Lewis River Bull Trout Recovery Monitoring and Evaluation: Patches, Occupancy and Distribution

2008 Progress Report

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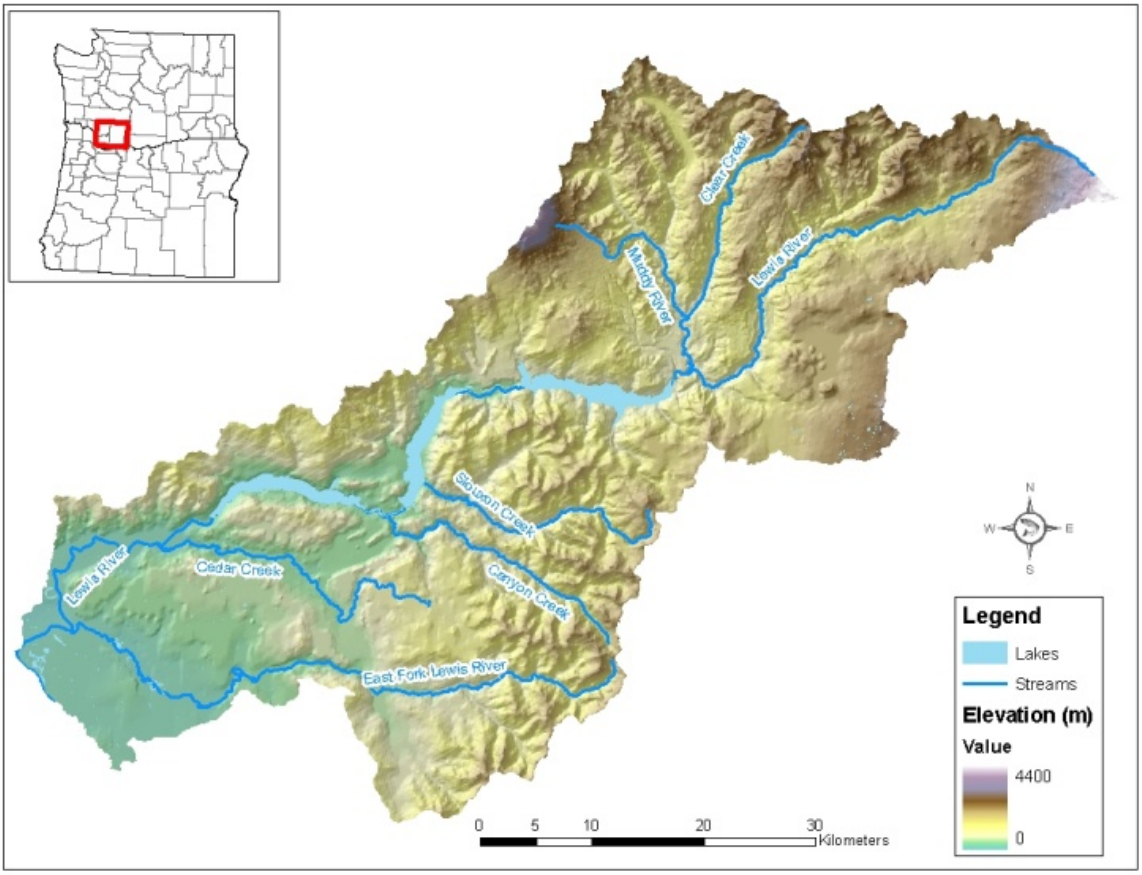
Introduction

Bull trout (*Salvelinus confluentus*) were listed as threatened on November 1, 1999 (USFWS 1999). Previously, the Columbia River distinct population segment (DPS) of bull trout had been listed as threatened since June 10, 1998. Factors contributing to the listing of bull trout include range wide declines in distribution, abundance and habitat quality. Land and water uses that alter or disrupt habitat requirements of bull trout can threaten the persistence of the species. Examples of such activities include: water diversions, dams, timber extraction, mining, grazing, agriculture, nonnative fish competition and/or hybridization, poaching, past fish eradication projects, and channelization of streams. These threats are prevalent throughout the Columbia River basin (USFWS 2000, 2002a).

Two core areas have been identified within the Lower Columbia River and they are associated with the Lewis and Klickitat rivers. The Lewis Core Area includes the mainstem Lewis River and tributaries downstream to the confluence with the Columbia River (Figure 1), with the exclusion of the East Fork of the Lewis River (USFWS 2002b). Bull trout are currently known to occupy the Cougar, Pine, and Rush creek watersheds of the Lewis River.
While the current known occupancy of bull trout in the Lewis River subbasin appears to be limited to these three watersheds, it is possible that the historic distribution of the species within this subbasin was more widespread. There also remain areas of the basin not yet sampled for bull trout. Prior to the installation of three hydropower projects beginning in 1929, bull trout in the Lewis River subbasin exhibited a fluvial life history strategy (USFWS 2002b). When this life history strategy was lost due to migratory barriers from the hydropower projects, and habitat was inundated by the reservoirs behind the projects, it is probable that the distribution of bull trout in the subbasin was impacted. However, it is unknown with any degree of confidence how much of the habitat is suitable for bull trout spawning and early life rearing, how much is occupied, or how distribution may change with restoration and recovery. To address these types of uncertainties and recovery efforts, the Bull Trout Recovery Monitoring and Evaluation Group (RMEG) have developed recommendations, utilizing a template based on potential habitat for monitoring changes in occupancy and distribution of bull trout relative to recovery of the species.

Figure 1: The Lewis River Subbasin.



Guidance from the Bull Trout RMEG (2008) recommends utilizing maximum annual stream temperature, stream size and catchment area as filters to begin to delineate potential bull trout habitat, or patches. Patches are defined as areas with a relatively high probability of supporting bull trout spawning and early life rearing. Patches may be thought of as areas delineating local biological populations (Rieman and McIntyre 1995). Many other factors summarized in Dunham and Rieman (1999) may also influence bull trout distribution (e.g., connectivity, stream gradient, geology, hydrologic regimes, presence of nonnative species, road density, solar radiation). However, maximum annual stream temperature (and the corresponding elevation) effectively dictates the range of this species (Rieman and McIntyre 1995) and patch size (catchment area) may be the most important factor determining the occurrence of bull trout populations (Dunham and Rieman 1999). Utilizing these three filters (information that most managers can readily acquire) provides the opportunity to apply and evaluate this approach as a tool for consistently delineating local population boundaries throughout the range of the species. This provides a standardized approach to developing a geographic template by which to assess bull trout status, including occupancy and distribution.

By researching the occupancy and distribution of bull trout within the Lewis River subbasin we can improve our understanding of this threatened species. The current work begins to establish a quantitative baseline from which bull trout occupancy and distribution in the Lewis River can be assessed. Implementation of this approach through a long-term monitoring program will provide data on trends in occupancy and distribution in the subbasin. This

understanding will allow us to work towards restoration and recovery of bull trout populations within the Lower Columbia Recovery Unit as well as range wide.

The objectives of this project are to 1) apply RMEG guidance on monitoring bull trout occupancy and distribution in the Lewis River subbasin, 2) evaluate the application of RMEG guidance to provide feedback on utility of approach in other subbasins, and 3) quantitatively assess occupancy and distribution of bull trout in the Lewis River subbasin. Specific tasks for 2008 were to assess occupancy in three patches.

Methods

Patch delineation and sample framework

Patches were delineated in 2006 and refined after 2007 field season (Figure 2). Sample reaches for the entire Lewis River subbasin were identified in 2006. Methods and results are presented in Hudson et al. (2010).

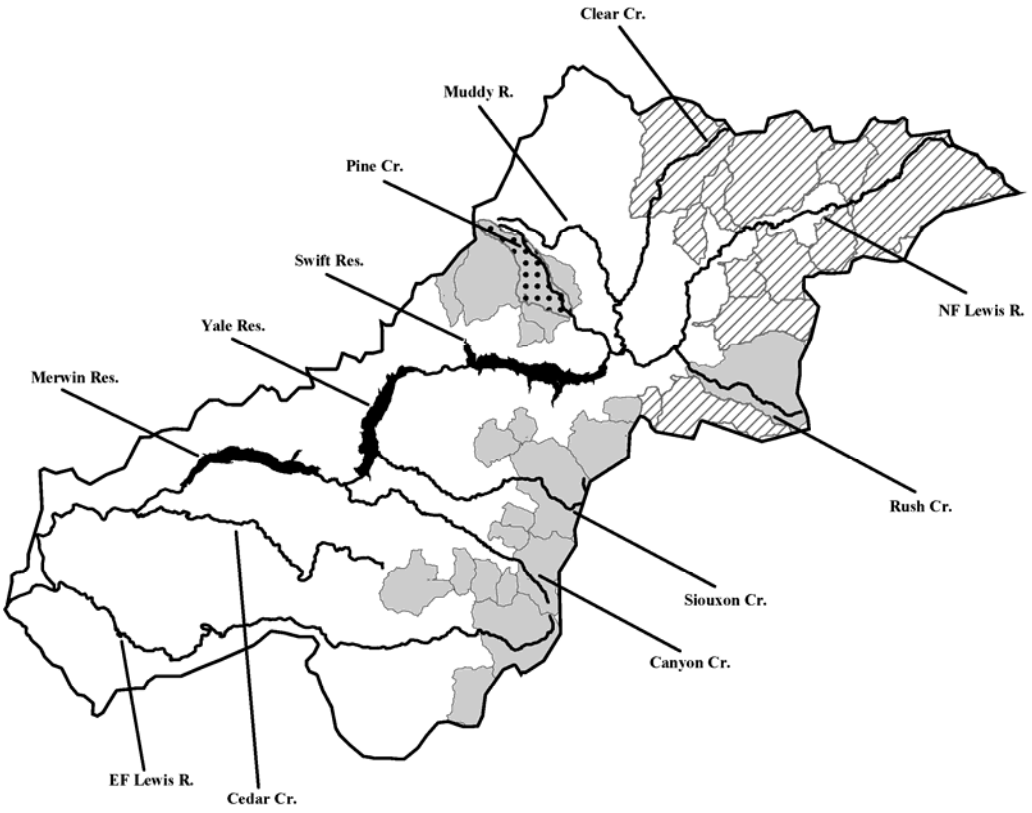


Figure 2. Lewis River subbasin bull trout patches identified by stream temperature, stream order and catchment area. Grey patches with dots are known to be occupied by bull trout, white patches with cross hatch are known to not be occupied by bull trout, and grey patches have not been sampled.

Site-specific detection probability and habitat covariates

The site-specific detection probability (SSDP) for bull trout in the Lewis River was estimated to be 0.375 (Hudson et al. 2010). When this SSDP is applied to the model developed by RMEG (2008), and 3, 5, or 7 reaches are sampled within a patch and no bull trout are detected, the probability that bull trout occupy that patch is less than 0.20, 0.10, or 0.05, respectively. Given the experimental nature of this project and the uncertainties associated with actual SSDP in each patch, up to seven reaches per patch were sampled in the Lewis River subbasin. Using the RMEG model, even at an SSDP as low as 0.18, this would ensure at least an 80% probability that bull trout were not present when not detected. During sampling, if two age classes (as determined by size classes > 30 mm difference in fork length) of bull trout were captured within the patch (in all reaches combined), it was considered occupied by a population.

To facilitate potential evaluation of the relationship between various habitat variables and SSDP, habitat measurements were collected from the study reach. The gradient of each reach was measured using a hand-held clinometer. Gradient was measured and recorded twice at each reach, from the top of the reach to the middle, and again from the middle to the bottom of the reach. The eye level height of the person sighting the gradient was measured against the person standing downstream. One surveyor stood level with the water's edge upstream and measured the percent gradient against the second surveyor standing downstream at level with the water's edge.

Transects were flagged along the thalweg at every 10 m mark from 0 to 50 m. Channel dimensions were then measured along each of the six designated transects within the 50 m sampling reach. For each transect, measurements were completed for the wetted width, maximum depth along the transect line, and depth recordings at a ¼, ½, and ¾ marks across the wetted width. Total length of the reach measured along the bank was also recorded as an index of sinuosity.

Within each reach, large woody debris (LWD) was categorized and counted. Only pieces of wood directly within the channel or within 1 m of the water's surface were considered. Wood was classified into four categories: LWD > 10 cm in diameter and > 3 m in length, LWD > 60 cm in diameter and > 10 m in length, root wads and LWD piles (aggregates of > 4 pieces of wood together) were quantified within each reach.

The number, type and size of undercut banks were measured along both sides of the sampling reach. Undercuts were defined as areas under boulders, banks, wood, or bedrock along the stream bank that were > 5 cm deep, > 10 cm in length, and > 5 cm in height (e.g., PIBO; Kershner et al. 2004). Only undercuts within 0.5 m of the stream surface were considered.

Occupancy and Distribution

Sampling was conducted during summer using backpack electrofishing. Each 50 m reach was sampled from the downstream to the upstream boundary in a "stalk and shock" manner as described in Cook and Hudson (2008). All fish encountered were captured and identified. Bull trout length and mass were documented to facilitate size class determination. The patch was considered occupied (by a population) if two age classes (as determined by size classes > 30 mm difference in fork length) of bull trout were captured in any combination of one or more reaches within a patch. Since, both bull trout and brook trout (*Salvelinus fontinalis*) may inhabit these watersheds and hybridization between the two could occur, *Salvelinus* species were carefully scrutinized for distinguishing features (e.g., vermiculation, black markings on fins, halos) before

identification (Holton and Johnson 1996). All fish captured were released alive within the sampled reach.

Results

SSDP and habitat covariates

Eight reaches were visited in the Pine 6 patch 07/01/2008-07/08/2008. Habitat data was collected from seven of these reaches (Table 1). Reach 5 was the highest reach in the patch near the headwaters; it was not sampled because it was still covered by snow and had no running water. Average water temperature across reaches was 6.8 °C (range 4.2 – 9.2).

Habitat data was collected from the one reach (Reach 4) visited in the Pine 4 patch on 07/09/08 (Table 1). This was the lowest reach in the patch. Temperature was 8.8 °C.

The four lowest reaches in the Swift 19 patch were visited 07/01/08 and all found dry (Figure 2). Reaches 4 and 6 were not visited because they were higher in the patch. It was apparent they would be dry as well.

Table 1. Habitat data 2008.

	Patch	**Pine 6**							**Pine 4**
	Reach	1	2	3	4	6	7	8	4
	Date	7/8/08	7/3/08	7/1/08	7/2/08	7/1/08	7/2/08	7/8/08	7/9/08
	Time Start	14:06	10:00	11:46	11:01	13:08	12:54	15:25	9:56
	Time End	14:55	11:00	12:40	12:17	14:15	14:11	16:07	11:00
	Temperature (°C)	6.0	4.2	6.7	9.2	5.7	9.2	6.8	8.8
	Conductivity (µs)	24.0	23.7	28.5	23.3	19.1	28.0	27.6	100.7
	Bank Length	48.3	48.0	47.3	50.0	50.0	50.0	47.9	50.0
	Thalweg Length	50	50	50	50	50	50	50	50
	Pools	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
	Clinometer Average (%)	13	9.5	5.5	9	5.5	8	9	2
Large Woody Debris	# >3m length >10 cm diameter	11	9	9	5	11	7	6	6
	LWD Piles (>4 pieces of LWD together)	2	2	2	1	0	0	0	0
	# >10 m length >60 cm diameter	5	4	1	4	2	1	3	0
	# Root Wads	1	1	2	1	0	0	0	1
	Average Depth (m)	0.3	0.2	0.2	0.2	0.1	0.3	0.2	0.3
	Average Wetted Width (m)	2.6	4.7	4.1	9.2	5.0	5.9	3.8	6.2
	% Undercut	21	26	21.3	26.5	41	23.3	23.8	15

Occupancy and Distribution

Field work in the Lewis River subbasin occurred July 1 through July 9 of 2008. Three patches were completed (Swift 19, Pine 6 and Pine 4). Among these patches, a total of 13 reaches were visited, 8 of which were sampled (Table 2). Seven reaches were surveyed in the Pine 6 patch (Figure 2) and no bull trout were captured. The Pine 4 patch was sampled only in Reach 4 where 2 bull trout were captured (representing two size classes; Figure 3). Four reaches in the Swift 19 patch were visited, but none were sampled because they were dry (Figure 4), and the patch was considered not occupied by bull trout. This information was incorporated into the current patch structure that was revised following the 2008 field season (Figure 5). Other Salmonid species found in these patches included cutthroat trout and trout fry (indistinguishable *Oncorhynchus clarki* and *O. mykiss*). The average electrofishing effort per reach was 416 seconds.

Table 2. Reaches surveyed and species found 2008. BT = bull trout, CCT = coastal cutthroat trout, TF = indistinguishable *O. clarki* and *O. mykiss* trout fry.

Patch	Reach	Date	Sample Status	Salmonid Species	Non-Salmonid Species
Pine 4	4	7/9/2008	Sampled	BT	-
Pine 6	1	7/8/2008	Sampled-No Fish	-	Dicamptodon, Tailed Frog
	2	7/3/2008	Sampled-No Fish	-	-
	3	7/1/2008	Sampled	CCT	Dicamptodon
	4	7/2/2008	Sampled	CCT, TF	-
	5	7/8/2008	Not sampled-Snow	-	-
	6	7/1/2008	Sampled	CCT, TF	-
	7	7/2/2008	Sampled	CCT, TF	Sculpin, Newt
	8	7/8/2008	Sampled	CCT	Dicamptodon, Tailed Frog
Swift 19	1	7/1/2008	Not sampled-Dry	-	-
	2	7/1/2008	Not sampled-Dry	-	-
	3	7/1/2008	Not sampled-Dry	-	-
	5	7/1/2008	Not sampled-Dry	-	-

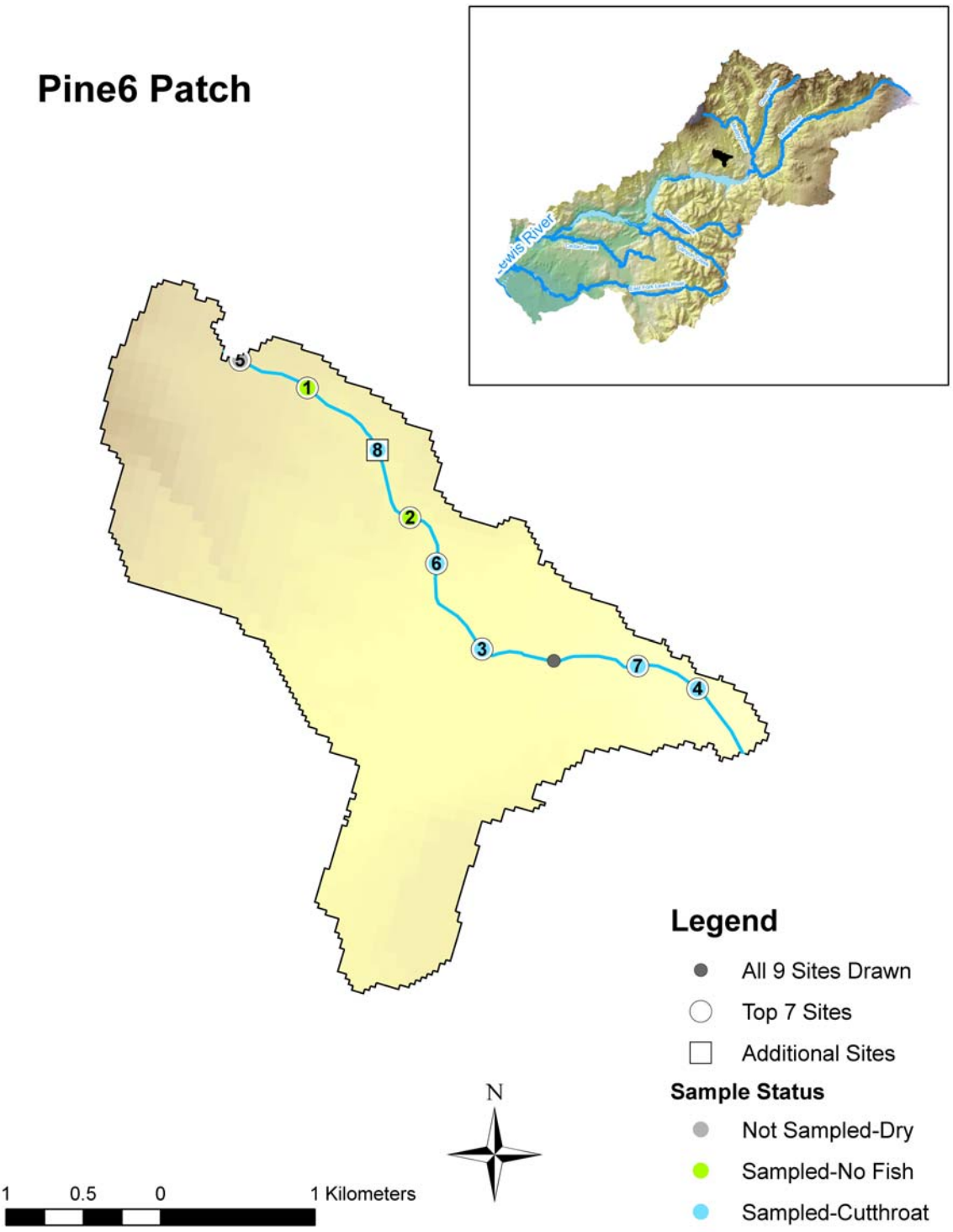


Figure 2. Reaches in Pine 6 Patch including all sites drawn within patch, top 7 sites, and any additional sites included in sampling because one or more of the top seven could not be sampled, as well as species captured within sampled reaches.

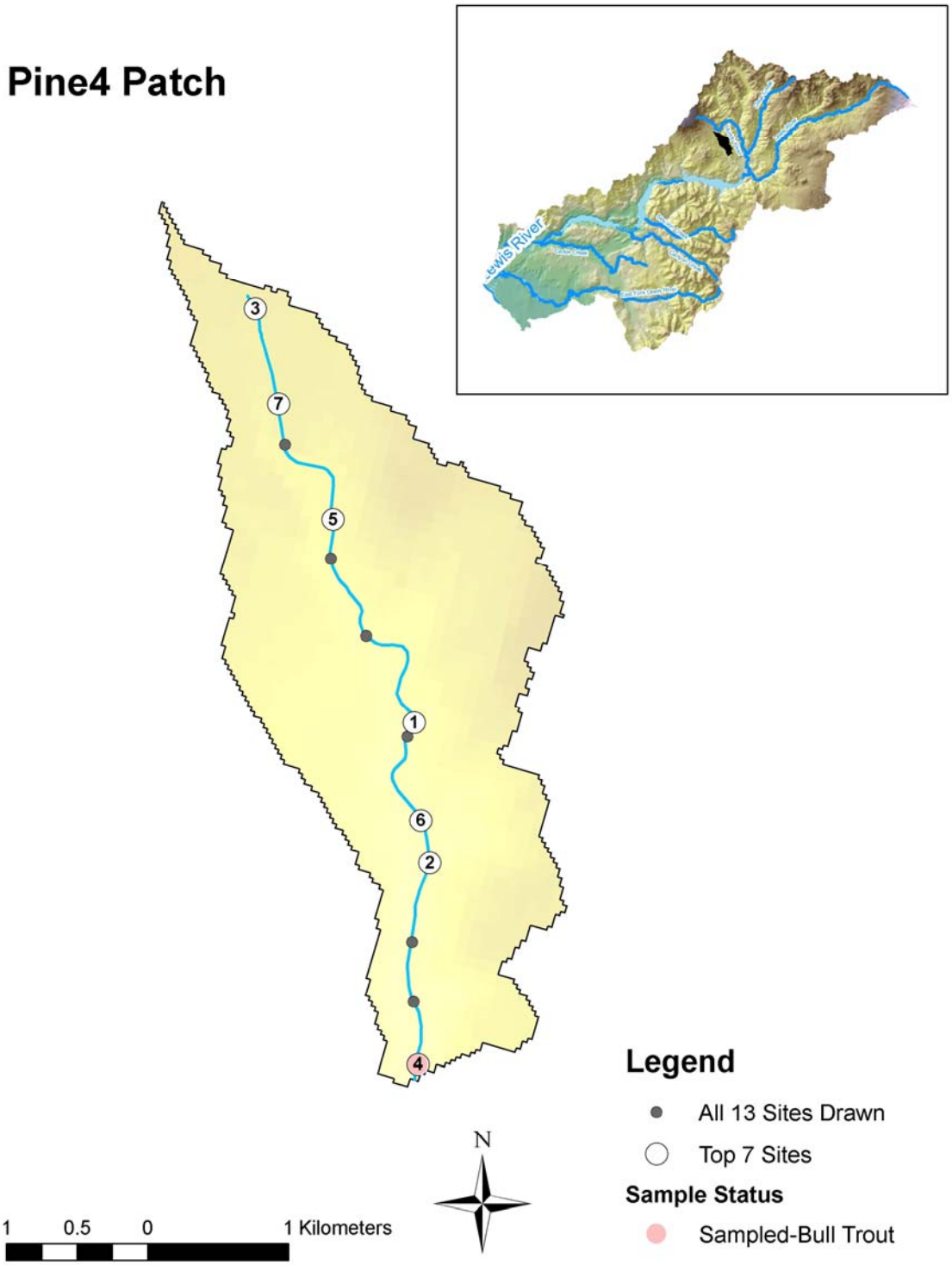


Figure 3. Reaches in Pine 4 Patch including all sites drawn within patch, and the top 7 sites, as well as species captured within sampled reaches.

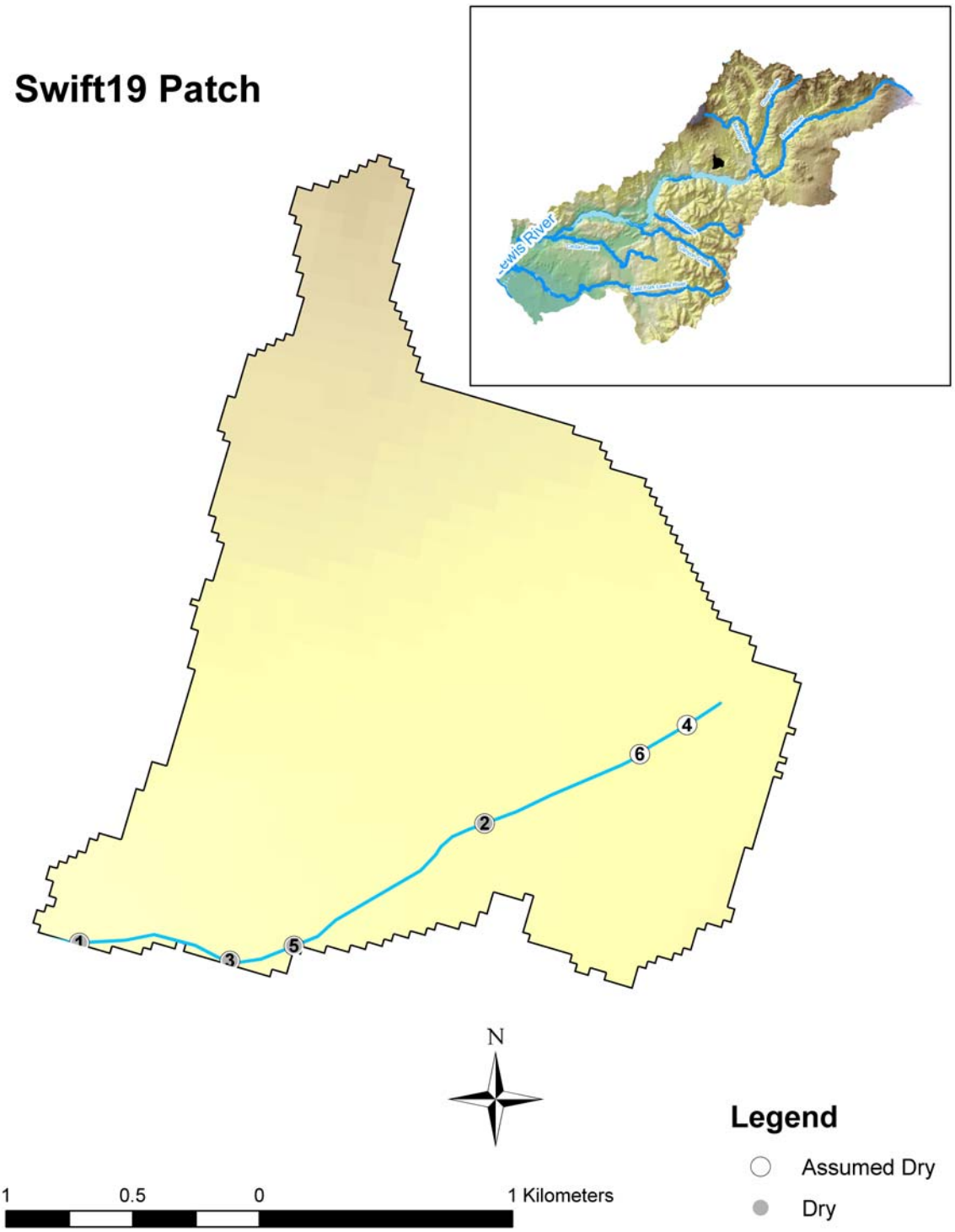


Figure 4. Reaches in the Swift19 Patch including all sites drawn within the patch, those reaches visited and found dry, and those reaches assumed dry.

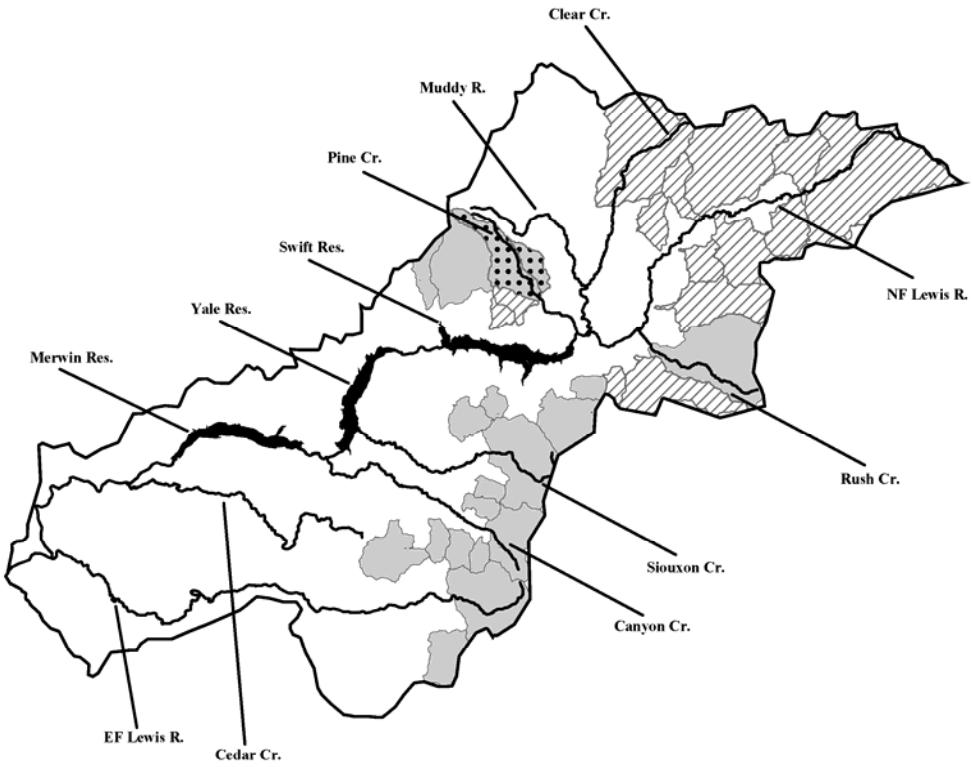


Figure 5. The Lewis River subbasin patch structure following the 2007 field season. Grey patches with dots are known to be occupied by bull trout, white patches with cross hatch are known to not be occupied by bull trout, and grey patches have not been sampled.

Findings

- By applying RMEG guidance on monitoring bull trout occupancy, sampling in the three designated patches resulted in an observation of bull trout in one patch. Thus, through quantitative assessment, we conclude that 33.3% (1 of 3) of the patches sampled in 2008 were occupied and 18.2% (2 of 11) of all Lewis River subbasin patches sampled through 2008 are occupied by bull trout.

- Effort to determine occupancy in 10 patches has required 78 person days over 2 years using a 3-person crew, or 7.8 person days per patch (the Pine5 Patch sampled in 2006 was not included in this calculation because occupancy of that patch was known and sampling was conducted to estimate SSDP for the subbasin). Much of this work could likely be done with a 2-person crew, reducing the amount of effort to 5.2 person days per patch. This is comparable to the 4 person days per patch reported by Isaak et al. (2009) using a 2-person crew and a smaller number of habitat covariates collected. Quantifying occupancy has required visiting and/or sampling as little as one reach within a patch (e.g., Pine4 Patch) and as many as 15 reaches to find seven that could be sampled (e.g., Curly Creek Patch). It is clear that natural barriers have affected the ability of bull trout to colonize and occupy certain portions of the Lewis River subbasin. Work in 2009 will include incorporating what is currently known about bull trout above natural barriers in the subbasin (i.e., not present) along with a barrier filter on the patch map to eliminate current potential patches due to lack of size to support a local population, thus altering the patch delineation process to more efficiently quantify bull trout occupancy.

- Results to date suggest that RMEG should give additional consideration to determining patch structure in subbasins that support adfluvial bull trout populations. It appears some spawning and potentially early rearing occurs both outside existing patch boundaries and in tributaries with catchment areas too small to be considered a patch. This suggests the reservoir may be playing a role in early rearing, thus affecting the patch boundary, and warrants further investigation.

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