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Yakama Nation Pacific Lamprey *Entosphenus tridentatus* Restoration Project

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CONFEDERATED TRIBES AND BANDS OF THE YAKAMA NATION

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EXECUTIVE SUMMARY

This report summarizes the effort to achieve greater coordination and strengthened partnerships between fisheries managers to save Pacific lamprey (*Entosphenus tridentatus*) populations. This research is in cooperation with Bonneville Power Administration (BPA) under the 2008 ACCORDS agreement. From the ACCORDS decisions, the Yakama Nation Pacific Lamprey Program (YNPLP) was developed with a three phase approach with Phase I occurring in 2009 – 2010. In general, the work completed this last year centered on: building this program, regional survey and data input coordination, developing relationships with local and regional entities and refine our YNPLP objectives (Appendix A). The eight objectives outlined in Appendix A is laid out to help us document the following: distribution and relative abundance of lampreys, identify recruitment, note limiting factors, identifying areas in need of rehabilitation interwoven with adaptive management. The goal of the Yakama Nation (YN) is to restore natural production of Pacific lamprey to a level that will provide robust species abundance, significant ecologic contributions and meaningful harvests within the Yakama Nations Ceded Lands and in the Usual and Accustomed areas. There are 8 objectives that will help the YN in achieving and all play a significant role in developing and implementation of the YNPLP.

Historically, the 14 Tribes and Bands that make up the YN have always fished for lampreys from time immemorial. Because of this fact, Traditional Ecological Knowledge (TEK) oral interviews were done from tribal elders, fishermen and tribal families. This knowledge was very useful in gaining baseline life history information. TEK helped more accurately identify eras when Pacific lampreys were abundant, where harvest took place, run timing at traditional fishing areas near rapids, crevices, and falls of rivers and streams. TEK helped exploit historical information from tribal fishers families who would no more about the historical locations other than the Yakama fishers and families (who value them). Traditional fishing techniques today are still being utilize with gaff hooks, dip nets, and by hand. Yakama people not only helped establish information of two run timing events, but also shared larval lamprey cycles by observations regarding activity in sand muddy depositional areas, and within large woody swimming areas. These observations occurred throughout the geographical range of the Columbia River Basin (CRB) pre-hydro dam eras. This project performance period report has given both historical descriptions as well as most current information to complement and identify new baseline information. Minimal information was found on the life histories for the Pacific lamprey, River lamprey (*Lampetra ayersi*), or Western Brook (*Lampetra richardsoni*) in the Klickitat River in western society manuscripts. To help us understand the status of lampreys in the Klickitat we gathered multiple samples of ammocoetes to help us identify each specific species. External morphological characteristics were used to identify ammocoetes to genus (Goodman et al. 2008). Little is known about the population status, biology or ecologic relationships of Pacific lamprey within the Yakama Nation Ceded Lands (YNCL figure 1), and areas of Usual and Accustomed territories. It is apparent that the populations throughout the YNCLs are on a markedly downward trend. Therefore, the project objectives are as follows: 1) continue collecting and reporting critical information to assess status, abundance and distribution along with other biologic characteristics of lamprey, and 2) identify known and potential limiting factors for Pacific lamprey within the Klickitat River subbasins. This work represents the first attempt in this basin to examine status and crude abundance estimates in larval lamprey.

Using aerial maps and GIS software sample sites were marked off every 2-river kilometers, 54 sites were examine up to RK 70, then subsamples occured randomly up to RK 145 (McCormack Meadows and Diamond Cr.). Six-hundred eighty six (686) larval lampreys were captured during the surveys, the minimum length being 20 mm and maximum length being 125mm, with an average of 64 mm. Most of the larval were Pacific lampreys in the lower river kilometers and decreased as we moved upstream. The distribution of larvae was found up to river kilometer 69.5 in the depositional areas. Larval distribution in the Little Klickitat subbasin was patchy and limited to the lower reaches of the stream. Pacific lamprey larval densities were highly variable in the lower Little Klickitat, and we did not find any above river kilometer 6. There was evidence found however, of Western Brook (*Lampetra richardsoni*) sub-population at RK 26, 28, and 29 respectfully (n=49).

There was no evidence found of any River lamprey (Lampetra ayersi) present in our findings, and as a direct result from this research, we have identified presence of lampreys in the Klickitat subbasin.

This study is one of several Pacific lamprey juvenile surveys to be completed. We plan to continue this work in the Yakima River and reservation areas. Over time, as the tribal Program grows in experience and regional coordination increases, we intend to expand field surveys to other rivers and streams and rivers of the Wenatchee, Methow, Entiat, and Crab Creek subbasins. Throughout this timeframe, the YNPLP will continue local and regional coordination with key parties. Those agencies and individuals interested in lamprey restoration will be primary means to be able to gain higher levels of efficiency and effectiveness toward achieving our goal.

ACKNOWLEDGEMENTS

We thank the following for their assistance: Yakama Nation Tribal Elders & members, Yakama Nation General & Tribal Councils, Cultural Resources, Department of Natural Resources, Fisheries Resource Management & Yakama Klickitat Fish Projects Staff, Confederated Tribes of the Umatilla, Walla Walla, Cayuse Tribes - Lamprey Staff, Confederated Tribes of Warm Spring Reservation of Oregon - Lamprey staff, Columbia River Inter-Tribal Fish Commission, Dr. Carl Schreck, and Li, Dr. Samantha Chisholm-Hatfield - Oregon State University, Dr. David Close, both Washington & Oregon Department of Fish & Wildlife, R. D. Nelle, Christine Luzier, and Howard Shaller - Unites State Fish and Wildlife Service, Dr. David Close - University of British Columbia, Bureau of Reclamation, John Crandell - Wild Fish Conservancy, and Dave Roberts, Peter Lofy - Bonneville Power Administration, and Stan van de Watering.

SECTION I

Historical, Traditional Ecological Knowledge (TEK), status and what is known of Pacific lamprey *Entosphenus tridentata* (formerly *Lampetra tridentata*) in the South central Washington.

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INTRODUCTION

The Pacific lampreys (*Estophenus tridentatus*) were, and still are, important to Native Americans throughout the Pacific Northwest. These fish are native to the Columbia River basin, spawning hundred of kilometers inland within the states of Washington, Oregon, and Idaho (Kan 1975; Hammond 1979; Vella et al. 1999). Both current and historical accounts from many Columbia River tribes utilized this fish for medicines and ceremonial purposes, and are still considered a delicacy by many. These fish are still very important to the YN people and is the driving force behind this research, and which will ultimately lead to Pacific lamprey restoration within the Confederated Tribes and Bands of the Yakama Nations (YN) Ceded Lands (**figure** 1) and Usual & Accustom Harvest Areas Rivers and streams.

Figure 1 Map of the Yakama Nation Ceded Area and Reservation

Since time immemorial, the Fourteen Bands (Palouse, Pisquose, Yakama, Wenatchapam, Klinquit, Oche Chotes, Kow way saye ee, Sk'in-pah, Kah-miltpah, Klickitat, Wish ham , See ap Cat, Li ay was and Shyiks) who make up the Yakama Nation, have shared a commonality utilizing and taking care of lampreys. Now following in that tradition are a number of regional government agencies of

Washington and Oregon Departments Fish & Wildlife, United States Fish Wildlife Service, Army Corp of Engineers, Bureau of Reclamation, US Geological Service, and Non-government organizations. The concerns each of the organization share, is the declining populations of lampreys is evitable. Since the mid 1960,'s the tribes of the Columbia River Basin have noticed the declines from previous eras and often documented this during tribal council meetings, yearly ceremonies, and to their fisheries programs, but funding always fell short to assist this issue.

Since the Northwest Pacific Power Council governs and encourages the Bonneville Power Administration to work closely with local tribal governments in resource management issues, implementing traditional ecological knowledge along with western science has become essential in modern society.

CULTURAL SIGNIFICANCE

Historically, Yakama people harvested adult Pacific lampreys (eels) based upon what western culture defines as river morphology, indicating the optimal location for eels harvesting. Traditional fishing areas occurred in rapids, crevices, and falls of rivers and streams. Due to the lack of literature relating to eels in Klickitat, Yakama, Entiat, Wenatchee, Methow Rivers, and Crab, Rock, Pine Creeks, a preliminary study of TEK from tribal members is appropriate and ongoing. Tribal elders and members have indicated through oral TEK, sites that were once prevalent, but are currently not passable, or have been inundated. These sites include but are not limited to: Kettle Falls, (Columbia River), Spokane Falls (Spokane River), Wenatchee Rapids down to Priest Rapids (Columbia River), Palouse Falls (Palouse River), and Celilo Falls. As the eel numbers remain low, harvest can only occur for ceremonial purposes until sustainable practices and implementation of restoration actions to foster increased eel populations.

The Yakama Nation currently continues to practice and carry on traditions and languages as best they can given the influences of western society. Today, oral histories from earlier eras help to validate TEK as an important component of how western society interprets tribal peoples (Barkes et al. 2000). Understanding natural ecosystems is the manner in which the Yakama people co-evolved with their surrounding environments. TEK can be used as a tool to help understand the life histories and historical status in the surrounding subbasins.

The eels were once an abundant food resource for many of the 14 bands of tribes of the Yakama Nation, and bartered throughout the entire Pacific Northwest (Hunn, 1990). Dried, smoked, or jarred eels were a delicacy for all the Yakama Nation and this fish has always been shared and has been a traditional item. Families would often travel long distances to visit, and eels were used as an honoring food, respecting the family, which was visiting. Eels played an important role in everyday lives of many Yakama elders and young alike. Stories of legends and creation, or times of famine were shared. These stories taught people about the past, and how the eels help people spiritually, as well as fostering the cultural society. One elder reflecting back in time shared "those were the times when the tribal people really cherished the foods . . . they took good care of them and when fish were plentiful all the time". It is because of implementing knowledge such as this that they have been able to maintain a way of life that has been carried for thousands of years. When an elder teaches younger people, they show the places and show areas when they revisit or go back in time and say "this spot, or that place, and this area was used at this time by these people before these people came here", that is that tradition that continues today. For many tribal people, such teaching techniques are ways to keep our past and our culture a part of our contemporary everyday life. This knowledge is the way our traditional culture and heritage is carried through traditions, ceremonies, language, religion and foods. So by maintaining these teaching techniques, we are reminded daily of our traditional ways through historical accounts, and our beliefs we continue to actively practice these customs, and are reminded of our history and traditions every day. This traditional way of life is emphasize, especially when the seasons change and new food resources come out each spring, summer, fall, and winter.

The elder men in Yakama families taught the younger generation the correct way to harvest eels, to hunt, gather, care for them, and perform ceremonies. These teachings are ensuring traditional ways were carried on. When there is a lack of resource like eels the younger generations cannot learn from experiences to gather (hence a loss of culture is gone). If we lose the eels, the younger generations do not have this option to fish for them anymore, they can learn only by listening to elders about past life experiences. Over thirty years ago, many former Yakama elders have shared that this project should have taken place when eels persisted at the local fishing areas, but their urging was ignored. This project evolved out of numerous discussions with many tribal fisheries staff, and from past Yakama Tribal and General Council men & women.

There was concern expressed during my presentation to the Yakama culture committee to holding onto many sensitive stories and legends they do not want to let the public know. Out of respect, I am leaving out the legends and creation stories about the eels. The cultural committee was concerned about losing traditional knowledge to outside entities is why they informed me to not publish the ladder. I explained how passionate and invested I am in my work to help this fish, and explained how I grew up fishing for eels as a kid living in the lower Columbia River. I knew that I would be able to appease their concerns, because my actions reflect that I am not "just another biologist" coming in to exploit their traditional knowledge. My goal is to help define historical accounts to help obtain baseline information to help define distribution of eels.

The focal point in this section is to conduct oral historical observations from tribal elders and fishers families. There were other strategies followed to obtain as historical coupled current information of lampreys as possible 1) literature reviews, 2) historical accounts with tribal elders, 3) world wide web internet historical hydro counts, and 4) local landowners and farmers while asking for permission to cross their lands to the streams and rivers.

METHODS

Interviews included both tribal elders and non-elders, as it was important to explore the transmission of trans-generational knowledge. Elders provided knowledge they were taught from their elders, as well as their experiences. Many of them have experienced significant changes even within their own lifetimes. Non-elders also shared traditional knowledge that they have been taught from their elders, they also offered new perspectives that intertwined western scientific knowledge with traditional knowledge. While many participants were Yakama tribal members, others had mix ancestry but were members of other affiliated Columbia Basin tribes. Many people felt a connection to the river and the environment, whether by ancestry, location, or upbringing in tribal communities. Therefore, I included participants in the tribal communities of which they expressed a connection or in which they resided.

Semi-directed interviews varied in time, ranging from 25 minutes to 2.5 hours, with the average length lasting an hour; the total number of interview hours equated to more than 167. I began the interviews by explaining the purpose of the interview, how the knowledge would be used, and asked if they had any questions. When I began my interviews I presented each participant with a one-page summary of the Yakama Nation research goals and objectives of this project, and how this project work helped to better understand lamprey distribution in the basin (Appendix A).

Each interview completed had a set of questions that were asked of the interviewee (Appendix A). This Project staff wrote a questionnaire designed to help us better understand the life history and historical status of lampreys. From this questionnaire, we interviewed members and their families on and off the Yakama Reservation. The ages of participants ranged from 35 to 92 years. To encourage participation, the fisheries staff sent out questionnaires to fishing families who were variously located across the lower, middle, and upper Columbia River basin. Information sought is as follows (see appendix A).

RESULTS

I focused my interviews on the men who harvest eels, because traditionally, men's roles in Yakama society are they are the fishermen (historically). The men are the ones who are working on the rivers and streams, and regularly see the fish while they are moving through the systems. I also interviewed women because they too are a part of the process of fishing, preparing fish, and have an equally important role in collecting the eels harvested. I interviewed both men and women who do not currently participate but are part of the knowledge base on historical accounts. These participants provided insight into traditional knowledge and experience that is gained solely/primarily through living a life that revolves around the river. It was also revealing to talk with those who lived on the river and actively fished when they were younger, moved away, and have since returned. Their insight provided valuable pathways to document changes that have occurred on the river over time, and to be able to differentiate what general knowledge is, as opposed to what is learned from spending a lifetime on the river actively utilizing traditional ways.

For the Klickitat subbasin, 167 interviews were conducted, the majority being men and women who grew up on the river fishing throughout the lower, mid, and upper Columbia River. These individuals gave both historical and contemporary accounts of most all the YNCL's areas to fish for eels. The participants were a combination of Yakama religious leaders, elderly, fishermen, and their families. The majority of the fishers had firsthand knowledge as young people growing up during famine years and/or experience coupled with anecdotal evidence, which indicated they remember there were two run times of eels. First runs being during spring freshets around April into May, the second run in the July and August months. In addition to run timing, several elders shared "eels" were dark during the early spring and then noticed a combination of sizes during the second run people noted larger grey, and copper colored "eels" migrating in June and July. These interviews are preliminary and ongoing works and this information did help in aligning western science and traditional ecological knowledge. The fishermen and/or their families are the individuals who best understand the comprehensive patterns of adult migration. The interviews had a common area lampreys were captured at and help confirm the distribution, timing, and relative abundances from assorted lower subbasins including the Klickitat River (Table 1).

TABLE 1.- YN oral interviews of accumulated site locations where Pacific lamprey (PL) were fished, timing, harvest amounts, notice declines, and limiting factors of mid-Columbia River.

Locations	Species	Time	Harvest	Declines	Limiting Factors
Oregon					
Celilo	PL	Apr.-Aug.	1000's	1958	Bonneville/Dalles Dam
Chenoweth	PL	May-July	100's	1966	Human encroachment
Deschutes	PL	July	100's	1965	Tribal policy
Fifteen mile	PL	May-July	100's	1970	Irrigators, Chemicals
Herman	PL	May	100's	1971	
Horsetail	PL	July	50's	1985	
Hood R.	PL	May	50	1962	Dams
John Day	PL	July	100's	1968	Tribal policy
Mill	PL	May-July	100's	1964	People, irrigation, chemicals
Umatilla	PL	May-July	100's	1965	Tribal policy
Sandy	PL	May-July	100's	1967	
Washington					
Chehalis	PL	July	100's	1972	
Klickitat	PL	Apr.-Aug.	100's	1973	
Lewis	PL	June/July	100's	1989	
Smith	PL	July	100's	1968	
Toutle	PL	July	100's	1987	
Washougal	PL	July	100's	1971	Pollution, people
Willamette	PL	August	100's	1972	Pollution, people
Yakama	PL	July-Aug.	1000's	1962	Irrigators, Chemicals

The fisher families are the product of their historical backgrounds; they often use western science of today, in association to their personal traditional knowledge to harvest lampreys (eels) from historical family sites. The majority of the participants believe a that combination of logging, agriculture, hydro dams, large woods in systems, water diversions, road development and over population all have contributed to the loss of lamprey (eels) populations.

Out of respect to the fishers, the majority informed me they did not want their fishing sites exploited nevertheless the majority fished near falls, rapids, and used gaffs.   Participants indicated witnessing both adult lampreys below the train tracks, while other people told of their experiences of lamprey (eels) spawning above Wahciakus and Klickitat rapids back in the 1960's. The majority of elderly participants shared the same highlights of the Klickitat and showed me on my maps, but the most common place to fish was at Celilo. Many all participants engaged in a common bond with their

childhood times of Celilo pre-The Dalles dam era (1957). Many shared stories while swimming they used to observe lamprey juveniles in the mud and sandy beaches and play with them. Timing and locations were mixed from mid to late summers they caught eels. Moreover, a lot of of the elders shared they had to crowd in with the tributary fishers (i.e. 3 mile, Deschutes), and waited in line to catch eels, then over time the tribes began enrollments and disallowed Yakama members to fish in those places by tribes new laws. People began to fight, sell and steal eels, or quit entirely, but many of the tribal fishers reflected to times of the past to where eels were harvested. This brought back fishing places in the lower Columbia River basin such as the Chehalis, Lewis, Toutle, and Washougal rivers. Many Yakama Tribal people still returned to the places of their ancestors to fish for eels but none is there any longer. To this very day, many of the Yakamas do migrate to the lower Columbia as their ancestors had done before them to exercise fishing in the Usual & Accustom places.
Most all the discussions with eels shared a commonality with salmon, suckers, sturgeon, white fish, and trout were, and still are, the primary foods of the tribal river people. Other fish mentioned in the interview conversations were western brook, mussels, northern pike minnows, red side shiners; these fish too had stories and legend stories associated with them. From the information provided through interviews, we made our planning and preparation for the larval lamprey distribution study.

DISCUSSION

Many of the interviews for this report were informal, and came out of observation and experience from fishing families living along the Columbia River. Many of the individuals who grew up along the river or Celilo then later moved back to their family's home on or near the Yakama Nation Reservation. Additionally, some participants preferred to have an informal conversation as compared to a more structured interview. I spoke with 167 participants informally. Often both informal and semi-directed interviews occurred in unusual locations or unexpectedly. Conversations often arose at the Longhouses, the tribal agency, or at tribal in-lieu sites along the Columbia River while I was traveling to or from the fishing grounds. These interviews were culturally appropriate and information was offered more readily because of the cultural setting. I found that my informal interviews with the fishermen or other local people often filled in missing pieces of my data western science could not provide. I had the opportunity to learn indirectly about their views and traditional knowledge on lamprey (eels). Though my other interviews were only semi-directed, the makeup of these informal discussions allowed participants to move beyond the given topic, and in essence, they became the connections that helped make the informational picture regarding lamprey (eels) more complete.

The measureless amount of knowledge shared regarding Pacific lamprey (eels) of the mid and lower Columbia was immense. The discussions and topics that came out of the Yakama eel fishers reflected the range and breadth of conflicting cultures of western society and traditions. The analysis conveying the importance of eels to the tribes was extremely lifting for this program. Due to the major losses in eel across the entire Columbia River Basin , the younger generations have not entirely had the opportunity to fish for eels, hence a loss of traditional culture is inevitable. During an interview, one elder told me "we may be witnessing the last generation of this fish" with tears in his eyes. This loss of eel populations and culture is what drives this program to restoration of eels for our younger generation to experience. Learning what our tribal leaders and elders have enlightened this project thought on how mainstem culture has started taking so many of the Creators gifts for granted. The elders and Longhouse leaders of the Yakama to this very day thank the Creator during the seasonal feasts of the foods that we have traditionally survived on. I am very optimistic the restoration efforts time has arrived and that there is strength in numbers to meet the challenges. It is to a point that a group effort to develop and accomplish “Action Plans” is required in order to succeed. Implementing action plan of lamprey into salmon recovery with the same type of goals we could achieve individually. By interviewing the fishing families, we did answer the questions on distribution, timing, relative abundance, and documented how important eels are to the people of the Yakama people. Western society can come across as if they are the only source value of information or understanding. The Yakama fishers and families often see value of science, but science does not see the value of traditions. Now we are prepared to begin efforts on the status in the Klickitat subbasin. Preparation included but was not limited to hiring crews, permits to electro fishing, purchasing necessary field equipment, selecting and marking sampling areas, attending USFWS, CTUIR, and CTWSO training, and studying the latest information on identification.

SECTION II

Distribution and status of both Pacific lampreys (*Entosphenus tridentatus*) in the Klickitat River

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INTRODUCTION

The Pacific lamprey belongs to the Order family Petromyzontidae; Genus: Lampetra, their binomial name is *Entosphenus tridentatus*. They have been found as far south as Baja, California, as north as The Berring Sea, as well as on both Eastern and Western Pacific Coasts (Moyle 2002). The life history of inland Pacific lampreys are complex, they have to pass the gauntlet of hydro dams in the mainstem of the Columbia River. This migration to the inlands extends hundreds of kilometers up rivers and streams. When looking at adult lampreys they can be readily recognized by their large round sucker appearance, which surrounds their mouth, and their single "nostril" on top of their heads are used to intake the chemicals their receptors smell. Their skin is smooth and slimy, thus hard to hold. On each side of their head, they have seven-gill pores extended past their semi large eyes. They are believed to overwinter in deep pools or in dense woody debris logjams, rock crevices, riprap boulder, and/or root wad or gabians (van de Wetering per personal communication April 2010) habitats. They typically spawn in some areas as steelhead and trout. Both male and female construct nests at or near tail out of pools and riffles. Depending upon the geographic range, the female fecundity ranges from about 10,000 - 200,000 eggs and die within 3 - 36 days after spawning (Kan 1975, Pletcher 1963). Larvae hatch in about ~19 days at 15 °C (Pletcher 1963) and emerged from their gravel nests; stream morphology drives the distribution into depositional areas. The larvae spend 4 – 7 years as ammocoetes in fine sediment, pumping water through their branchial chamber, filtering diatoms, algae, and detritus (Beamish and Levings 1991).

As they grow Pacific lampreys transform, their physiology changes from a filter-feeding organism to become parasitic and briefly stop growing until they change into macropthalmia from July through December seasons (McGee 2008). This metamorphosis is critical to development (Youson 1980), perhaps encompassing multiple seasons. Based upon the literature, the time at which Pacific lamprey's complete metamorphosis is somewhat ambiguous (Pletcher 1963, Kan 1975, Hammond 1979; Beamish 1980; Richards 1980; Richards and Beamish 1981; Beamish and Levings 1991; van de Watering 1998; Claire 2003). The same may be true regarding how long they reside in the system with the hydrosystems during migration in the reservoirs of Columbia River Basin. The larval stage has been estimated to range 4-6 years spent in this phase (Pletcher 1963; Kan 1975; Richards 1980) although it may extend up to 7 years (Hammond 1979; Beamish and Northcote 1989). The morphological transformation of Pacific lamprey probably does fluctuate depending on subbasins plasticity, it is estimated that macrothalmia migrate and stay in the oceans ranging from 20 to 40 months in the (Kan 1975). During their ocean phase, Pacific lampreys are parasitic they attach themselves on other fishes by means of their sucker, scrape their host skin with their rasping tongue, and suck their bodily fluids. Very little information is available about their life history in the oceans other than random samples of individuals captured aboard fishing vessels, fish scaring anomalies, fish captures with lamprey in their stomachs (per communication A. Brumo 2010), or from by-catch information (Luke 1992 commercial fishing vessel Bering Sea, Alaska).

To date, there is not very much information available of any of the three species of lampreys in the Columbia River Basin (Graham, J., C.V. Brun 2004). We know two are anadromous species the Pacific lamprey, and the River lamprey *Lampetra ayersi*; a third fish the Western brook lamprey

Lampetra richardsoni a residential fish that spends its entire life in fresh water (Beamish 1980). Many of the same factors that lead to declines of salmonids are probably associated with losses of lamprey populations over time as well (Close per communication). Both salmon and lamprey needs are the same, from rearing habitats, to mainstem passage corridors, to and from the ocean at different temporal and spatial scales. The Columbia River Basin Lamprey Technical Workgroup in 2004 stated the lack of "lamprey friendly" environments, and screening criteria from the projects has been a problem, and remains a problem still today including the Lamprey Passage System on Cascades Island at Bonneville Dam. "Management and conservation needs are useful to consider the distribution and abundance of lamprey at each life history stage" (CBPLTWG 1999). Currently, multiple lamprey projects are going on to address many of the uncertainties, including projects by: Army Corp of Engineers, NOAA, University of Idaho, CTUIR, CTWSO, Kramer, NPT, OSU, and YN. For over 30 years the YN have felt that the ecological, economic, and cultural significance of lamprey have been undervalued and there has always been a need to restore this important species.

Currently, little is known about the population status, biology or ecologic relationships of Pacific lamprey within the Yakama Nation Ceded Lands (YNCL figure 1), and areas of Usual and Accustomed territories. However, it is apparent that the populations throughout the YNCLs are on a markedly downward trend. Therefore, our objectives are to 1) collect and report critical information to evaluate status, abundance, and distribution as well as other biologic characteristics of Pacific Lamprey, 2) identify known and potential limiting factors for Pacific lamprey within the Klickitat River subbasins. This work represents the first attempt in this basin to examine status and trends in larval lamprey.

STUDY AREA

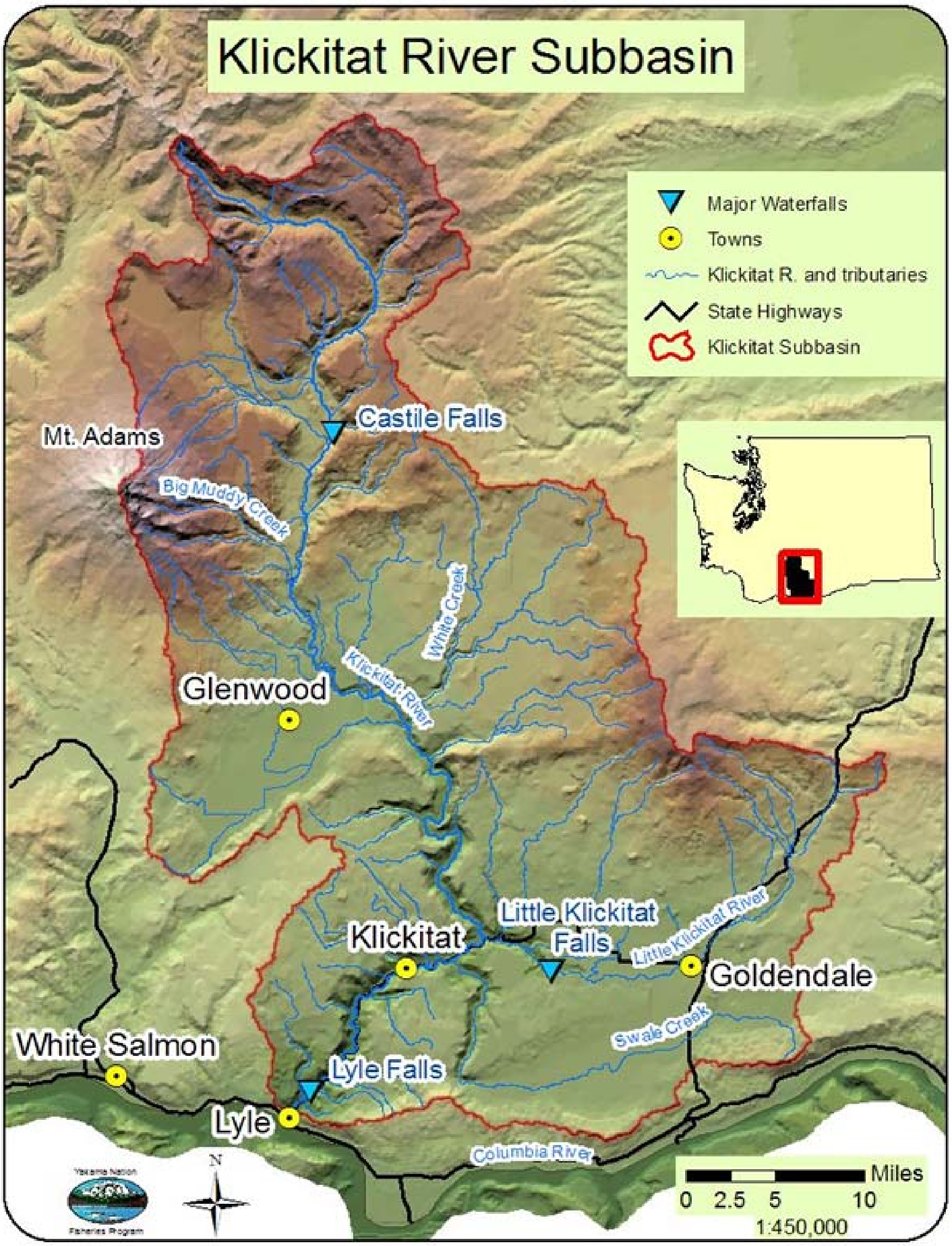

Figure 2 Map of Klickitat Subbasin Study Area

From the Yakama Klickitat Subbasin Master Plan, the Klickitat River subbasins cover an area of 1,350 square miles in south central Klickitat and Yakima counties in Washington State. It begins in the Cascade Mountains below Mt. Adams a 12,281-foot dormant volcano with widespread glacial system. The Klickitat[1] begins in the headwaters in the Goat Rocks Wilderness (Tieton Pk. 7.775 ft.) and flows over 95 miles to join the Columbia River at Lyle, Washington (RM 180.4), 34 miles upstream of Bonneville Dam (elevation 74'). It is one of the longest undammed rivers in the Pacific Northwest. The Klickitat Subbasins stretches west to the Cascade Mountain crest, north and east to the basalt ridges and plateaus of the Yakama Reservation, and south to the Columbia River Gorge Klickitat River Subbasin (fugure 2).

The landscape consists primarily of a basalt plateau with a total thickness of several thousand feet, which is beveled by deep (700 to 1,500 feet), steep-walled canyons carved by the watershed's network of streams and rivers. This geology has created several cascades and waterfalls on the mainstem and tributaries. Two notable waterfalls on the mainstem are Lyle Falls (RK 3.2) and Castile Falls (RK 102). Major tributaries to the Klickitat River include Swale Creek (RK 26.3), Little Klickitat River (RK 31), Outlet Creek (RK 63), Big Muddy Creek (RK 84.8), West Fork Klickitat River (RK 98.1), and Diamond Fork (RK 115).

Forests cover three-quarters of the watershed. The Yakama Nation is the primary landowner of forested lands; the State of Washington and numerous private parties own the remaining forested land. The rest of the watershed is used primarily for pasture, orchards, dry-land farming, and livestock grazing. Agricultural use is concentrated in the Glenwood/Camas Prairie area in the western part of the watershed and on the southeastern plateau. Part of the Klickitat subbasins is within the Klickitat wildlife areas owned and managed by Washington Department of Fish and Wildlife; the southernmost part is within the Columbia River Gorge National Scenic Area, administered by the USDA Forest Service; the lower 10 miles of the Klickitat River have federal wild and scenic designation.

The Klickitat River subbasin supports two species of Pacific salmon, Chinook (*Oncorhynchus tshawytscha*) and coho (*O. kisutch*), as well as steelhead (*O. mykiss*). The following stocks are found in the Klickitat subbasin: spring Chinook; summer Chinook; early run fall (tule) Chinook; late run fall (upriver bright) Chinook; steelhead (summer and winter); and coho (primarily late run). through multiple documentations spring Chinook and summer steelhead are known to have existed historically in the watershed; winter steelhead which were "discovered" by western scientists in the early 1980s, are also presumed to have existed historically through tribal historical accounts. Steelheads are part of the Middle Columbia steelhead Distinct Population Segment (DPS), which has been listed as "threatened" under the Endangered Species Act.

Pacific lamprey and River lamprey are another anadromous species of interest in the Klickitat subbasins, as well as resident Western brook lampreys. Although historic abundance and distribution are relatively unknown, our efforts are underway to collect information on the present distribution and status. Fine sediment delivery from Mt. Adams glaciers provides required rearing conditions during the ammocoete life stage of the species.

[1] Ykfp.org/Klickitat/into_Klickbasn.htm

Resident fish in the Klickitat include rainbow trout (*O. mykiss*), westslope cutthroat (*O. clarki lewisi*), brook (*Salvelinus fontinalis*), bull trout (*S. confluentus*) and northern pike minnow (*Ptychocheilus oregonensis*). Naturally, reproducing populations of rainbow trout are widespread within the subbasin. Westslope cutthroat trout were historically present, however, current distribution and abundance is severely limited. Brook trout were introduced into the Klickitat subbasin in the late 1970s and early 1980s, and may have impacted cutthroat trout populations.

Bull trout, found in some headwater tributaries, are listed as threatened under the ESA. The potential for hybridization and competitive interactions between brook and bull trout are of concern to fisheries managers in this area.

The watershed is subject to a continental climate, but receives a stronger marine influence than other east side basins. A climatic gradient is noticeable as one move from the northwest (cooler, wetter) to the southeast (warmer, drier) portions of the watershed. Summers are typically hot and dry (avg. temp. 55°F -70°F) and winters are cold and wet (avg. temp. 25°F - 37°F). Precipitation decreases significantly from west to east across the subbasin, ranging from 140 inches on Mount Adams to 6-9 inches on the southeastern plateau. Mean monthly precipitation values are highest in the months of December and January and lowest in July and August 75-85% of all precipitation falls between November and May.

In average years, a shallow snow pack is typically present on Jan. 1 in the upper 2/3 of the subbasin and the Little Klickitat watershed and in approximately half in the southern area that drains Dillacort, Swale, Snyder, and Wheeler Creeks. Snow is largely absent in the Columbia Tributaries area on Jan. 1. Snow pack typically increases in depth throughout the winter and spring in the northern part of the subbasin and in the higher elevation areas of the middle mainstem and Little Klickitat watersheds, usually reaching its maximum by April 1.

This report summarizes the work needed in order to restore Pacific lampreys in the Klickitat River; we need a better understanding of what is currently happening in this system.

METHODS

Seasonal timing of ammocoetes surveys began in June and ran into November 2009; goal is to document presence and determine age classes. The presence of age 1+ lamprey are important to help understand recent recruitment (Moser and Close 2003; Harvey and Cowx 2003) and helps capture a reliable snapshot of larval abundance.

Locations of each site were determined using National Agriculture Imagery Photos at 1:24,000-scale aerial maps [2] and GIS software (YKFP). Sampling sites began from the confluence of the Columbia spaced every two river kilometer (RK) in the closest Type I, II larval lamprey habitats (Hansen et al. 2003). The only exceptions to these criteria were when we could not get sampling gear through miles of basalt fissures, and/or gorges, mostly in the upper subbasin below Castile Falls reaches (RK 102). Larval lamprey distribution surveys began June – November 2009 in the Klickitat River.

[2] Huffman, Paul 2006 YKFP. NAIP Photo 1:24,000-scale watercourse data (vector polyline coverage converted to shapefile format.

At each RK sample site the first Type I/II habitat was chosen, then a 7.5-m^2 plot was measured, if larvae were present with the first 90 second depletion pass, we continued two more consecutively. A total of three depletion passes protocol (consecutive samples collected at sites; e.g., Pajos and Weise 1994; Beamish Lowartz 1996; Harvey and Cowx 2003; Torgeson and Close 2004; Stone and Brandt 2005) were done using a backpack model Abp-2 electrofishing unit (Engineering Technical Services, University of Wisconsin, Madison, Wisconsin), in wade able <0.8 meter in depth waters. The electrofishing unit delivered 3 pulses per second (125 volts DC) at 25% duty cycle, with a 3:1 burst pulse train (three pulses on, one pulse off) to remove larvae. Following collection, larvae were anaesthetized in MS-222 at 50 mg/L (tricane methanesulfonate). Larvae were identified using Goodman et al. 2008 by the caudel ridge / pigmentation with a 20X Nikon Field Microscope. Habitat characteristics were taken per site Table 1, and individual weights were taken of each fish to the nearest 1/10 gram Table 2. After larvae recovered, they were returned to the river.

Table 1 Habitat characteristics measured at 55 sample sites in Klickitat River, Washington 2009

Habitat Characteristic	Sample site	Sub-samples
Water Temperature	X	X
pH	X	X
Dissolved Oxygen (%)	X	X
Dissolved Oxygen (mg/L)	X	X
Conductivity	X	X
Specific Conductivity	X	X
GPS Waypoint	X	X
Densiometer	X	
Depth	X	X
Velocity	X	X
Percent Substrate*	X	
Fine Substrate Depth	X	X
Bycatch	X	X

* Substrate Fines measured at each site (<9 mm), small gravel (9-16 mm), large gravel (17-64 mm), cobble (65-256 mm), boulder (257-4096), and bedrock (>4096 mm).

RESULTS

Larval distribution

We documented larvae Pacific lamprey within the depositional habitats. Fifty-eight (58) sites were sampled in the Klickitat River subbasin (figure 3). Larval abundance was defined as the sum of larval densities per site. We did not evaluate the capture efficiency of electrofishing because of restrictions on sampling methods to protect salmonid presence (NOAA permit).

Using aerial maps we documented spatial distribution every 2-river kilometers (± 100 meters) margins longitudinally in the Klickitat River. Each site location criteria were accessibility, preferred larval habitats of Type I (loosely compacted mixture of sand fines in depositional areas), acceptable Type II (shifting sand or gravels with fine organic matter), unacceptable Type III (bedrock, rip rap/rubble, large gravels). In general, as we moved upriver, the number of larvae decreased in size as we moved up stream from the mouth of the Columbia River. Depletion estimates for three-pass removal were not calculated, larval abundance was defined as the sum of larval densities per site (Figure 4). Larval Pacific and Western brook lampreys were identified during the 2009 electrofishing survey. A total of 37 of the 58 sites sample had lamprey presence. Pacific lampreys were identified in the Klickitat mainstem from river kilometer 2 through 69.5, and in the Little Klickitat from RK 2-6 respectively. Western brooks were identified only in the Little Klickitat samples near river kilometer 26 within the township of Goldendale, Washington USA. A potential limiting factor of distribution could be the two major water falls in the lower part of the Little Klickitat (~25 and 40 feet height). Since we were quantifying presence and relative abundance we did not estimate the population, probability of capture, standard error, and density were not calculated. The means of both species are found in Table 2 from both main stem Klickitat and Little Klickitat accumulation.

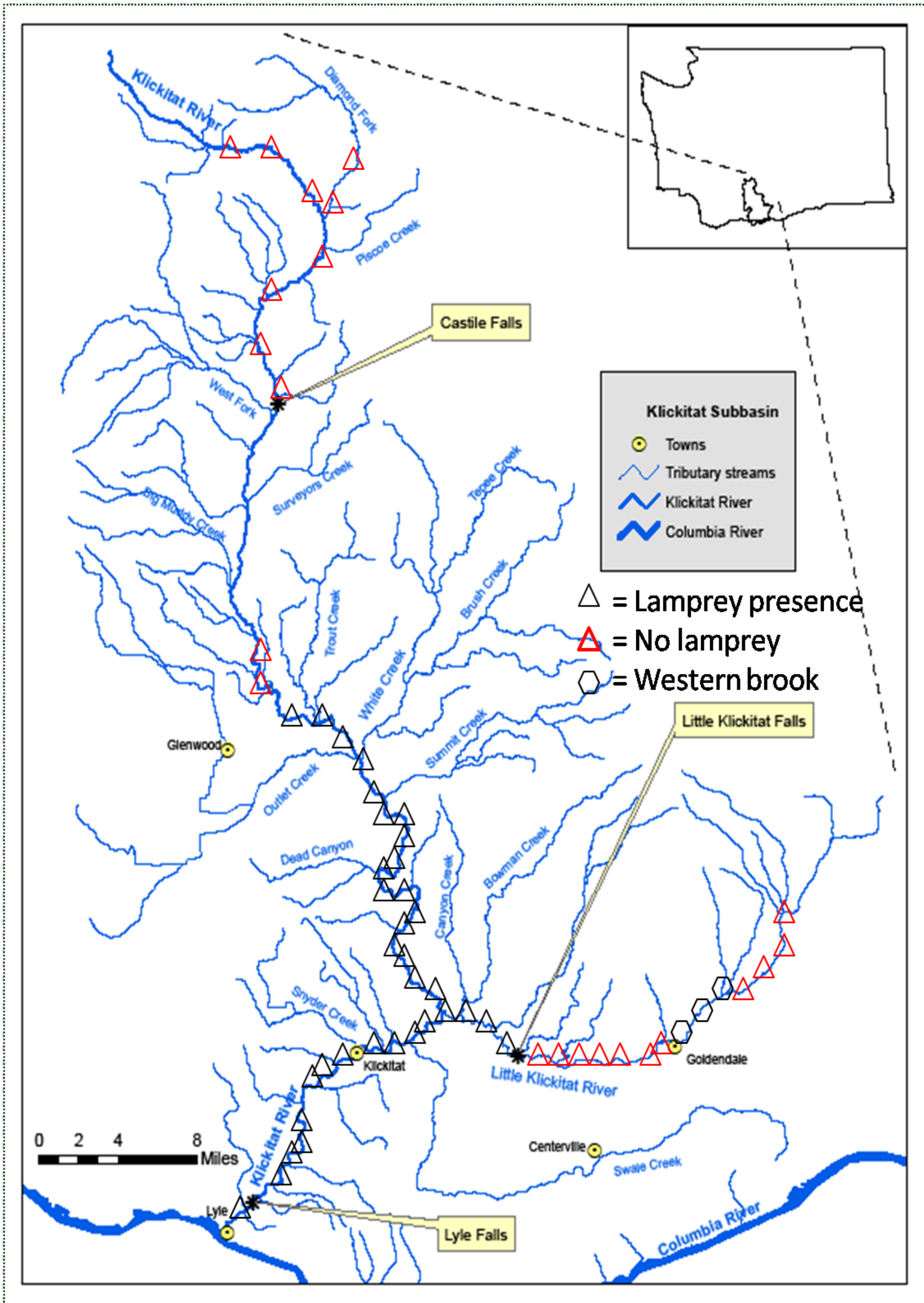

Figure 3. Distribution of larval Pacific and Western brook lampreys in the Klickitat Subbasin 2009.

Among the rivers surveyed, the highest sample site was at river kilometer 12 with 78 larvae (Figure 4).

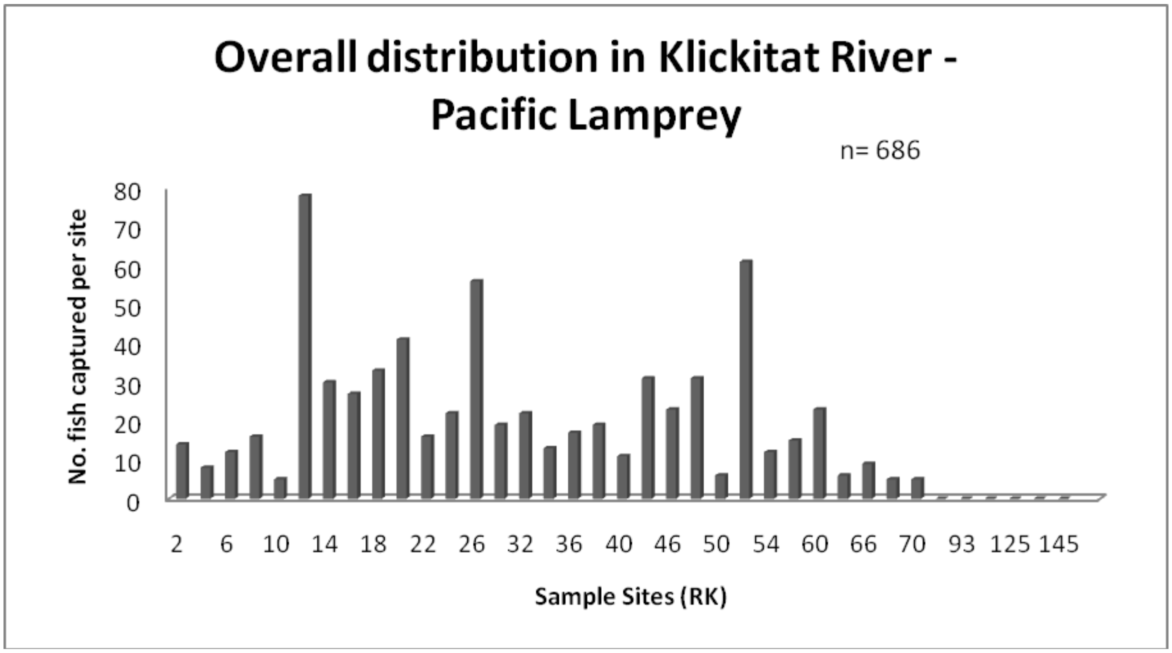

Figure 4. Study Area showing number of lamprey per site and distribution 2009 field season.

Larval Pacific lampreys were distributed throughout the entire lower end of the Klickitat subbasin but were patchy in the Little Klickitat subbasins and only found in the lower 6 river kilometers. We confirmed habitat use, and at each sampling event, individuals were identified as Pacific or Western brook lampreys. Summary of both species are in Table 2, lengths to the nearest (mm), and weights to the nearest (g).

Table 2 Data collected from juvenile lamprey in the Klickitat River, Washington 2009

Sample	Pacific lamprey	Western brook
Minimum Length (mm)	21	29
Average Length (mm)	64	67
Maximum Length (mm)	127	125
Minimum Weight (g)	.07	.08
Average Weight (g)	.63	.75
Maximum Weight (g)	3.67	3.25
Number Captured (n)	693	49

Substrate depths were measured at four sampling points in the $7x1m^2$ plots and ranged from 2 – 105 mm, respectively. A habitat characteristic was collected at each site and is summarized in Table 3 in the mainstem Klickitat and Table 4 in the Little Klickitat subbasins.

Table 3 Habitat characteristics measured at 35 sample sites in Klickitat River, Washington 2009

Habitat Characteristic	Minimum	Mean	Maximum
Water Temperature (°C)	8.5	13.5	21
pH	6.2	7.4	9.1
Dissolved Oxygen (mg/L)	2.0	7.2	12.8
Conductivity (µ Siemens)	91.7	204.4	299
Turbidity (*ntu*)	0.1	28.2	55.5
Depth (cm)	0.3	16.4	61.3
Velocity (m/s)	0.1	0.8	2.5
Percent Substrate* (Type I, II)	20	81.9	100

* Substrate Fines measured at each site (<9 mm), small gravel (9-16 mm), large gravel (17-64 mm), cobble (65-256 mm), boulder (257-4096), and bedrock (>4096 mm).

Table 4 Habitat characteristics measured at 20 sample sites in Little Klickitat River, Washington 2009

Habitat Characteristic	Minimum	Mean	Maximum
Water Temperature (°C)	7.8	9.3	20
pH	7.21	7.71	8.76
Dissolved Oxygen (mg/L)	5.15	12.3	19.7
Conductivity (µ Siemens)	145	219.2	412
Turbidity (*ntu*)	0.01	5.83	29.2
Depth (cm)	0.31	3.32	4.75
Velocity (m/s)	0.01	0.35	4.75
Percent Substrate* (Type I, II)	20	64	100

* Substrate Fines measured at each site (<9 mm), small gravel (9-16 mm), large gravel (17-64 mm), cobble (65-256 mm), boulder (257-4096), and bedrock (>4096 mm).

In assessing recent adult recruitment, we pooled together the length frequencies of at least a sample size greater than 30 specimens and graphed RK 12, 26, 42, and 52 sites (Figure 5). We found strong evidence of Pacific lamprey recruitment in the Klickitat subbasin and decreased with increasing distance from the mouth of the Columbia River (figure 5). However, we did not find many Pacific lamprey above RK 5 on the Little Klickitat River, but when we surveyed RK 26 we found the presence of Western brook lampreys n=49 a colder water residential fish. Genetic samples of Western brooks will be taken and analyzed in CRITFC genetic laboratories.

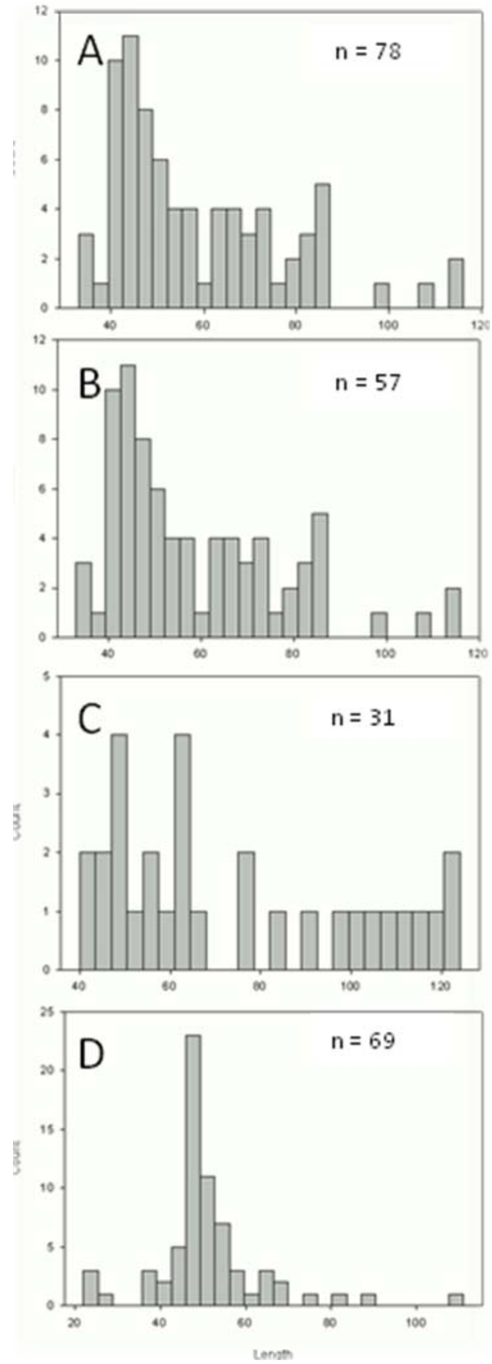

Figure 4. Length Frequency sites (a) RK 12, (b) RK26, (c) RK 42, and (d) RK 52. The y-axis indicates the number of larval lamprey that fell into the x-axis length (>30 fish per site).

From this length frequency data, evidence clearly showing several age classes when comparing (a) RK 12, (b) RK 26, (c) RK 42, and (d) RK 52 with a sample size >30. Pletcher 1963, Kan 1975 used modes to help determine age class difference, we correlated Meeuwig and Bayer 2005 statolith aging ammoceotes with the lengths to age see differences. Although they nor we could not define a separation among age based upon modal lengths we did not estimate precise ages, we used this information to help us identify recruitment. Furthermore, there are several age class transformation overlapping within groups as fish get older, we assume fish grew with length. These length frequency graphs help us understand yearly recruitment of adult spawning throughout the range. Younger of the year and older individuals were found with 1+ up to 6-year ammoceotes throughout the system respectively. The model for lamprey length and weights as seen in (Figure 5) had shown below shows as older individuals grow correlates with growth. The model is y = 0.248x – 0.9487 R^2 = .8456, this model does not take into account the young of the year or larval less than 40 mm in lengths (difficult to measure) and did not want any mortality due to our work therefore are not counted in this analysis.

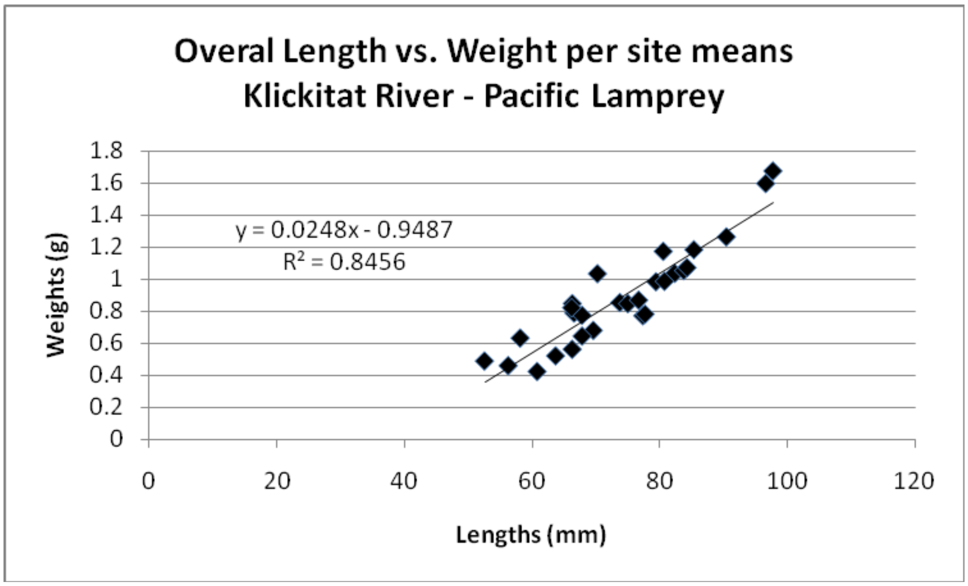

Figure 5 Regression of larval Pacific lamprey length vs weight for fish captured during Klickitat River, Washington.

In summary, our research objectives were met on presence, and we determined lamprey distribution. We also developed standardized sampling protocols (Appendix C) to gather the same data as the other three CRB tribe's lamprey projects. Data does show several reaches to protect and/or designate larval lamprey protection reaches.

DISSCUSSION

Throughout this entire study, we zero mortality. The research on larval Pacific and Western brook lamprey distribution indicated natural reproductive and rearing habitats in some of the Klickitat River subbasin. Plasticity in the Klickitat is variable and fish do grow at different rates at different elevations in the system (lower fish warmer temperatures grow faster than up river fish, day light is a factor too). The surveys completed have been useful in developing our general understanding of lampreys and documents lamprey presence and relative abundance. We noticed how temperature correlates to early life history stages, which drives metabolism hence, growth, helped us to identify critical habitat that influences distribution and abundance. From historical high water events like the winter and spring freshets younger fish actively and passively migrate and inner mix with older age fish therefore we see several younger age classes inter mixing yet we found many more younger fish in the mid to upper basin. Alternatively, if larval densities are high in a site, one could infer fish out compete and outgrow their cohorts, and as fish move downstream temperatures increase therefore metabolisms increase (complex).

We gained a better understanding by observing the substantial morphological changes in larval lamprey. The change and expression of their eyes (iris, pupil), mouth (anterior cirrhi), and branchial grooves (gill pores) regions. We learned how to tell the major differences between Pacific and Western brook lampreys using our field microscope and correlating with Goodman et. al *Lamprey Identification key* (Appendix E) helped us distinguish variation between species. Our sampling approach was appropriate for establishing preliminary baseline abundance data within and among the Yakama Nations traditional fishing areas. We recommend that sampling efforts be increased at the site reach level. For example, conducting more sub sampling with square meter plots, as opposed to one large 7.5-m^2 plot within a particular site. This may be more effective for separating local-scale variation in larval density from large-scale patterns of larval abundance (Close per communication). Continued monitoring and increased sampling efforts will allow us to evaluate population dynamics in the Klickitat River.

We hypothesize, if we remove the barrier from Klickitat hatchery then reintroduce through translocation, our results could increase larval densities over time. All the while, the Klickitat River has sufficient salmon & steelhead production; the carrying capacity could support larger lamprey species abundance.

Limiting factors in the mainstem of the Klickitat are minimal at this time. It is unclear whether the wastewater sewage plant in the township of Klickitat has any detrimental effect on lamprey. Moreover, the old sawmill within this same township is shut down too but it is unclear whether there is metals leaching into the Klickitat at this time. At river kilometer 68.5 there is a salmon blockage weir that has 45-degree angle preventing access to more lamprey spawning grounds. From our habitat surveys, most of the notes on limiting factors were in association to human impacts such as roads, cutoff banks, channelization, and limited depositional areas. The Little Klickitat River is the opposite of the mainstem, we had higher than normal temperatures on the lower end (RK 2, 4, 6), as we moved upstream we noticed there is large basalt cliffs gorges for 8 river kilometers. This entire system from river kilometer 12 upwards is a huge scoured and cut ban channel with little to no depositional or meandering at all. From historical accounts, the Little Klickitat system did have abundant mussels, steelhead and trout populations. Currently, there is limited access to really evaluate the Little Klickitat River; many private landowners did not appreciate us being upon their lands to conduct our habitat survey. Our findings of Western brook lamprey (n=49) at RK 26 was surprising and uplifting for us to find out, we plan to take genetic samples and have them analyzed via CRITFC labs.

SECTION III

Estimate numbers of Lampreys outmigrants abundance

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INTRODUCTION

Since 1995, the Yakama Nation Fisheries Department Yakama Klickitat Fish Project (YKFP) Wahkiacus field office has been monitoring juvenile salmonid emigration using two cone screw traps. This section presents the monitoring effort of by-catch of lampreys from 2003 through 2009 respectively. The YKFP objectives are to monitor emigrant patterns of anadromous salmonids on the lower Klickitat River. Out-migrant lampreys were captured by rotary screw traps (E. G. Solutions Inc., Corvallis, Oregon) at or near river kilometer 4 (figure 6), 68.5, and 145 respectively. The traps were operated yearly weather permitted based upon high flow events. Trap efficiency and outmigrants were only, ammoceotes were checked for anomalies, counted, then released back into the Klickitat River.

Figure 6. Rotary screw trap at river kilometer 4 on the Klickitat River.

These traps are to monitor movement patterns and timing of salmonid species in real time to help detect both Coded-wire tags, and Passive Integrated Transponder tags and naturally production of salmonid emigration time, note lamprey are by-catch counts only.

METHODS

Rotary Screw Traps

Site locations (figure 7) near bottleneck areas. Flows were monitored by USGS gagging stations located at river kilometer 18. The Lyle screw trap has an 8-ft. cone, the Hatchery and Castile screw traps have 5-ft. cones checked daily and not operated over the weekends. Daily tasks were to inspect all cables, pulleys, and cones to ensure proper functions. Captured lampreys were not anesthetized or identified to stage of metamorphosis; total lengths were not measured or checked for anomalies just counted.

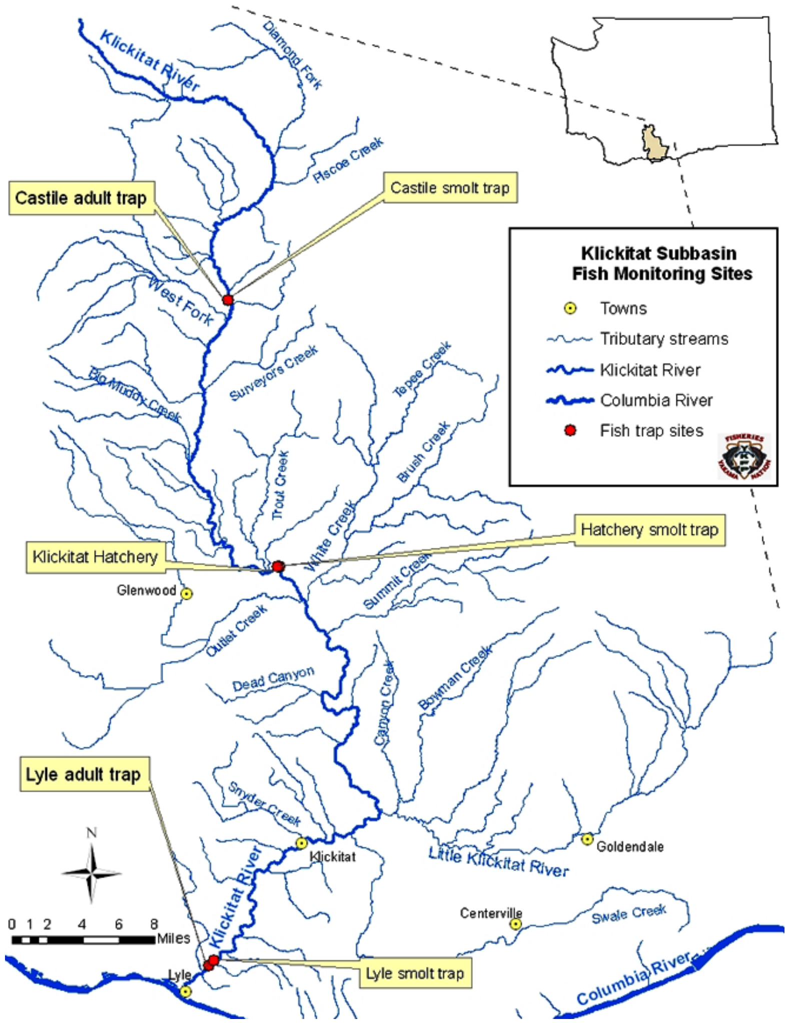

Figure 7. Klickitat River juvenile fish monitoring sites.

RESULTS

The upper Castile juvenile traps have no recorded lamprey data, the hatchery trap had extremely low numbers over the years and is not included in this results. The data of lamprey presence and relative abundance were estimates from the Lyle trap only (RK 4). The overall weekly catches n = 10,963 juvenile lampreys from January through December 2003 through 2009 respectively (figure 8).

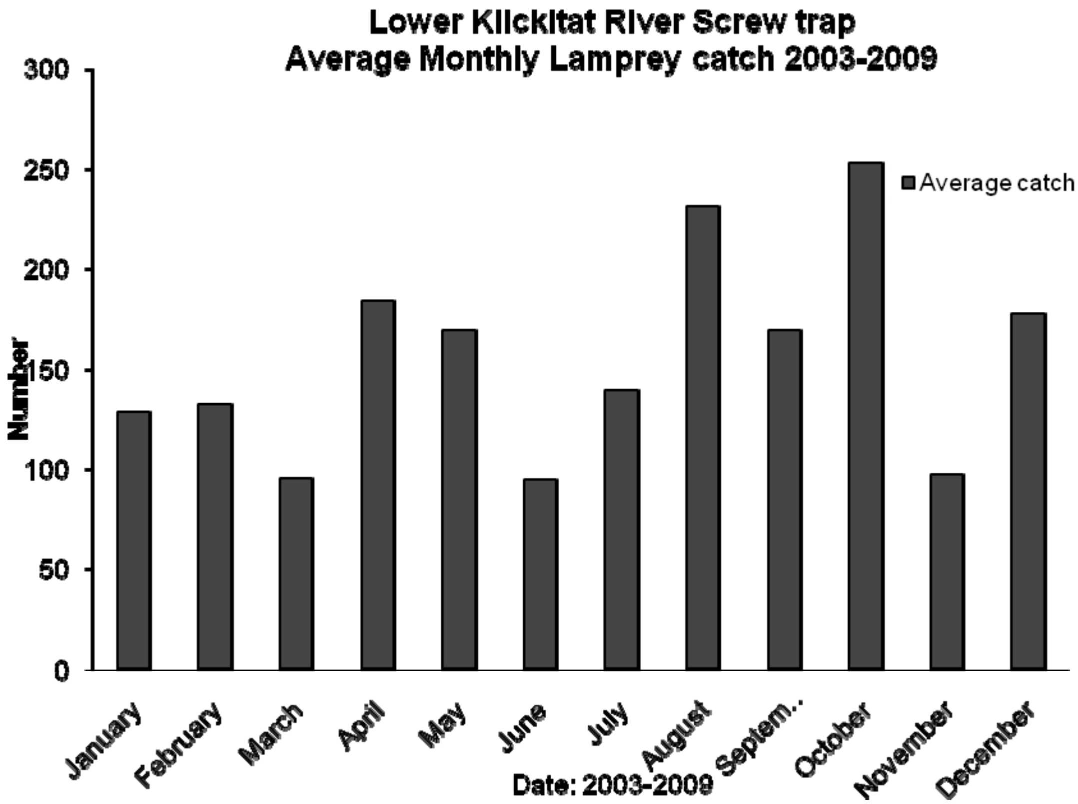

Figure 8 Out-migrant movement in Klickitat River, Washington. Ammoceote average monthly captur**e** rates from 2003 to 2009.

The accumulated data confirms the presence, to help define abundance; the average relative abundance catches for each month for the following years 2003 through to 2009 were averaged. The gaps in trapping period are due to pulling the cone up when managers release hatchery fishes, and high flows (esp. in spring months) affect trap catch numbers. From the data, we could infer there may have been more or less over the years because as mentioned in the ladder traps are not in operation during high flows, high river debris levels, and large hatchery fish releases. These variable events and conditions are the risks associated with losing the trap entirely. Estimating abundance of out migrating fish is a goal, but has not yet been achieve with good precision due to the trap removal times mentioned above and trap efficiencies respectively. Screw traps have been fished Yakama Klickitat Fish Project in the lower Klickitat River since about 1995 and at the Hatchery from about 1997-2008. To our knowledge, Washington Department of Fish & Wildlife did not run a screw trap before YN Fisheries, but it is possible they did intermittently use screw traps (WDFW did fish a screw trap in the West Fork Klickitat in 2001 during a joint WDFW/YN bull trout survey but caught no lamprey per communication Bill Sharp).

DISCUSSION

From historical accounts and current surveys Pacific and Western brook lamprey are present in the Klickitat River, Washington USA. From our habitat surveys, we know larval lampreys are distributed throughout much of the lower 69.5 river kilometers of the mainstem of the Klickitat. Little Klickitat we found presence of larval lampreys up to river kilometer 6, and a subpopulation of Western brook lampreys from RK 26 through 30. We found that the greatest densities were associated with low flow and organic depositional areas. From the screw trap data, we see movement throughout the years but we are uncertain if active or passive migration was occurring.

The distribution and densities of larval lamprey presence of lamprey is site specific, our habitat surveys were for mere presence, and vague therefore we could not precisely estimate abundance at this time. Our depletion sampling could only be used for presence, but future work would entail our surveys to answer population dynamics and randomization would be incorporated. Out migrant movements was closely associated with increased flow events, lampreys do utilize these events to help migrate and should be fished 24 hour basis to capture a more precise and accurate movements.
Plans are for continued monitoring with screw traps and identifying to determine survival rates and travel times, and hopefully for improved abundance estimations.

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APPENDIX A

Programs Goal and Objectives Larval Distribution
The goal of the Yakama Nation is to restore natural production of Pacific lamprey to a level that will provide robust species abundance, significant ecologic contributions and meaningful harvest within the Yakama Nations Ceded Lands and in the Usual and Accustomed areas. The Yakama Nation intends to achieve these goal by developing a long-term Management and Action Plans specific to Pacific lamprey in cooperation with local and regional government entities and consistent with efforts associated with the CRITFC Pacific Lamprey Tribal Recovery Plan, the U.S. Fish and Wildlife Service Conservation Initiative, the Lamprey Management Plans that have been or are currently being developed through the FERC relicensing processes of Chelan County, Douglas County and Grant County Public Utility Districts and other ongoing efforts conducted by the Nez Perce, Umatilla, and Warm Springs Tribes.

The YNPLP is just beginning its first year of development. In addition, there is a rapid and urgently evolving regional awareness of the issues surrounding these fish. Basic information is needed and there is much work to be completed in regional coordination in data collection methods, data interpretation and reporting formats. Given this, it is impossible to describe all YNPLP aspects over the next 10-years. Adaptive Management will play a significant role in the development and implementation of the YNPLP.

The Yakama Nation Pacific Lamprey Program will be developed over three phases with Phase 1 occurring in years 2009-2010, Phase 2 in years 2011-2012 and Phase 3 anticipated in years 2013-2017. In general, Phase 1 will initiate the YNPLP and efforts will center on initiating surveys, refining regionally accepted survey protocols, developing cooperative relationships with local and regional entities and continuing to develop and refine YNPLP objectives and future work elements. Phase 2 will continue the Phase 1 effort and will expand our work geographically. During Phase 2, we will also emphasize the identification of habitat limiting factors within the various subbasins and begin development of a comprehensive and detailed restoration action plan for each of these subbasins. In Phase 3, we anticipate a greater emphasis in actively enhancing and restoring Pacific lamprey habitats and documenting progress, as well as more refined, quantitative estimates of abundance and distribution of adult and juvenile lamprey within key watersheds of the YNCLs.

Through 2009-2012, the YNPLP will obtain basic information relevant to Objectives 1–6, as described below, by completing preliminary field surveys, beginning in the Klickitat, Yakima, Wenatchee and Entiat subbasins. Over time, as our Program grows in experience and regional coordination increases, we intend to expand field surveys to other streams and subbasins and more aggressively continue work relevant to Objectives 7 and 8. Throughout this timeframe, the YNPLP will continue local and regional coordination with key Parties interested in lamprey restoration as a primary means to gain a high level of efficiency and effectiveness toward achieving our goal.

Program Objectives over the next 10-years:

1) Document historic distribution of adult lamprey from historical records, literature reviews and oral interviews and compare with known current distribution.
2) Participate in and contribute to regional consistency in data collection, data management, analysis and reporting.
3) Document status of larval Pacific lamprey with presence/absence surveys to determine distribution of recruitment.
4) Document biologic condition, migration behaviors and environmental cues that trigger migration for both adult and juvenile Pacific lamprey.
5) Identify habitat characteristics that are preferred at various life stages and determine the extent these habitats are available and are being utilized (habitat mapping).
6) Identify and inventory all known and potential limiting factors, and current threats existing in tributary habitats. Develop and implement a Pacific Lamprey Action Plan for the following subbasins: Methow, Entiat, Wenatchee, Crab Creek, Yakama, Rock Creek, Klickitat, White Salmon, Wind, and Little White Salmon (including all perennial tributary streams to the Columbia River within the YNCLs).
7) To increase larval abundance in tributary streams, implement a pilot adult Pacific lamprey translocation program from main-stem Columbia River hydro-electric projects into various subbasins (to be determined) and evaluate methodology and potential biological benefits and risks of expanding this program as appropriate.

8) Evaluate the potential for and participate in the development of supplementation / artificial propagation techniques of Pacific lamprey.

Appendix B

Fishers List and Questionnaire

Acknowledgements of fisher families who contributed to this program

Aleck, Joe Sr., fisher, Toppenish, WA
Alexander, Clifford, fisher, Cook, WA
Antone, Tina Jim, fisher, Goldendale, WA
Beavert, Columbus, fisher, Wapato, WA
Beavert, Charles, fisher, Wapato, WA
Beavert, Joseph, fisher, Wapato, WA
Beard Selina M., fisher, Wapato, WA
Begay, Bobby, fisher, The Dalles, OR
Begay, Wilson, fisher, The Dalles, OR
Blevins, Ellen, fisher, Wapato, WA
Brisbois, Mike, fisher, Cooks, WA
Casseseka, Clifford, fisher, Toppenish, WA
Cloud, Jason, fisher, Dallesport, WA
Cloud, Raymond, fisher, Dallesport, WA
Cloud, Warren, fisher, Lyle, WA
Colfax, Yvonne, fisher, Harrah, WA
Cootes, Allen, fisher, White Swan, WA
Dave, Anita J., fisher, Wapato, WA
Dave, Leonard, fisher, Wapato, WA
Dick, Roger Sr., fisher, Toppenish, WA
Escene, Cynthia, fisher, Home Valley, WA
Ganuelas, Rena B., fisher, Wapato, WA
George, Carl F., fisher, Yakima, WA
George, Georgianna, fisher, Warm Springs, OR
George, Josephine, fisher, Toppenish, WA
George, Michael, fisher, Goldendale, WA
George, Theodore, fisher, Harrah, WA
George, Victor G. Jr., fisher, Goldendale, WA
Goudy, Georgia, fisher, The Dalles, OR
Goudy, James, fisher, Dallesport, WA
Goudy, Mark, fisher, Lonepine, OR
Goudy, Patrick M. Sr., fisher, Toppenish, WA
Goudy, Pamela, fisher, Toppenish, WA
Goudy, Sharon, fisher. The Dalles, OR
Gruetzmacher, Ernie, fisher, Arcata, CA
Harbaugh, Don, fisher, Toppenish, WA
Hart, Raymond, fisher, Wapato, WA
Henry, Grant, fisher, Brownstown, WA
Hoptowit, David L., fisher, White Swan, WA
Hoptowit, Fred, fisher, Yakima, WA
Hoptowit, Sophie, fisher, White Swan, WA
Howard, Darrell, fisher, Wapato, WA
Howell, Leroy, fisher, Toppenish, WA
Howtopat, Lindsey, fisher, Goldendale, WA
Hunt, Kenneth, fisher, Mattawa, WA
Hunt, Lawrence R., fisher, Toppenish, WA
Hunt, Virgil, fisher, White Swan, WA
Iman, Shirley, fisher, Dallesport, WA
Jack, David, fisher, Toppenish, WA
Jack, Raymond L., fisher, Toppenish, WA
Jacob, Roger, fisher, Harrah, WA
Jackson, Johnny W., fisher, Underwood, WA
James, Peter, fisher, Wapato, WA
Jim, Bernice, fisher, Goldendale, WA
Jim, Bronsco & Ella, fisher, Goldendale, WA
Jim, Delvis R., fisher, Toppenish, WA
Jim, Ezra Stuart, fisher, Wapato, Wa
Jim, Jamie, fisher, Wishram, WA
Jim, Jonas, fisher, Tuba City, AZ
Jim, Lon, fisher, Toppenish,WA
Jim, Lucille, fisher, The Dalles, OR
Jim, Ronald W., fisher, The Dalles, OR
Jim, Sam Sr., fisher, Goldendale, WA
Kachlamet, Nora, fisher, Lyle, WA
Kuneki, Inez, fisher, Wapato, WA
LaCource, Phillip A., fisher, Toppenish, WA
LaRoque, Wilson, fisher, Toppenish, WA
Leslie, Ervin A. Jr., fisher, Goldendale, WA
Lesser, Leila E., fisher, Goldendale, WA
Lewis, Gary, fisher, Brownstown, WA
Lewis, Evans Sr., fisher, White Swan, WA
Lloyd, Byron, fisher, Toppenish, WA
Lopez, Dale, fisher, Stevenson, WA
Looney, Bobby A. Goldendale, WA
Looney, Carolina S., fisher, Wapato, WA
Looney, Oscar, fisher, Goldendale, WA

Hogue, Nathan, fisher, Willamina, OR
Martin, Jerry, fisher, Harrah, WA
Meanus, Oly, fisher, Celilo, OR
Mesplie, Virginia, fisher, Wapato, WA
Mesplie, Wayne, fisher, Toppenish, WA
McConville, Alfred, fisher, White Swan, WA
Minninick, Johnson, fisher, Toppenish, WA
Miller, Veronica, fisher, White Swan, WA
Miller, Joe P., fisher, White Swan, WA
Noonan, Jackie, fisher, Toppenish, WA
Olney, Chuck, fisher, Union Gap, WA
Olney, Laura, Stevenson, WA
Paul, Chris & Jennifer, fisher, White Swan, WA
Peters, Silas Sr., fisher, Granger, WA
Polk, Murphy K., fisher, Wapato, WA
Porter, Michael, fisher, Wapato, WA
Rabanal, Larry, fisher, Ellensburg, WA
Sampson, Jesse M., fisher, White Swan, WA
Schuster, Elmer B., fisher, Toppenish, WA
Shilow, Arthur, fisher, Cascade Locks, OR
Shippentower, Eva M., fisher, Goldendale, WA
Slockish, Wilbur Jr., fisher, The Dalles, OR
Sohappy, David Jr., fisher, Cook, WA
Sohappy,Sam, fisher, Cook, WA
Sohappy, Tim, fisher, White Swan, WA
Smiskin, Harry, Wapato Longhouse, Wapato, WA
Sutterlict, Carl, fisher, White Swan, WA
Spencer, Dirk, fisher, Toppenish, WA
Spencer, Roland Sr., fisher, Toppenish, WA
Spencer, Warren, fisher, Goldendale, WA
Spino, Billy V., fisher, Dallesport, WA
Squeochs-Dick, Cyrus, fisher, Toppenish, WA
Sweowat, James & Miller, fisher, White Swan, WA
Tahkeal, Lillian, fisher, Toppenish,WA
Teeias, Celcil, James Jr., fisher, Wapato, WA
Teeias, Ernest, James, fisher, Harrah, WA
Tewee, Melvin Sr.,fisher, Warm Springs, OR
Thompson, Marlene G., fisher, Goldendale, WA
Thompson, Moses, fisher, Granger WA
Martin, Zack, fisher, White Swan, WA
Tulee, Francis, fisher, Toppenish, WA
Vigil, Sam Jr., fisher, Harrah, WA
Wahpat, Chester, fisher, Toppenish, WA
Wahchumwah, Jim, fisher, White Swan, WA
Walsey, Laurie, fisher, Toppenish, WA
Washines, Anthony, fisher, Wapato, WA
Watlamet, Raymond, fisher, Granger, WA
Watlamet, Pernell, fisher,White Swan, WA
Watlamet, Phillip, fisher, Lyle, WA
Wesley, Anthony, fisher, White Swan, WA
Wesley, Cecillia P. fisher, Harrah, WA
White, John Douglas, fisher, Toppenish,WA
Whitefoot, Samuel, fisher, Harrah, WA
Wilawitsa, Lila, fisher, White Swan, WA
Winnier, Nicole, fisher, Sweethome, OR
Yallup, Debra Dogsleep, fisher, Toppenish, WA
Yallup, Selena K., fisher, Toppenish, WA
Yallup, William Jr., fisher, Toppenish, WA
Young, Joseph H., fisher, White Swan, WA
Zach, Rex, fisher, Toppenish, WA

Appendix C

Questionnaire:

Yakama Nation Lamprey Questionnaire

Columbia River Subbasin (watershed)____

Information provided by (name) _______________________________________YN# _______________

Address or email ____Phone: ______________________

1. Do you have knowledge of lamprey populations (past and/or present) in subbasin? Yes ___ No ____ if not, go to question #6, if yes describe exact location____

2. Which species lamprey have you been/are present: Pacific ___, River ___, Western Brooks ____Or don't know ____? Describe exact location___________________________________

3. If current from question 2? Rare ____, common ______, abundant _______, n/a _________
When was the last time you harvested lamprey?______________________________________
Have you ever found fish tags in lampreys and where? _______________________________
How long have you fished for lamprey? ____
How many were harvested (pounds or number of fish)? _______________________________
How was the lampreys harvested or preferred ways? _________________________________
____
Do you remember the peak run time months? Yes ___, no ___, if yes, describe ____________
____
How far did you have to travel to fishing grounds? ___________________________________
What were the river/creek conditions (high, low, time)? _______________________________
Do you remember the year of declines? ____
Would you share photos of lampreys (present or historical (will return))? _________________

4. If currently present in the basin, what was observed? Spawning redds ____, Adults _______
Ammocoetes (juveniles) _____________, other _____________________________________

5. Any recent or ongoing studies in subbasin? Yes _____, No _____, if yes briefly describe ___
____

6. Are there any known or suspected passage impediments to lamprey in subbasin? Yes_____, No_____
If yes, describe impediment and any recommendations you may have to address the passage problem (e.g., location, culverts, irrigation screens)__________________________________
____

7. Are there any chemical treatment activities in subbasin? Yes ____, No _____. If yes, describe impediment and any recommendations you may have to address the passage problem (location).____

8. Are there any known or suspected activities in subbasin detrimental to lamprey life history? Logging___, grazing ____, gravel mining ____, channelization ____, riparian ____, degradation ____, other ____________________________. Briefly describe detrimental activities____

9. Any other information relevant to lamprey that may be of interest (Oral histories/anecdotal)?

Thank you for taking the time to answer these questions.

Appendix D

Tributary	Species	Fishing Time	Harvested	Run time	Declines (yr)	Observe	Limiting factors
Location	Pacific (PL) - West.brook (WB)	Month	# fish caught	time/day	Noticed (yr.)	Experience (Y/N)	Why
Oregon							
Astoria cr.	PL	April-August	500	day	1970's	Yes	
Bonneville	PL	April-August	500	day	1982	Yes	Laws
Celilo	PL	April-July	1000's	dusk	1962	Yes	Hydro-dam
Deschutes	PL	April-July	1000's	dusk	1965	Yes	Laws
3 Mile	PL	April	100's	night	1980's	Yes	Population encroach
15 Mile	PL	April-July	100's	night	1990's	Yes	Chemicals/Farmers
Herman Cr.	PL	June-July	100's	night	1990's	Yes	
Horsetail Cr.	PL	June-July	100's	night	1990's	Yes	
Mill Cr.	PL	April-July	100's	night	1990's	Yes	Chemicals/Farmers
Mollala	PL	August	50's	day/night	1960's	Yes	
Sandy	PL	July	50's	night	1980's	Yes	
Silver Falls	PL	July	50's	day/dusk	2001	Yes	
Smith	PL	July	75	day	2002	Yes	
Umatilla	PL	April	500	night	1965	Yes	Laws
Willamette	PL	June-July	1000's	day	1960/70's	YEs	
Washington							
Ceder Cr.	PL	June-July	100's	dusk	2001	Yes	
Chahalis	PL	June-July	50	dusk	1978	Yes	
Kettle Falls	PL	August		night	1950	Yes	
Klickitat	PL	April-August	100	night	2004	Yes	
Lewis	PL	July	100	night	1966	Yes	
Logee/Dry	WB	October		day	1963	Yes	
Palouse	PL	August	100	night	1950	Yes	Dams

Rock Cr.	PL	July	50	night	1940-50	Yes	Low water
Washougal	PL	July	50	night	1972	Yes	Pulp mill
Wenatchee	PL	August	50	night	1940	Yes	Dams
Yakama	PL	April August	100	night	1979	Yes	Dams

Appendix E

Yakama Nation Pacific lamprey field protocols

Sampling procedures

1) Sites are predefined using aerial photographs on maps with coordinates. Sites will be sampled from the confluence upstream in each subbasin. If the site does not fall upon Type I or II habitat it will be noted in data sheet, and a site will be chosen closest up or downstream of sites (from downriver upstream + - 100 meters).

2) Sample work from the confluence upstream of the watershed by river kilometers.

3) Sites are in UTM coordinates (Datum: NAD1983). They are predefined and already loaded in the GPS unit which should be used in conjunction with maps to locate sites.

4) Once site is located measure out, then mark off in sand and set up and coordinate with the electro-fisher.

5) Collectors coordinate tasks before electrofishing; take initiative to work together on gather water characteristics of on the data sheet, dates, begin time, country/county, drainage, water of body, location (directions to site), site ID., latitude/longitude, elevations, collectors initial, habitat type, stream gradient, sinuosity, landscape, site conditions, appearance, conductivity, pH, D.O., turbidity, water temperature, time of temperature, substrate type, %vegetation cover, finally fish sample buckets per pass (keep separated per pass).

6) Electrofisher settings prearranged, observe voltage, pulse frequency, duty cycle, and burst pulse.

   a. Shocker settings: Tickle = 3.0 rate; 25 duty cycle
   Stun = 30 rate; 2.5 duty cycle
   Voltage = 125, voltage range = 0-125

   b. Know duties, shock from downstream up, keep anthode/cathode a few inches from substrate, shock 1 X 7 meter plot. Netters set up on both sides and listen for commands to capture fish. Each sample pass will be kept separate from each other for each depletion pass removal. Net fish and keep in bucket until end of sample time. Relatively less time can be spent on Type III bedrock, large boulder habitats.

7) Keep fish in fresh water to work up fish – measure total lengths, identify then weigh to nearest gram per site.

   a. Anesthetize with MS-222 (8ml of concentrated MS solution in small rectangular Tupperware filled to black line with water, with same amount of buffered solution). Only anesthetize as many fish as you can work up at one time. Do not let fish linger in MS.

b. ID fish (lamprey sp.) and stage (yoy, ammocoete, transformer, adult)

c. Measure closest millimeter (mm)

d. Weigh nearest gram (g)

e. After each fish is worked up return it to a fresh water recovery bucket. Keep fish in the recovery bucket until they are swimming normally without prodding.

f. Release fish in good habitat (slow water, fine substrate) in same sample site.

8) Habitat (always collected after efishing)

a. Flow – capture velocity with water meter.

b. Gradient – Measure the gradient of each reach with a clinometer. Use Erniemeter to account for water and substrate depth.

c. Substrate – Record the dominant and subdominant substrate size and % fines at all 4 sites within 1x7plot.

1. Dominant	2. Subdominant	3. %fine
a. <0.25”	a. <0.25”	1. 0-25%
b. 0.25 – 1”	b. 0.25 – 1”	2. 25-50%
c. 1-3”	c. 1-3”	3. 50-75%
d. 3-6”	d. 3-6”	4. 75-100%
e. 6-12”	e. 6-12”	
f. 12-40”	f. 12-40”	
g. >40”	g. >40”	
h. Bedrock	h. Bedrock	

d. Habitat Association – Record association for each level capture bi-catch and other observations at site.

e. record sediment depths in four sections of 1x7 meter plot.

9) Mussel/Snail Survey – As you are taking habitat data survey the reach for freshwater mussels and clams. Record presence and species on data sheet.

10) Report invasive species if applicable.

Appendix F

Data Sheet

Field #	Project	
Date	Begin Time	End Time
Country	State	County
Drainage		HUC
Waterbody		Site ID
Locality:		
Latitude ° ' " N S	Longitude ° ' " W E	
Elevation		
Collectors		
Other Coll. Field #'s		Photos
GEAR		
SAMPLED upstream downstream both		
SAMPLED all Left-shore Right-shore Midchannel L-shore+mid R-shore+mid		
LENGTH SAMPLED meters	ELECTROSHOCK TIME sec	

Location Description:

STREAM GRADIENT	flat low moderate high
SINUOUSITY	straight slight-meandering strongly-meandering braided
GENERAL LANDUSE	Natural old-field rowcrop pasture silviculture urban/industrial
LANDUSE DESCRIPTION (30 characters)	
SITE CONDITION	Undisturbed Slightly-disturbed Moderately-disturbed Very-dist.
TIDE	slack-high slack-low incoming outgoing MOON New 1/2 3/4 Full
LEVEL	no flow low flow normal flow full bank flood
APPEARANCE	clear tannic green/algae white/milky muddy
VISIBILITY	<0.1m 0.1-0.3m .3-1m 1-3m 3-10m >10m

Conductivity	pH	Salinity ppt	D.O. ppm	Turbidity ntu	PO4 ppm	NO4 ppm
Air Temp C	Water Temp C	Temp Time	Secchi	Current m/s		

% SUBSTRATE COVER ESTIMATE

____ soft silt-mud	____ bedrock/claypan	Run %
____ silt-sand mix	____ bedrock ledges/fissures	Riffle %
____ sand(0.125-1.9mm)	____ vegetation	Pool %
____ gravel(2-63mm)	____ shred detritus, organics	Backwater %
____ rubble(64-256mm)	____ leaves, sm branches	
____ boulder(>256mm)	____ logs	

% VEGETATION COVER ESTIMATE

____ algae	____ emergent	____ floating	% CANOPY COVER
____ submergent	____ overhanging	____ standing-trees	

SPECIES