Final Report
For
Redband Trout Status and Evaluation Project

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Objective 1: Distribution maps

Andy Weiss and Brian McTeague provided development assistance with the distribution maps. Eastern Washington district biologists Chris Donley, Bob Jateff, Eric Anderson, Jeff Korth, Bill Brooks, Glen Mendel, Art Viola, and Paul Hoffarth reviewed existing GIS data on rainbow trout and barrier data and provided updates.

Objective 2: Field sampling

Thanks to Kyle Gulbranson and Ryan Regner for volunteering with the fieldwork. Much help was received on the Master Sampling (also referred to as EMAP) process from Phil Larson (Environmental Protection Agency, EPA). Attending the Intrinsic Potential and Redband Workshops greatly increased our awareness of the habitat and sampling considerations for assessing redband distribution. Discussions with Chris Donley, Jason McClellan, Bob Jateff, Jeff Korth, Casey Baldwin, Maureen Small, and Scott Blankenship from WDFW and with Gene Schull of USFS and Nancy Wells of USFWS greatly increased our understanding of previous redband work, current projects, and assisted with planning for future work.

Abstract

Despite their popularity as a sport fish, much remains to be learned about native resident rainbow trout (*Oncorhynchus mykiss*) east of the Pacific Northwest's Cascade Crest. Typically referred to as *O. mykiss gairdneri*, redband trout, and inland trout, the populations that comprise this designation in the Columbia Plateau region may have been replaced or hybridized by hatchery plantings of coastal rainbow trout. Yet in the few places where genetic analysis has occurred, researchers have found that native redband trout persist. The lack of information about these resilient fish has prevented the development of a fish management plan as well as investigation as to whether these fish should be listed as threatened under the Endangered Species Act.

To further our knowledge about redband trout in the Columbia Plateau region that covers eastern Washington State and the lands of the Colville Confederated Tribes and the Spokane Tribe of Indians, maps were created using ArcGIS that show historic and current presence of these resilient fish as well as streams where genetic analysis needs to be done to verify their presence. In addition, Washington Department of Fish and Wildlife biologists reviewed existing field protocols and then field tested a protocol to assess redband trout presence in Washington State.

1.1 Introduction

The ubiquity of rainbow trout (*Oncorhynchus mykiss*) in the inland waters of the Pacific Northwest has made them popular for families and children's first fishing experiences during the past few hundred years. The history of these fish from an evolutionary timeframe reveals them to be remarkably persistent and resilient, likely in part due to their plasticity and polymorphy. They have persisted over a span of about 70,000 years, despite immense geologic and hydrologic change that includes volcanoes, continental glaciation, the Missoula floods, and the formation and dessication of large pluvial lakes (Schroeder, 2007). They inhabit diverse habitats, from deserts to forests and mountain regions and have more variable anadromy and life history patterns than salmon, including anadromous, fluvial and adfluvial (Quinn and Meyers, 2004; Behnke, 2007). The bulk of their range is shared with other salmonids but typically they are an outlier. For instance, they are present in environments that range from cold mountain rivers to high desert streams in conditions where most of their salmonid relatives cannot survive. Li (2007) provides examples that include: ability to tolerate warm water temperatures (Buchanan, 1991; Behnke, 1992); resistance to the parasite *Ceratomyxa shasta* (Currens et al., 1997); and ability to withstand alkaline pH for extended periods (Buchanan, 1991). Further, there are populations that spawn nearly all (11) months of the year (Buchanan et al., 1990) and an adfluvial population has been shown to persist despite periodic drying of the lake (Federal Register, 2000).

Behnke (1992, 2002) refers to *O. mykiss* populations located in the Columbia Basin east of the Cascade Mountains as well as in the Northern Great Basin (including the Upper Klamath Lake Basin) as redband trout (also referred to as inland rainbow trout) and suggests their scientific name be *O. mykiss gairdneri*. Historically, the Columbia Basin fish were distributed throughout the interior Pacific Northwest from the Cascade crest to the barrier falls on the Pend Oreille, Spokane, Snake, and Kootenai rivers (Allendorf, 1980; Behnke 1992, 2002).

Morphological differences have been used to differentiate *O. mykiss gairdneri* from coastal rainbow trout (Behnke, 1992) but genetic analyses that include protein electrophoresis (Currens, 2009), microsatellite DNA (Small et al., 2007), and single nucleotide polymorphism or SNP (Brunelli et al., 2008) are the only methods to correctly identify redband trout as unique from other salmonids. Genetic analyses allow individuals to be placed into one of four categories:

1) A genetically pure population of redband trout
2) A population derived from introduced coastal rainbow trout
3) A population that is a mixture of the redband trout and introduced coastal rainbow trout
4) A population that is a mixture of redband trout and cutthroat trout

And within a stream system, individuals that are genetically pure should be evaluated to determine if one or multiple genetically pure redband populations exist. For instance, recent work by Gayeski (Washington Trout) and Winans (NOAA Fisheries) indicate that more than one genetically pure population of redband trout exists in the Icicle River (Gayeski, personal communication, Washington Trout, 2009).

As has been the case with Westslope cutthroat and bull trout, redband trout populations are expected to have declined due to habitat degradation through anthropogenic causes (e.g. farming, logging, and development). Further impact to native redband trout may have occurred as a result of extensive hatchery stocking of coastal rainbow trout (McCloud strain). Unfortunately, although much work has been done to document the distribution and abundance of redband trout's relatives in Washington State, at best a few pockets of geographic area have received focused effort to characterize the distribution and abundance of the redband. This is a problem because although redband trout have been nominated for listing under the Endangered Species Act, the lack of information has prevented consideration. In part because of the lack of information, the Western Native Trout Initiative (WNTI) status report recommends improving the status of redband trout through population surveys, genetic analyses, and fish population manipulation. WNTI recommends that key actions will include locating and assessing redband trout populations, conducting standardized surveys to assess population status, and performing genetic analyses to define population structure and indentify introgression from hatchery fish.

During 2008 and 2009, fisheries agencies that included Washington Department of Fish and Wildlife (WDFW); the Colville Confederated Tribes (CCT), and the Spokane Tribe of Indians (STI) assessed what is known about the status of redband trout for the Columbia Basin region that spans eastern Washington State. Funding for this venture was provided to WDFW and STI through a grant from the Western Native Trout Initiative (WNTI). Further, recognizing that little information exists for streams managed by WDFW, field testing was done to develop a plan to evaluate redband distribution and abundance for these streams.

The objectives of this study were to: 1) Document what is historically and currently known about redband trout presence in the Columbia Plateau region that covers eastern Washington State and the CCT and STI tribal lands and identify streams where further genetic analysis needs to be done to assess presence; and 2) Field test a protocol to assess redband trout presence in Washington State. WNTI addresses only the resident form of redband trout in nonanadromous zones and consequently, we used anadromous barriers to identify areas where field testing could occur.

1.2 Methods

Objective 1: Document what is historically and currently known about redband trout presence in the Columbia Plateau region that covers Washington State and the CCT and STI tribal lands and identify streams where further genetic analysis needs to be done to assess presence.

During the course of the grant, the following tasks were accomplished:

- WDFW sent agency district fish biologists maps showing a GIS data layer for rainbow trout distribution and asked them to update the data for historic and current Washington redband distribution; for barriers to redband movement; and to recommend streams to sample for redband as funds become available.
- Representatives from each agency (WDFW, CCT, and STI) attended the redband trout multi-agency workshop and workgroup development meetings for western state Redband trout monitoring and evaluation.
- WDFW, CCT, and STI exchanged data layers and compiled a common template to display redband distribution maps for each agency that shows historic distribution, current distribution, and rivers where genetic sampling needs to occur. This was done using Geographic Information Systems (GIS).
- WDFW attended an Intrinsic Potential Workshop (sponsored by NOAA) to explore this method as a means of developing an historic distribution layer for redband trout.

Objective 2: Field test a protocol to assess redband trout presence in Washington State

Sampling protocols for resident salmonids, including those created by Idaho and Oregon for redband trout, were obtained. We (Ashbrook and Mizell) also met with WDFW biologists (Chris Donley and Jason McClellan) to discuss their recent work on presence and abundance of redband trout in the Spokane River. As part of the mapping project (Objective 1), we received information from WDFW district biologists in the eastern portion of Washington State to obtain their feedback on native redband, barriers to their movement, and any other recommendations for protocols. We also met with USFS, and USFWS biologists in the Okanogan area to receive their feedback and advice for areas that should be sampled. From these sources (Table 1), a list of metrics was developed.

After the WDFW district biologists identified streams of interest for redband trout, we chose diverse geographic locations that included desert, agricultural, and forest lands so that we could obtain a better general idea of the length of time to conduct the sampling and get to the sites. The sampled section of a stream was chosen based on the presence of a barrier that ensured resident fish only, in accordance with WNTI's grant policy. Once the anadromous barrier of a particular stream was identified, sampling locations were chosen using the Environmental Monitoring and Assessment Program's (EMAP) master sampling program (Diaz-Ramos et al. 1996, Stevens and Olsen 2004). For each stream, about 15 sites were identified. We began with the first site and moved down the list until two sites were sampled. A standard 1:100,000 stream hydrography layer was used to overlay the EMAP sites.

Table 1. Protocol reviewed, date of study, method, method approach, day or night hours, if habitat data were collected and reach length. JSAP is an acronym for Joint Stock Assessment Program. The reference section contains further information for each protocol.

Who	Date	Major use	How	When	Habitat	Reach length
Butler and Crossley	2001-2005	Electrofish	Up to 3 pass	Day	end transects	90 m
O'Connor and McClellan	2007-2008	Electrofish/ Mark recapture	Up to 3 pass	day/night	none	About 6 miles
Meyer	2001-2002	Electrofish	1 to multi-pass	Day	Basic meas.	100 m
Small et al.	2007	Electrofish	10 fish per 100 m	Day	--	100 m
Heck et al.	2008	Electrofish	2 to 4 pass	Day	Full	30 channel widths or 30 m to 100 m
Bonar	1997	Snorkel	3 person	Night	Some full	100 m
Mizell and Anderson	2008	Snorkel	3 person	Night	Main and transects	100 m
Thurow	1996	Snorkel	--	Day/night		100 m
Hillman	1993	Electrofish/ Snorkel	--	Day	--	100 m
Goetz	1991	Snorkel	--	day/night	--	--

The systems we chose for field testing were Spring Creek, Toats Coulee and Quilomene Creek (Figure 1). The first site, Spring Creek, is located in Lincoln County, is a tributary to the Spokane River, and lies in the midst of agricultural land. The second site, Toats Coulee, is located in Okanogan County and is federal forest land. For the third site, we decided to sample one of the creeks in the desert area of Kittitas County. Much of this land was formerly used for cattle ranching and was purchased by WDFW in 1962. Since purchase by WDFW, the land is being allowed to return to its natural state and provides a refuge for elk in addition to other wildlife.

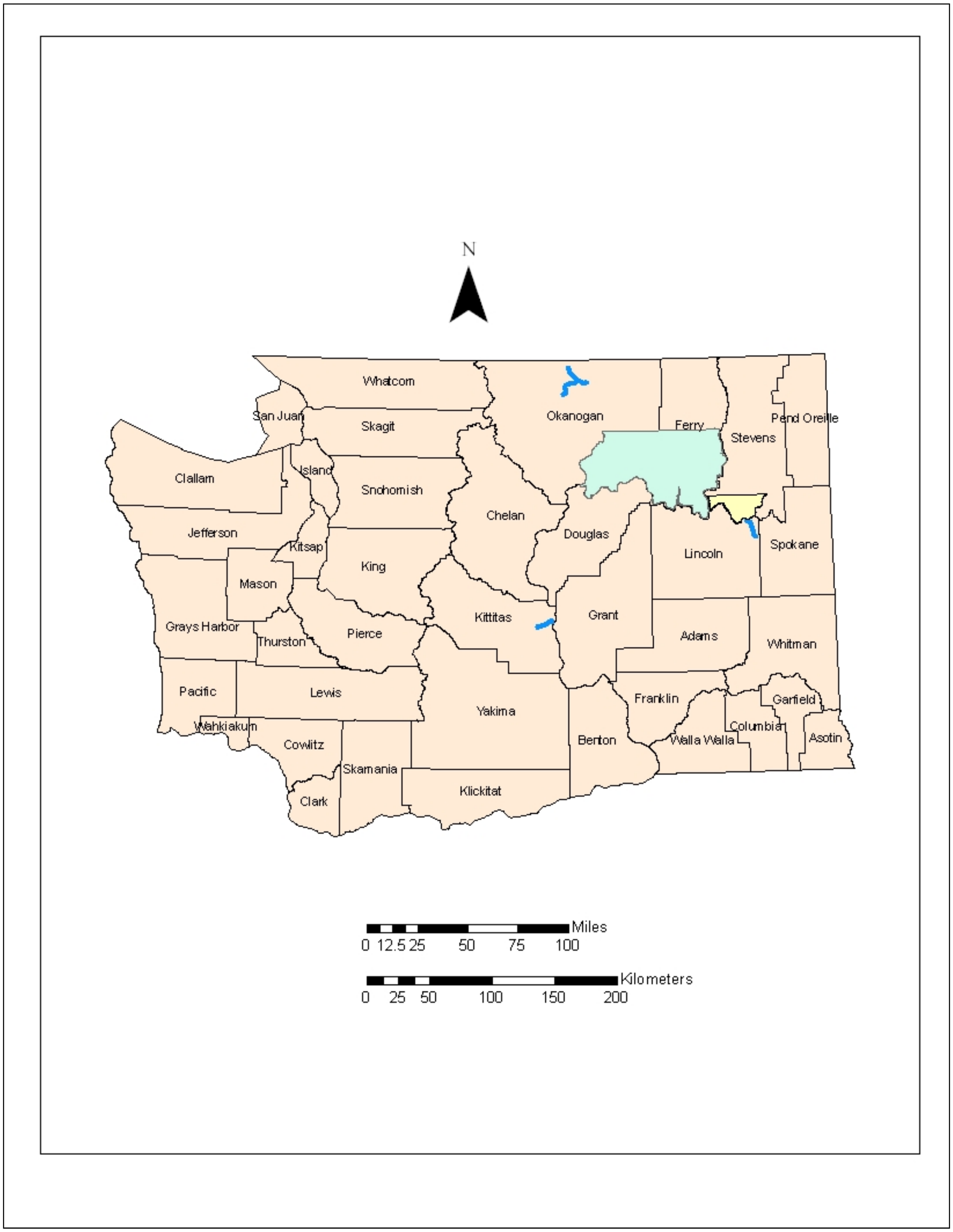

Figure 1. Map of Washington State divided into counties with sampled rivers shown in blue. The Colville Confederated Tribe lands are shown in green and the Spokane Tribe of Indians lands are shown in yellow.

We sampled during low flow conditions (during the months of August, September and October) to facilitate fish capture and standardize sampling conditions. The protocol was not designed to address temporal population fluctuations. If the site was dry, we moved onto the next sample site. Data from each site were recorded on a separate data form, and were divided into two sections: 1) Fish identification and measurements and 2) Site description and habitat measurements. Snorkel surveys occurred first and were followed by a pause of about eight hours. Electrofish surveys occurred next. To avoid disturbing fish prior to the surveys, site description and habitat data were collected at the end.

Block nets were installed at the upper and lower ends of the sites and care was taken to set them without walking in the section of the river to be sampled. Depletion sites were 100 m in length (depending on habitat types and ability to place block nets). Provided there was enough water in the stream, snorkel surveys occurred first. Two people snorkeled in tandem in larger water. For smaller systems, two people snorkeled each section ten minutes apart. The number of fish observed by species were reported to a researcher on the bank. Then, the surveyors exchanged positions and re-did the survey. Surveys were done from the bottom to the top of the section to prevent researchers from creating water turbidity and disturbing fish in the sampling section.

To capture fish, we used a backpack mounted electrofisher similar to the methods described in Zeollick and Cade (2006). At least two removal passes were made for each site that was not dry. Additional passes were made until the catch per pass declined by 50% or more between successive passes. The Smith-Root electrofisher was set at 40 Hertz and 200 to 275 voltage; these settings were adjusted as needed based on conductivity levels and fish reactions. No fish were visibly injured or killed during the study. Capture efforts focused on trout species, but captured non-game fish were identified to species and measured. Following identification, each fish was measured to the nearest mm using forklength and total length, and weighed to the nearest mg. Fin clips of salmonids were collected so that when funding is available, genetic identification and purity (e.g. McCloud hatchery strain, native, or hybrid of McCloud strain and native) analysis can be done. Following this, the fish were released back to the area where they had been collected.

Habitat data collection included the following:

- Stream name, date, and time
- Elevation
- Water and air temperatures
- Wetted width
- GPS of upper and lower ends of sample site
- Dominant riparian vegetation on both banks
- Percentage cover/shade
- Average gradient

Stream depth and flow
Number of pools, riffles and runs in section (based on federal protocols)
Woody debris by small, medium, and large
Substrate (fines, sand, gravel, cobble, boulder, bedrock)
Aquatic vegetation

1.3 Results

Objective 1: Document what is historically and currently known about redband trout presence in the Columbia Plateau region that covers Washington State and the CCT and STI tribal lands and identify streams where further genetic analysis needs to be done to assess presence.

Below are maps (Figures 1 through 10) for each agency involved in this project that show redband distribution patterns in the following order: historic; current; and genetic sampling that has occurred and where future genetic sampling is recommended.

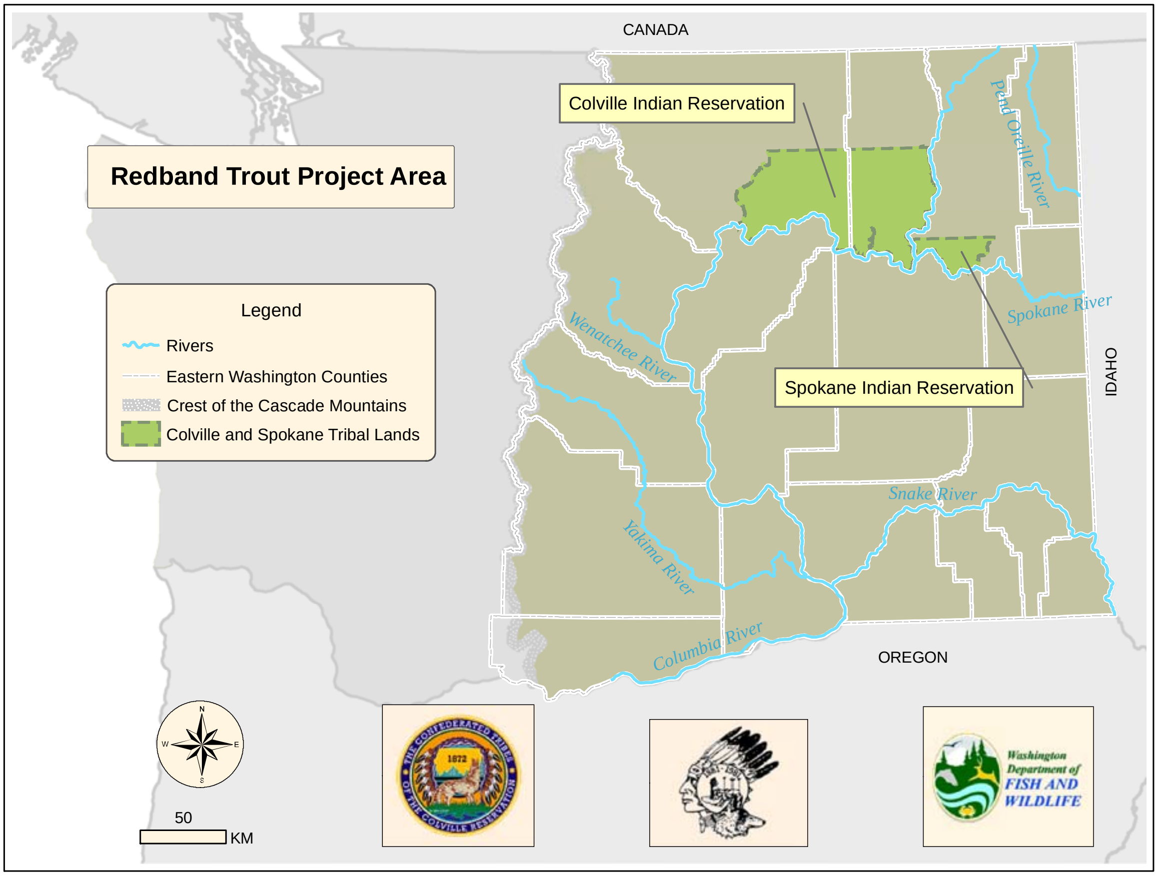

Figure 2. Map of redband trout project area.

Spokane Tribe of Indians

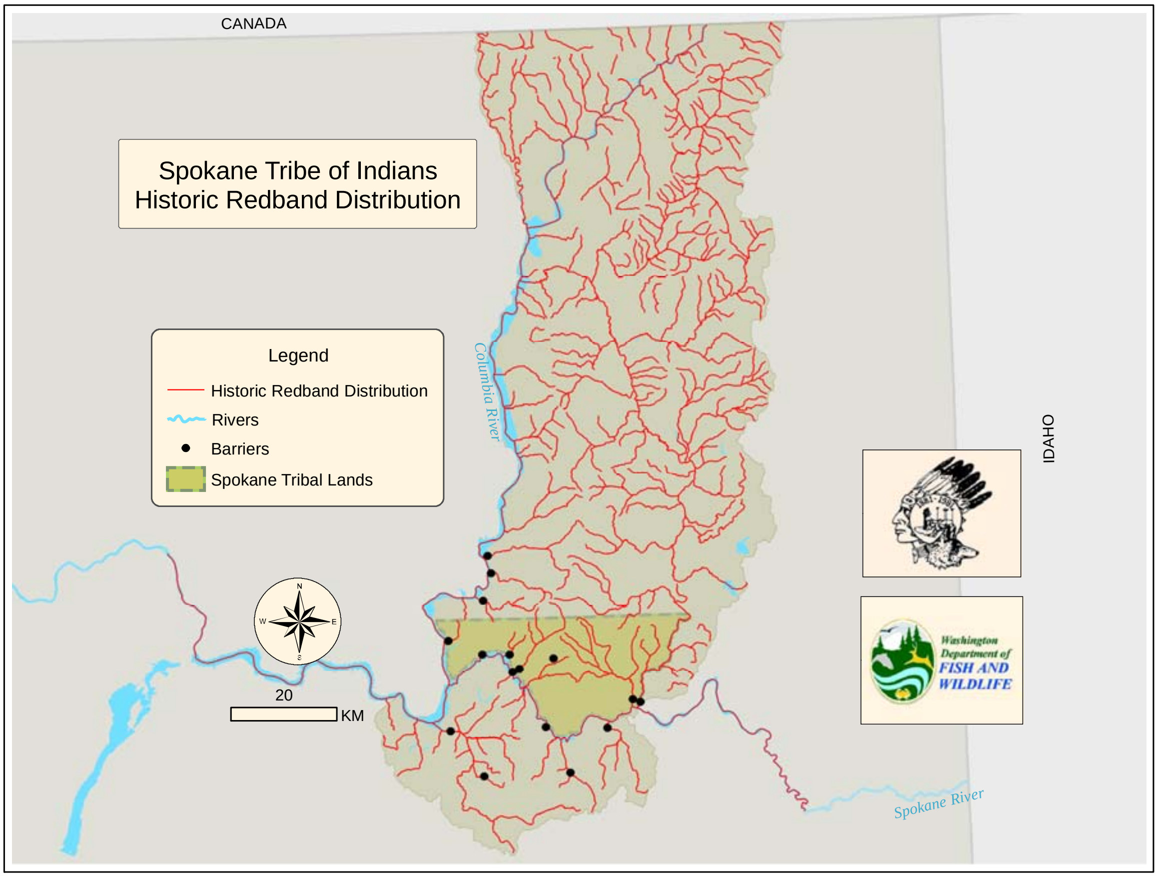

Figure 3. Spokane Tribe of Indians' presumed historic distribution of redband trout.

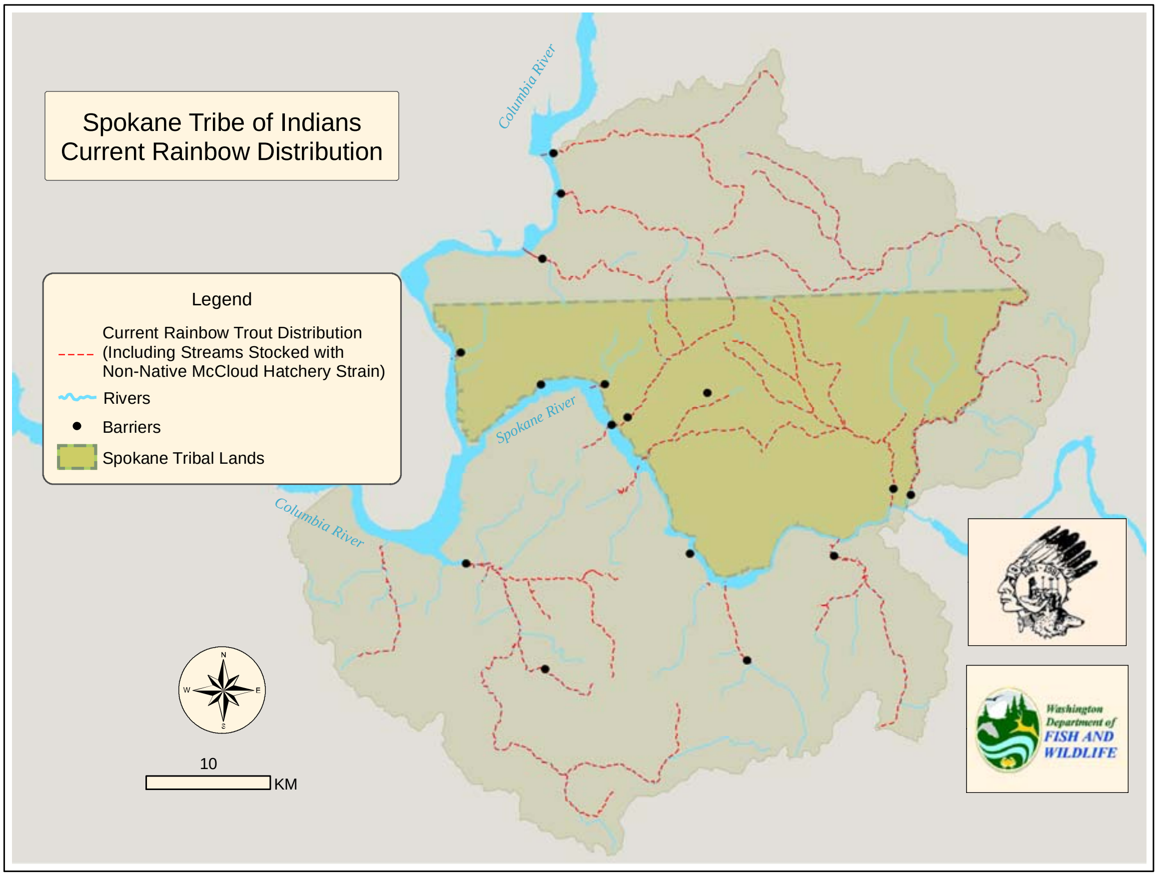

Figure 4. Spokane Tribe of Indians' rainbow trout distribution, most of which has been stocked by WDFW with non-native McCloud Hatchery strain. None of these fish can be distinguished as the subspecies redband because genetic analysis has not occurred. Genetic samples have been collected from the upper Chimacum River, where the potential for hybridization with stocked fish is considered unlikely. However, these samples have not been analyzed for genetic purity.

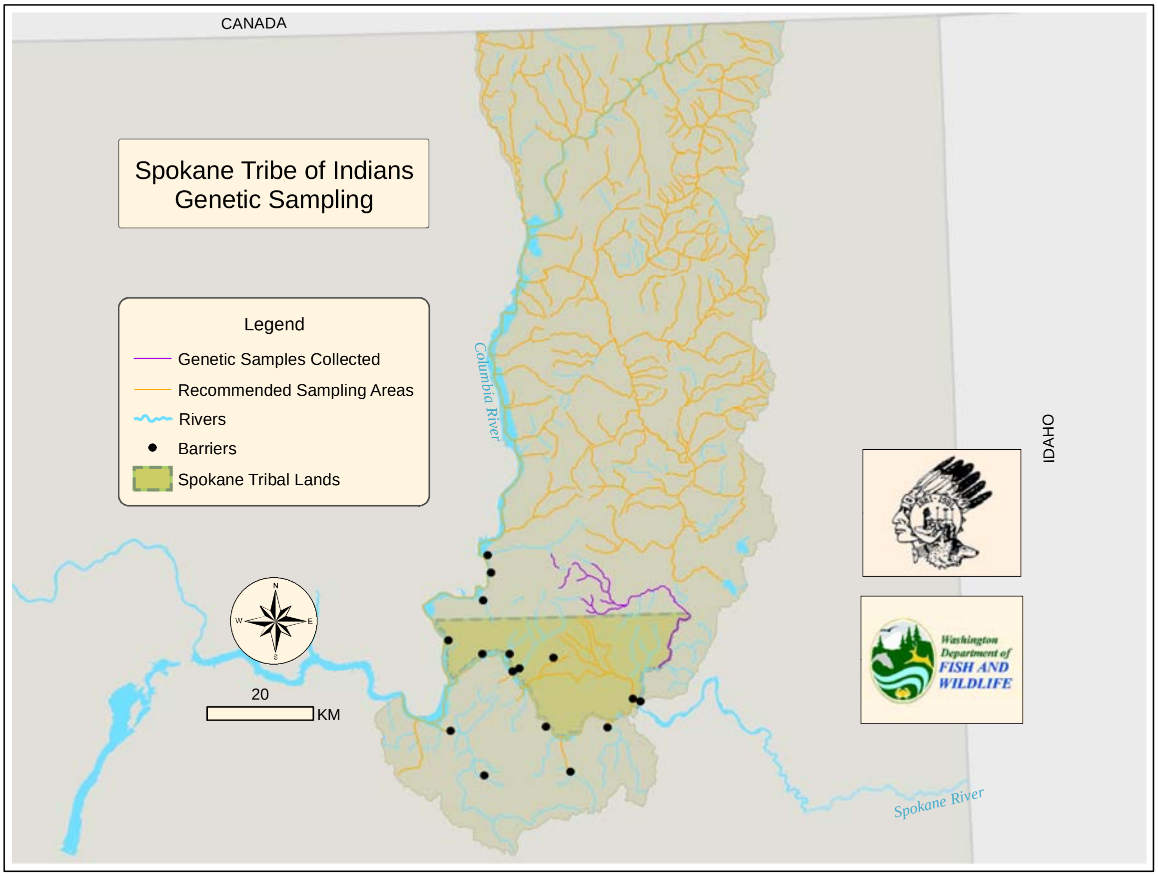

Figure 5. Spokane Tribe of Indian's recommendation for future genetic sampling of redband trout.

Colville Confederated Tribes

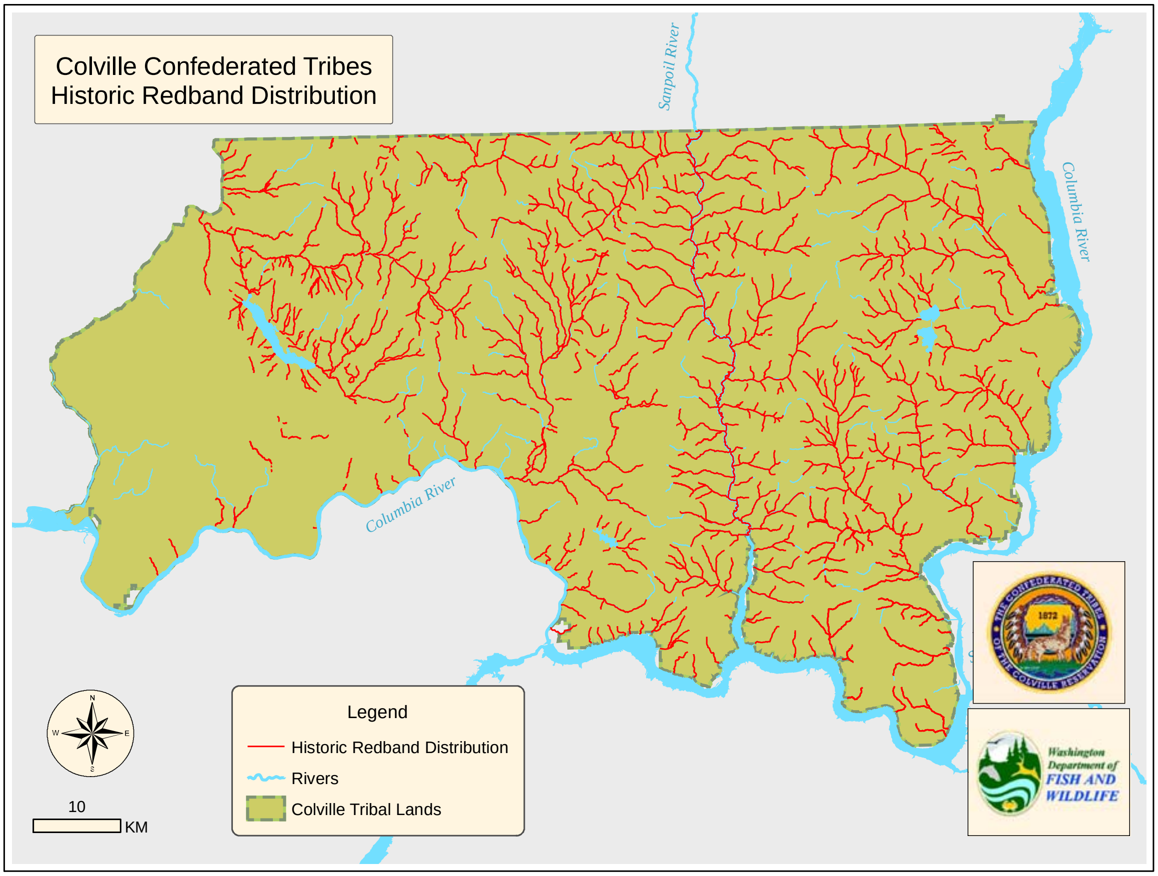

Figure 6. Colville Tribes' presumed historic distribution of redband trout.

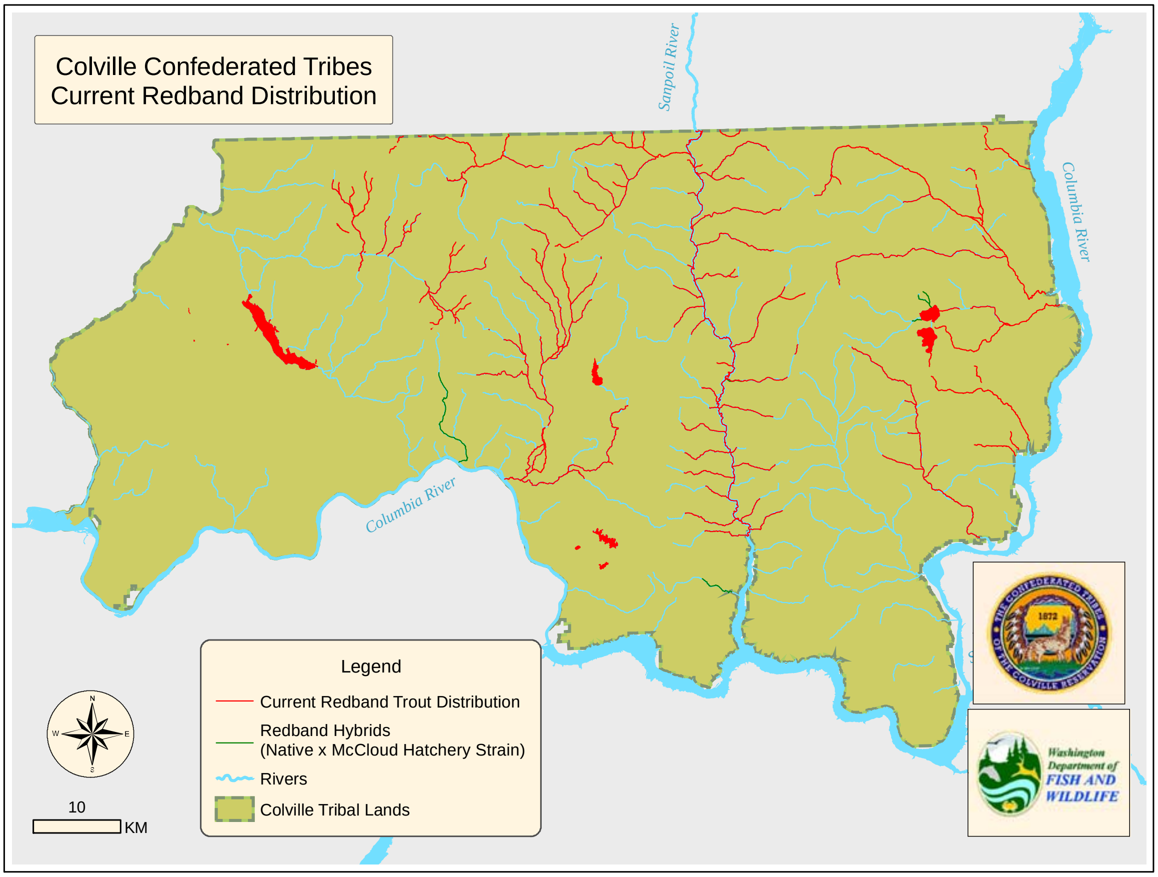

Figure 7. Colville Tribes' current Redband trout distribution.

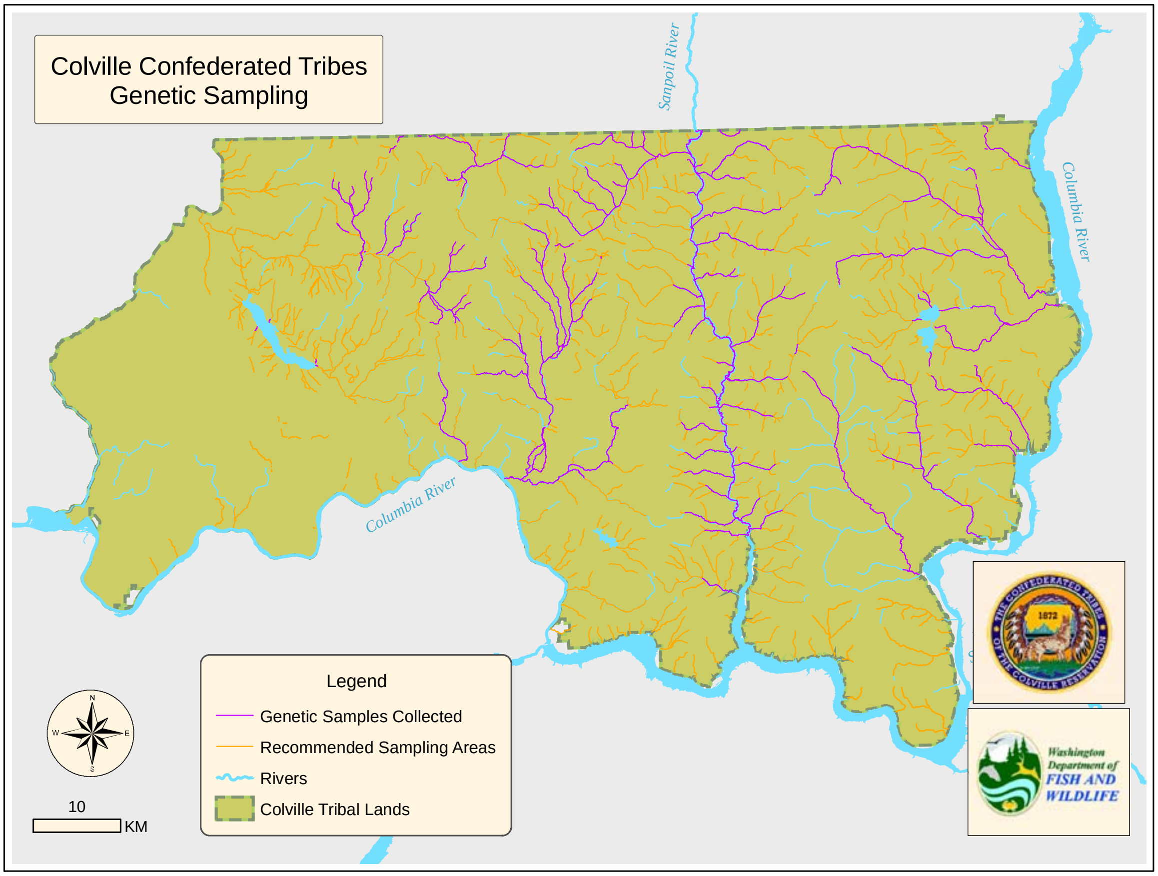

Figure 8. Colville Tribes' recommendation for future genetic sampling of redband trout.

Washington State Department of Fish and Wildlife

With the exception of the Palouse area, WDFW district biologists expect that redband trout were historically distributed everywhere east of the Cascade crest (Figure 8). They expect that in the current day, *O.mykiss* distribution includes historic areas as well as non-historic areas where hatchery stocking of coastal trout has occurred (Figure 9). To verify the presence of native redband trout, genetic sampling is recommended for nearly all streams (Figure 10). Recently, genetic sampling has occurred in two systems, the Spokane River (Small et al., 2007) and Icicle Creek (Gayeski, personal communication, Washington Trout, 2009). High priority systems to sample were identified by WDFW's Fish Program district biologists (Tables 2 and 3).

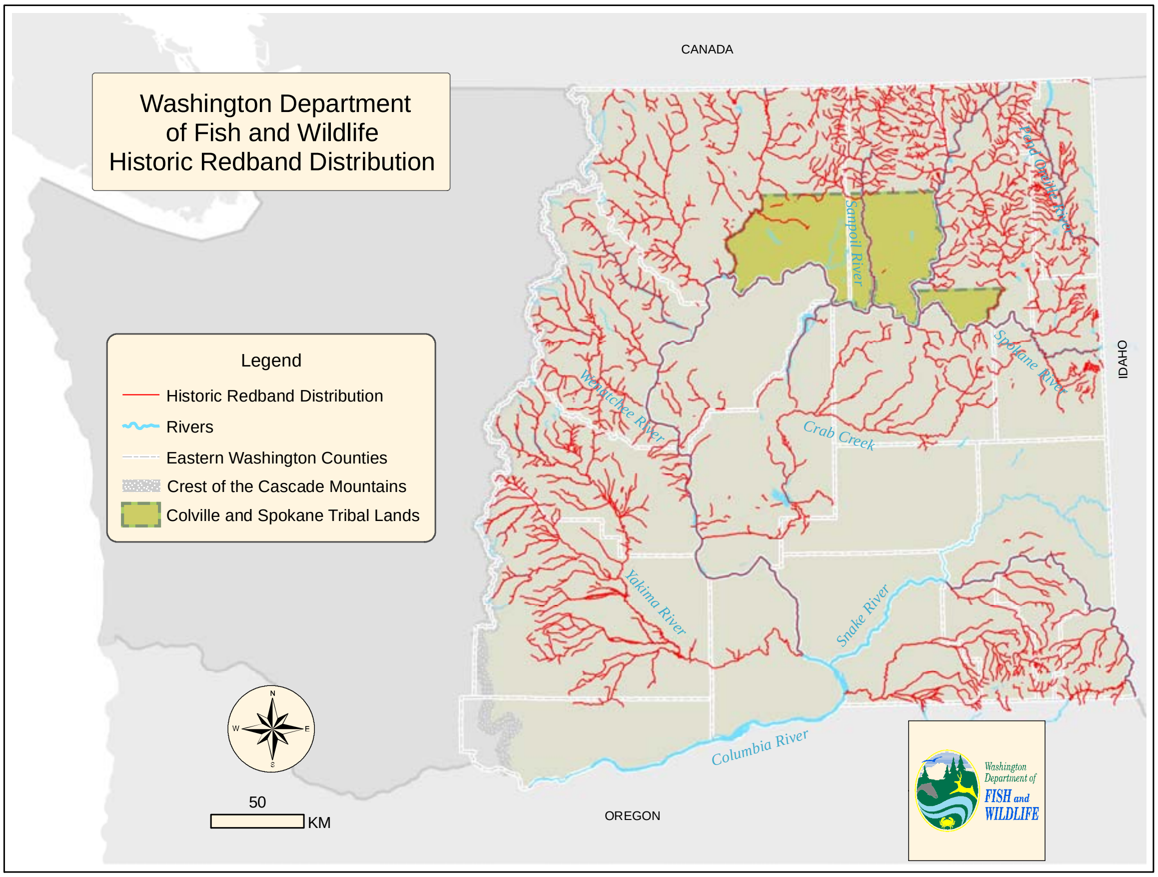

Figure 9. Washington State presumed historic distribution of redband trout.

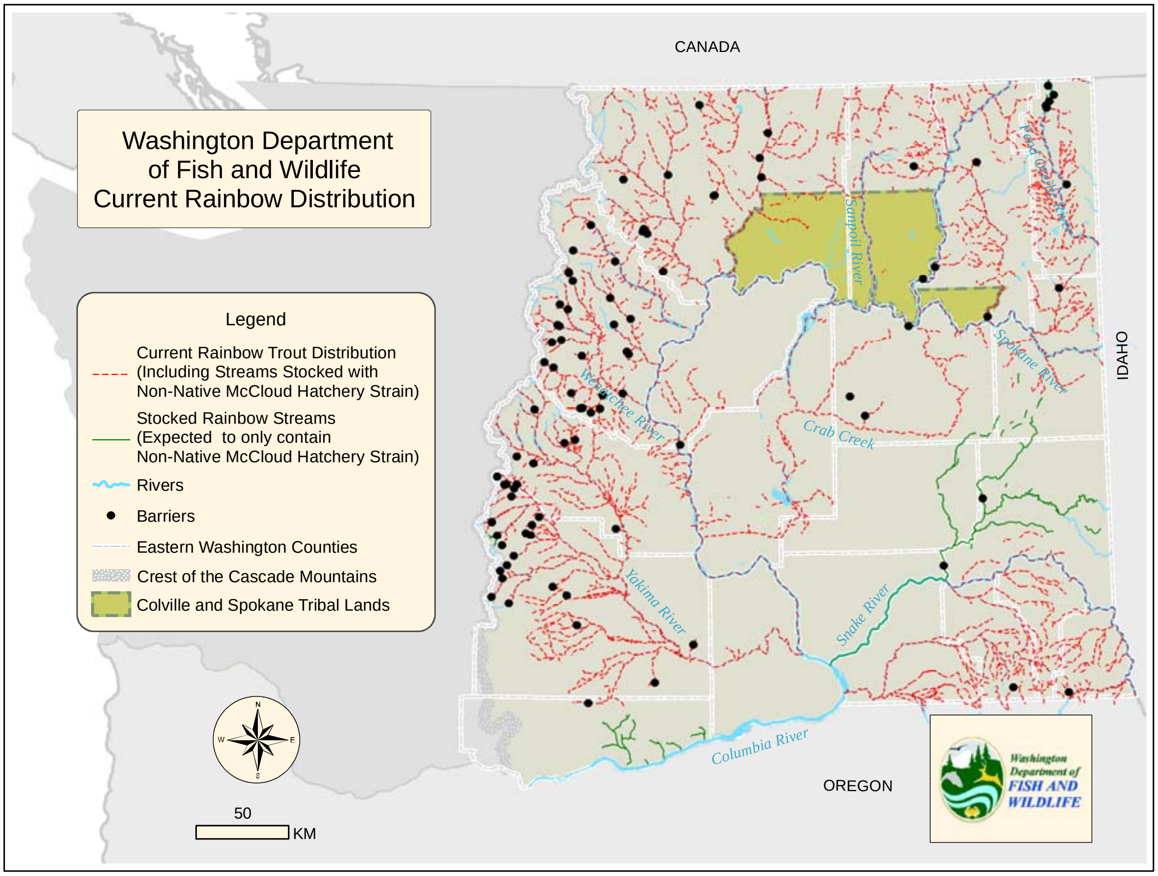

Figure 10. Washington State current rainbow trout distribution, much of which has been stocked by WDFW with non-native McCloud Hatchery strain. With the exception of a few rivers, none of these fish can be distinguished as the subspecies redband because genetic analysis has not occurred.

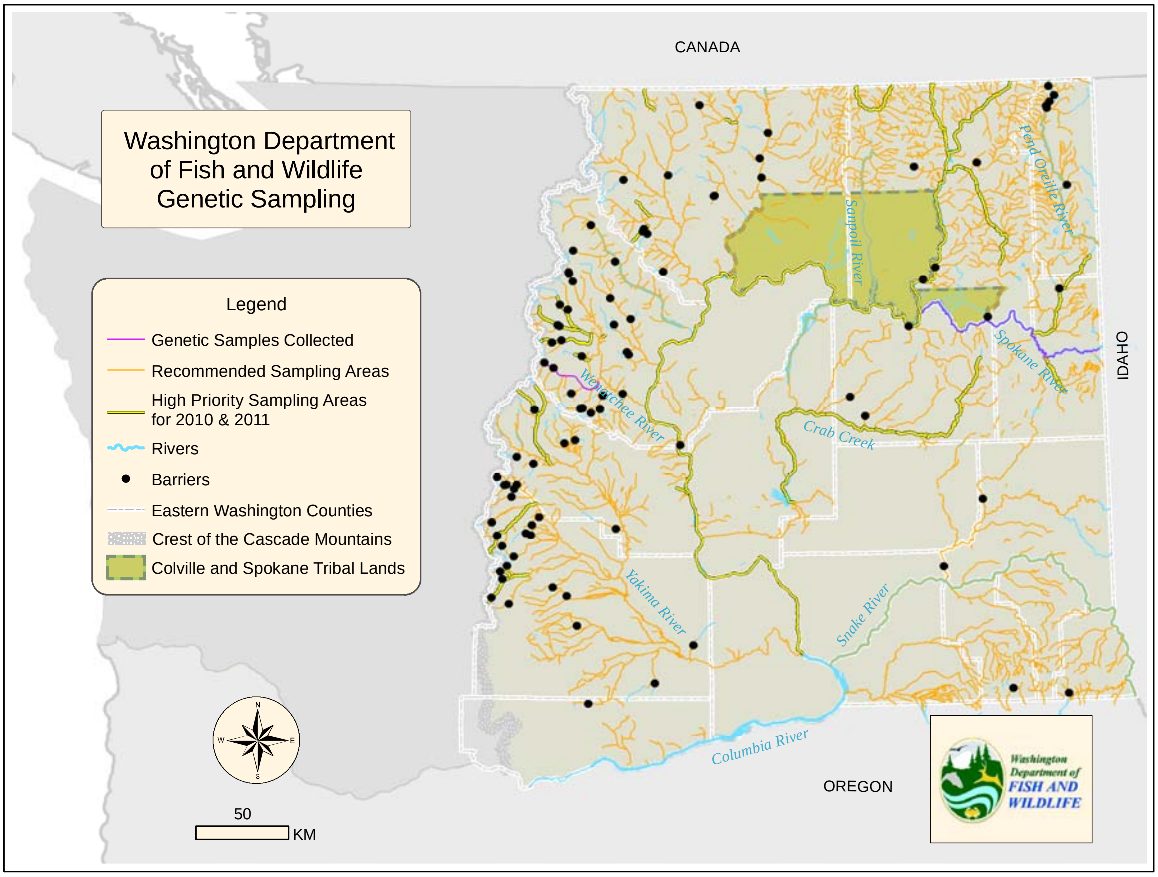

Figure 11. Washington State recommendation for future genetic sampling of redband trout, including high priority areas.

Table 2. High priority streams to sample for genetic presence of native redband trout during 2010 and 2011.

Stream	County
Kettle River	Stevens
Colville River	Stevens
Upper Cle Elum & Waptus rivers	Kittitas
Upper North Fork Tieton River & Clear Creek	Yakima
Toats Coulee	Okanogan
Little Bridge Creek	Okanogan
Upper Little Wenatchee River	Chelan
Upper White River	Chelan

Table 3. Additional streams to sample for genetic presence of native redband trout as funds become available.

Stream	County
Crab Creek	Lincoln,Grant
Columbia River above Grand Coulee Dam	Various
Sanpoil River	Ferry
Spokane River & Little Spokane River	Stevens, Spokane
Hangman (Latah) Creek	Spokane
Upper Bumping River	Yakima
Skookumchuck Creek	Kittitas
West Fork Buttermilk Creek above barrier falls	Okanogan
Upper Nason River	Chelan
Upper Chiwaukum Creek above natural falls	Chelan
White Pine Creek	Chelan
Ashnola River	Okanogan

Objective 2: Field test a protocol to assess redband trout presence in Washington State.

Spring, Toats Coulee, and Quilomene creeks were sampled based on geographic diversity and recommendations from WDFW's district biologists. Habitat data collection took about two hours and included site description data to describe the location and gross characterization of the stream we sampled. This information could be used to analyze the influence of habitat on native salmonid presence, abundance, and growth.

At Spring Creek, reconnaissance was done for all EMAP sites but only one site had water present. On September 15, 2008, 90 trout were collected, 62 on the first pass and 28 on the second pass (Table 4). Based on visual observation, 85 were identified as *O.mykiss* and five were identified as trout fry.

Table 4. Spring Creek fish data for forklength, total length, and weight.

Species	Forklength (mm)			Total Length (mm)			Weight (mg)		
	Average	Range	S.E.	Average	Range	S.E.	Average	Range	S.E.
O. mykiss	101.9	53-184	2.58	107.3	55-194	2.73	14.32	1.5-72.4	1.20
Trout Fry	61.2	55-73	3.26	63.6	57-76	3.41	2.66	1.9-4.0	0.380

We sampled the first site on Toats Coulee on September 18, 2008. We collected 66 fish total: 20 on the first pass; 23 on the second pass; 15 on the third pass; and 8 on the 4th and final pass. Based on visual observation, 43 were identified as *O.mykiss.* The remainder included 19 brook trout (Figure 13), 3 fish that showed characteristics of both brook and bull trout (Figure 14), and one trout fry (Table 5). On September 19, 2008, the second site was sampled. We collected 65 fish total. Based on visual observation, 64 were identified as *O.mykiss*, and one as a brook trout (Table 6).

Table 5. Fish data collected from the first sample site on Toats Coulee during 2008.

Species	Forklength (mm)			Total Length (mm)			Length	Weight (mg)			Weight
	Average	Range	S.E.	Average	Range	S.E.	N	Average	Range	S.E.	n
O. mykiss	161.8	92-220	5.12	169.0	96-228	5.21	43	57.4	16-114	6.18	20
Trout Fry	46.0	46	0	48.0	48	0	1	1.0	1	0	1
Brook trout	160.2	100-204	6.34	167.4	105-212	6.68	19	55.8	33-93	7.14	8
Unknown brook/bull trout	125.0	101-150	14.2	136.7	115-166	15.2	3	No data			0

Table 6. Fish data collected from the second sample site on Toats Coulee during 2008.

Species	Forklength (mm)			Total Length (mm)			Length	Weight (mg)			Weight
	Average	Range	S.E.	Average	Range	S.E.	N	Average	Range	S.E.	n
O. mykiss	142.0	84-197	3.65	149.2	89-205	3.78	64	35.37	6.4-84.7	2.42	64
Brook trout	115	115	0	121	121	0	1	18.4	18.4	0	1

Figure 12. Fish collected at first Toats Coulee sampling site and identified as a brook trout. (Photo by Michael Mizell).

Figure 13. Fish captured at first Toats Coulee sampling site and identified as an unknown brook/bull trout. (Photo by Michael Mizell).

The sampling of Quilomene Creek was problematic. After deciding to sample one of four rivers that were expected to hold redband trout in Kittitas County, we learned from a local research scientist (Baldwin, personal communication, WDFW, 2008), that all of these creeks potentially had anadromous steelhead. To meet the grant requirements that we only conduct fieldwork in areas where anadromous fish were not present, we looked at a GIS barrier layer. Based on the WDFW GIS barrier layer, Quilomene Creek seemed the most promising for having an anadromous barrier, because a manmade pond appeared to block off anadromous access to the creek's headwaters. During reconnaissance, we experienced difficulty with access. Although access appeared possible for both sides of the creek using a four wheel drive vehicle on primitive roads, we learned that both roads were washed out within about four miles of the creek. Consequently, no data were collected.

Figure 14. Quilomene Creek, Kittitas County. The small lake was created to provide water for elk and the structures that create it are expected to form an anadromous barrier to redband trout that are above it. Although four wheel drive roads lead to the site on both sides of the creek, their condition makes ATV use necessary for sampling redband trout. (Photo by Michael Mizell).

Figure 15. Spring Creek, Lincoln County. True to its name, this creek originates from a spring and travels adjacent to a highway and creates a green oasis in the midst of wheatfields near the city of Spokane, Washington. Only one site could be sampled because the other sample sites did not contain water during September. (Photo by Michael Mizell).

Figure 16. Toats Coulee, Okanogan County. Electrofishing for redband trout on Toats Coulee, near Omak, Washington. (Photo by Michael Mizell).

Figure 17. Data collection at one of two sample sites on Toats Coulee. (Photo by Michael Mizell).

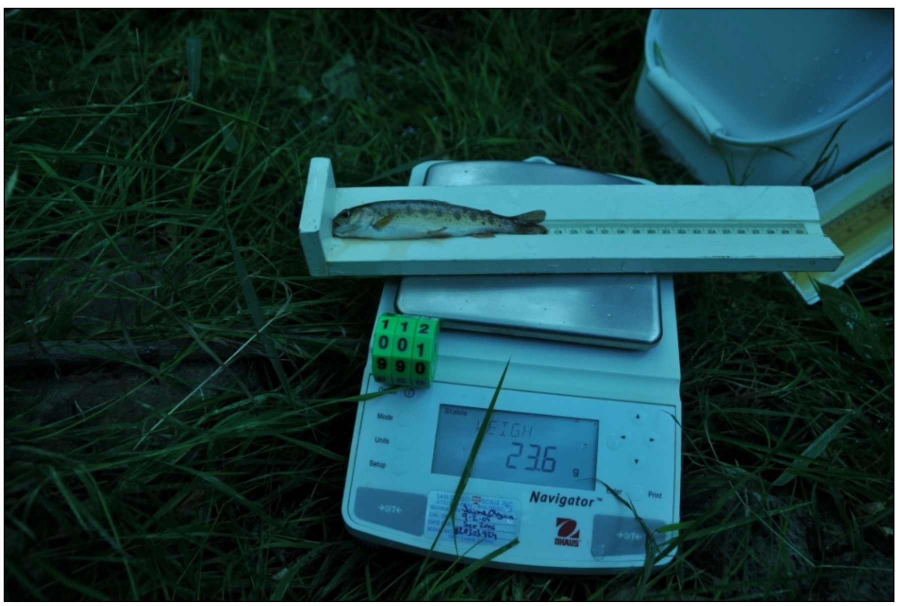

Figure 18. We collected biometric data for each trout; this includes forklength, weight, a DNA sample, and a photograph of each fish sampled. In addition, photographs were taken for each fish to assist with species identification and document any visual injuries. (Photo by Michael Mizell).

1.4 Discussion

The information we obtained from this study was presented at the 2009 Redband Trout Multi-agency Workshop held in Portland, Oregon.

Objective 1: Document what is historically and currently known about redband trout presence in the Columbia Plateau region that covers Washington State and the CCT and STI tribal lands and identify streams where further genetic analysis needs to be done to assess the presence of redband trout.

WDFW

From the distribution maps, it is clear that much hwork needs to be done to verify native redband trout presence in Washington State. At best a few pockets of areas have been genetically evaluated for presence and abundance. Areas where this has been done include the Spokane River area (Small et al., 2007) and recently, Icicle Creek (Gayeski, personal communication, Washington Trout, 2009). Current efforts are also underway to evaluate the *O. mykiss* in the Yakima River (Blankenship, personal communication, WDFW, 2009). Recently in Lower Crab Creek, a native juvenile redband trout was captured in a fish trap (Burgess, personal communication, WDFW, 2009) along with four hatchery *O. mykiss*. A GIS database for redband trout will be used to coordinate this and future information for redbands in Washington State. This should allow researchers an overview of redband distribution and ultimately, combining the data with that of Oregon and Idaho will provide an understanding of the Columbia Plateau redband trout.

It is expected that there are at least two populations of redband trout in Toats Coulee in the Okanogan (Proebstel et al., 1998). This combined with the recent finding of at least three populations in Icicle Creek (Gayeski, personal communication, Washington Trout, 2009) suggest that for future fieldwork, investigators should prepare to look for multiple populations in each watershed. Currently, geneticists recommend at least 48 samples per system for population analysis. For multiple populations in one system, that sample number may well increase to 48 samples per sampling reach.

For the historic and current distribution maps, we assume that native redband trout are present, but ultimately genetic analysis is required to ensure that hybridization or replacement with hatchery plants of rainbow trout has not occurred. The hatchery records for the stocking of O.mykiss began as of 1909 (Henderson, personal communication, WDFW, 2009).

Currently, there is a native redband trout hatchery program where WDFW collects gametes from Phalon Lake trout, rears them at the Colville Hatchery, and releases them in Pend Oreille and Stevens counties. However, this program is planned to be disbanded, in part because Phalon Lake redbands originate from upper Kettle River tributaries and biologists recommend not stocking them into other systems because of the potential for 1) introducing genetics that may not be beneficial to populations and 2) diluting the population genetics of native *O. mykiss* that may already be present.

Because detracting factors to redband population persistence include habitat degradation, fragmentation, and non-native species introductions (Thurow et al., 2007), we recommend efforts be made to convert the hatchery resident *O. mykiss* to a native program, continued efforts be made to reduce habitat degradation and fragmentation, and that field sampling to determine presence via genetic methods and abundance occur. In addition, future work on redband trout in the study area (Figure 1) should include tribal groups such as the Yakama and Kalispel tribes. We also expect that partnerships with the United States Forest Service and the United States Fish and Wildlife Service will prove beneficial. For instance, in the Okanogan area and Yakima Basin, much of the land is owned by the USFS and their staff should be consulted about potential redband trout streams. Further, for particularly challenging terrain to access streams such as the Ashnola, where pack animals are expected to be necessary, the field experience of USFS personnel in this region should prove very helpful.

Assessing historic distribution can be done in various ways. For this project, we showed historic distribution based on Behnke's (1992, 2002) definition of all native *O. mykiss* east of the Cascade Mountain crest. Thurow et al. (2007) assessed historic distribution using statistical models and a classification tree. Following his work on historic distribution, Thurow et al. (2007) predicted redband trout presence and the likely status of redband populations within subwatersheds of the Interior Columbia River Basin. Although we prioritized sampling areas (Tables 2 and 3) based on recommendations from district biologists, another approach would be to begin with the systems predicted by Thurow et al. (2007). Yet another method that could be used to identify historic distribution is Intrinsic Potential (IP) analysis. The IP workshop attended by one of us (Ashbrook, 2008) revealed that while this method of assigning historic distribution holds promise, it required more time than the current grant allowed. Because so much work needs to be done to assess current presence of these fish and because genetic analysis to evaluate the potential for multiple populations in individual systems will be time consuming and expensive, we recommend that future work focus on fieldwork and genetic sampling instead of historic information.

CCT

Of the area that this study covered, the lands owned by the Colville Tribes have received the most distribution and population assessment work. After determining they had native redband using genetic analysis (Small and Dean, 2006; Young et al., 2008), the Tribes changed their hatchery redband program from using McCloud strain redband, a coastal variety, to local native stocks. The CCT first discovered redband in 2001 and immediately started a broodstock at the Tribal hatchery. In 2008 there were sufficient egg take from the broodstock to meet all the planting needs, with extra fry available for use by other agencies. Currently (2009 and 2010), the WDFW Colville Hatchery, which produces *O. mykiss*, is funded by the CCT.

STI

The STI, in partnership with various agencies as part of the Joint Stock Assessment Project (JSAP; Butler and Crossley, 2005), has been collecting genetic samples and archiving them so that they can be analyzed as funds come available. As part of this process, abundance estimates of O. mykiss are also occurring.

Objective 2: Field test a protocol to assess redband trout presence in Washington State.

The WDFW does not have explicit management plans associated with redband trout, largely because of the lack of information about this *O. mykiss* subspecies. This field sampling effort was the first step in developing a coordinated plan to determine presence of redband trout in Washington State.

Valuable information was learned from the fieldwork, from conversations with local biologists, and from conversations with the Idaho and Oregon researchers during the 2008 Redband Trout Workshop. Below are lessons learned and recommendations for future work:

- Determine sample sites by placing the EMAP system on the NHD 100k river layer. Currently, WDFW does not use this layer so a first step will be to transfer over to this water layer. Work is currently underway to do this for other agency projects so cost efficiency is likely.

- Of the three systems we attempted to field sample during 2008, Spring Creek contained the most *O. mykiss*. From 1935 to 1985, WDFW stocked 23,173 *O. mykiss* and 48,600 brook trout (*Salvelinus fontinalis*), so these fish could be the progeny of these hatchery plants. Genetic analysis needs to be done to determine if these are hatchery origin fish, if they are hybrids with native redband trout, or if they are native redband trout. Because the other nine sites we planned to sample were dry, it is likely the portion of Spring Creek that remains wetted throughout the year ensures the survival of these trout and that it will vary in fish abundance depending on the season.

- The EMAP system is beneficial for collecting a random sample that is spatially distributed and allows abundance estimates. However, for each new sampling site, reconnaissance is needed to determine access, whether the area contains water, and any safety concerns, and this can be time consuming. Not including the travel time to go from our home office (Olympia) to the site, the time for reconnaissance ranged from a half day (Spring Creek) to two days (Quilomene Creek). Consequently, we recommend using EMAP to select sampling sites (with adjustments made as needed based on field reconnaissance), and that those same sites become index areas for periodic assessment of redband trout. This approach could be combined with the sampling of new sites as time and funds allow so that changes outside of the index areas can be documented. For abundance estimation, about twenty sites need to be sampled for each system. Because of the time required to sample twenty sites, researchers may want to sample fewer sites and plan to estimate abundance on a regional scale.

- To reduce travel time, we recommend that fieldwork for future redband trout studies have a central meeting place located in Eastern Washington. This could be a WDFW hatchery or a district or regional office. We recommend that a field crew of up to ten people be hired, with teams of two people assigned to sample streams each week. A field supervisor can be hired to alternate with the teams of two and ensure consistency in data collection. Time must also be planned for researching historical stocking records and determining what systems have been sampled previously for other studies.

- Plan to spend time reviewing historical hatchery stocking records or have this information incorporated into a redband GIS geodatabase. Native redband trout have been found to persist despite hatchery plantings (Small and Dean, 2006; Small et al., 2007; Young et al., 2008; Gayeski, personal communication, Washington Trout, 2009). This historical information may be used by biologists to prioritize stream sampling. For example, the Spokane Tribe of Indians has prioritized the collection of salmonid DNA samples from systems where the potential of hybridization with hatchery planted fish is expected to be minimal
(Butler, personal communication, STI, 2009).

- During the 2008 fieldwork, we collected biological data for every fish. For future field sampling, we recommend sub-sampling when more than 48 fish of the same species are captured. For genetic analysis, about 48 samples are needed for each location where population identification is desired. Collect photographs of each fish. Photographs will allow us to see visual differences that can exist between redband trout in different systems and they also may be used for future morphometric analysis. Microsatellite DNA analysis of 16 loci should be done to clarify if the population is native.

- We were unable to sample Quilomene Creek but later learned that a few of the other nearby streams had been sampled earlier in the year as part of another project (Cummins and Anderson, 2009). Here the biologists collected about eight *O.mykiss* tissue samples for genetic analysis. The fish were collected at the headwaters, the location where redband trout are most likely to be present. Local projects such as this, although they will not provide random collections of redband trout, should prove cost effective for increasing our knowledge of redband trout distribution

- Document whether the flow is at peak, minimal, or average flow for each system when it is surveyed. The 2008 field sampling occurred during low flows. At Spring Creek, all but one of the sample sites was dry. The site we sampled contained many fish and we expect this location provides a refuge for fish during low water and high temperature conditions. At high flows, which are difficult to sample, a much different picture of redband trout distribution is likely to emerge for Spring Creek. A system like Toats Coulee, which remains wetted throughout the year, is less likely to have the abundance fluctuations in particular river sections.

- We did not collect scales because they can be inaccurate and imprecise for aging redband trout (Schill, 2009). Consequently, we determined to only collect scale samples if fish we sampled died, because this would enable us to also collect otoliths for age verification. Fish sampling took about two hours for the snorkel survey and about three hours for the electrofishing and data collection. Electrofishing is known to be size selective (Reynolds 1996). For future work, we recommend assigning redband trout that exceed or equal 100 mm in length to the adult category (equal to or greater than 1 year of age.)

- Because of the enormity of work to be done to assess redband presence, we have suggested the next phase of streams to field sample (Figure 17; Tables 2 and 3). However, when funding is secured, we recommend that care be taken to incorporate suggestions by existing management plans. For example, redband assessment of Lake Roosevelt (including the mainstem and the Spokane River below Little Falls Dam) and the Upper Columbia River above the impoundment is a priority of the Lake Roosevelt Management Team and the Spokane Tribe of Indians.

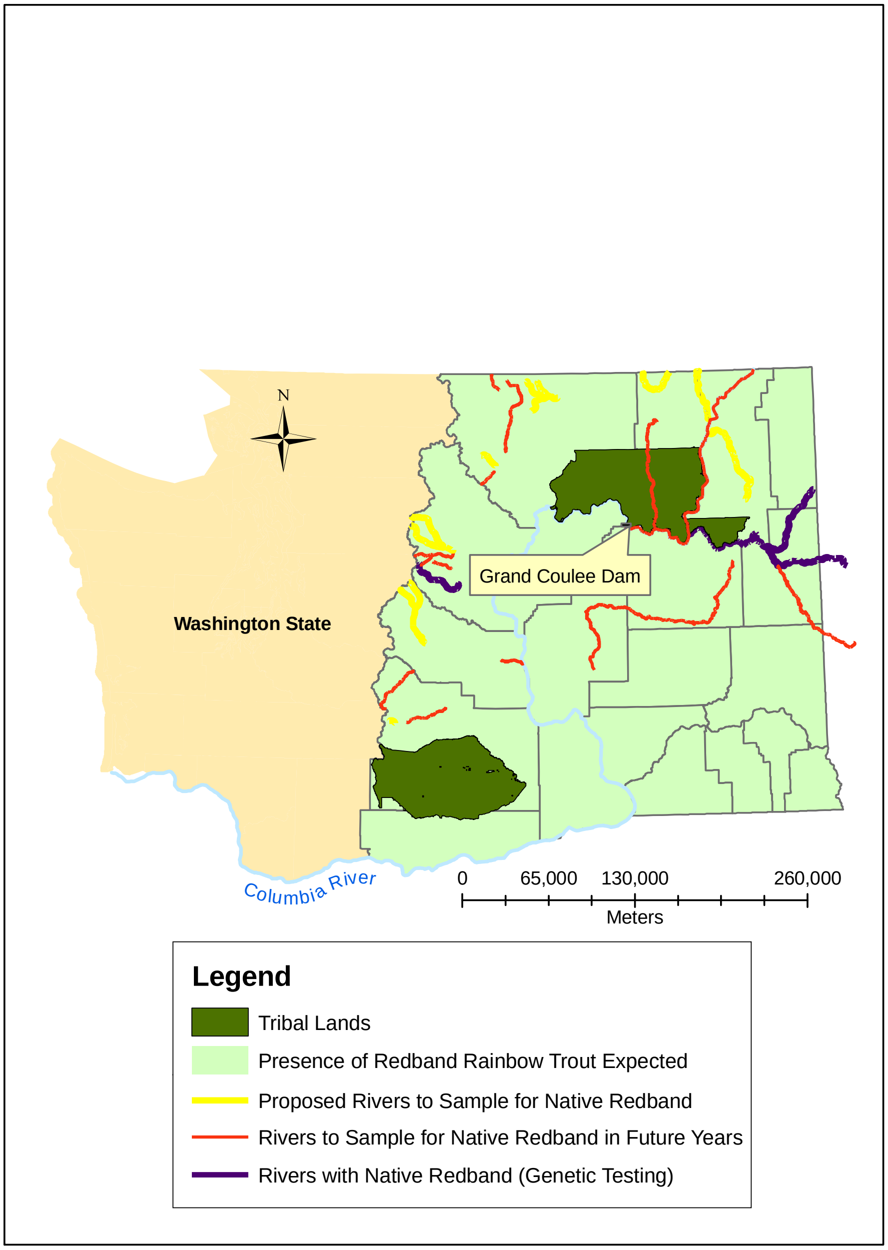

Figure 19. Map of Washington State and tribal lands with rivers to be sampled for native redband trout during the next phase identified.

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