58.6 (24.1)	30/104
		Lampetra richardsoni	Western Brook lamprey	3	121.7 (15.3)	105/135
	Salmonidae	*Oncorhynchus tshawytscha*	Chinook salmon	2	102.0 (36.8)	76/128
		Oncorhynchus clarki	Cutthroat	2	104.0 (—)	—
		Oncorhynchus mykiss	Steelhead	1	91.0 (—)	—
Johnson Creek	Catostomidae	*Catostomus macrocheilus*	Largescale sucker	51	106.5 (44.0)	50/283
	Centrarchidae	*Lepomis macrochirus*	Bluegill	2	113.0 (84.9)	53/173
		Lepomis cyanellus	Green sunfish	1	100.0 (—)	—
	Centrarchidae	*Micropterus salmoides*	Largemouth bass	1	126.0 (—)	—
		Lepomis gibbosus	Pumpkinseed	2	90.0 (14.1)	80/100
		Micropterus dolomieu	Smallmouth bass	2	177.5 (128.0)	87/268
	Cobitidae	*Misgrunus anguillicaudatus*	Oriental weatherfish	1	186.0 (—)	—
	Cottidae	*Cottus Asper*	Prickly sculpin	44	122.4 (41.3)	31/217
		Cottus perplexus	Reticulate sculpin	824	57.2 (9.6)	15/94
		Cottus gulosus	Riffle sculpin	3	63.7 (10.7)	57/76
	Cyprinidae	*Cyprinus carpio*	Common carp	1	183.0 (—)	—
		Rhinichthys cataractae	Longnose dace	93	73.4 (24.2)	30/128
		Ptychocheilus oregonensis	Northern pikeminnow	3	56.7 (5.5)	51/62
		Richardsonius balteatus	Redside shiner	618	63.9 (16.7)	17/127

Appendix Table 5. Continued.

Season, Drainage, Stream	Family	Genus species	Common name	Count	Mean (Std)	Min/Max
Summer cont.,						
Johnson Watershed cont.,						
Johnson Creek cont.	Cyprinidae cont.	*Rhinichthys osculus*	Speckled dace	511	53.8 (12.2)	17/95
	Gasterosteidae	*Gasterosteus aculeatus*	Threespine stickleback	14	37.0 (7.9)	17/49
	Ictaluridae	*Ameiurus nebulosus*	Brown bullhead	1	211.0 (—)	—
	Petromyzontidae	*Lampetra*	Ammocoetes	52	109.2 (22.1)	51/156
		Lampetra richardsoni	Western Brook lamprey	3	129.3 (8.6)	120/137
	Salmonidae	*Oncorhynchus tshawytscha*	Chinook salmon	9	82.9 (13.0)	60/99
		Oncorhynchus kisutch	Coho salmon	8	74.9 (9.7)	66/95
		Oncorhynchus clarki	Cutthroat	124	90.3 (51.5)	50/301
		Oncorhynchus mykiss	Steelhead	31	98.1 (60.6)	52/335
Kelley Creek	Centrarchidae	*Lepomis macrochirus*	Bluegill	2	86.0 (48.1)	52/120
		Lepomis cyanellus	Green sunfish	1	94.0 (—)	—
	Cottidae	*Cottus perplexus*	Reticulate sculpin	305	59.4 (10.0)	40/87
		Cottus gulosus	Riffle sculpin	1	76.0 (—)	—
	Cyprinidae	*Richardsonius balteatus*	Redside shiner	51	71.8 (11.1)	50/98
		Rhinichthys osculus	Speckled dace	126	57.1 (14.6)	18/90
	Petromyzontidae	*Lampetra*	Ammocoetes	23	86.7 (33.2)	23/134
		Lampetra richardsoni	Western Brook lamprey	1	111.0 (—)	—
	Salmonidae	*Oncorhynchus kisutch*	Coho salmon	26	75.2 (9.2)	64/114
		Oncorhynchus clarki	Cutthroat	185	77.9 (27.7)	50/197
				3	62.3 (6.7)	55/68
Mitchell Creek	Cottidae	*Cottus perplexus*	Reticulate sculpin	119	59.4 (8.9)	45/89
		Cottus gulosus	Riffle sculpin	2	77.0 (12.7)	68/86
	Petromyzontidae	*Lampetra*	Ammocoetes	41	78.2 (14.5)	45/103

Appendix Table 5. Continued.

Season, Drainage, Stream	Family	Genus species	Common name	Count	Mean (Std)	Min/Max
Summer cont.,						
Johnson Watershed cont.,						
Mitchell Creek cont.	Salmonidae	*Oncorhynchus clarki*	Cutthroat	125	65.5 (24.3)	36/136
Miller Drainage,						
Miller Creek	Centrarchidae	*Micropterus salmoides*	Largemouth bass	1	45.0 (—)	—
	Cottidae	*Cottus Asper*	Prickly sculpin	29	65.0 (21.0)	34/157
		Cottus perplexus	Reticulate sculpin	44	68.7 (11.4)	47/93
		Cottus gulosus	Riffle sculpin	27	68.7 (10.5)	50/91
	Gasterosteidae	*Gasterosteus aculeatus*	Threespine stickleback	23	36.9 (6.8)	22/47
	Poeciliidae	*Gambusia affinis*	Western mosquitofish	1	47.0 (—)	—
	Salmonidae	*Oncorhynchus kisutch*	Coho salmon	4	76.3 (5.1)	70/82
Stephens Drainage,						
Stephens Creek	Cobitidae	*Misgrunus anguillicaudatus*	Oriental weatherfish	1	170.0 (—)	—
	Cottidae	*Cottus Asper*	Prickly sculpin	3	65.3 (6.0)	59/71
Fall,						
Fanno Drainage,						
Fanno Creek	Cottidae	*Cottus perplexus*	Reticulate sculpin	43	69.6 (17.0)	46/99
	Cyprinidae	*Richardsonius balteatus*	Redside shiner	4	32.3 (2.2)	30/35
	Petromyzontidae	*Lampetra*	Ammocoetes	1	124.0 (—)	—
		Lampetra richardsoni	Western Brook lamprey	8	133.5 (10.0)	123/152
Vermont Creek	Cottidae	*Cottus perplexus*	Reticulate sculpin	40	75.7 (13.4)	45/109
Johnson Watershed,						
Crystal Springs Creek	Catostomidae	*Catostomus macrocheilus*	Largescale sucker	7	177.9 (127.5)	85/450
	Centrarchidae	*Lepomis macrochirus*	Bluegill	11	98.5 (29.8)	52/145
		Micropterus salmoides	Largemouth bass	2	154.5 (48.8)	120/189

Appendix Table 5. Continued.

Season, Drainage, Stream	Family	Genus species	Common name	Count	Mean (Std)	Min/Max
Fall cont.,						
Johnson Watershed cont.,						
Crystal Springs cont.	Centrarchidae cont.	*Lepomis gibbosus*	Pumpkinseed	8	84.1 (22.9)	51/110
	Cottidae	*Cottus perplexus*	Reticulate sculpin	104	60.0 (11.6)	41/95
	Cyprinidae	*Acrocheilus alutaceus*	Chiselmouth	3	80.0 (13.5)	65/91
		Cyprinus carpio	Common carp	1	82.0 (—)	—
		Carassius auratus	Goldfish	1	118.0 (—)	—
		Ptychocheilus oregonensis	Northern pikeminnow	2	91.0 (43.8)	60/122
		Richardsonius balteatus	Redside shiner	80	52.6 (22.4)	25/102
		Rhinichthys osculus	Speckled dace	67	58.1 (16.8)	32/98
	Gasterosteidae	*Gasterosteus aculeatus*	Threespine stickleback	37	41.1 (11.8)	21/65
	Ictaluridae	*Ameiurus nebulosus*	Brown bullhead	1	76.0 (—)	—
Johnson Creek	Catostomidae	*Catostomus macrocheilus*	Largescale sucker	39	96.2 (33.4)	59/230
	Centrarchidae	*Lepomis macrochirus*	Bluegill	7	82.3 (27.7)	44/120
		Lepomis cyanellus	Green sunfish	1	100.0 (—)	—
		Micropterus salmoides	Largemouth bass	2	98.0 (25.5)	80/116
		Lepomis gibbosus	Pumpkinseed	5	89.4 (16.9)	63/106
		Micropterus dolomieu	Smallmouth bass	12	55.5 (8.1)	40/65
	Cottidae	*Cottus Asper*	Prickly sculpin	16	96.9 (57.8)	35/201
		Cottus perplexus	Reticulate sculpin	420	54.7 (8.6)	26/96
	Cyprinidae	*Acrocheilus alutaceus*	Chiselmouth	1	82.0 (—)	—
		Cyprinus carpio	Common carp	16	85.9 (10.4)	72/112
		Notemigonus crysoleucas	Golden shiner	1	121.0 (—)	—
	Cyprinidae	*Rhinichthys cataractae*	Longnose dace	37	81.2 (16.9)	47/110
		Ptychocheilus oregonensis	Northern pikeminnow	4	86.0 (23.6)	58/114

Appendix Table 5. Continued.

Season, Drainage, Stream	Family	Genus species	Common name	Count	Mean (Std)	Min/Max
Fall cont.,						
Johnson Watershed cont.,						
Johnson Creek cont.	Cyprinidae cont.	*Mylochelilus caurinus*	Peamouth chub	1	89.0 (—)	—
		Richardsonius balteatus	Redside shiner	561	48.3 (21.9)	18/122
		Rhinichthys osculus	Speckled dace	436	50.9 (13.9)	22/91
	Gasterosteidae	*Gasterosteus aculeatus*	Threespine stickleback	9	47.6 (8.1)	39/67
	Ictaluridae	*Ameiurus nebulosus*	Brown bullhead	21	65.6 (7.6)	51/77
	Petromyzontidae	*Lampetra*	Ammocoetes	17	108.2 (26.9)	50/142
		Lampetra tridentate	Pacific lamprey	1	150.0 (—)	—
		Lampetra richardsoni	Western Brook lamprey	4	128.5 (18.4)	118/156
	Poeciliidae	*Gambusia affinis*	Western mosquitofish	1	34.0 (—)	—
Kelley Creek	Cottidae	*Cottus perplexus*	Reticulate sculpin	159	59.3 (10.4)	37/96
	Cyprinidae	*Richardsonius balteatus*	Redside shiner	43	73.3 (11.7)	32/100
		Rhinichthys osculus	Speckled dace	121	59.8 (15.8)	24/91
	Petromyzontidae	*Lampetra*	Ammocoetes	22	61.1 (29.4)	21/116
		Lampetra richardsoni	Western Brook lamprey	15	121.9 (11.7)	95/145
Mitchell Creek	Cottidae	*Cottus perplexus*	Reticulate sculpin	68	59.3 (9.8)	45/97
	Cyprinidae	*Rhinichthys osculus*	Speckled dace	4	71.5 (10.8)	59/85
	Petromyzontidae	*Lampetra*	Ammocoetes	21	65.0 (25.2)	23/105
		Lampetra richardsoni	Western Brook lamprey	2	117.5 (31.8)	95/140
Miller Drainage,						
Miller Creek	Centrarchidae	*Lepomis macrochirus*	Bluegill	3	41.3 (1.5)	40/43
		Micropterus dolomieu	Smallmouth bass	2	57.5 (2.1)	56/59
	Cottidae	*Cottus Asper*	Prickly sculpin	1	55.0 (—)	—
		Cottus perplexus	Reticulate sculpin	31	66.6 (11.5)	46/93

Appendix Table 5. Continued.

Season, Drainage, Stream	Family	Genus species	Common name	Count	Mean (Std)	Min/Max
Fall cont.,						
Miller Drainage cont.,						
Miller Creek cont.	Cyprinidae	*Acrocheilus alutaceus*	Chiselmouth	3	45.7 (10.0)	36/56
		Ptychocheilus oregonensis	Northern pikeminnow	1	54.0 (—)	—
		Richardsonius balteatus	Redside shiner	5	38.2 (4.1)	34/43
	Fundulidae	*Fundulus diaphanous*	Banded killifish	10	82.6 (4.7)	77/92
	Gasterosteidae	*Gasterosteus aculeatus*	Threespine stickleback	6	48.8 (6.4)	41/55
	Poeciliidae	*Gambusia affinis*	Western mosquitofish	2	40.5 (4.9)	37/44
Stephens Drainage,						
Stephens Creek	Cyprinidae	*Cyprinus carpio*	Common carp	1	82.0 (—)	—
		Mylochelilus caurinus	Peamouth chub	3	55.7 (3.1)	53/59
	Ictaluridae	*Ameiurus nebulosus*	Brown bullhead	2	68.0 (2.8)	66/70
	Poeciliidae	*Gambusia affinis*	Western mosquitofish	3	43.3 (3.2)	41/47
Winter,						
Fanno Drainage,						
Fanno Creek	Cottidae	*Cottus perplexus*	Reticulate sculpin	11	74.1 (11.0)	61/90
Vermont Creek	Cottidae	*Cottus perplexus*	Reticulate sculpin	30	69.7 (22.8)	31/105
	Petromyzontidae	*Lampetra tridentate*	Pacific lamprey	1	161.0 (—)	—
Johnson Watershed,						
Crystal Springs Creek	Catostomidae	*Catostomus macrocheilus*	Largescale sucker	11	75.0 (10.9)	59/96
	Centrarchidae	*Lepomis macrochirus*	Bluegill	1	85.0 (—)	—
	Cottidae	*Cottus Asper*	Prickly sculpin	1	59.0 (—)	—
		Cottus perplexus	Reticulate sculpin	107	59.3 (11.1)	45/85
	Cyprinidae	*Acrocheilus alutaceus*	Chiselmouth	3	77.7 (6.8)	70/83
		Ptychocheilus oregonensis	Northern pikeminnow	6	71.0 (16.8)	59/102

Appendix Table 5. Continued.

Season, Drainage, Stream	Family	Genus species	Common name	Count	Mean (Std)	Min/Max
Winter cont.,						
Johnson Watershed cont.,						
Crystal Springs cont.	Cyprinidae cont.	*Richardsonius balteatus*	Redside shiner	62	57.7 (26.0)	25/104
		Rhinichthys osculus	Speckled dace	66	50.5 (14.7)	32/94
	Fundulidae	*Fundulus diaphanous*	Banded killifish	1	69.0 (—)	—
	Gasterosteidae	*Gasterosteus aculeatus*	Threespine stickleback	57	42.4 (7.7)	30/60
	Petromyzontidae	*Lampetra*	Ammocoetes	3	58.3 (29.3)	27/85
		Lampetra tridentate	Pacific lamprey	1	105.0 (—)	—
		Lampetra richardsoni	Western Brook lamprey	8	116.0 (17.1)	99/152
	Salmonidae	*Oncorhynchus tshawytscha*	Chinook salmon	2	52.5 (0.7)	52/53
		Oncorhynchus kisutch	Coho salmon	6	101.5 (12.6)	85/117
		Oncorhynchus clarki	Cutthroat	1	51.0 (—)	—
		Oncorhynchus mykiss	Steelhead	4	147.8 (39.0)	91/180
Johnson Creek	Catostomidae	*Catostomus macrocheilus*	Largescale sucker	38	246.0 (141.7)	63/481
	Cottidae	*Cottus Asper*	Prickly sculpin	2	136.0 (48.1)	102/170
		Cottus perplexus	Reticulate sculpin	65	56.5 (8.1)	46/80
	Cyprinidae	*Rhinichthys cataractae*	Longnose dace	1	96.0 (—)	—
		Richardsonius balteatus	Redside shiner	322	52.1 (22.4)	16/100
		Rhinichthys osculus	Speckled dace	89	56.9 (14.3)	30/95
	Petromyzontidae	*Lampetra*	Ammocoetes	2	43.5 (9.2)	37/50
		Lampetra tridentate	Pacific lamprey	3	100.7 (4.0)	97/105
		Lampetra richardsoni	Western Brook lamprey	2	130.0 (21.2)	115/145
	Salmonidae	*Oncorhynchus tshawytscha*	Chinook salmon	5	115.6 (18.6)	94/145
		Oncorhynchus kisutch	Coho salmon	18	94.4 (10.7)	71/111
		Oncorhynchus clarki	Cutthroat	3	171.0 (60.0)	116/235

Appendix Table 5. Continued.

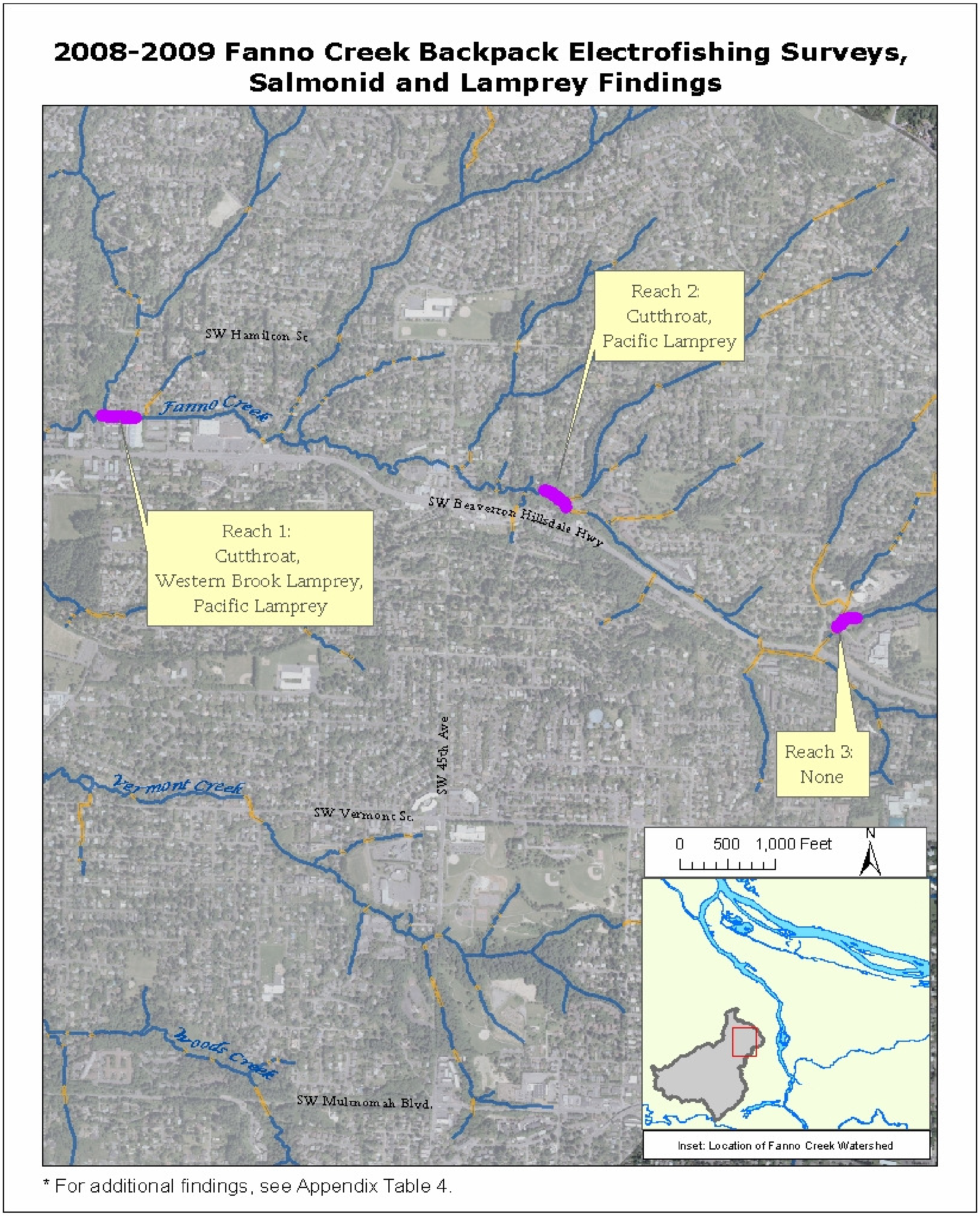
Season, Drainage, Stream	Family	Genus species	Common name	Count	Mean (Std)	Min/Max
Winter cont.,						
Johnson Watershed cont.,						
Johnson Creek cont.	Salmonidae cont.	*Oncorhynchus mykiss*	Steelhead	75	138.7 (43.9)	77/270
Kelley Creek	Cottidae	*Cottus perplexus*	Reticulate sculpin	90	59.4 (9.7)	40/89
	Cyprinidae	*Richardsonius balteatus*	Redside shiner	20	73.6 (5.3)	63/83
		Rhinichthys osculus	Speckled dace	68	53.1 (17.0)	23/86
	Petromyzontidae	*Lampetra*	Ammocoetes	2	41.0 (1.4)	40/42
		Lampetra richardsoni	Western Brook lamprey	7	121.7 (25.1)	100/176
	Salmonidae	*Oncorhynchus kisutch*	Coho salmon	2	95.5 (9.2)	89/102
	Salmonidae	*Oncorhynchus clarki*	Cutthroat	51	127.5 (71.6)	52/335
Mitchell Creek	Cottidae	*Cottus perplexus*	Reticulate sculpin	45	60.1 (9.3)	46/78
		Cottus gulosus	Riffle sculpin	4	74.5 (8.5)	62/81
	Petromyzontidae	*Lampetra*	Ammocoetes	1	76.0 (—)	—
		Lampetra tridentate	Pacific lamprey	1	104.0 (—)	—
		Lampetra richardsoni	Western Brook lamprey	5	94.0 (7.5)	87/105
	Salmonidae	*Oncorhynchus clarki*	Cutthroat	75	96.6 (44.6)	45/357
Miller Drainage,						
Miller Creek	Cottidae	*Cottus Asper*	Prickly sculpin	3	65.3 (23.1)	39/82
		Cottus perplexus	Reticulate sculpin	16	64.8 (13.1)	50/90
	Cyprinidae	*Cyprinus carpio*	Common carp	1	69.0 (—)	—
		Ptychocheilus oregonensis	Northern pikeminnow	2	30.0 (1.4)	29/31
		Rhinichthys osculus	Speckled dace	1	28.0 (—)	—
	Fundulidae	*Fundulus diaphanous*	Banded killifish	2	86.0 (5.7)	82/90
	Gasterosteidae	*Gasterosteus aculeatus*	Threespine stickleback	7	47.3 (3.6)	43/53
	Salmonidae	*Oncorhynchus kisutch*	Coho salmon	6	86.8 (12.0)	68/102

Appendix Table 5. Continued.

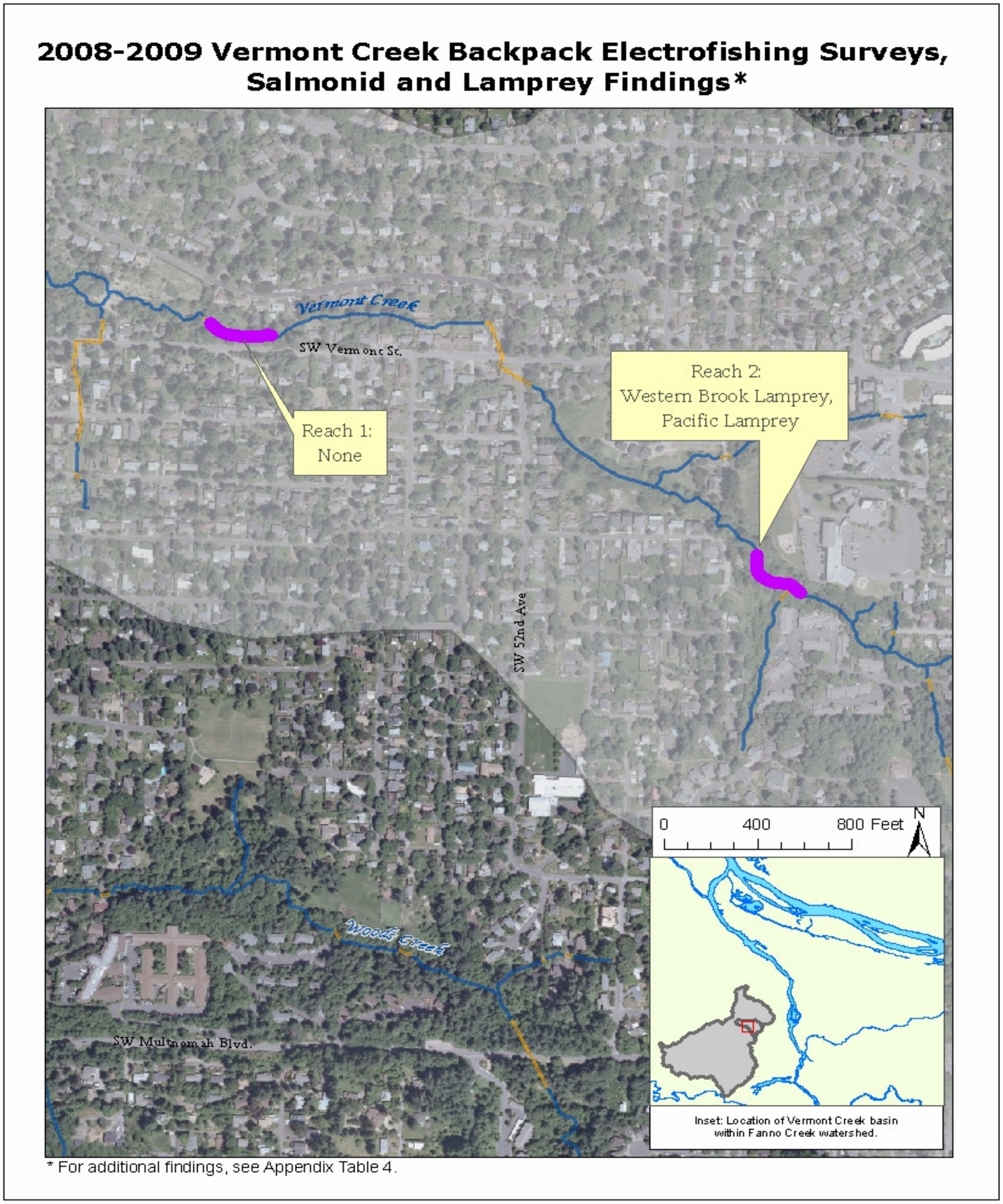
Season, Drainage, Stream	Family	Genus species	Common name	Count	Mean (Std)	Min/Max
Winter cont.,						
Stephens Drainage,						
Stephens Creek	Centrarchidae	*Micropterus dolomieu*	Smallmouth bass	2	51.5 (3.5)	49/54
	Cottidae	*Cottus Asper*	Prickly sculpin	2	60.0 (2.8)	58/62
		Cottus perplexus	Reticulate sculpin	4	55.8 (13.0)	47/75
	Cyprinidae	*Rhinichthys cataractae*	Longnose dace	1	56.0 (—)	—
		Rhinichthys osculus	Speckled dace	17	31.8 (4.5)	24/39
	Fundulidae	*Fundulus diaphanous*	Banded killifish	1	32.0 (—)	—
	Salmonidae	*Oncorhynchus tshawytscha*	Chinook salmon	1	50.0 (—)	—
		Oncorhynchus mykiss	Steelhead	2	92.5 (0.7)	92/93

APPENDIX FIGURES A

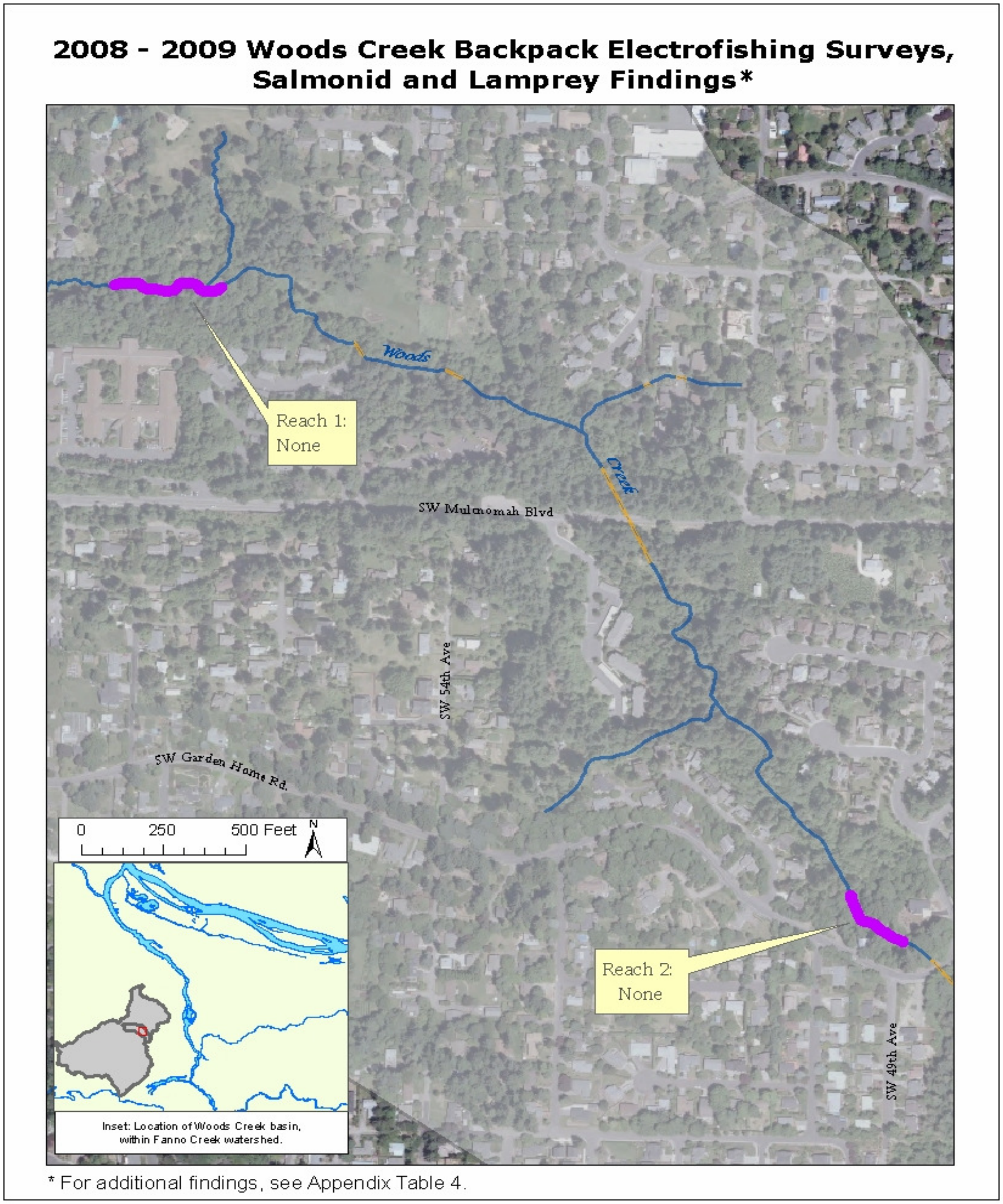
Maps of multiple pass stream reaches in Fanno Creek drainage, Johnson Creek Watershed, and Miller and Stephens Creek drainages



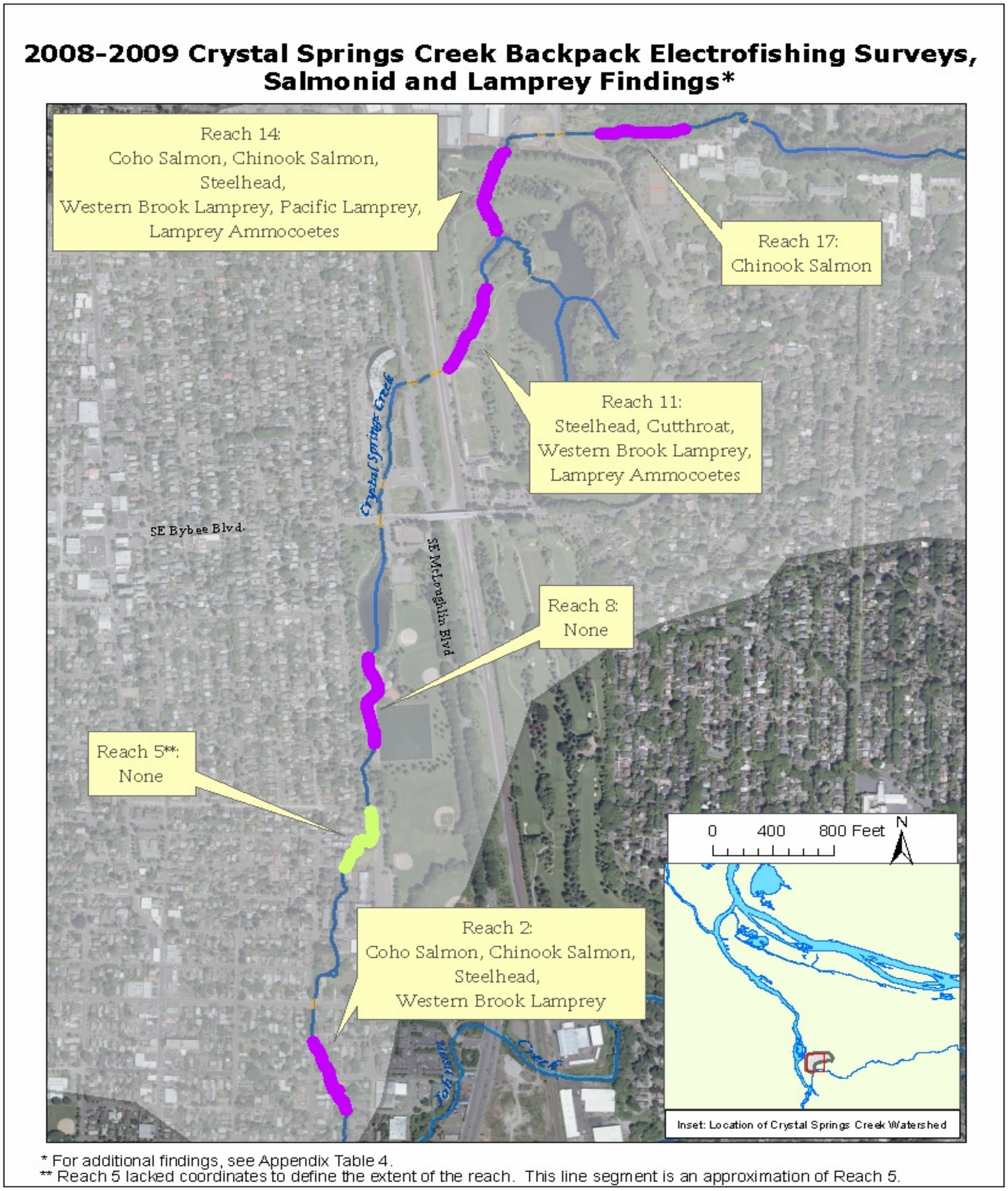
Appendix Figure A-1. Map showing an overview of upper Fanno Creek highlighting reaches 1-3 (purple ribbons) where multiple pass surveys were conducted during 2008-2009. Callouts provide reach number with common name of Pacific salmon and trout (Family Salmonidae) and lamprey (Family Petromyzontidae) observed on at least one occasion during one of the four seasons sampled. Species specific estimates are provided in Appendix Table 4.



Appendix Figure A-2. Map showing an overview of Vermont Creek, a tributary of Fanno Creek, highlighting reaches 1-2 (purple ribbons) where multiple pass surveys were conducted during 2008-2009. Callouts provide reach number with common name of Pacific salmon and trout (Family Salmonidae) and lamprey (Family Petromyzontidae) observed on at least one occasion during one of the four seasons sampled. Species specific estimates are provided in Appendix Table 4.

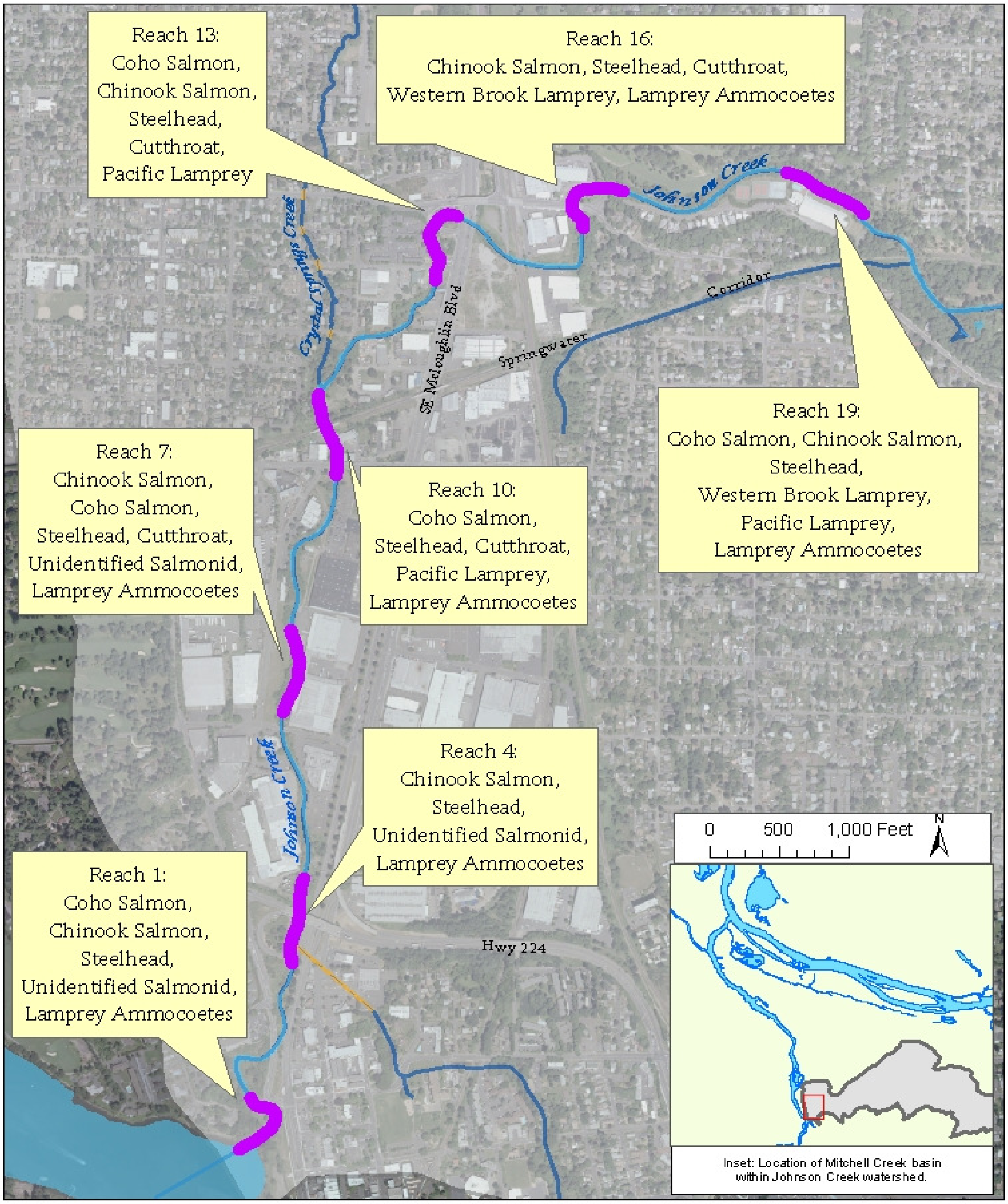


Appendix Figure A-3. Map showing an overview of Woods Creek, a tributary of Fanno Creek, highlighting reaches 1-2 (purple ribbons) where multiple pass surveys were conducted during 2008-2009. Callouts provide reach number with common name of Pacific salmon and trout (Family Salmonidae) and lamprey (Family Petromyzontidae) observed on at least one occasion during one of the four seasons sampled. Species specific estimates are provided in Appendix Table 4.



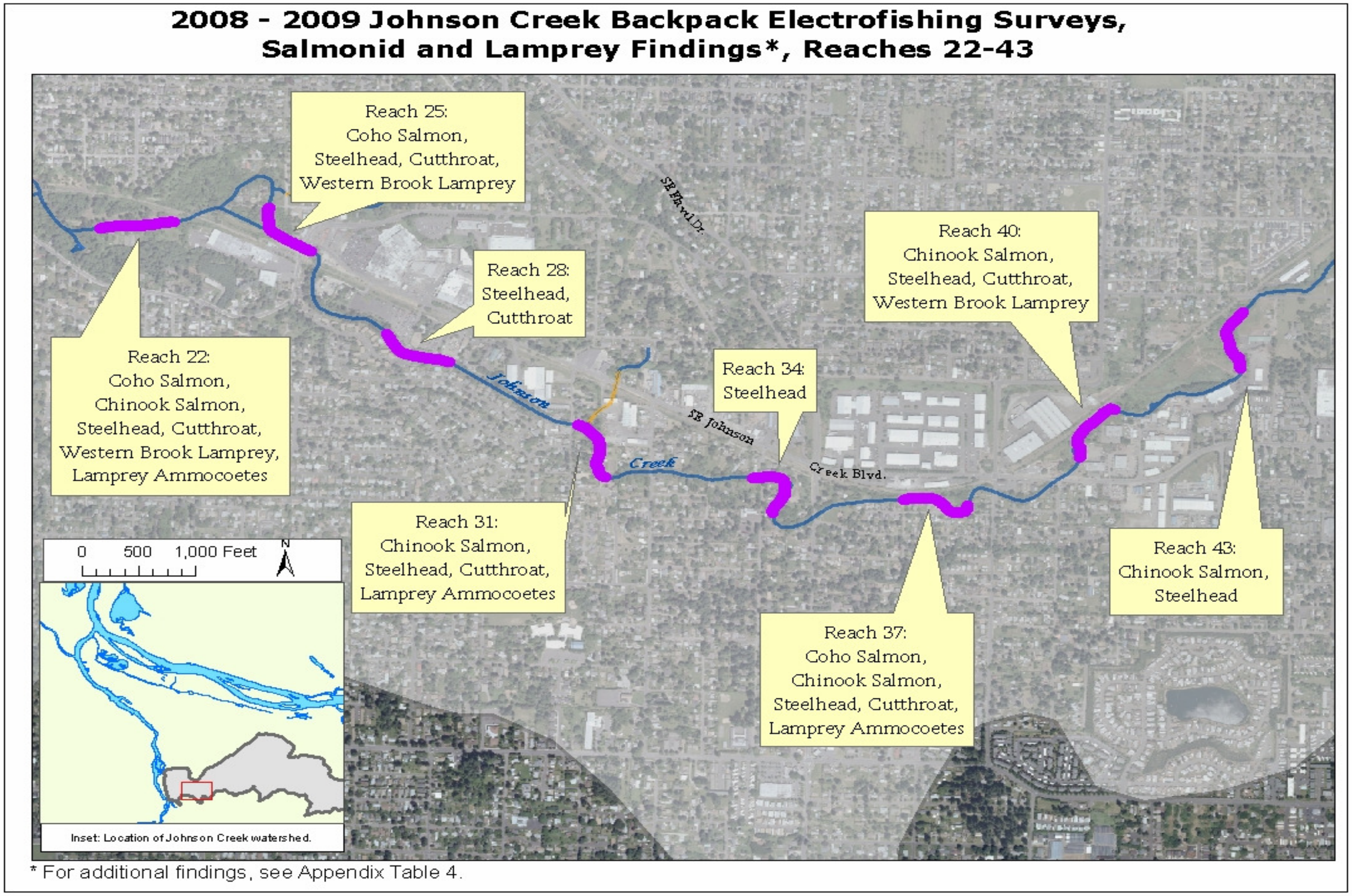
Appendix Figure A-4. Map showing an overview of Crystal Springs Creek, a tributary of Johnson Creek, highlighting reaches 2-17 (purple ribbons) where multiple pass surveys were conducted during 2008-2009. Approximated reach boundaries (Chartreuse ribbon) in the absence of GPS measured coordinates. Callouts provide reach number with common name of Pacific salmon and trout (Family Salmonidae) and lamprey (Family Petromyzontidae) observed on at least one occasion during one of the four seasons sampled. Species specific estimates are provided in Appendix Table 4.

2008 - 2009 Johnson Creek Backpack Electrofishing Surveys, Salmonid and Lamprey Findings*, Reaches 1-19

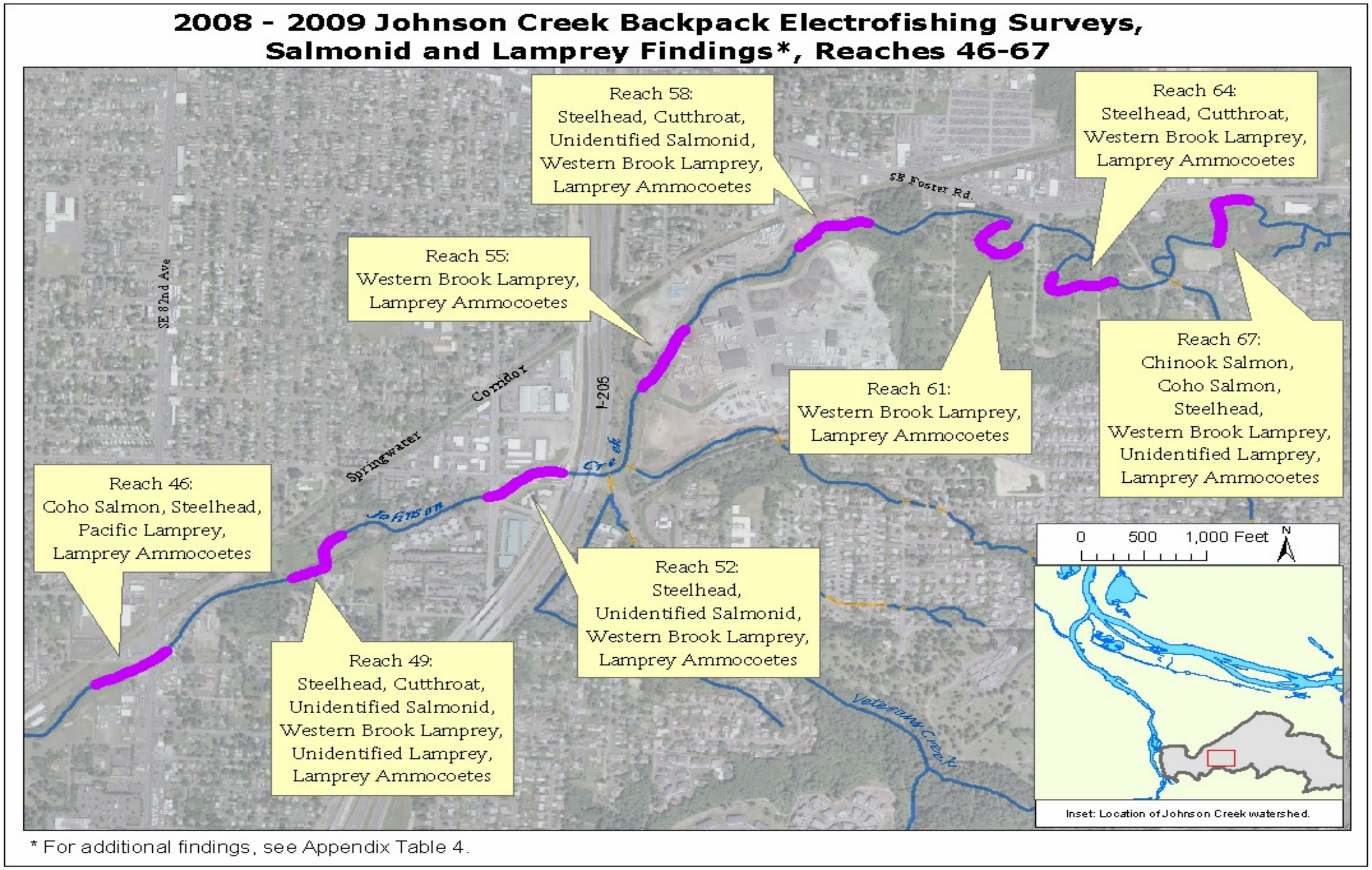


* For additional findings, see Appendix Table 4.

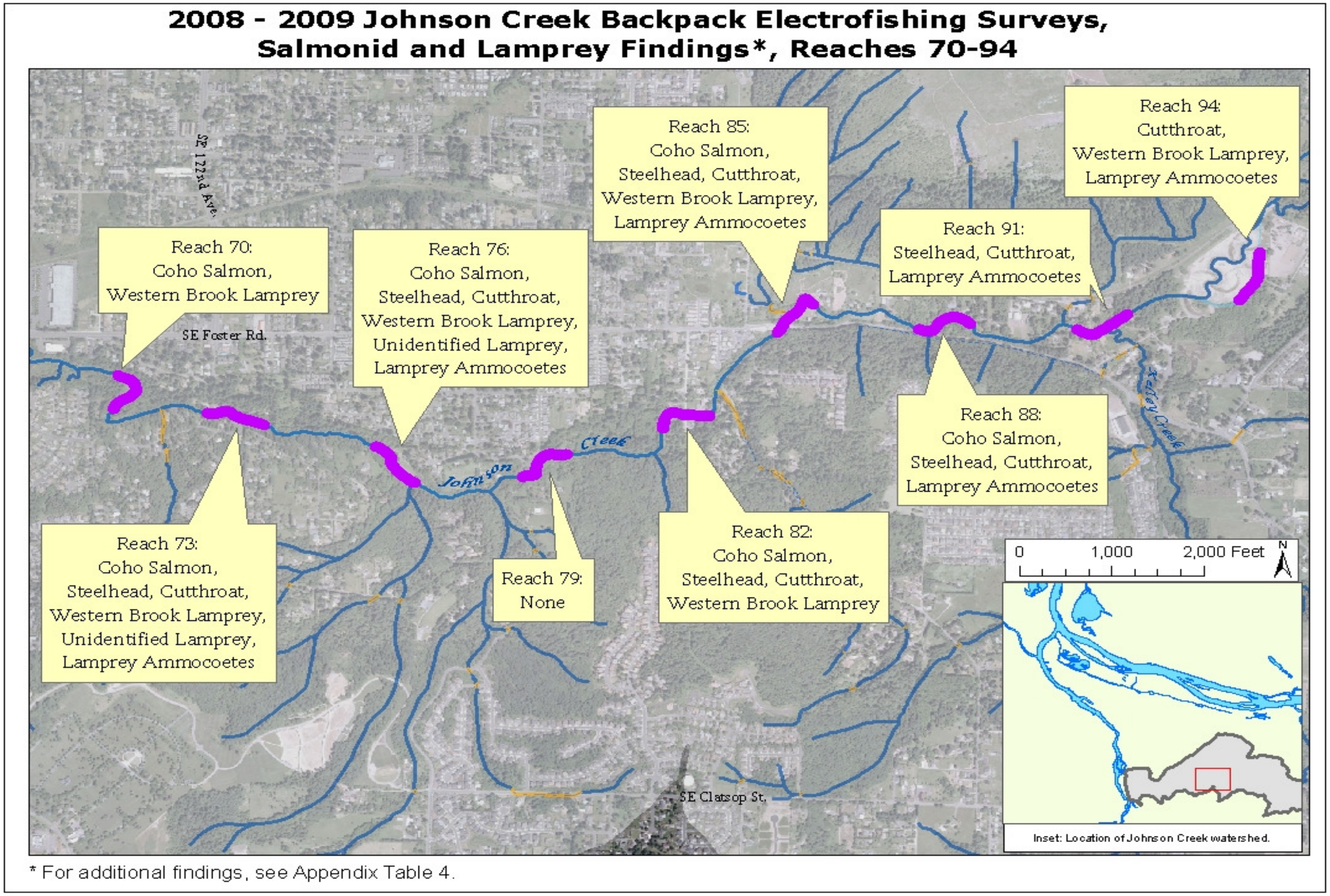
Appendix Figure A-5. Map showing an overview of Johnson Creek highlighting reaches 1-19 (purple ribbons) where multiple pass surveys were conducted during 2008-2009. Callouts provide reach number with common name of Pacific salmon and trout (Family Salmonidae) and lamprey (Family Petromyzontidae) observed on at least one occasion during one of the four seasons sampled. Species specific estimates are provided in Appendix Table 4.



Appendix Figure A-6. Map showing an overview of Johnson Creek highlighting reaches 22-43 (purple ribbons) where multiple pass surveys were conducted during 2008-2009. Callouts provide reach number with common name of Pacific salmon and trout (Family Salmonidae) and lamprey (Family Petromyzontidae) observed on at least one occasion during one of the four seasons sampled. Species specific estimates are provided in Appendix Table 4.

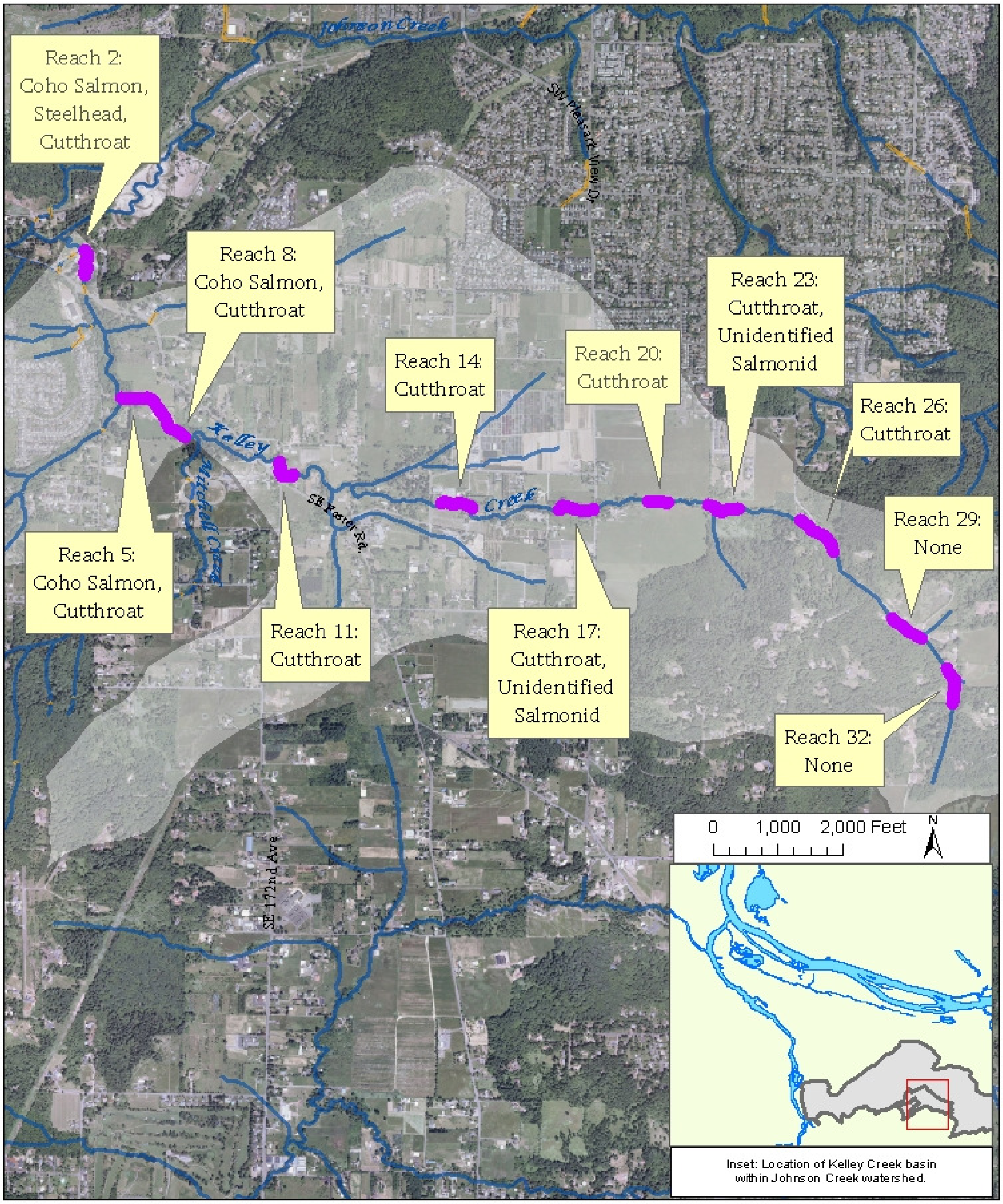


Appendix Figure A-7. Map showing an overview of Johnson Creek highlighting reaches 46-67 (purple ribbons) where multiple pass surveys were conducted during 2008-2009. Callouts provide reach number with common name of Pacific salmon and trout (Family Salmonidae) and lamprey (Family Petromyzontidae) observed on at least one occasion during one of the four seasons sampled. Species specific estimates are provided in Appendix Table 4.



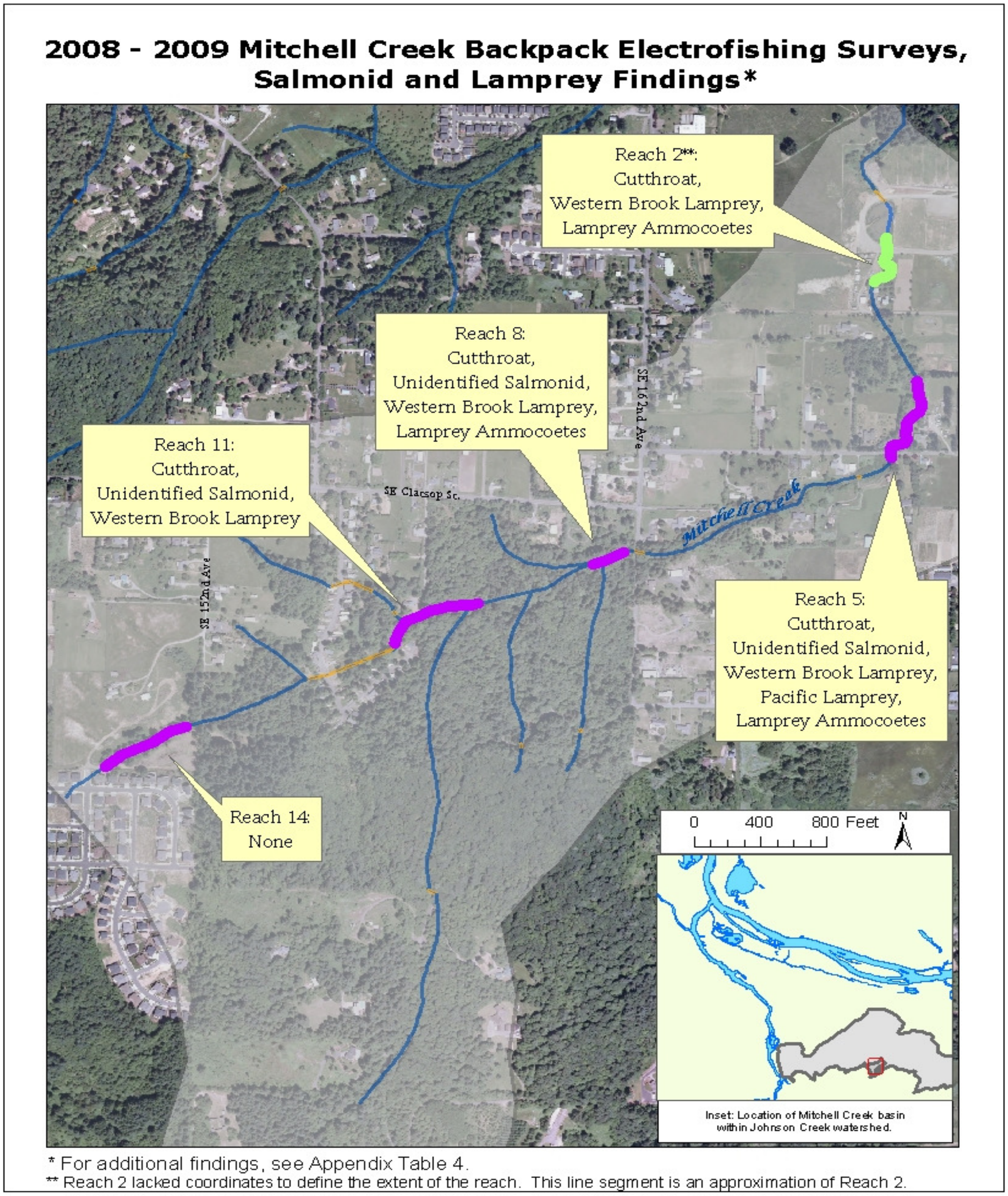
Appendix Figure A-8. Map showing an overview of Johnson Creek highlighting reaches 70-94 (purple ribbons) where multiple pass surveys were conducted during 2008-2009. Callouts provide reach number with common name of Pacific salmon and trout (Family Salmonidae) and lamprey (Family Petromyzontidae) observed on at least one occasion during one of the four seasons sampled. Species specific estimates are provided in Appendix Table 4.

2008 - 2009 Kelley Creek Backpack Electrofishing Surveys, Salmonid and Lamprey Findings*

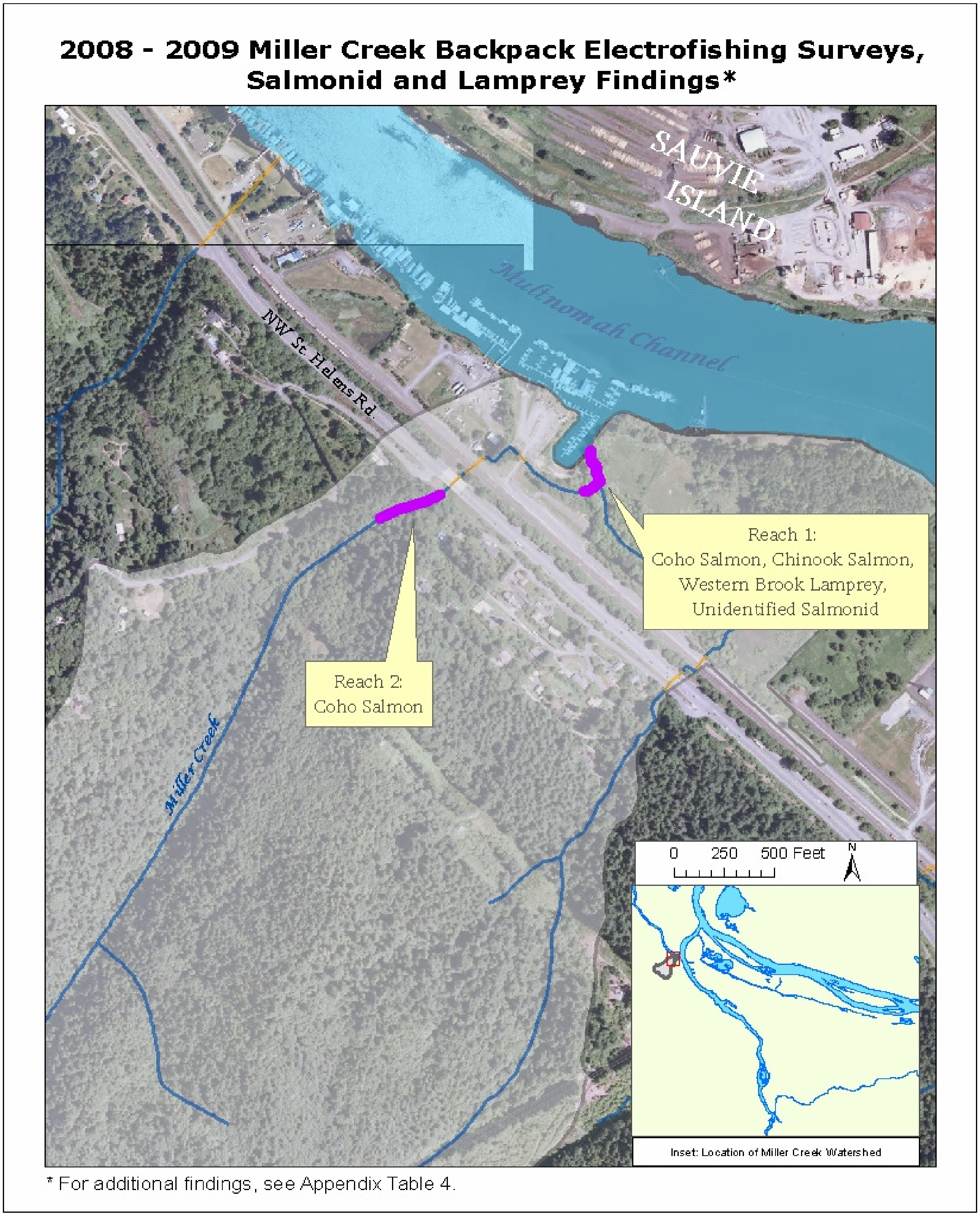


* For additional findings, see Appendix Table 4.

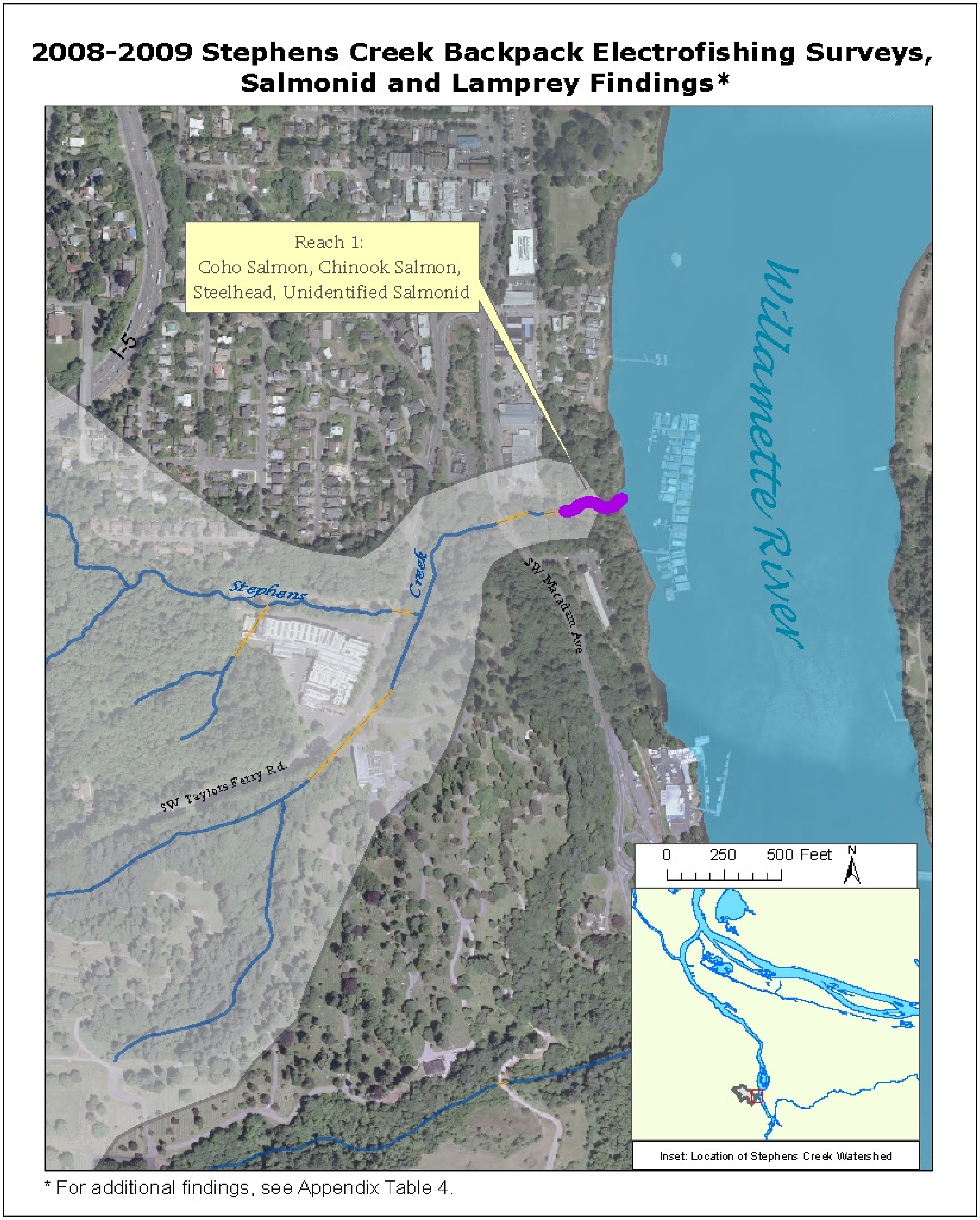
Appendix Figure A-9. Map showing an overview of Kelley Creek highlighting reaches 2-32 (purple ribbons) where multiple pass surveys were conducted during 2008-2009. Callouts provide reach number with common name of Pacific salmon and trout (Family Salmonidae) and lamprey (Family Petromyzontidae) observed on at least one occasion during one of the four seasons sampled. Species specific estimates are provided in Appendix Table 4.



Appendix Figure A-10. Map showing an overview of Mitchell Creek, a tributary of Johnson Creek, highlighting reaches 2-14 (purple ribbons) where multiple pass surveys were conducted during 2008-2009. Approximated reach boundaries (Chartreuse ribbon) in the absence of GPS measured coordinates. Callouts provide reach number with common name of Pacific salmon and trout (Family Salmonidae) and lamprey (Family Petromyzontidae) observed on at least one occasion during one of the four seasons sampled. Species specific estimates are provided in Appendix Table 4.



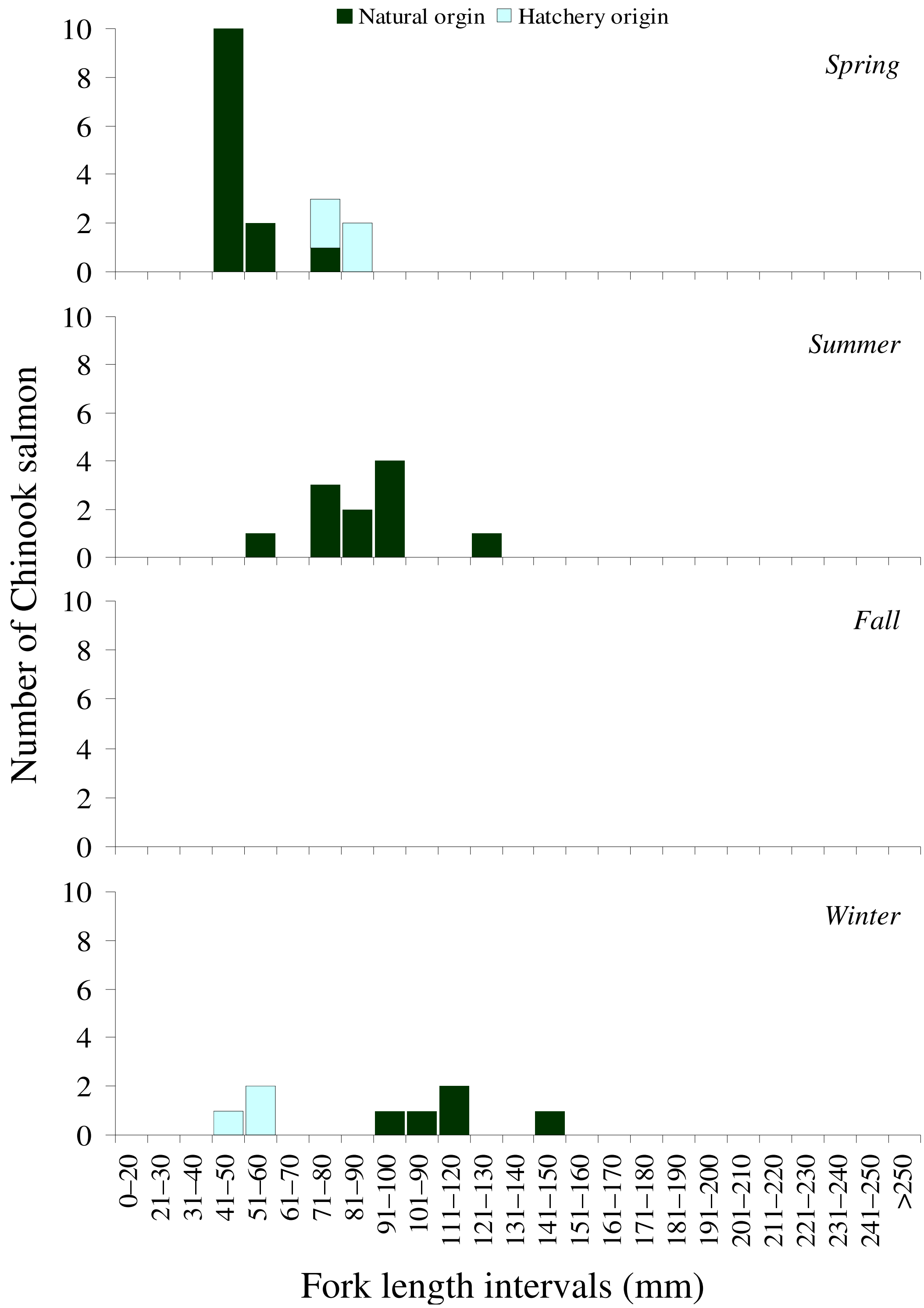
Appendix Figure A-11. Map showing an overview of Miller Creek highlighting reaches 1-2 (purple ribbons) where multiple pass surveys were conducted during 2008-2009. Callouts provide reach number with common name of Pacific salmon and trout (Family Salmonidae) and lamprey (Family Petromyzontidae) observed on at least one occasion during one of the four seasons sampled. Species specific estimates are provided in Appendix Table 4.



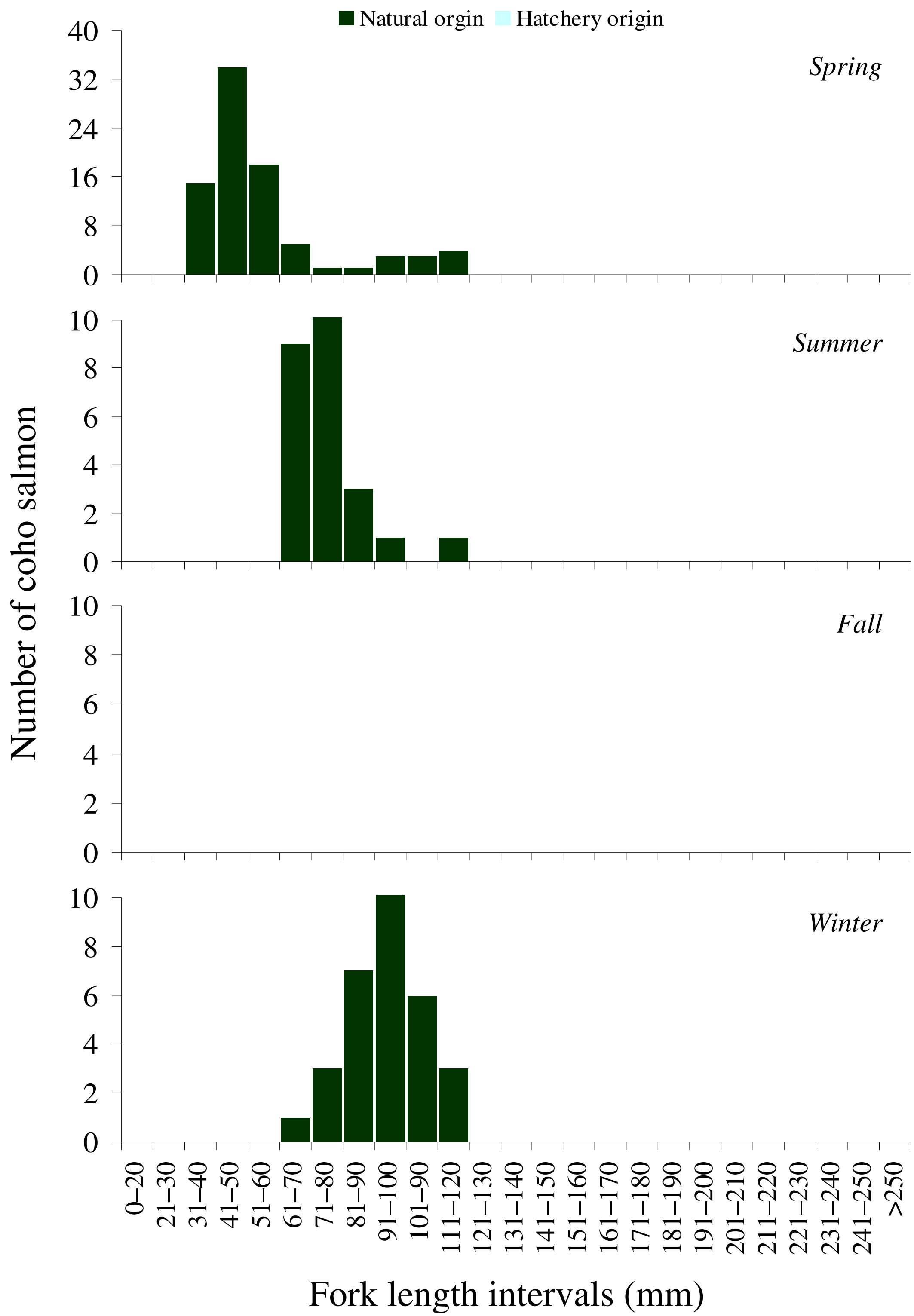
Appendix Figure A-12. Map showing an overview of Stephens Creek highlighting reach 1 (purple ribbon) where multiple pass surveys were conducted during 2008-2009. Callout provides reach number with common name of Pacific salmon and trout (Family Salmonidae) and lamprey (Family Petromyzontidae) observed on at least one occasion during one of the four seasons sampled. Species specific estimates are provided in Appendix Table 4.

APPENDIX FIGURES B

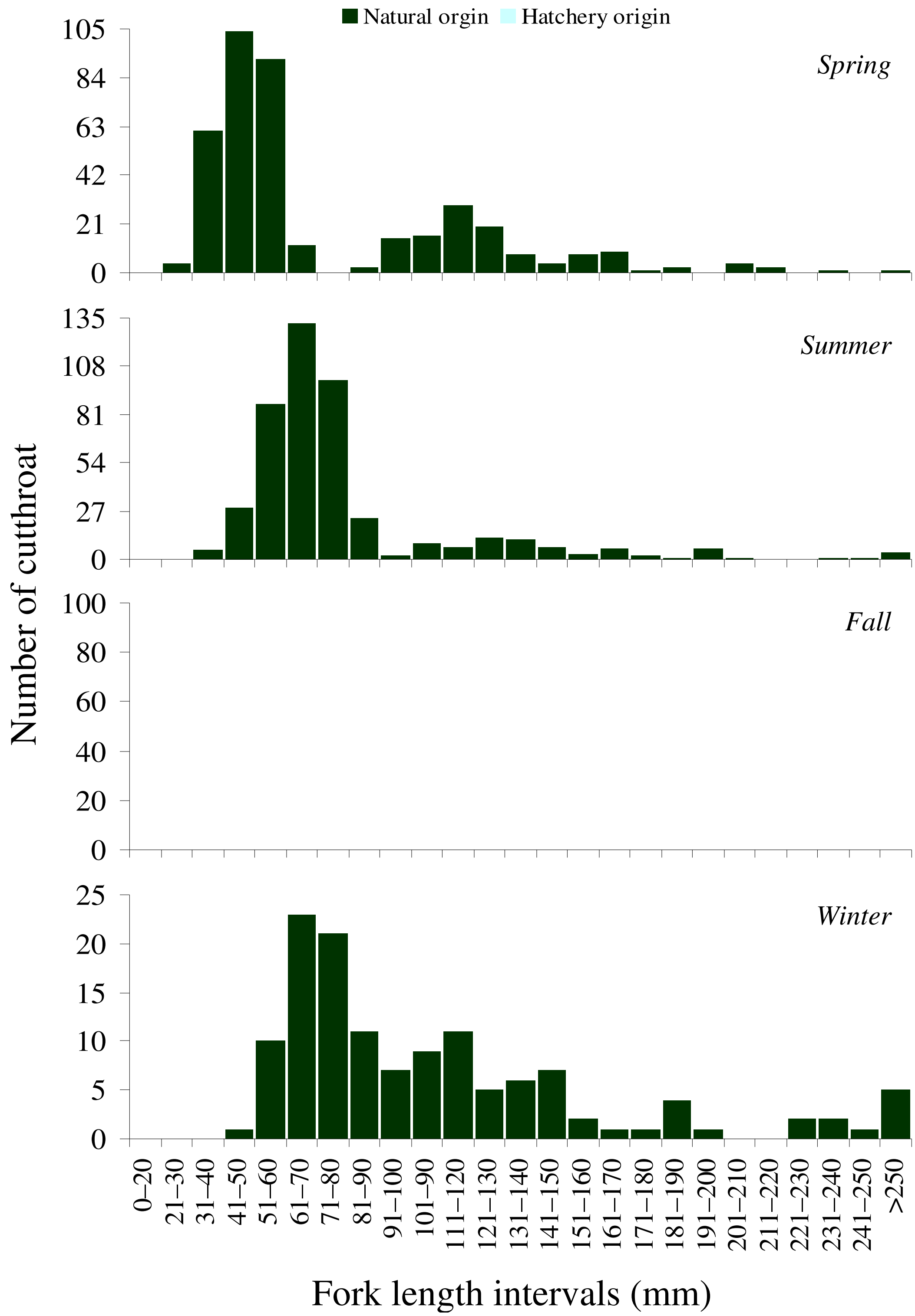
Pacific salmon and trout length histograms



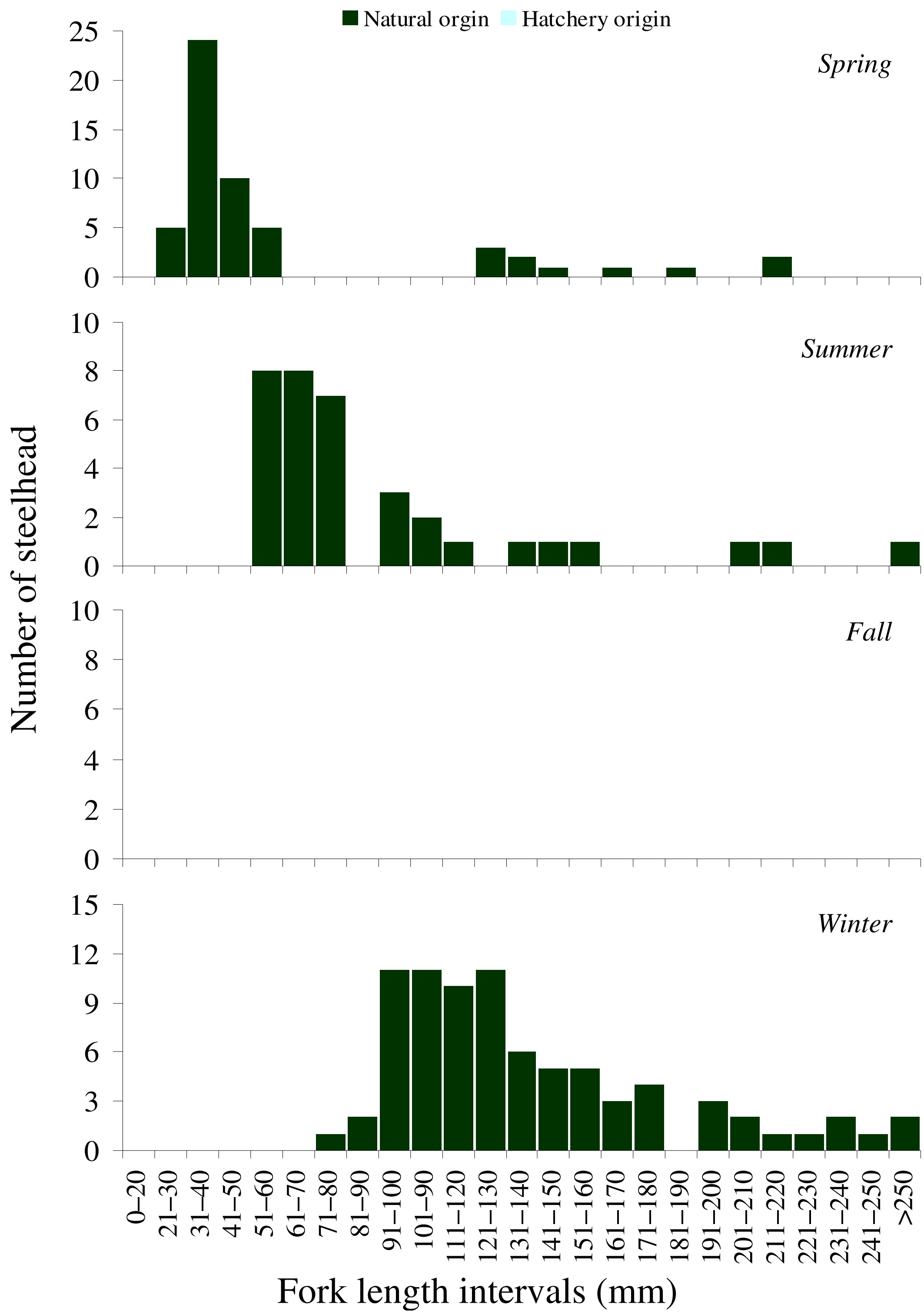
Appendix Figure B-1. Length frequency histogram for Chinook salmon captured each season. Collections were combined using all fish measured during a season in Johnson Creek Watershed, and Miller and Stephens creeks. No fish were measured during fall.



Appendix Figure B-2. Length frequency histograms for coho salmon captured each season. Collections were combined using all fish measured during a season in Johnson Creek Watershed, Miller, and Stephens creeks. No fish were measured during fall.



Appendix Figure B-3. Length frequency histograms for cutthroat captured each season. Collections were combined using all fish measured during a season in Fanno Creek and Johnson Creek Watershed. No fish were measured during fall.



Appendix Figure B-4. Length frequency histograms for steelhead captured each season. Collections were combined using all fish measured during a season in Johnson Creek Watershed and Stephens Creek. No fish were measured during fall.