2016 Chehalis ASRP Instream Amphibian Survey Report

3rd Progress Report for Post-Feasibility Effort

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EXECUTIVE SUMMARY

Introduction

Western toads (*Anaxyrus boreas*) are one of the nine non-fish species targeted in the Chehalis Basin Aquatic Species Restoration Plan (ASRP). The 2014 Aquatic Species Enhancement Plan Data Gaps Report specified an incomplete understanding of the processes affecting the species' and their distribution as a limitation for modeling impacts related to flood retention strategies. WDFW surveys done prior to the Data Report recorded Western toads breeding within the mainstem Chehalis in the vicinity of the proposed dam, but the limited spatial extent of the surveys made it impossible to draw conclusions about the species' distribution basin-wide. The instream surveys presented here are focused on closing that data gap, with the work being incorporated into restoration modeling efforts as well as the selection of restoration strategies and locations.

To date (2014-2016), a total of 142.2 river miles (RM) of the Chehalis River and its major tributaries have been surveyed. The 2016 effort reinforced patterns of Western toad distribution that began to emerge in 2014:

- Western toad breeding in the Chehalis mainstem is almost entirely limited to the upper watershed (RM 82 and upstream) and a few larger upstream tributaries.
- Breeding is more extensive in the footprint of the proposed dam and reservoir than it is either up- or downstream of the site. This finding may be related to the quality of breeding and upland habitat and reflect the species preference for upland timbered landscapes over agricultural landscapes.
- Shading associated with increasing canopy closure appears to be a limiting factor for the extent of breeding activity in the Upper Chehalis. While there are likely several factors associated with this, a portion of the limitation is associated with the species breeding preference for warmer, open waters.
- The downstream extent of species in the Chehalis mainstem appears to be linked to increased turbidity and depth, and an associated reduction in light penetration and primary production.
- While these toads do not appear to use off-channel floodplain habitats for breeding, they are used by a few post metamorphic life stages.

Implications

While additional research is needed, finding to date support that the construction of either a Flood Retention Only (FRO) or a Flood Retention/Flow Augmentation (FR/FA) dam will eliminate instream breeding habitat in the footprint of the structures and reservoir. Due to the limited distribution of suitable breeding habitat outside this area, either configuration of

dam will result in the loss of a significant proportion of the species' populations in the Basin's lowlands. Toads are known to use permanent reservoirs for breeding, but the magnitude and timing of water level fluctuations associated with both the FRO and FRFA configurations provide no certainty that a breeding population will successfully reestablish.

The FRFA alternative will also reduce or eliminate suitable breeding habitat for some distance downstream of the dam due to cooler water outflows and seasonally atypical flow regimes (higher).

Methods

Western toad surveys were conducted by 2 to 5 surveyors, who slowly walked and/or kayaked both margins of selected stream reaches. Surveyors stopped to record all in-channel locations where toad eggs, aggregates of tadpoles or metamorphosing animals were found. Additional information collected at each location included the number of toad life stages; pool data (location, river bank, depth, width, substrate, water velocity, description of connection to the main body of the river, canopy cover); photographs of the site; other amphibians, fishes, aquatic invertebrates and incidental wildlife present.

A parallel set of data for a randomly selected adjacent pool was also recorded for use in modeling Western toad breeding and rearing habitat using the Physical Habitat Simulation System (PHABSIM).

Next Steps

The 2017 field season will represent the completion year for this study and a concentrated effort will be made to:

- Identify the upper limits of instream breeding for Western toads in the Chehalis mainstem tributaries.
- Sample the remaining spatial gaps in the downstream mainstem to verify the lack of Western toad breeding.
- Randomize sampling above, within, and below the dam and reservoir footprint to verify the greater frequency of Western toad breeding.
- Determine the basis of the downstream limit of Western toads in the mainstem.

Additional efforts will include completion of Occupancy Modeling and Final Report (December 2017), incorporation of the data into an updated PHABSIM model to evaluate potential changes in toad habitat as a result of flood control alternatives, and informing and prioritizing g restoration efforts in the Chehalis floodplain

REPORT

Introduction

In the course of sampling during the stream-associated amphibians (i.e., Dunn's and Van Dyke's salamanders) near the Panesko Bridge on 27 May 2014, we found Western toad (*Anaxyrus boreas*) egg masses in a side pool of the Chehalis River mainstem. That find led us to initiate instream channel-margin surveys in 2014 that ultimately covered 25.0 river miles (RM) 40.5 river kilometers (RKm) of the Chehalis mainstem and its tributaries.

This report summarizes the results of the instream Western toad surveys though our 2016 effort. This progress report augments information from the surveys completed in 2014 with data collected in 2015 and 2016.

Site Selection

In 2016, we had three survey targets: 1) A subset of the proposed reservoir footprint, which had been completely sampled in 2014 - our target was to survey about one third (~3 miles) of mainstem through the proposed reservoir footprint, divided into reaches approximately 500 m long and separated by 1000-m intervening reaches; 2) The Chehalis mainstem from the proposed dam site to Highway 101 bridge in Aberdeen - we sampled 1-3 mile reaches within each of the 10 river segments (Figure 1 and 2); 3) We expanded surveys of tributaries not previously surveyed (up to 5 miles upstream from their confluence with the Chehalis).

In 2014, surveys had encompassed the complete reservoir footprint from the East and West Fork Chehalis River confluence to the proposed dam site, and those pieces of major tributaries with enough habitat within the proposed reservoir footprint to indicate that they might be occupied (i.e., Big, Crim, Lester and Thrash Creeks). During the Western toad breeding season, we also continued surveying downstream of the dam site as time allowed.

In 2015, surveys were more limited because of other important survey priorities. As a result, we subsampled three Chehalis mainstem river reaches (Figure 2) and three major tributaries; Newaukum, Skookumchuck and Satsop Rivers.

Sampling

Western toad surveys were conducted by 2-5 surveyors, who slowly walked and/or kayaked both margins of stream reaches and stopped to record all in-channel locations where Western toads had bred (eggs) or in which evidence of recent breeding (i.e., aggregated tadpoles or metamorphosing [transforming] animals) was found. Where we found evidence of Western toad breeding, we estimated the number of toad life stages, recorded pool data (location, river bank, depth, width, substrate, water velocity, description of connection to the main body of the river [if any], canopy cover and species, and took photographs) and a parallel set of data for a randomly selected adjacent pool not used for breeding were also recorded. We do not report the latter data here, but they will be used to assist modeling Western toad breeding and rearing habitat in support of PHABSIM habitat modeling. We also collected data on aquatic vertebrate species (amphibian and fishes) and predatory invertebrates (crayfish, giant water bugs, diving beetles, back swimmers, water scorpions) associated with Western

toad breeding pool habitat. Incidental wildlife were recorded along the entire survey reach both in and out of Western toad breeding sites.

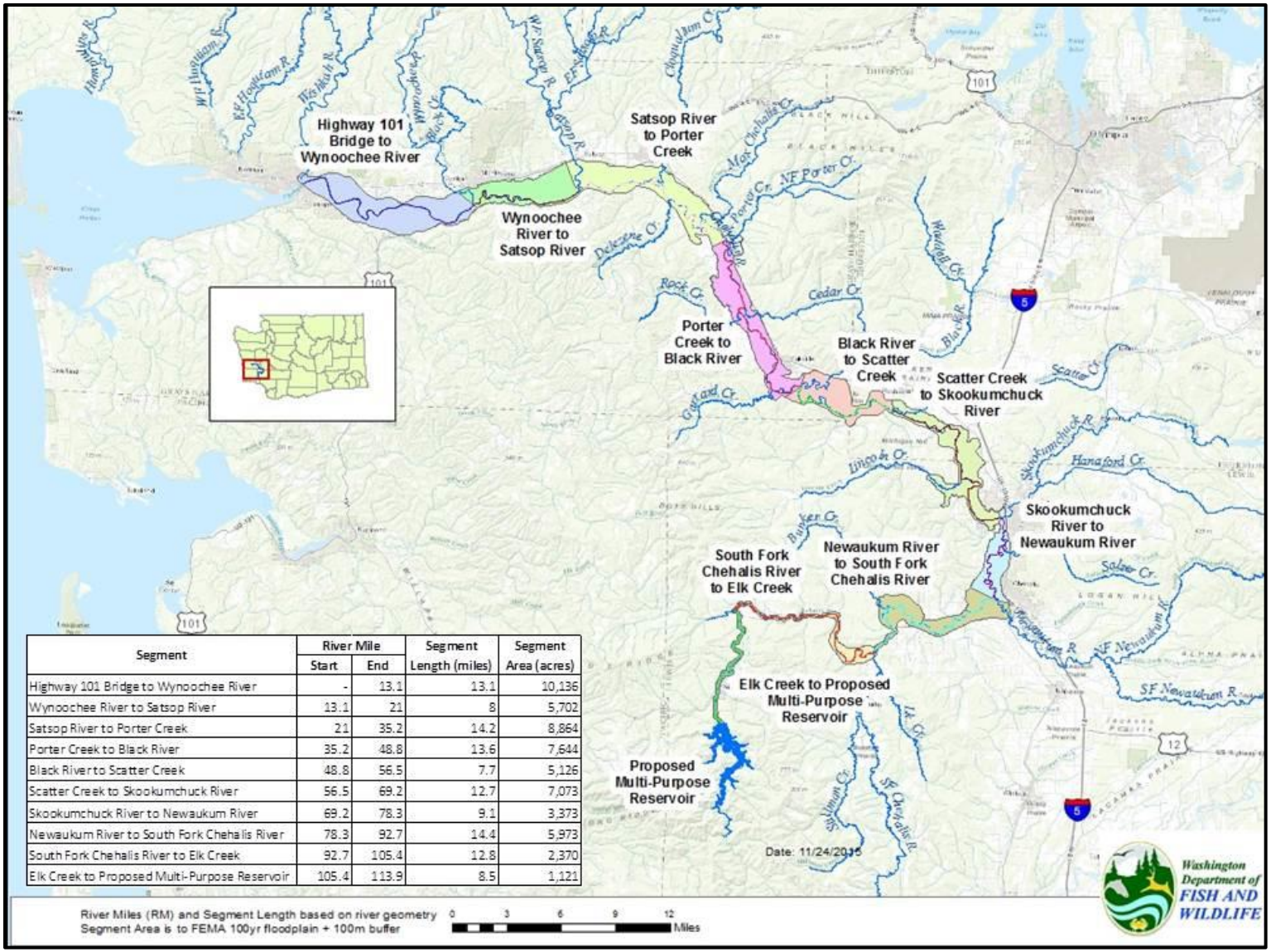
In 2016, we surveyed over 15 days within the interval from 9 May to 15 June. In 2014, we surveyed over 17 days over the two-month period 28 May-28 July. In 2015, our surveys were limited to six days in the interval 1 to 28 July.

Results

In 2016, we surveyed 83.0 RM (133.6 RKm) of the mainstem and its tributaries (Figure 2), including 3.2 RM (5.1 RKm) within the proposed reservoir inundation footprint, and 47.6 RM (76.5 RKm) downstream of proposed dam (Tables 1 and 2). We also surveyed tributaries upstream of the proposed reservoir footprint (Table 2), including 3.5 RM (5.6 RKm) of the East Fork of the Chehalis, 3.0 RM (4.8 RKm) of the West Fork of the Chehalis, 2.5 RM (4.0 RKm) of Roger Creek and 1.8 RM (2.9 RKm) Cinnabar Creek. We also surveyed 40.1 RM (64.4 RKm) that collectively included nine major tributaries with potential toad breeding habitat downstream of the proposed dam location (Table 2), including the Black River (4.3 RM [6.9 RKm]), the South Fork Chehalis River (3.5 RM [5.6 RKm]), the Wynoochee River (2.5 RM [4.0 RKm]), Cedar Creek (0.9 RM [1.4 RKm]), Elk Creek (2.8 RM [4.5 RKm]), Independence Creek (0.9 RM [1.4 RKm]), Lincoln Creek (1.4 RM [2.3 RKm]), Porter Creek (3.9 RM [6.3 RKm]), and Scatter Creek (1.2 RM [1.9 RKm]). In 2016, we resampled 8.6 RM (13.8 RKm) from 2014-2015.

In 2014, instream surveys covered 21.9 RM (35.1 RKm) of the Chehalis mainstem, which comprised the entire 9.1 RM (14.6 RKm) within the proposed reservoir inundation footprint, 2.5 RM (4.0 RKm) immediately above that inundation footprint, and 10.3 RM (16.5 RKm) immediately below the inundation footprint downstream to about 95 RM (152.6 RKm) (Tables 1 and 2). Our 2014 instream surveys also addressed the five major tributaries with potential Western toad breeding habitat within the proposed reservoir footprint (Table 2), including Big Creek (0.9 RM [1.4] RKm), Crim Creek (0.8 RM [1.3 RKm]), Lester Creek (0.1 RM [0.2 RKm]),

Figure 1. Chehalis River mainstem segments used to stratify sampling of instream surveys.



Segment	River Mile		Segment Length (miles)	Segment Area (acres)
	Start	End		
Highway 101 Bridge to Wynoochee River	-	13.1	13.1	10,136
Wynoochee River to Satsop River	13.1	21	8	5,702
Satsop River to Porter Creek	21	35.2	14.2	8,864
Porter Creek to Black River	35.2	48.8	13.6	7,644
Black River to Scatter Creek	48.8	56.5	7.7	5,126
Scatter Creek to Skookumchuck River	56.5	69.2	12.7	7,073
Skookumchuck River to Newaukum River	69.2	78.3	9.1	3,373
Newaukum River to South Fork Chehalis River	78.3	92.7	14.4	5,973
South Fork Chehalis River to Elk Creek	92.7	105.4	12.8	2,370
Elk Creek to Proposed Multi-Purpose Reservoir	105.4	113.9	8.5	1,121

Figure 2. Instream survey reaches for Western toads for the years 2014-2016.

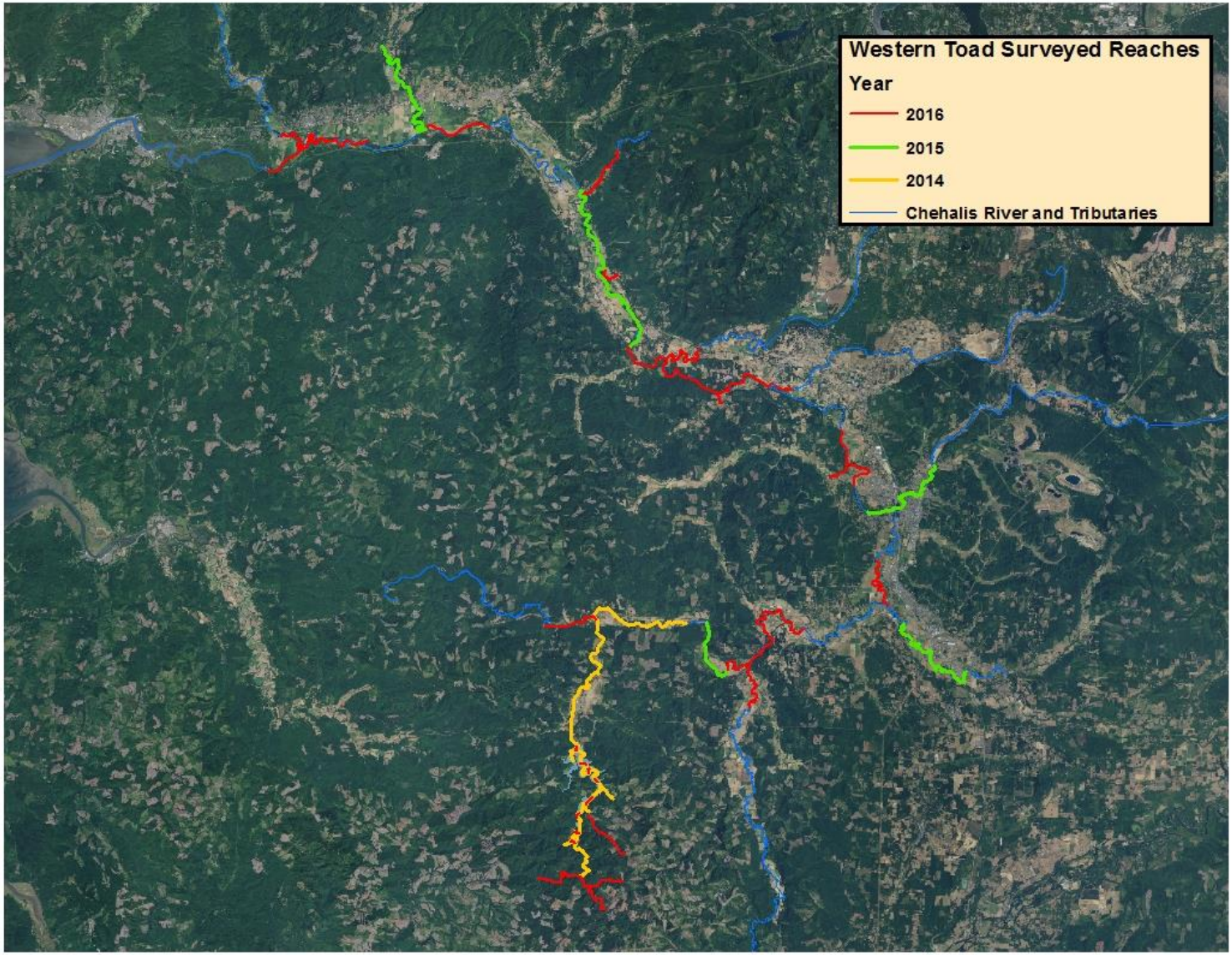


Table 1. 2014-2016 mainstem survey distance summary for instream surveys partitioned by river segments. Survey distances are in river miles (RM) and river kilometers (RKm). Inundation footprint (or footprint) refers to the footprint of the proposed dam and reservoir at full pool.

Survey Unit	2014		2015		2016		Resurvey (RM)	Resurvey (RKm)
	RM	RKm	RM	RKm	RM	RKm		
Mainstem – Within Inundation Footprint	9.1	14.6			2.8	4.5	2.8	4.6
Mainstem - Upstream of Footprint	2.5	4.0						
Mainstem - Downstream of Footprint								
1 – Highway 101 Bridge to Wynoochee River					2.0	3.2		
2 – Wynoochee River to Satsop River					5.5	8.9		
3 – Satsop River to Porter Creek			0.4	0.6	3.5	5.6		
4 – Porter Creek to Black River			10.4	16.7	6.0	9.7	3.0	4.8
5 – Black River to Scatter Creek					7.8	12.6		
6 – Scatter Creek to Skookumchuck River			1.2	1.9	4.3	6.9		
7 – Skookumchuck River to Newaukum River					4.0	6.4		
8 – Newaukum River to South Fork Chehalis River					7.9	12.7	1.3	2.1
9 – South Fork Chehalis River to Elk Creek	5.6	9.0	3.6	5.8	2.3	3.7		
10 – Elk Creek to Proposed Dam	4.7	7.5			4.3	6.9	4.3	6.9
Downstream of Footprint Subtotals	**10.3**	**16.5**	**15.6**	**25.0**	**47.6**	**76.6**	**8.6**	**13.8**
Mainstem Totals	**21.9**	**35.1**	**15.6**	**25.0**	**50.4**	**81.1**	**11.4**	**18.4**

Table 2. 2014-2016 tributary survey distance summary for instream surveys. Survey distances are in river miles (RM) and river kilometers (RKm). Inundation footprint (or footprint) refers to the footprint of the proposed dam and reservoir at full pool. Mainstem subtotal is drawn from Table 1.

	2014		2015		2016	
Survey Unit	**RM**	**RKm**	**RM**	**RKm**	**RM**	**RKm**
Within Inundation Footprint						
Big Creek	0.9	1.4				
Crim Creek	0.8	1.3				
Lester Creek	0.1	0.2				
Roger Creek	0.4	0.6			0.4	0.6
Thrash Creek	0.7	1.1				
Subtotals	**2.9**	**4.6**			**0.4**	**0.6**
Upstream of Footprint						
Cinnabar Creek					1.8	2.9
East Fork Chehalis					3.5	5.6
Roger Creek					2.5	4.0
Thrash Creek	0.1	0.2				
West Fork Chehalis					3.0	4.8
Subtotals	**0.1**	**0.2**			**10.8**	**17.3**
Downstream of Footprint						
Black River					4.3	6.9
Cedar Creek					0.9	1.4
Elk Creek					2.8	4.5
Independence Creek					0.9	1.4
Katula Creek	0.1	0.2				
Lincoln Creek					1.4	2.3
Newaukum River			7.0	11.3		
Porter Creek					3.9	6.3
Satsop River			6.8	10.9		
Scatter Creek					1.2	1.9
Skookumchuck River			4.8	7.7		
South Fork Chehalis River					3.5	5.6
Wynoochee River					2.5	4.0
Subtotals	**0.1**	**0.2**	**18.6**	**29.9**	**21.4**	**34.3**
Tributary Totals	**3.1**	**5.0**	**18.6**	**29.9**	**32.6**	**52.2**
Mainstem Totals	**21.9**	**35.1**	**15.6**	**25.0**	**50.4**	**81.1**
Annual Grand Totals	**25.0**	**40.1**	**34.2**	**54.9**	**83.0**	**133.6**

Roger Creek (0.4 RM [0.6 RKm]), and Thrash Creek (0.7 RM [1.1 RKm]). In addition, we also surveyed a small piece of Thrash Creek beyond the footprint (0.1 RM [0.2 RKm]) and a small piece of Katula Creek downstream of Rainbow Falls (0.1 RM [0.2 RKm]).

In 2015, instream surveys covered 15.6 RM (25.0 RKm) of the Chehalis mainstem and 18.6 RM (29.9 RKm) of tributaries downstream of the proposed reservoir (Tables 1 and 2), which included the Newaukum River (7.0 RM [11.3 RKm]), Satsop River (6.8 RM [10.9 RKm]) and Skookumchuck River (4.8 RM [7.7 RKm]).

To date (2014-2016), our instream surveys have covered 142.2 RM (228.3 RKm), of which 11.4 RM (18.4 RKm) were resurveys (Tables 1 and 2). This includes 11.9 RM (19.2 RKm) of the inundation pool (of which 2.8 RM [4.6 RKm] were resampled), 3.3 RM (5.2 RKm) of tributaries of the mainstem within inundation pool, 2.5 RM (4.0 RKm) in the Chehalis River mainstem upstream of the inundation pool, 10.9 RM (17.5 RKm) in tributaries upstream of the inundation pool, 73.5 RM (118.0 RKm) in Chehalis River mainstem downstream of the inundation pool (of which 8.6 RM [13.8 RKm] were resampled), and 40.1 RM (64.4 RKm) in tributaries of the Chehalis River mainstem downstream of the inundation pool.

During instream surveys in 2016, we recorded evidence of Western toad breeding (egg masses, mixed aggregated hatchling tadpoles and egg masses, or aggregated hatchling tadpoles/toadlets) at 56 locations (Figures 3 and 4). Eighteen of these locations had only egg masses, 13 locations had a mix of aggregated hatchling tadpoles and egg masses, 24 locations had only aggregated hatchling tadpoles and one site had a mix of aggregated tadpoles and metamorphosing toadlets. Twenty-four of these locations were located below the footprint of the proposed dam and reservoir, 18 were recorded within the footprint, and the remaining 14 were recorded above the footprint (Table 3).

At these 56 locations collectively, we conservatively estimated a minimum of 98 egg masses to have been present, 25 of which were recently laid (<2 days old). We also estimated another 29 egg masses based on aggregated tadpole groups, 44 based on mixed egg masses and aggregated tadpole groups (Table 3). Fifty of these egg masses were located within the footprint of the proposed reservoir, 33 egg masses were recorded below the proposed reservoir, and 15 egg masses were recorded above the proposed reservoir (Table 3). We found 125 toadlets at one location on the South Fork Chehalis River on 6 June; tadpole estimates for all reaches combined exceeded 900,000 animals. All post metamorphic toads (n = 30) observed were upstream of the proposed dam site. Counts of adults (5 in the inundation pool, 3 upstream) and juveniles (4 in the inundation pool, 21 upstream tributaries), of these 12 were associated to a breeding site (Figure 4).

When instream survey data were standardized for distance, the density index for each of the number of Western toad breeding locations and egg mass numbers were higher within the proposed reservoir footprint than either above or below it (Table 3). In particular, density

Figure 3. 2016 instream survey map for Western toads by life stage.

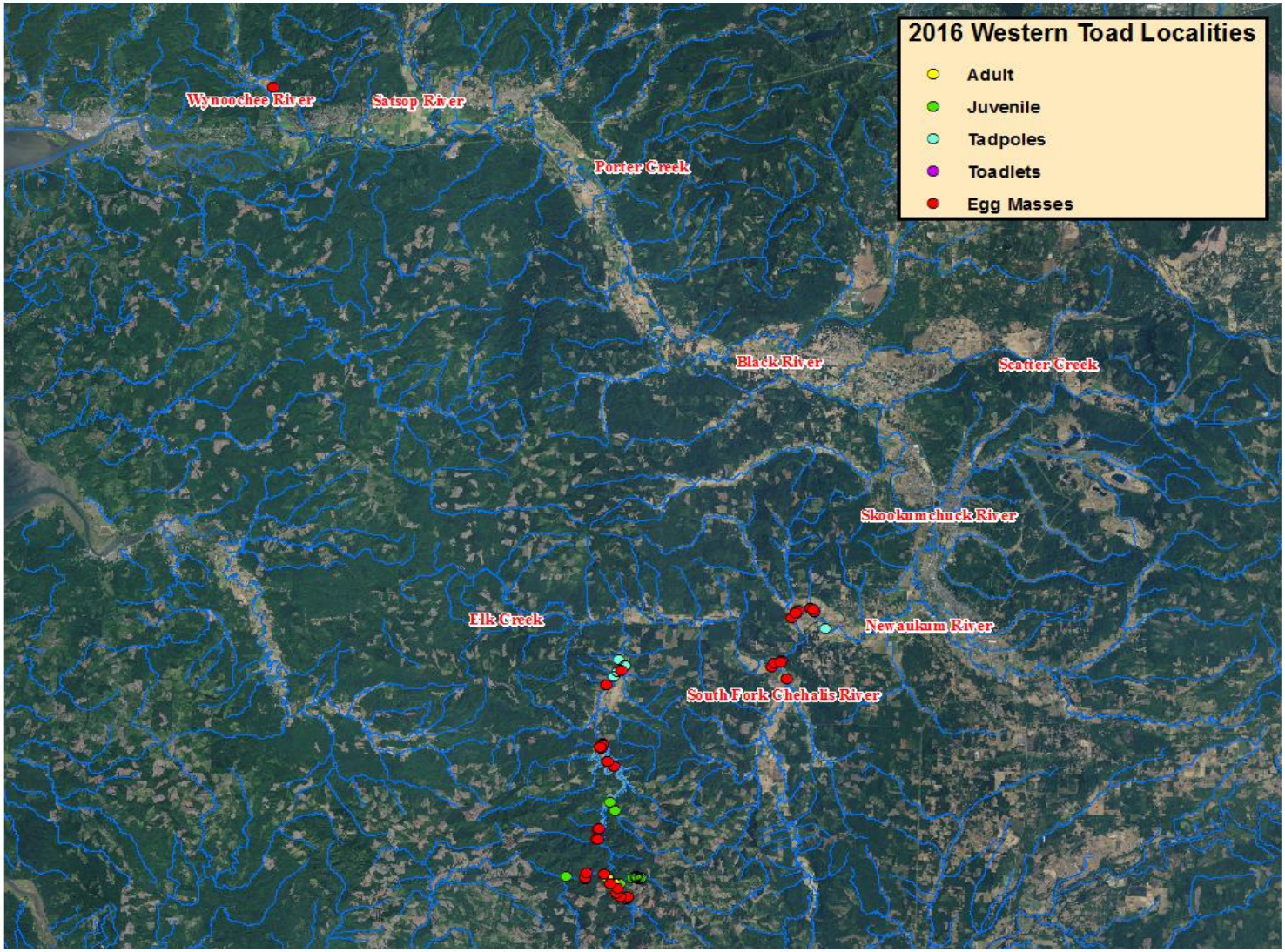


Figure 4. 2016 map of Western toads locations upstream of the Newaukum River by life stage.

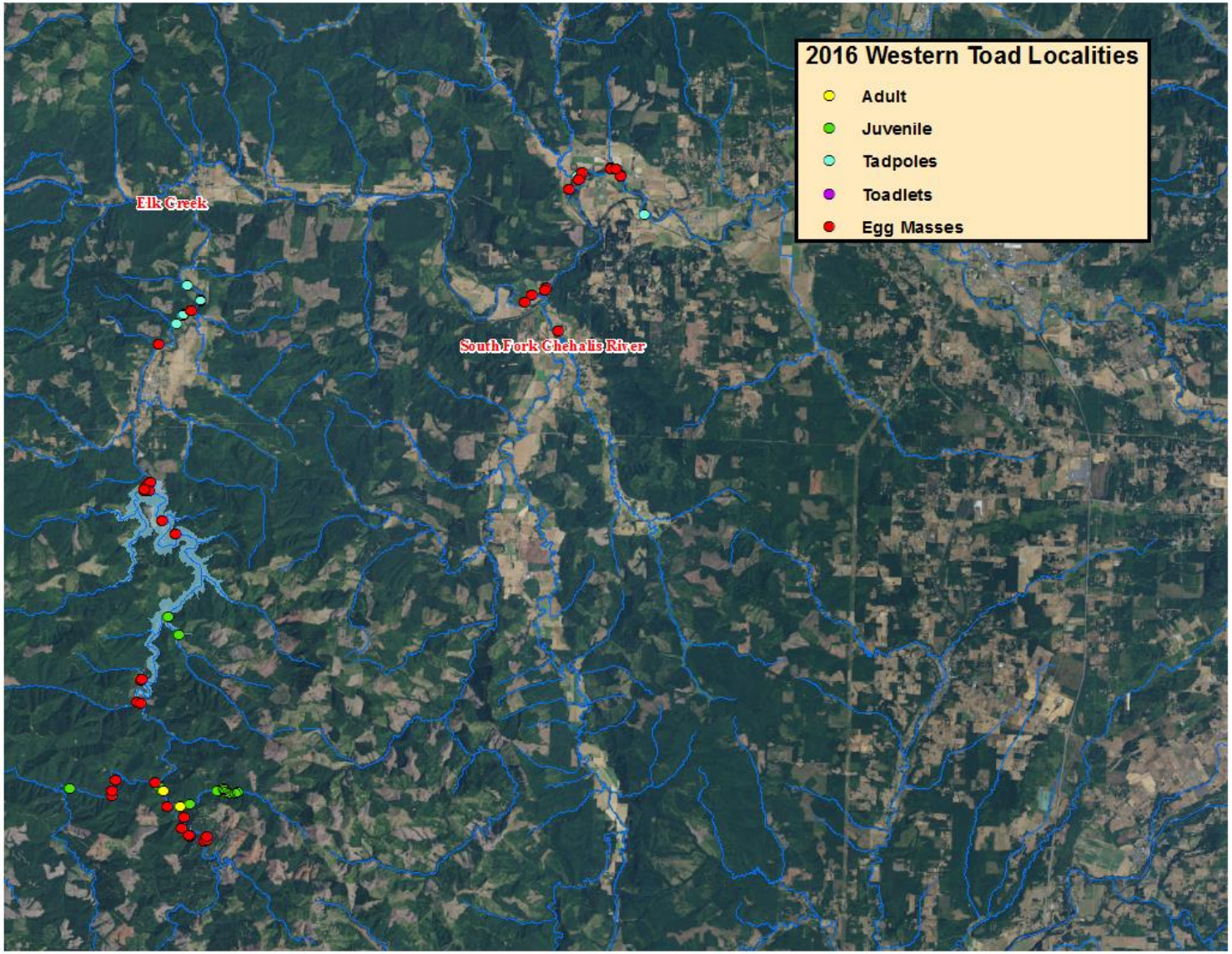


Table 3. Numbers and density indices of Western toad breeding locations and egg mass estimates below, within and above the proposed reservoir footprint in 2016.

Location Relative to Proposed Reservoir Footprint	Breeding Category	Number	Density Index	
			n/RM	n/RKm
Below	Breeding Locations	24	0.35	0.22
	Egg Mass Estimate	33	0.48	0.30
Within	Breeding locations	18	5.63	3.53
	Egg Mass Estimate	50	15.63	9.80
Above	Breeding locations	14	1.30	0.81
	Egg Mass Estimate	15	1.39	0.87

indices for the number of breeding locations and egg mass numbers per river mile were, respectively, over 15 and 30 times higher within the footprint than in the mainstem Chehalis below the footprint. The same indices were, respectively, over 4 and 10 times higher within the footprint than in the mainstem Chehalis above the footprint.

Besides Western toads, we also incidentally observed six additional amphibian species during the 2016 instream surveys (Table 4). The incidental species for which we have the most observations (n = 103) was the American bullfrog, seen at 13 locations. The Roughskin newt was next most often encountered (n = 38), seen at 12 sites. All incidental observations of bullfrogs and newts were from below the proposed reservoir footprint. Less frequently, we recorded Northern red-legged frogs (n = 10), Coastal tailed frogs (n = 10), giant salamanders (n = 2) and Pacific treefrogs (n = 14). All observations of Coastal tailed frogs and giant salamanders were in tributaries above the proposed reservoir footprint. Four of the Pacific treefrog observations were egg masses found within the same breeding pools as Western toads.

At least one fish species, Coho salmon (*Oncorhynchus kisutch*, as fry), was regularly observed in side pools during instream surveys in 2016. Coho salmon fry were recorded in several of the same side pools in which Western toads had reproduced (n = 19). Though these pools were most often connected to the mainstem river, we did see Coho fry in 5 pools that were now disconnected from the river. We also observed lamprey or lamprey redds at 12 separate locations; at six locations, we determined the lamprey to be Pacific lamprey (*Entosphenus tridentatus*). At the remaining six locations, juvenile lamprey (ammocoetes) could not be identified. We also observed Northern pikeminnow (*Ptychocheilus oregonensis*, n = 2), Cutthroat trout (*Oncorhynchus clarki*, n = 1), Largescale sucker (*Catostomus macrocheilus*, n = 1), Redside shiner (*Richardsonius balteatus*, n = 1), Rock bass (*Ambloplites rupestris*, n = 1), Speckled dace (*Rhinichthys osculus,* n = 1), Three-spine stickleback (*Gasterosteus aculeatus*, n = 1), and an unidentified species of sculpin (*Cottus* sp., n = 1 collectively) in these same breeding pools. The only exotic fish, Rock bass, was observed exclusively in the Elk Creek to South Fork reach downstream from the proposed dam and reservoir footprint.

We also incidentally recorded Beaver or their sign (n = 29); all Beaver records were downstream of the proposed dam/reservoir footprint within the mainstem or tributaries.

Table 4. Incidental amphibian species observed during 2016 instream surveys 2016. Subtotals or totals for sites may be less than summed site sums for species across habitat categories because one or more species may have occurred at the same site.

Species		Numbers of Observations				
		Position Relative to Proposed Reservoir				Totals
Standard	Scientific	Below		In	Above	
English Name	Name	Mainstem	Tributaries	Mainstem	Tributaries	
Stillwater Breeding						
Northern red-legged frog	*Rana aurora*	4	2	1	3	**10**
Roughskin newt	*Taricha granulosa*	31	7			**38**
Pacific treefrog	*Pseudacris regilla*	10		4		**14**
American bullfrog	*Lithobates catesbeianus*	101	2			**103**
Subtotals		**146**	**11**	**1**	**3**	**161**
Streambreeding						
Coastal tailed frog	*Ascaphus truei*				10	**10**
Giant salamanders	*Dicamptodon spp.*				2	**2**
Subtotal						**12**
Grand Total		**146**	**11**	**1**	**3**	**173**

In 2014, instream surveys recorded 162 locations with Western toad breeding (egg masses, mixed aggregated hatchling tadpoles and egg masses, or aggregated hatchling tadpoles) or evidence of breeding (aggregated toadlets) (Appendix Figure 1, Appendix Table 1). Forty-four of these locations had only egg masses, 98 locations had a mixture of aggregated hatchling tadpoles and egg masses, 9 locations had exclusively aggregated hatchling tadpoles, and 11 locations had exclusively aggregated toadlets. Four of these locations were located below the footprint of the reservoir, 130 of these locations were recorded within the reservoir footprint, and 28 of these locations were recorded above the proposed reservoir footprint.

At these 162 locations collectively, we estimated a minimum of 261 egg masses to have been present; 44 of which were recently laid. We also estimated another 197 egg masses from aggregated tadpole groups, 9 from mixed egg masses and aggregated tadpole groups, and 11 from aggregated toadlet groups. A minimum of 223 of these egg masses were located within the footprint of the proposed reservoir, nine egg masses were recorded below the

proposed reservoir, and 28 egg masses were recorded above the proposed reservoir. In 2014, aggregated toadlet groups were observed during surveys only in later July: we estimated that the 11 aforementioned aggregated toadlet groups collectively represented 9,440 toadlets. Ten of these groups collectively estimated to represent 9,365 toadlets were found upstream of the proposed reservoir footprint; the remaining toadlet group, estimated to represent 75 individuals, was recorded from within the footprint of the proposed reservoir.

When instream surveys for Western toad were standardized for distance, both the number of breeding locations and the egg mass estimates reveal a generally higher density of breeding locations and egg masses within the reservoir footprint than either above or below (Appendix Table 1). In particular, we recorded, respectively, over 25 and 20 times as many Western toad breeding locations and egg masses per river mile within the proposed reservoir footprint as below the footprint. We found almost twice as many Western toad egg masses per river mile within the proposed reservoir footprint as above the footprint. However, the number of Western toad breeding sites per river mile was about the same within as above the footprint. During the 2014 instream surveys, we also recorded numerous Pacific treefrogs early life stages (egg packets [Pacific treefrogs, unlike Western toads, deposit eggs into separate packets rather than a single mass] and/or tadpoles) at 33 sites, 14 of which were sites where Western toad breeding had been recorded (Appendix Figure 2). One of those sites was below the proposed reservoir footprint, 29 were within the footprint, and three were above the footprint. We also observed 256 post-metamorphic Pacific treefrogs (juveniles and adults) at seven sites. Most post-metamorphic Pacific treefrog observations (n = 250 or 97.7%) came from one site upstream of the proposed reservoir footprint. The remaining six observations were made across six sites within the proposed reservoir footprint.

Besides Western toads and Pacific treefrogs, we recorded six additional amphibian species incidentally during instream surveys (Appendix Table 2). All these species were recorded at five or fewer sites. The incidental species for which we have the most observations was the Columbia torrent salamander. Twenty-eight Columbia torrent salamanders were found at three geographically separated sites, two of which were within the footprint of the proposed dam. One of the footprint sites, which had two small seeps within a meter of each other along Crim Creek, had 26 of 27 individuals. The remaining individual was found at one location upstream from the proposed reservoir footprint.

The Roughskin newt ranked second in number of observations among incidentally recorded amphibians observed during instream surveys (Appendix Table 2). We found 10 adult Roughskin newts were recorded at four sites. Two of those sites were at the Western toad breeding sites. Roughskin newts were also recorded from an additional two instream off-channel habitats in which Western toads were not found. Newts were only recorded at sites within and below the proposed dam footprint (Appendix Table 2).

Similarly to Roughskin newt, post-metamorphic Northern red-legged frogs were observed both below and within the dam footprint; seven individuals were observed at five different sites (Appendix Table 2). The remaining three amphibians observed during instream surveys (Dunn's

and Western red-backed salamanders and Coastal tailed frog) were all observed at either one or two sites and observations represented one or two individuals (Appendix Table 2).

We also regularly observed at least five fish species in side pools during the 2014 instream surveys. Most common were juvenile speckled and longnose dace (*Rhinichthys cataractae*) and Coho salmon fry, which were observed in several of the same side pools in which Western toads had bred. In addition, we also occasionally observed juvenile lamprey or ammocoetes (species undetermined) and individuals of unidentified species of sculpin.

In 2015, we observed only one site with Western toad breeding over the 34.2 RM (54.9 RKm) surveyed. This was represented by one egg mass was found on the Satsop River within 2.7 miles of the confluence to the Chehalis. Surveys on the Newaukum and Skookumchuck Rivers did not reveal Western toad breeding activity, nor did the 25 RK (15.6 RM) of mainstem we surveyed. The river segment from the South Fork Chehalis River to Elk Creek, surveyed on July 1, also did not reveal any evidence of Western toad breeding activity, however, reaches both downstream and upstream of it had been found to have Western toad breeding activity in 2014 and 2016 (Appendix Figure 1 and Figure 4).

Discussion

Patterns observed during the 2016 instream surveys reinforce the patterns we began to observe in 2014 with select minor differences. Examination of Western toad breeding and distribution patterns in the lowland Chehalis Basin (i.e., <1,500 ft [457 m]) based on a combination of instream surveys and other studies in off-channel habitats in the mainstem Chehalis floodplain (i.e., egg mass and extensive surveys) has begun to show that instream habitat may be the exclusive habitat used for breeding by Western toads in the lowland portions of this system. Moreover, not all instream habitats appear to be used. To date, we have observed Western toad breeding in the Chehalis mainstem is entirely limited to the upper one-quarter of its length (i.e., vicinity of RM 82 [RKm 131.7] upstream), select few larger tributaries upstream (mostly the East and West Forks of the upper Chehalis River); and a few larger tributaries downstream, namely, the South Fork Chehalis, Satsop and Wynoochee Rivers.

The common denominator of Western toad breeding habitat appears to be unvegetated stillwater or near stillwater conditions that are well illuminated (insolated) for the balance of daytime hours. This is especially evident near the upper limit of its breeding distribution where shading as a consequence of decreased stream size resulting from progressively greater overhead canopy closure appears to be the limiting factor in some tributaries to the upper Chehalis mainstem. For example, outside of shading from canopy closure over the stream, structural habitat conditions in Crim Creek do not appear to change where Western toad breeding is ultimately lost. This pattern is consistent with Western toads occupying open early successional habitat for reproduction (Crisafulli et al. 2005). In the instream habitat, annual freshets maintain habitat openness. Based on the egg mass and extensive studies, Western toad breeding was not found in off-channel habitats in the floodplain where it was

expected, that pattern may indicate impairment of the processes that maintain the openness of those habitats or the renewal of shallow shelf habitat utilized by this warm-water breeder.

Factors limiting the downstream extent of Western toads in the Chehalis mainstem are less clear. However, the area of the Chehalis mainstem where Western toads were no longer found breeding downstream is a region where the river changes geomorphically in a substantial way. Substrate fines become almost completely dominant; and water turbidity and depth increase. Increased turbidity also limits light penetration. How these factors interact to limit Western toad reproduction is not clear, but an influence on oviposition habitat is likely.

Western toad breeding is more extensive in the proposed dam and reservoir footprint than either up or downstream of this footprint. This difference was most marked in the two years where it was compared (2014 and 2016) between the footprint and downstream. This may be reflective of juxtaposed high quality breeding habitat with high quality upland habitat within the proposed footprint of the dam reservoir, and a potential contrast between a managed timber landscape (potentially higher quality uplands for Western toad) and an agricultural landscape (potentially lesser quality for Western toad).

A significant species assemblage also utilizes the habitats in which Western toads breed. Among the more important are Coho salmon, for which fry overlap in their rearing habitat, lamprey, for which ammocoetes (larval lamprey) also overlap in their rearing habitat, and Pacific treefrogs, which partially overlap in breeding habitat. However, at least half a dozen other native fish species and some other amphibians may make occasional to regular use of Western toad breeding habitat.

The aforementioned pattern of Western toad distribution in the lowland (<1,500 ft [450 m] elevation) Chehalis Basin provides some insight about habitat changes the proposed dam and reservoir alternatives may result in for Western toad. These include:

a) Western toad instream breeding habitat in the proposed dam/reservoir footprint will be eliminated. For the FRFA alternative, this pattern is certain because a stillwater pool will replace the instream habitat. For the FRO alternative, instream habitat would be eliminated when dam closure pools a freshet. If that occurs during the time of Western toad breeding, the entire breeding complement would be eliminated. If it occurs outside the breeding period, its effects depend on residual habitat changes necessary for Western toad breeding and rearing. That pattern is uncertain.

b) The FRFA alternative may add stillwater breeding habitat. Western toads are known to breed in reservoirs (Nussbaum et al. 1983, Wente et al. 2005), but this addition or its extent is uncertain because the magnitude and timing of water level fluctuations as a consequence of the combination of dam operations and reservoir filling/emptying patterns. If substantial water fluctuations (>6 inches [15 cm]) occur immediately post-breeding, Western toad eggs and embryos

could die from stranding with a water level drop or experience impaired development or greater mortality from excessive water depth.

c) The FRFA alternative will reduce or eliminate suitable breeding habitat for Western toad for some unspecified distance downstream if cooler water outflow below the dam is maintained. One of the advantages claimed for the FRFA alternative is that cool water withdrawals from the hypolimnion will maintain a cooler water mainstem downstream. Cooler water delivered during breeding could impair Western toad development, increasing mortality.

d) The FRFA alternative will reduce or eliminate suitable habitat for Western toad for some unspecified distance downstream if discharge from the dam is maintained at a level somewhat higher than what is seasonally typical. Western toads laid unattached eggs in strings (Nussbaum et al 1983) and do not tolerate any level of significant flow. Even a relatively small elevation in flow levels may either prevent breeding or move eggs or embryos into habitats unsuitable for development.

In summary, either dam alternative may result in loss of a significant proportion of Western toad populations in the lowland Chehalis Basin because no significant breeding of Western toad occurs outside of its instream breeding in the lowland basin. Loss with FRFA alternative is probably more severe than for the FRO alternative. Effort in the 2017 season, the last for this study, will be to reduce the uncertainty regarding the effects of these alternatives for Western toad. This will be done by:

1. identifying the precise upper limits of instream breeding for Western toads in tributaries to the Chehalis mainstem;
2. sampling remaining gaps in the downstream mainstem Chehalis to verify the lack of Western toad breeding in these reaches;
3. randomizing sampling above, within, and below the footprint to absolutely verify the greater frequency of Western toad breeding within the proposed dam/reservoir footprint; and
4. making a particular effort to determine the basis of the downstream limit of Western toads in the mainstem in part by sampling other major tributaries, namely the Satsop and Wynoochee, to determine whether a pattern parallel to the Chehalis mainstem exists.

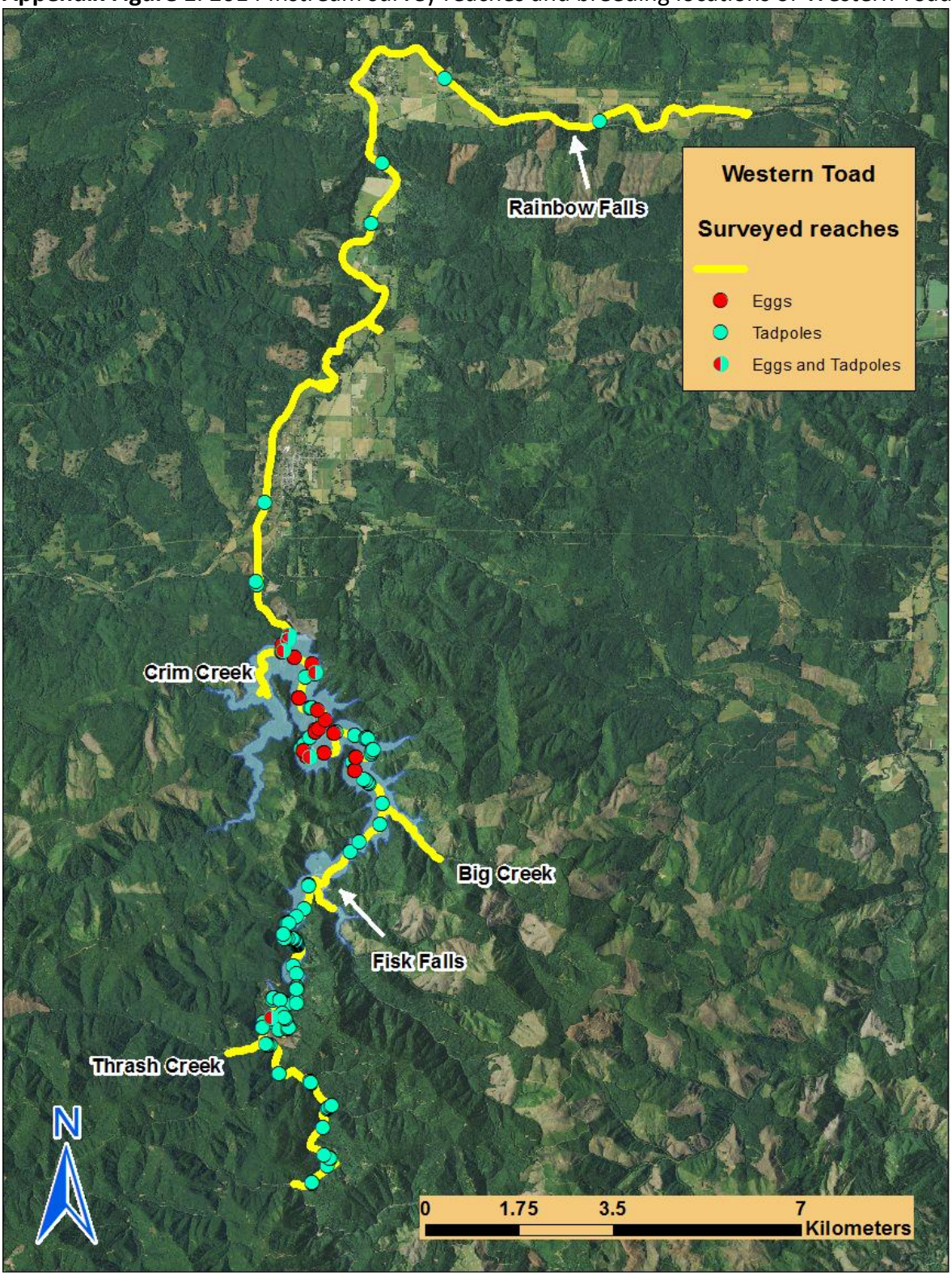
Literature Cited

Crisafulli, C.M., L.S. Trippe, C.P. Hawkins, and J.A. MacMahon. 2005. Amphibian responses to the 1980 eruption of Mount St. Helens, Pp. 183-197. In: Dale, V.H., F.J. Swanson, and C.M. Crisafulli (editors), *Ecological Responses to the 1980 Eruption of Mount St. Helens*, Springer, New York, New York, USA.

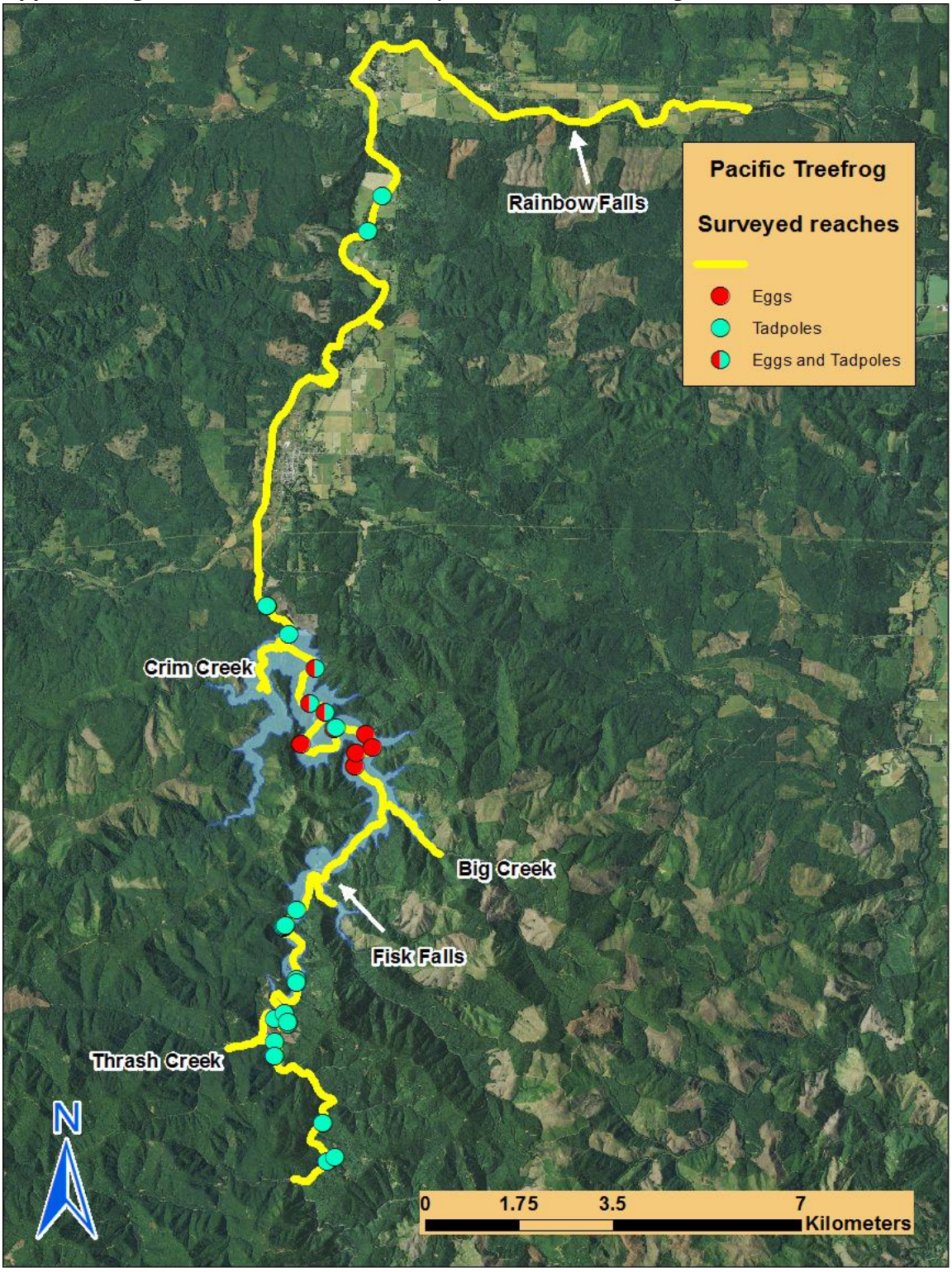
Nussbaum, R.A., E.D. Brodie, Jr., and R.M. Storm. 1983. *Amphibians and reptiles of the Pacific Northwest*. University Press of Idaho, Moscow, Idaho, USA. 353 pp.

Wente, W., M.J. Adams, and C.A. Pearl. 2005. Evidence of decline for *Bufo boreas* and *Rana luteiventris* in and around the northern Great Basin. *Alytes* 22(3/4):95-108.

Appendix Figure 1. 2014 Instream survey reaches and breeding locations of Western Toads.



Appendix Figure 2. 2014 Instream survey reaches and breeding locations of Pacific Treefrogs.



Appendix Table 1. Estimate of the number of breeding locations and egg masses for Western toad and their relative densities below, within and above the proposed reservoir footprint based on 2014 instream surveys.

Location Relative to Proposed Reservoir Footprint	Breeding Category	Number (n =)	Density Index	
			n/RM	n/RKm
Below	Breeding locations	4	0.38	0.24
	Egg mass estimate	9	0.87	0.54
Within	Breeding locations	130	10.83	6.77
	Egg mass estimate	223	18.58	11.61
Above	Breeding locations	28	10.77	6.67
	Egg mass estimate	28	10.77	6.67

Appendix Table 2. Incidental amphibian species observed during 2014 instream surveys. Subtotals or totals for sites may be less than summed site sums for species across habitat categories because one or more species may have occurred at the same site.

Species		**Numbers of Sites and Individuals (Ind) observed**							
		Below footprint		**In footprint**		**Above footprint**		**Totals**	
Standard English Name	**Scientific Name**	**Sites**	**Ind**	**Sites**	**Ind**	**Sites**	**Ind**	**Sites**	**Ind**
Terrestrial Amphibians									
Dunn's salamander	*Plethodon dunni*	0	0	0	0	1	2	**1**	**2**
Western red-backed salamander	*Plethodon vehiculum*	0	0	2	2	0	0	**2**	**2**
	Subtotals	**0**	**0**	**2**	**2**	**1**	**2**	**3**	**4**
Stillwater-breeding Amphibians									
Northern red-legged frog	*Rana aurora*	2	4	3	3	0	0	**5**	**7**
Roughskin newt	*Taricha granulosa*	1	4	3	6	0	0	**4**	**10**
	Subtotals	**3**	**8**	**6**	**9**	**0**	**0**	**9**	**17**
Stream-breeding Amphibians									
Coastal tailed frog	*Ascaphus truei*	0	0	1	1	0	0	**1**	**1**
Columbia torrent salamander	*Rhyacotriton kezeri*	0	0	2	27	1	1	**4**	**28**
	Subtotals	**0**	**0**	**3**	**28**	**1**	**1**	**5**	**29**
	Overall Totals	**3**	**8**	**11**	**39**	**2**	**4**	**16**	**50**