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Upper Chehalis Instream Fish Study 2015

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Executive Summary

Although knowledge of a fish's spatial distribution is a key element both for evaluating impacts to it and developing a restoration plan, little is known about the distributions of non-salmonid fishes in the Chehalis River Basin. This study is designed to address that data gap and more fully inform the analyses of a potential flood control dam in the Upper Chehalis River. Primary objectives for the study were to identify and describe the fish assemblage (not abundance) within the proposed dam inundation footprint.

A total of 59 reaches were surveyed during July, August, and September of 2015 – 25 in the inundation footprint for the Upper Chehalis, 24 in the lower extent of several tributaries within the inundation footprint, and 10 located upstream and downstream of the inundation footprint. Characterization of fishes in the reaches surveyed used a combination of upstream and downstream snorkeling, electrofishing, seining, and dip netting.

Overall, 14 species of fishes were identified in the study area—one species of catostomids, two species of cottidae, four species of cyprinids, two species of petromyzontids, and five species of salmonids. The most widely-distributed species were torrent sculpin (93% of surveyed reaches), juvenile steelhead or rainbow trout (92% of reaches), coho salmon (83%), speckled (59%) and longnose dace (44%). Lamprey ammocoetes not identified to species occupied 49% of surveyed reaches, with Pacific lamprey ammocoetes identified in 41% of the reaches. In addition to torrent sculpin, reticulate sculpin (41%) were also detected, and their distribution was limited to the mainstem portion of the inundation footprint. Largescale sucker, redside shiner, and mountain whitefish were detected in the downstream portion of the inundation footprint, and northern pikeminnow were only detected in supplemental survey reaches downstream of the proposed dam site.

Salmonids were distributed throughout the inundation footprint. The majority of trout identified to in the mainstem reaches were rainbow trout, while cutthroat trout were positively identified in surveyed reaches within the tributary portion of the inundation footprint. Juvenile coho salmon were found throughout the inundation footprint, while juvenile Chinook salmon were detected in only two reaches of the downstream portion of the mainstem inundation footprint.

Non-salmonid species richness was highest in the downstream, mainstem portion of the inundation footprint. Detections in the tributary portions of the inundation footprint were limited to torrent sculpin, speckled dace, and, to a lesser extent, longnose dace. Distributions of the detected fishes are likely related to a variety of factors including habitat preferences, water temperature, physical and biological barriers, and migration timing.

Given their relatively limited migratory behavior, many of the native non-salmonids are present year-round. With respect to the dam, inundation, either permanent or during the winter months during flood-stage events, would impact the fish species present in the Upper Chehalis.

Introduction

Knowledge of a fish's spatial distribution is a fundamental component in developing a conceptual model for evaluating impacts to or developing a restoration plan for that species. However, little is known about the drainage-specific freshwater distributions of non-salmonids in North America. This is especially true for benthic species such as sculpin and lamprey ammocoetes (Quinn, 2005; Reid & Goodman, 2015; Wydoski & Whitney, 2003; Young, McKelvey, Pilgrim, & Schwartz, 2013). Recognizing this need, recent and ongoing research aims to further our understanding of sculpin (Young et al., 2013) and lamprey distributions (Jolley, Silver, Harris, Butts, & Cook-Tabor, 2016) in particular.

Species assemblages are largely driven by habitat diversity (St Pierre & Kovalenko, 2014; Tews et al., 2004); therefore, in addition to understanding fish distributions, it is also important to consider the habitat in which they reside. Reach-scale habitat-fish associations are another important component in evaluating impacts to or developing a restoration plan for a given species.

In the Upper Chehalis River of Washington State, a flood reduction dam is being proposed at approximately river kilometer (RKm) 183, just upstream of the town of Pe Ell. In order to understand what species could be affected or lost by inundation of their habitats, a more detailed description of fish distributions within the proposed dam inundation footprint (hereafter called the inundation footprint) was required.

For this study, the objectives were to survey instream habitat within the inundation footprint in July, August, and September of 2015 and describe the current instream fish assemblage and distribution (not abundance), including both non-salmonids and salmonids (Table 1).

Table 1. Select Native Freshwater Fish Previously Identified and Potentially Present in the Upper Chehalis River

Family	Species (Standard English Name)	Scientific Name
Catostomidae	Largescale sucker	*Catostomus macrocheilus*
	Salish sucker	*Catostomus catostomus*
Cottidae	Torrent sculpin	*Cottus rhotheus*
	Reticulate sculpin	*Cottus perplexus*
	Riffle sculpin	*Cottus gulosus*
	Prickly sculpin	*Cottus asper*
	Shorthead sculpin	*Cottus confusus*
Cyprinidae	Speckled dace	*Rhinichthys osculus*
	Longnose dace	*Rhinichthys cataractae*
	Peamouth	*Mylocheilus caurinus*
	Northern pikeminnow	*Ptychocheilus oregonensis*
	Redside shiner	*Richardsonius balteatus*
Petromyzontidae	Pacific lamprey	*Entosphenus tridentatus*
	River lamprey	*Lampetra ayresii*
	Western brook lamprey	*Lampetra richardsonii*
Salmonidae	Coho salmon	*Oncorhynchus kisutch*
	Chinook salmon	*Oncorhynchus tshawytscha*
	Steelhead trout	*Oncorhynchus mykiss*
	Rainbow trout	*Oncorhynchus mykiss*
	Cutthroat trout	*Oncorhynchus clarkii*
	Mountain whitefish	*Prosopium williamsoni*

Methods

Study area

We surveyed 25 reaches in the Upper Chehalis River from upstream of the Thrash Creek confluence to the proposed dam site (approximately 16 km) as well as 24 reaches in the lower extent of multiple tributaries to the Chehalis River (Crim Creek, Lester Creek, Hull Creek, Browns Creek, Big Creek, Roger Creek, Alder Creek, and Thrash Creek; approximately 16 km in total) that could be inundated from a proposed dam. There are two types of dams being considered: a flood reduction, flow augmentation (FRFA) dam with a permanent reservoir and a flood reduction only (FRO) dam with a reservoir forming upstream during flood-stage events occurring approximately every 7 years. Figure 1 shows the proposed inundation footprints from the FRFA and FRO dams being considered. In addition, 10 supplemental reaches located upstream and downstream of the inundation footprint were also surveyed to capture fish distributions adjacent to the inundation footprint. Active logging in the inundation footprint near Alder Creek prohibited surveying in the stream; therefore, no fish distribution or habitat data were collected there. Reaches were defined by measuring approximately 200 m lengths along the thalweg. In the mainstem portion of the inundation footprint, reaches aligned with previously-defined 2014 Chehalis Riverscape reaches. In the tributaries, reaches started at each tributary's confluence with the mainstem Chehalis. To cover the entire inundated footprint, every third reach of the mainstem and tributaries was surveyed.

Sampling

HABITAT DATA COLLECTION

As sampling conducted in the mainstem inundation area aligned with previously-defined 2014 Chehalis Riverscape reaches, habitat information collected during the 2014 Chehalis Riverscape Survey was used for this study. Habitat sampling conducted in the inundated portion of the tributaries followed the same method as the 2014 Chehalis Riverscape Survey and included channel type (Beechie, Liermann, Pollock, Baker, & Davies, 2006; Montgomery & Buffington, 1997), reach length, wetted width, bankfull width, number of pools, maximum pool depth, pool forming structure, thalweg depth, number of water inflows, dominant substrate, subdominant substrate, and large woody debris (LWD) counts in each surveyed reach. Table 2 was modified from Zimmerman and Winkowski (2013) and defines each habitat metric measured.

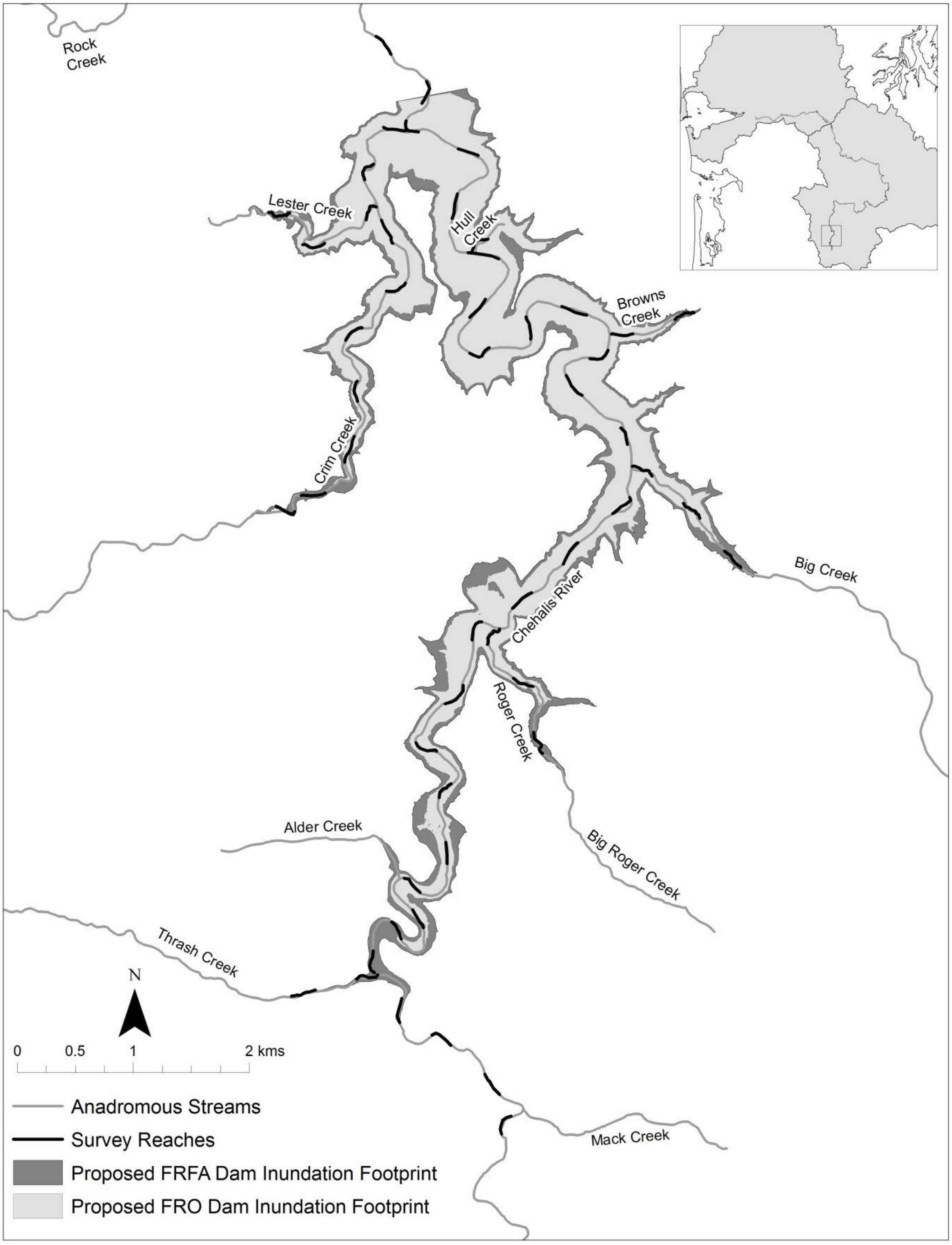

Figure 1. Study Area for the Upper Chehalis Instream Fish Study

Table 2. Habitat metrics definitions and sources

Name	Unit	Definition	Source
Reach Length	Meters	Length between start and end way points (~200 m)	
Wetted Width	Meters	Average: Begin, 50%, End	
Bankfull Width	Meters	Average: Begin, 50%, End	
Pool Quantity	Count	Number of depressions at summer low flow	
Maximum depth	Meters	Maximum depth in reach	
Pool Forming Structure	Category	Wood, Boulder, Bedrock, Bridge, Sinuosity, Other	
Thalweg depth	Meters	Average: 25%, 75%	
Channel Type	Category	-Montgomery/Buffington classification: Cascade, Step-Pool, Plane Bed , Forced Pool-Riffle, Pool-Riffle, Dune ripple, Canyon	Montgomery and Buffington (1997)
		-Beechie classification: Straight, Meandering, Island-Braided, Braided, N/A (<20 m BFW)	Beechie et al. (2006)
Inflow	Count	How many tributary junctions, seep inputs in this reach	
Dominant Substrate	Category	Silt, Sand, Gravel, Cobble, Boulder, Bedrock	Cummins (1962)
Subdominant Substrate	Category	Silt, Sand, Gravel, Cobble, Boulder, Bedrock	Cummins (1962)
LWD	Count	The number of logs greater than 30cm in diameter and greater than 2m in length occurring in (or suspended ≤ 0.5 meter directly above) the wetted area of the sampling unit.	Modified from Garwood and Ricker (2013), CDFW

FISH DATA COLLECTION

In each reach, sampling included a combination of upstream and downstream snorkeling, electrofishing, and seining depending on the type of habitat unit (e.g., pool, riffle, glide, etc.). The use of multiple sampling techniques aimed to capture habitat-specialized pelagic and benthic fish species. In general, riffles were electrofished; pools were snorkeled, seined, and netted using dip nets along the margins; and backwaters were electrofished and netted using dip nets (Table 3).

Table 3. Methods used for sampling fish species in the different types of habitat units

Type of habitat unit	Snorkel	Backpack electrofisher	Stick seine	Dip net
Pool	X	X	X	
Riffle		X		
Glide	X	X	X	
Margins		X		X
Backwater		X		X

When conditions in a habitat unit allowed for snorkeling, it was conducted first and fish were identified to species whenever possible. Snorkeling also identified locations of pelagic fish, which improved collection efforts. Following this, stick seines, a backpack electrofisher, and dip nets were used to collect fish. Collected fish were identified to species whenever possible. Those not identified to species were photographed for further investigation. All electrofishing was done with a Smith-Root LR-20B backpack electrofisher with frequency set to 15 Hz at 20% duty cycle and voltage set depending on local conditions to ensure sufficient current (range of 250–400 V).

In order to identify the effort required to effectively sample fish in a reach, initial sampling of three reaches included five consecutive electrofishing passes of a riffle within a surveyed reach. The three reaches were selected at the uppermost, approximate midpoint of, and lowermost mainstem reaches included in the inundation footprint to provide spatial representation. Species collected during this effort were separated by pass and identified to species. With all three five-pass efforts, the highest species richness was obtained in the first pass; therefore, one pass was used as a minimum sampling effort in all reaches surveyed for fish in our study.

In addition, given the difficulty in identifying sculpin to species and the recent work on scuplin species identification using genetic analysis, fin clips were taken for some sculpins following tissue sampling protocol described by Young (2013) and shipped to his laboratory for genetic analyses. Whenever possible, ammocoetes greater than 70 mm were identified to species using Goodman et al. (2009) and Reid and Goodman (Lampreys of the Olympic Peninsula Field ID Key 2009).

Results

Habitat data

Overall, the habitat within the inundation footprint was generally similar, though some differences were found between the mainstem and tributary portions. Compared to the mainstem, the tributaries had higher large woody debris (LWD) counts (Figure 2). The vast majority of channel types in the Upper Chehalis are pool-riffle; however, the proportion of cascade, step-pool, and plane bed were higher in the tributaries than in the mainstem (Figure 3).

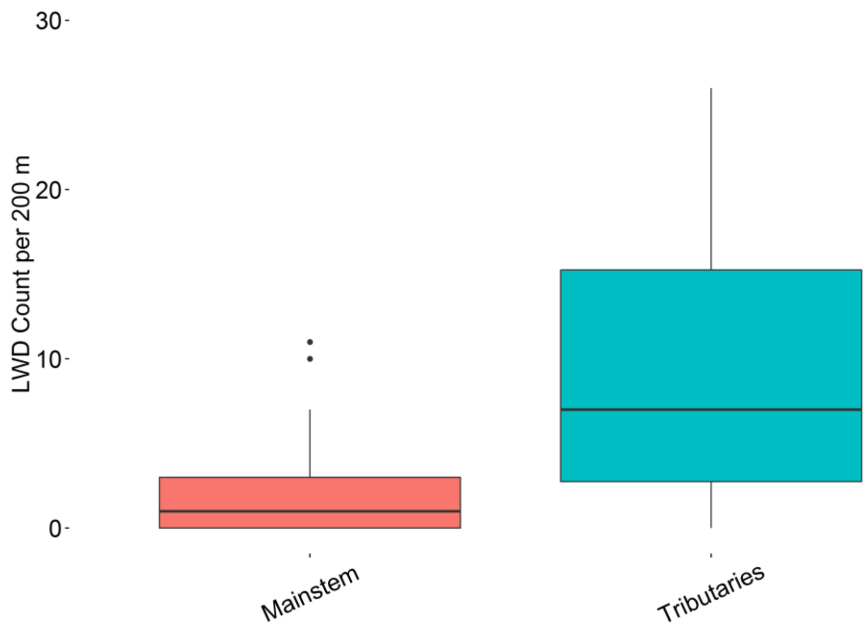

Figure 2. Large woody debris counts per 200 m reach within the mainstem and tributary portions of the proposed dam inundation footprint

Figure 3. Proportions of channel types present in the mainstem and tributary portions of the proposed dam inundation footprint

Fish data

Overall, 14 species of fish were identified in the Chehalis River study area (Table 4) and included one species of catostomids, two species of cottidae, four species of cyprinids, two species of petromyzontids, and five species of salmonids. The most widely distributed species were torrent sculpin and juvenile steelhead or rainbow trout, which occupied 93% and 92% surveyed reaches, respectively. Following this, coho salmon occupied 83% of surveyed reaches, speckled and longnose dace occupied 63% and 44% of surveyed reaches, respectively, and ammocoetes not identified to species (i.e., <70 mm in length) occupied 49% of surveyed reaches. Pacific lamprey ammocoetes were identified in 41% of surveyed reaches.

Table 4. Number of surveyed reaches in which fish species, including those identified to family but not identified to species, were detected

Species (Standard English Name)	Number of Surveyed Reaches (Percent of Total)
Torrent sculpin	55 (93)
Rainbow trout/steelhead	54 (92)
Coho salmon	49 (83)
Speckled dace	37 (63)
Unknown lamprey sp.	29 (49)
Longnose dace	26 (44)
Pacific lamprey	24 (41)
Reticulate sculpin	24 (41)
Unknown sculpin sp.	17 (29)
Large trout	16 (27)
Redside shiner	10 (17)
Cutthroat trout	9 (15)
Largescale sucker	9 (15)
Mountain whitefish	4 (7)
Northern pikeminnow	4 (7)
Western brook lamprey	4 (7)
Chinook salmon	3 (5)

Species distributions within the inundation footprint were found to vary by taxonomic group as well as individual species. Non-salmonid and salmonid fish distributions in the inundation footprint are shown in Figures 4 and 5, respectively. Torrent sculpin and rainbow trout were distributed throughout the inundation footprint except in the uppermost surveyed reaches of Hull Creek, Roger Creek, and Browns Creek. Except for three mainstem reaches, coho salmon were also distributed throughout the inundation footprint though they were not detected in the uppermost surveyed reaches Hull Creek, Roger Creek, and Browns Creek.

Longnose and speckled dace were both found downstream of Fisk Falls (RKm 193; just upstream of the confluence of Roger Creek) in the mainstem portion of the inundation footprint and in the lower 2 km portion Crim Creek. Speckled dace, however, continued to be detected upstream of Fisk Falls in many surveyed reached of the mainstem, including those upstream of the inundation footprint as well as in the downstream-most reaches of Lester Creek and Big Creek. Neither dace species was detected in Browns Creek, Roger Creek, or Thrash Creek.

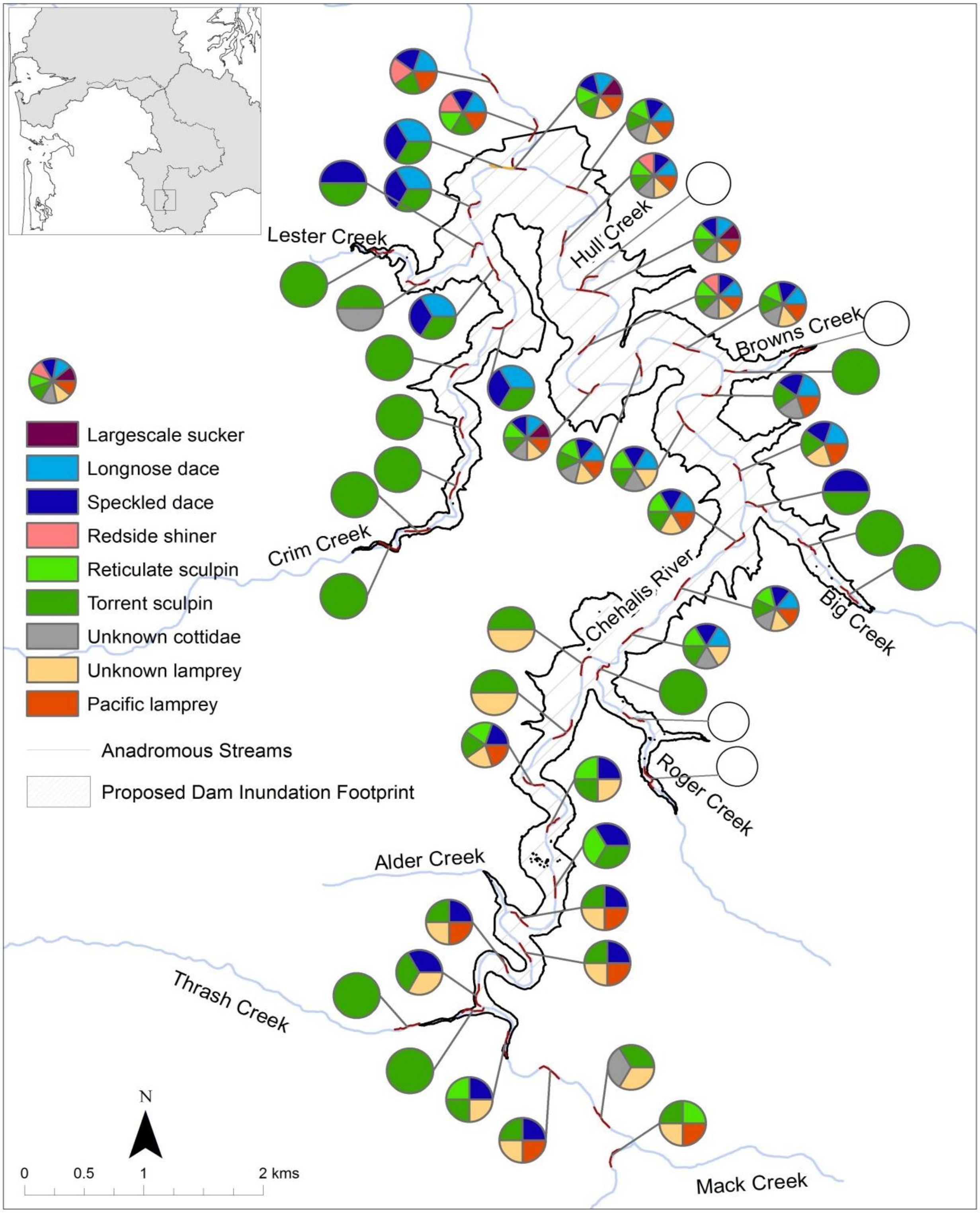

Figure 4. Detections of non-salmonids in the Upper Chehalis

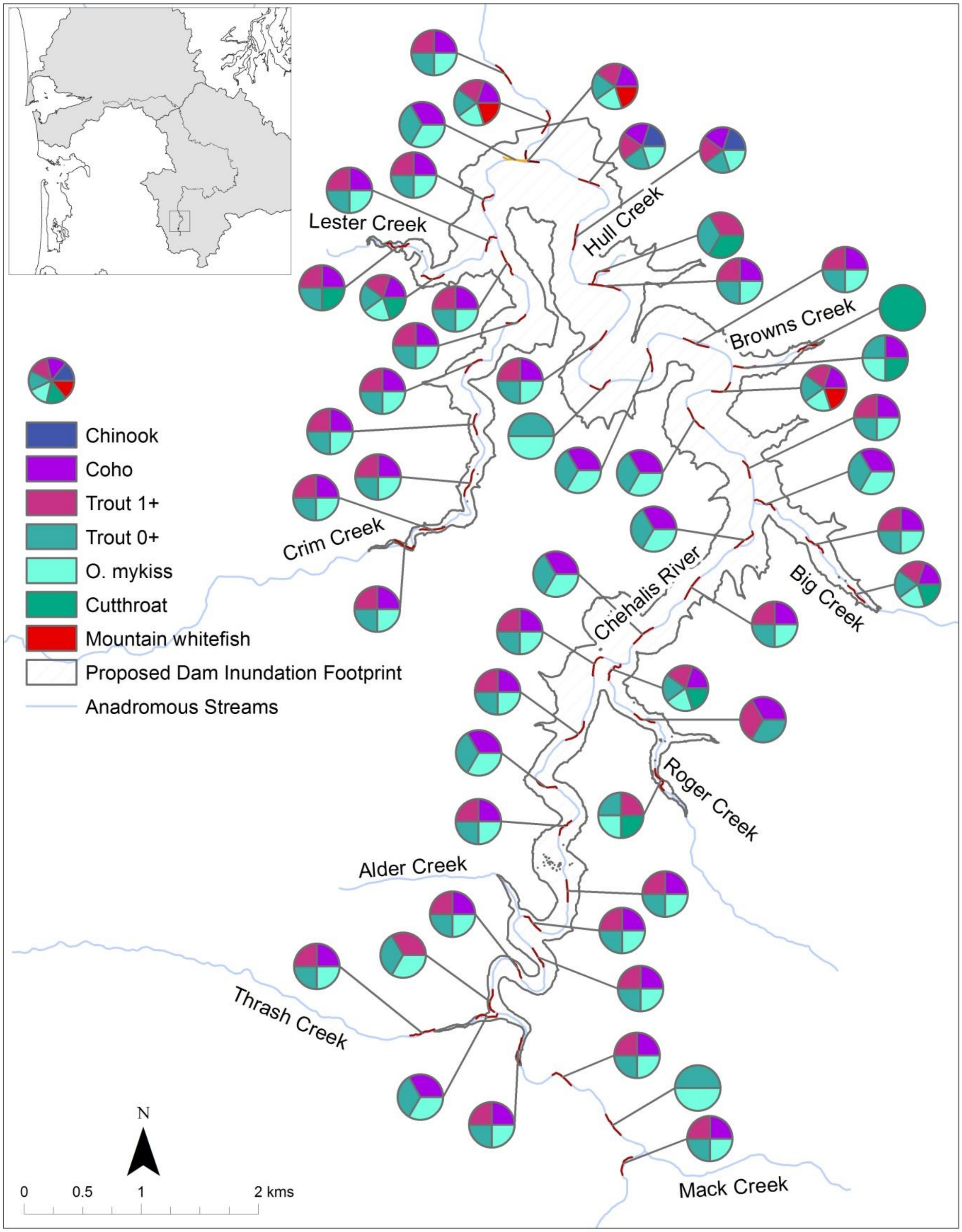

Figure 5. Detections of salmonids in the Upper Chehalis

Pacific lamprey ammocoetes and ammocoetes collected but not identified to species were found throughout the mainstem portion of the inundation footprint, but no ammocoetes were detected in the tributary reaches. Ammocoetes require fine substrate for burrowing and prefer lower-gradient habitat during their rearing phase (Reid & Goodman, 2015; Stone & Barndt, 2005). As the tributary portions of the inundation footprint are generally higher gradient with less depositional material, they provide less available rearing habitat for ammocoetes. Notably, adult lamprey are known to spawn in Thrash Creek (WDFW unpublished data), which suggests larval drift is occurring to some degree. Western brook lamprey ammocoetes were only detected in supplemental surveyed reaches downstream of the proposed dam site; however, ammocoetes less than 70 mm were not identified to species.

Genetic analyses of collected sculpin fin clips showed that in addition to torrent sculpin, one other sculpin species was detected in the inundation footprint, but to a lesser extent (in 41% of surveyed reaches). All detections were limited to the mainstem portion of the inundation footprint as well as downstream and upstream of the mainstem portion of the inundation footprint. Sculpin were also observed throughout the inundation footprint while snorkeling, but for the most part they were not identified to species.

Largescale sucker, redside shiner, and mountain whitefish were not detected above RKm 187. In addition, northern pikeminnow were only detected in supplemental surveyed reaches downstream of the proposed dam site.

Cutthroat trout were only positively identified in surveyed reaches within five tributaries in the inundation footprint: Lester Creek, Hull Creek, Browns Creek, Big Creek, and Roger Creek. There were several large trout, age 0+ trout, and age 1+ trout identified while snorkeling that were not identified to species (i.e., rainbow trout/steelhead or cutthroat trout). However, all trout identified to species during electrofishing sampling in the mainstem surveyed reaches were rainbow/steelhead trout. Juvenile Chinook salmon were only detected in two reaches of the downstream portion of the mainstem inundation footprint; however, our surveys occurred outside of a timeframe in which we would expect to find juvenile Chinook salmon.

The proportion of non-salmonid species detections was significantly higher in the mainstem portion of the inundation footprint compared to the tributaries ($p<<0.05$, $n=58$, $F=66.9$). Detections were mostly limited to torrent sculpin and, to a lesser extent, speckled dace in the tributary portions of the inundation footprint. On the other hand, the proportions of salmonid species in the inundated portion of the mainstem compared to the tributaries was the same ($p=0.75$, $n=58$, $F=0.10$). Within the mainstem portion of the inundation footprint, there were higher proportions of species detected at the downstream half compared to upstream half ($p<0.05$, $n=34$, $F=12.8$).

Discussion

Our study reflects similar habitat and species distribution patterns found in other western Oregon and Washington streams (Roni, 2002). Within the inundation footprint, habitat differences between the mainstem and tributary portions, including channel type and LWD counts, likely reflect the higher gradients present in the tributaries.

In terms of species assemblages, non-salmonids were concentrated in the mainstem portion of the inundation footprint, with the exception of torrent sculpin. Torrent sculpin's widespread distribution, both in the mainstem and tributary portion of the inundation footprint, could be attributed to their preference for or tolerance of higher-gradient habitats present in the tributary portion of the inundation footprint. Indeed, Roni (2002) found that age-0 torrent sculpin density was higher in riffles than pools; however, densities were similar for age-1 torrent sculpin. This distribution pattern could also be related to their pre-spawning, upstream migratory behavior (Thomas, 1973).

Salmonids were widely distributed throughout the inundation footprint during the summer low flow sampling timeframe. The exceptions to this were mountain whitefish, which were found in only three surveyed reaches, and cutthroat trout, which were found only in the upper portions of several tributaries. In other studies, mountain whitefish were also found lower in watersheds compared to other salmonids (Maret, Robinson, & Minshall, 1997; Platts, 1979). During summer low flows, it is possible their preference for deep pools is not well supported in the upper watershed. Notably, given their spawning migratory behavior (Davies & Thompson, 1976; Pettit & Wallace, 1975), it is likely that they would display a different distribution in the winter months. For cutthroat trout, most observations occurred upstream of presumed anadromous barriers. Their upstream distribution is similar to other resident cutthroat trout populations in the Pacific Northwest (Montgomery, Beamer, Pess, & Quinn, 1999).

Along with habitat availability and diversity, water temperature also contributes to species distribution (Ebersole, Liss, & Frissell, 2003). The tributary portion of the inundation footprint is relatively colder than the mainstem (WDFW unpublished data), which could also be contributing to differences in some salmonid and non-salmonid species distributions. In addition, the distribution of species within the inundation footprint was likely impacted by the 100- to 500-year flood event that occurred in December 2007. Based on redd surveys in the Upper Chehalis, we know that coho recruitment was greatly lowered and the impact continues to be seen on subsequent brood years (WDFW unpublished data). It is also likely that resident fish distributions were impacted and may not have returned to a pre-2007 state.

It is well documented that species distribution changes seasonally and many species observed in this study undergo seasonal spawning and feeding migrations (on the order of hundreds or thousands of kilometers), including the salmonids (Davies & Thompson, 1976; Quinn, 2005) and largescale sucker (Baxter, 2002). Other non-salmonids migrate much shorter distances (on the order of hundreds of meters or less), including torrent sculpin (Thomas, 1973), reticulate sculpin (Krohn, 1968), and lamprey ammocoetes (Liedtke, Weiland, & Mesa, 2015; Quintella, Andrade, Espanhol, & Almeida, 2005). Our study describes the distributions of detected fishes within the inundation footprint during the summer low flow months, providing a snapshot of fish assemblages in this relatively small area. However, given the relatively short migratory behavior of many native non-salmonids, they are likely to be present year-round. With respect to the dam, inundation, either permanent or during the winter months during flood-stage events, would impact the fish species present in the Upper Chehalis. If resident fish are able to withstand inundation, the long-term effects of permanent or recurring inundation or subsequent changes to their habitat due to inundation are unknown, although impoundments are known to greatly impact species assemblages in other systems (Bonner & Wilde, 2000; Johnson, Olden, & Vander Zanden, 2008; Mims & Olden, 2013; Spence & Hynes, 1971). While many of the species we found are present elsewhere in the Chehalis River and its tributaries, a loss or depression of these fish in up to 16 RKm of a subbasin may impact geographically and/or genetically isolated groups in particular.

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