



**Yakama Nation Pacific Lamprey *Entosphenus tridentatus*
Restoration Project**

Annual Progress Report

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Performance Period

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EXECUTIVE SUMMARY

In accordance with Bonneville Power Administration Contract # 2008-470-00 and the Confederated Tribes and Bands of the Yakama Nation (YN) has prepared this Annual Progress Report for the Yakama Nation Pacific Lamprey Project. This report outlines the activities undertaken by the Yakama Nation Pacific Lamprey Project (YNPLP) from March 1, 2011 through February 29, 2012.

Over the past couple of years, the YNPLP has grown considerably, especially with our general knowledge about Pacific lamprey in the Yakima River. During this contract year our focus was primarily within the Yakima River Basin. Presence / absence surveys for juvenile Pacific lamprey were performed with an emphasis in the upper portions of the Basin as well as surveys in various irrigation canals. These latter surveys were completed in close coordination with the Bureau of Reclamation (BOR). Additionally, the YNPLP continued to support a radio telemetry study being implemented by the US Fish and Wildlife Service (USFWS). This evaluation, in coordination with the US Army Corps of Engineers and the BOR, is designed to evaluate potential passage issues for returning adult lamprey over irrigation diversion dams within the mainstem of the Yakima River.

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 harvests throughout the Yakama Nations Ceded Lands and in the Usual and Accustomed areas (see Figure 1).

To accomplish this goal the YNPLP is focusing all activities towards five general objectives, including: (1) establishing baseline information for the presence and absence of Pacific lamprey, (2) understanding primary limiting factors affecting abundance of local populations, (3) development of subbasin "Action Plans" that identify key activities that can be implemented in each subbasin to promote Pacific lamprey recovery in that area, (4) initiate research and development into both juvenile and adult supplementation practices to re-introduce Pacific lamprey back into areas where

local populations have been extirpated - or at least functionally extirpated and (5) establish long-term status and trend monitoring.

The 2010 presence/absence surveys initiated our work in the Yakima Subbasin. This work was continued throughout the 2011 field season. This Progress Report combines the information collected from both these years, providing a complete picture of our current understanding for lamprey presence. In 2010, work in the Yakima River began with approximately 50 surveys performed. This work continued in 2011 with approximately 100 surveys performed. Pacific lamprey juveniles were found at river kilometer 144 and in locations above, but in very low numbers. Western brook *Lampetra richardsoni* presence was prevalent throughout the upper Yakima River basin, and there was no clear evidence of River lamprey *Lampetra ayersi* presence during both sample seasons. No estimates associated with density or relative abundance of any of these three species are available at this time.

Through BPA/Fish Accords funding, the YNPLP has been able to obtain significant cost-share opportunities supporting and expanding the objectives of this contract. We have successfully completed an initial Agreement with the USACE (Seattle District) to support a radio-telemetry study for adult Pacific lamprey at lower river irrigation facilities, and we are about to enter into our second agreement. We have also successfully developed a Cooperative Agreement with Bureau of Reclamation and finished Project Year 1 (of 4). These reports are included in the Appendix of this YNPLP Annual Progress Report to BPA as a demonstration of our sincere desire to use these BPA / Fish Accords funds, and cost-share opportunities to the maximum potential.

INTRODUCTION

The Pacific lamprey (*Estophenus tridentatus*) has always been important to Native Americans throughout the Pacific Northwest. Since time immemorial, the Fourteen Bands (Palouse, Pisuouse, 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 taking care of lampreys as a medicine, food source, and cultural icon. 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). Over the past three decades the tribes of the Columbia River Basin have noticed drastic declines from the previous era. These trends are now well known and documented within most current literature about Pacific lamprey throughout their range.

Since initiation of the YNPLP (2008) we have understood the development of this Project to occur in roughly three distinct phases, each requiring approximate three years.

- Phase 1 has been simply the establishment of the Project, initiating preliminary surveys throughout several subbasins, establish general protocol and to begin wide ranging coordination - both regionally and locally. For the most part, these efforts have been successful, particularly with respect to the experience and basic knowledge we have gained in this short time. We have developed much needed cost-share partnerships, surveyed much ground, have produced a first Action Plan for the Yakima Subbasin and have engaged other agencies and publics at both regional and local levels.
- Phase 2, which we are now moving into, focuses the survey experience we have gained towards establishment of long-term "index-sites" from which we can monitor status and

trend. These sites will include the following subbasins, White Salmon, Klickitat, Yakima, Wenatchee, Entiat, and Methow, at a minimum. From our many deliberations about the current state of Pacific lamprey populations, current funding levels and other considerations, we have also concluded that aggressive initiation of supplementation research and activities will likely be central for meaningful lamprey recovery within the foreseeable future. Also, we will continue development of Action Plans for key subbasins within the Yakama Nation Ceded Lands (Figure 1, below) in close coordination with the Bureau of Reclamation. And, we are fully committed to continuing our work with the USACE and the Mid-Columbia Public Utility Districts towards Columbia River mainstem passage issues, supporting the USFWS with their progress towards the Conservation Initiative, continued coordination with the CRITFC and member tribes, specifically in the implementation of the Tribal Pacific lamprey Recovery Plan and in the many other forums that we have been engaged.

- Phase 3 will focus on implementation of the knowledge we have gained from Phase 1 and 2, specifically (but not limited to) we anticipate (1) passage and entrainment issues within the Yakima Basin will begin to be addressed, (2) supplementation activities will be well defined, developed and initiated in a manner to measure the biological performance of reintroduced local populations, (3) habitat restoration activities oriented primarily towards salmonid recovery will have lamprey habitat needs incorporated, (4) initiate programmatic actions that will reduce toxic chemical levels within juvenile lamprey tissues, (5) fully engage a regional, if not international effort to better understand the ecology of Pacific lamprey within the marine environment, and (6) continued coordination as described in Phase 2.

The 2011 field season was essentially a continuation of the 2010 field work - focusing efforts on the Yakima River basin. Our general findings to date indicate Pacific lamprey are at very low numbers throughout the Yakima River, although Western Brook lamprey appear to be relatively abundant in some local areas. Adult counts at Roza Dam (approximately 15 miles above Yakima, WA.) continue to indicate no Pacific lamprey entering the upper Yakima basin. Adult counts at Prosser Dam fish counting station continue to indicate that only a few, if any adult lamprey pass this location each year. Only in the years 2002, 2003 and 2004 were significant counts noted (22, 87, 65 respectively) whereas in all following years, very few if any were counted (Figure 2, below).

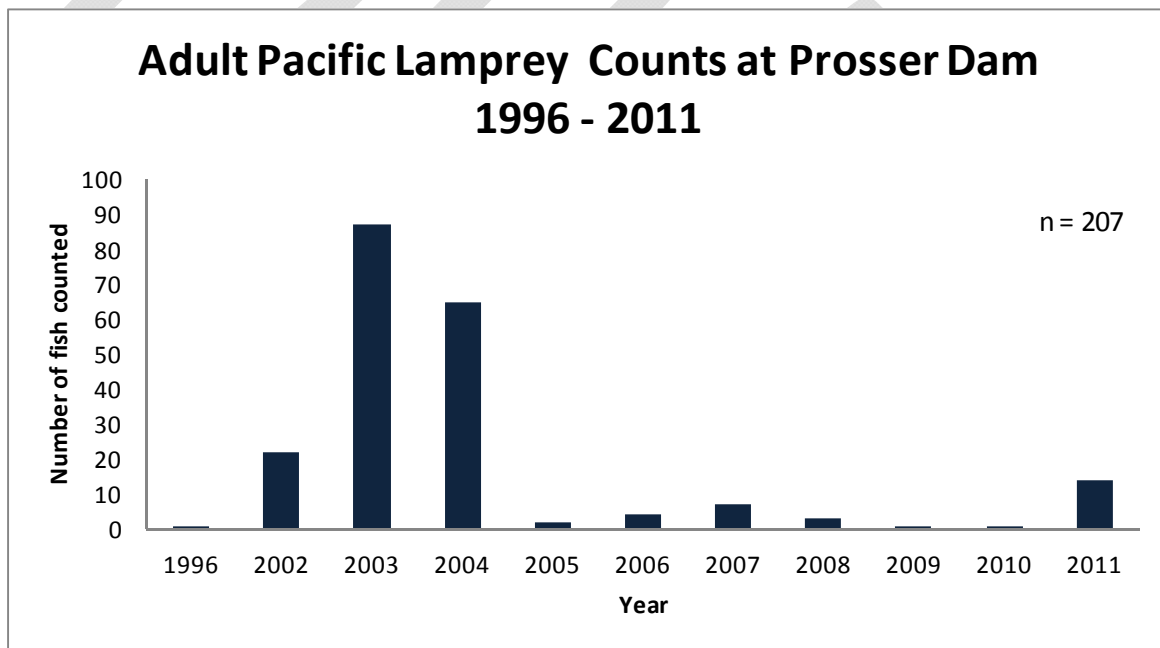


Figure 1. Adult Pacific lamprey counts at the Prosser Fish Counting Station, Lower Yakima River, Prosser, WA.

Prior to 1996 adult lamprey were not counted at Prosser. From 1997 zero adults were observed up to 2002, but only day counts were monitored and there could of been more since Pacific lamprey are nocturnal. In 2007 a digital video recorder was put into operation.

If one were to assume approximately 7-years between egg through metamorphosis and out-migration (juvenile life stage) from the Yakima River, all juveniles from the 2002-2004 brood years will have left this area. Our recent electro-shocking findings are consistent with this notion. It is our general conclusion that Pacific lamprey are functionally extirpated (i.e. they contribute little or no ecological value to the basin and essentially no abundance or genetic contribution to the population as a whole) in the Yakima River - if not literally extirpated.

We also speculate, based upon discussions and findings within recent literature that pheromones produced by both juveniles and adults play a significant role in "homing" of adult lamprey to spawning locations. If this is true, there is little "incentive" (pheromone production) left within the Yakima River. Also, given the current low population that migrates up to, and could be available to the Yakima River, it is difficult to imagine a significant change in the current status over the next ten or more years. From this context it is logical to conclude that a re-introduction effort of either adults (through translocation) or juveniles (through artificial propagation) are management options that must be developed and probably undertaken. However, we are very much aware that these efforts will be successful without addressing many other local and regional limiting factors simultaneously.

We would like to acknowledge that because of the non-federal BPA funds, resulting from the 2008 Fish Accords, the YNPLP has had the important opportunity to use these funds as a cost-share match towards a USACE sponsored funding grant (Public Assistance to the States). With this grant, the USACE provides to the USFWS approximately \$100,000 to evaluate adult passage issues at Yakima River irrigation diversions. The Yakama Nation (through the YNPLP) provides a 50:50 cost-share match, made up primarily of our planning and labor within the Yakima River. Resources from this grant were available through the 2011 season and a second grant is now being initiated and

anticipated to be available throughout the 2012 field season. Without BPA funding, this grant - and evaluation would not be available.



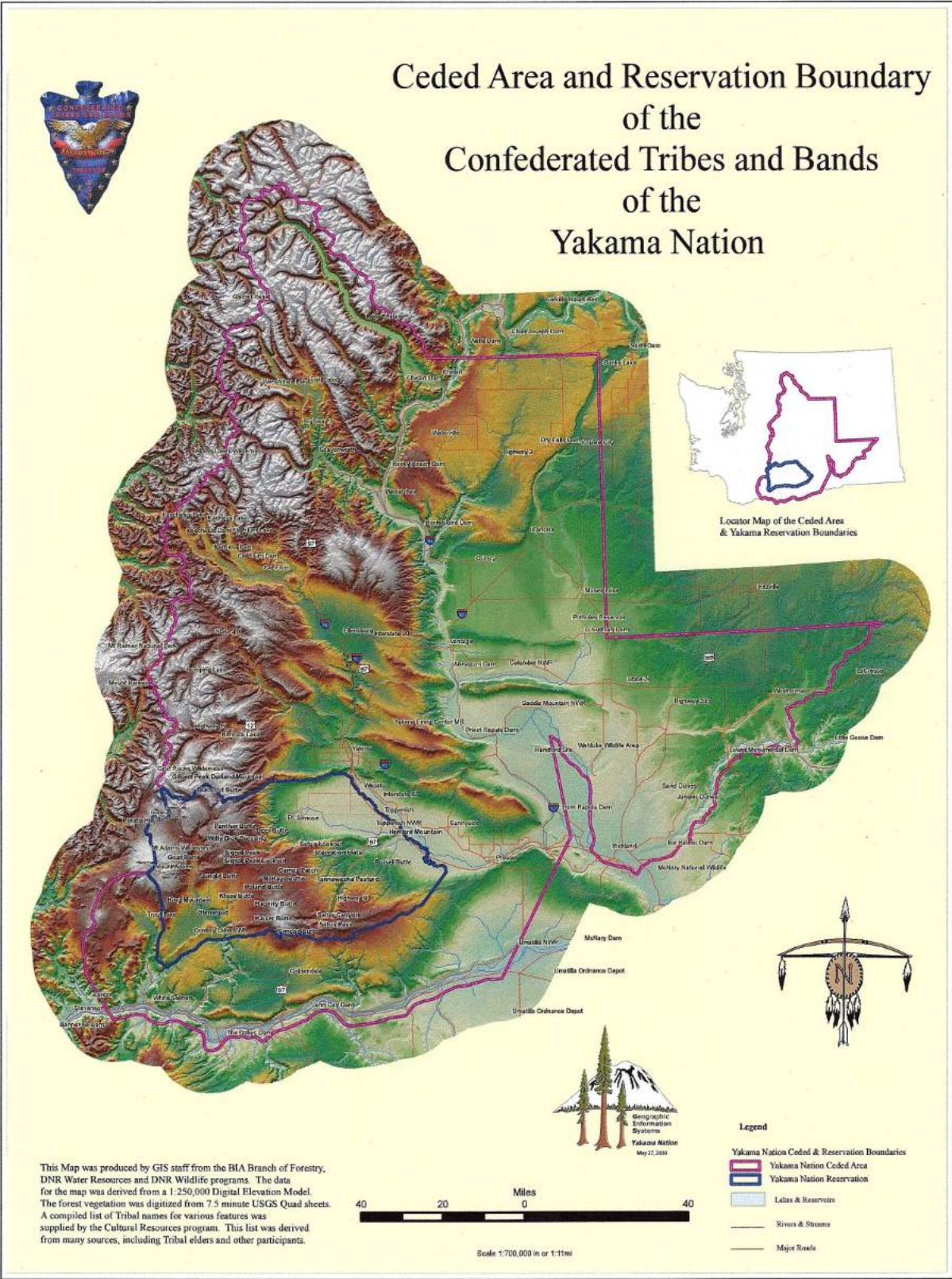


Figure 2. Ceded Area and Reservation Boundary of the Yakama Nation

STUDY AREA

The Yakama subbasin is one of the major tributaries of the Columbia River basin, with its confluence 335 miles from the ocean. The Yakima River flows 214 miles and is located in central Washington. The watershed contains an area of approximately 6,155 square miles with nearly 2,000 miles of perennial rivers and streams from the crest of the Cascade Mountain to the Columbia River 325 kilometers from the Pacific Ocean. Its large size contributes not only to sheer volume of available lamprey habitat but the wide variety of geologic, topographic, and ecological conditions producing a wide range of habitat types. These habitats are suitable for a variety of species and provide habitat diversity that supports multiple life stages of lamprey species. Specifically, Pacific Lamprey larvae, ammocoetes, macrophthalmia and adults have different optimal habitat types necessary to carry out essential life functions including migration, feeding, rearing, and spawning.

The major tributaries of the Yakima River include Keechelus, Kachess, and Cle Elum, Teanaway rivers in the northern part of the subbasin, and the Naches and Tieton rivers in the west. The Ahtahum, Toppenish and Satus creeks join the Yakima in the lower parts. There are five major reservoirs located in this subbasin, and form the storage components of the federal Yakima Projects managed by the Bureau of Reclamation, including: Keechelus Lake, Kachess Lake, Cle Elum Lake, Rimrock Reservoir and Bumping Lake. The north fork of the Tieton River connects Clear Lake with Rimrock Lake. These important features are illustrated below in Figure 3.

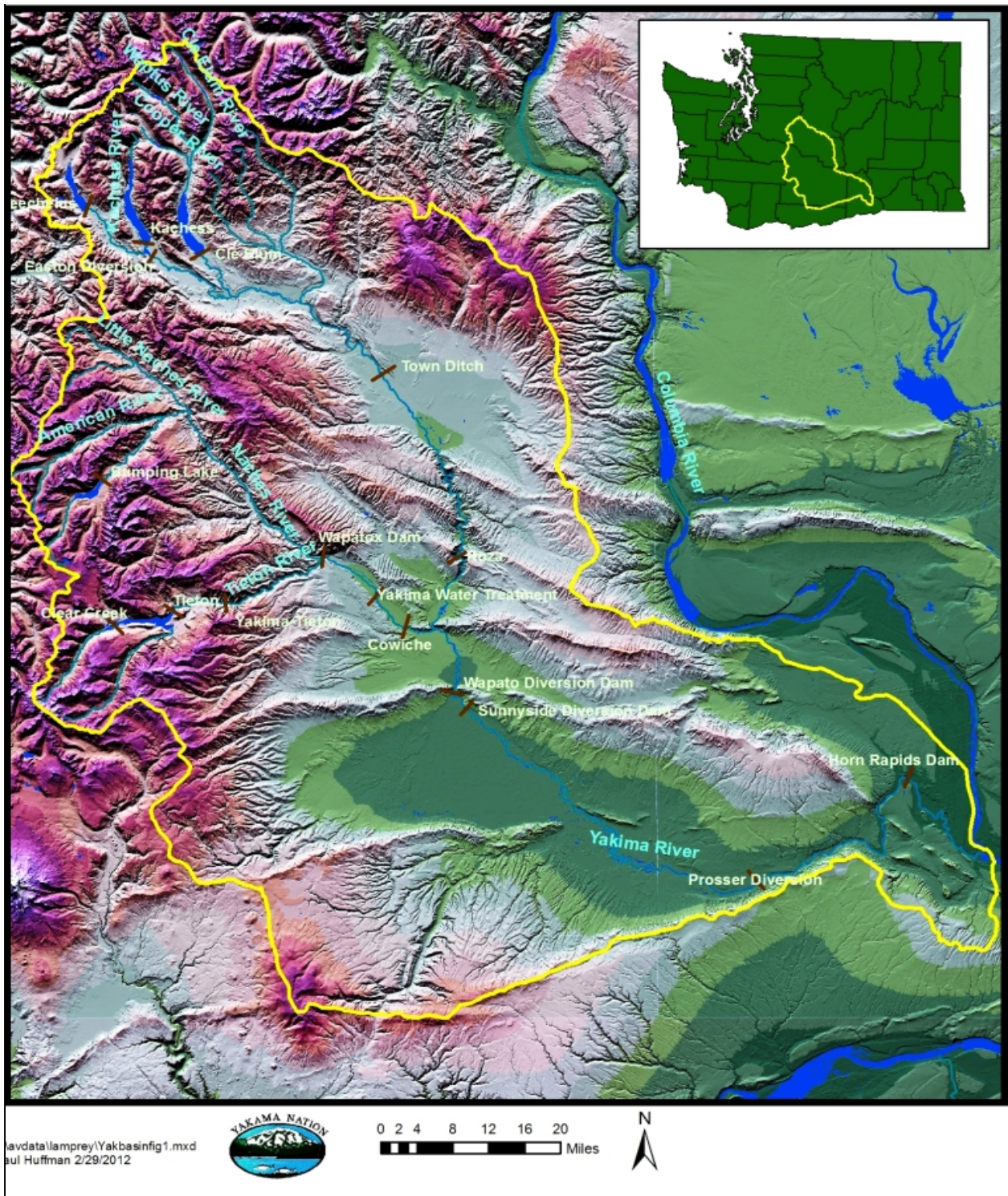


Figure 3. The Yakima River Basin and major irrigation facilities.

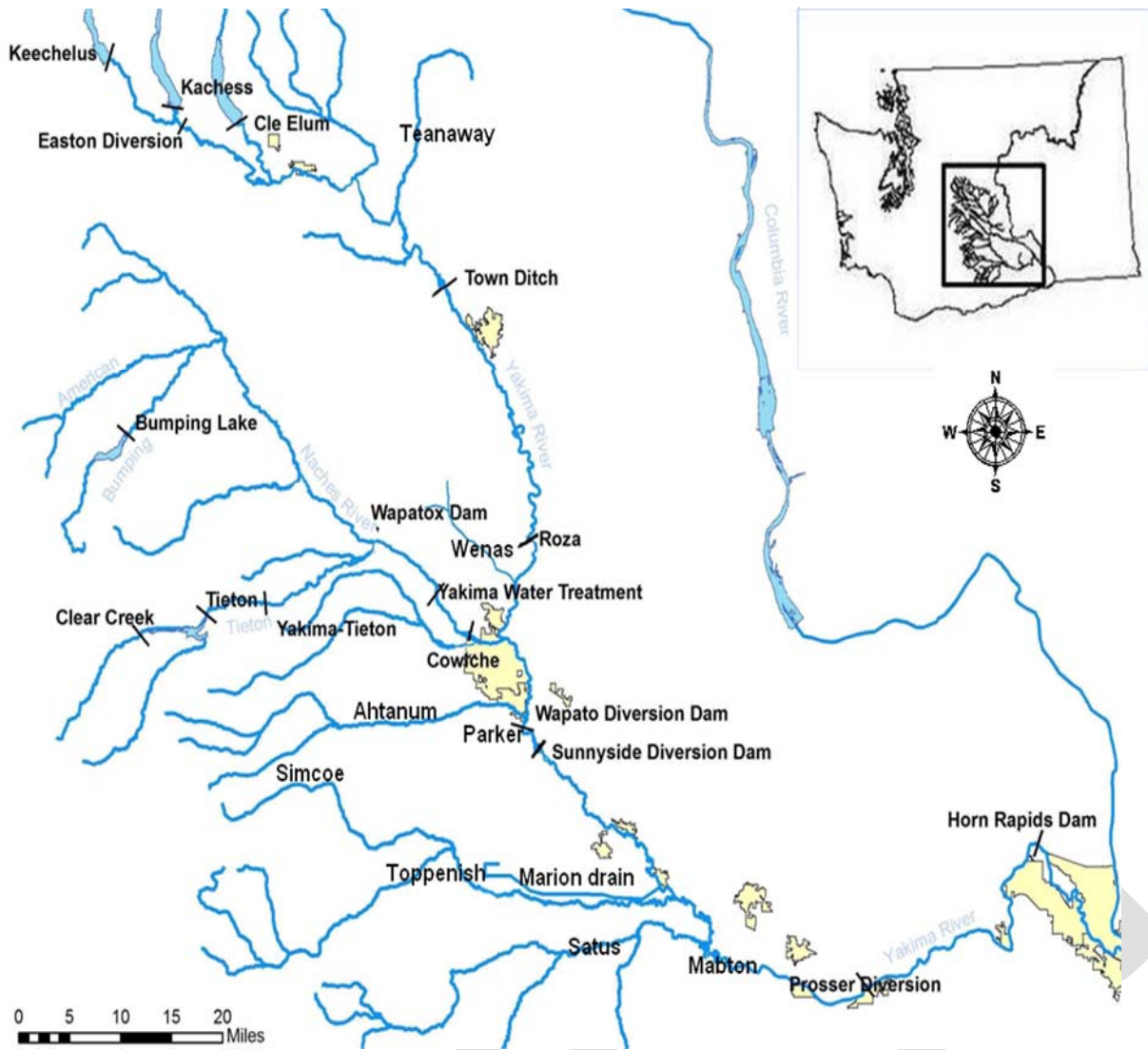


Figure 4. Schematic diagram of the Yakima River and major tributaries and irrigation facilities.

Tributary descriptions

For convenience, we have dissected the Yakima River Basin into five separate Analysis Units (AUs), each having distinct geo-physical and/or hydrologic properties. These AUs are briefly outlined below. Additional information is available within the Yakima Action Plan (Appendix B). Primary ac-

tivities in 2011 occurred in the Upper Yakima and Satus Creek, although other areas were surveyed as well.

Upper Yakima – includes the Yakima River and tributaries above the confluence of the Naches and Yakima Rivers. Pacific lamprey are believed to be extirpated - or essentially extirpated from this area. No adults have been counted at the Roza Dam fish counting window. Plentiful habitat exists in this Analysis Unit, both spawning and rearing although river flow management may be a potential limiting factor. Recent WDFW surveys have also shown areas where lamprey are present, but these are all believed to be Western Brook. The Yakama Nation surveys in 2011 confirm this account.

Naches– includes the Naches, Tieton, Bumping and American rivers, as well as their tributaries. Pacific lamprey are believed to currently occupy this Analysis Unit, but in very low numbers. Due to the periodic flashy flows, (primarily from the Tieton) and generally higher gradients and elevations, useable habitats, especially rearing are limited. The lower Naches River remains largely unconfined and braided and has the potential to provide good spawning and rearing habitats, although restoration actions would likely be needed to enhance the quality and quantity of these habitat-types.

Middle Yakima–includes the Yakima River and tributaries between Granger and the Yakima River/Naches River confluence. This Analysis Unit is designated due to its long, continuous and sinuous channel morphology that lends itself to prime rearing habitats and moderate river temperatures.

Lower Yakima– includes the mainstem Yakima River and tributaries (excluding Toppenish and Satus Creeks) between its confluence with the Columbia River and the community of Granger. This Analysis Unit is designated due to the likelihood that water temperatures exceed tolerance of juvenile lamprey and offer little opportunity to contribute to overall basin productivity. Winter rearing

is available although no lamprey were found throughout most of this AU during the 2010 presence/absence surveys.

Toppenish-Satus- includes Toppenish and Satus creeks and their tributaries. Each of these streams exist primarily on the Yakama Nation reservation, are relatively small and are degraded in places. However, with continuing restoration efforts (primarily salmonid), several stream reaches offer good opportunities for high productivity and research.

METHODS

Methods 2010

Habitat Designation: Habitat characteristics that help describe juvenile lamprey habitat are defined as: Type I – suitable and preferred substrate of fines, soft organic sediment, particulate fine silt, sand, and clays mixtures. Type I habitats are often found in backwater areas or along the margins of larger pools. Type II – similar habitat but with larger contribution of gravels and smaller cobble. Type III – generally unsuitable juvenile habitat with a preponderance of hard substrates such as bedrock, hard clays, cobble or coarse gravels (Fodale 1999).

In 2010, the general focus for surveys was in the lower portion of the Yakima basin. A systematic survey was attempted where sample sites were generally randomly selected and equally spaced. Site locations were pre-determined using National Agriculture Imagery Photos at 1:24,000-scale aerial maps and GIS software. Sampling sites began from the confluence with the Columbia, spaced every four-river kilometer (RK) up to river kilometer 204. At each site a search by foot was done to find the first preferred larval habitat in Type I or II habitats (Hansen et al. 2003). The only exceptions to these criteria are when we could not get our sampling equipment through unsafe areas or not accessible from the road.

Sites with Type I or Type II habitats were surveyed. Once lamprey were found a 7.5-m² plot was delineated and "depletion pass protocols" were performed (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). The use of a backpack model Abp-2 electrofishing unit (Engineering Technical Services, University of Wisconsin, Madison, Wisconsin), in wade able (<0.1 meter in depth) waters. The electro fishing 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. If larvae were present with the first 90 second depletion pass, two more passes were completed. Observation of presence was noted then stun pulsation slowed the larval enough for capture. If the larvae got away it was counted and marked undefined. Following collection, larvae were placed into a 1 liter bath of anaesthetize MS-222 at 50 mg/L (tricane methanesulfonate). Larvae were identified using Goodman & Lampman 2008 caudal ridge / pigmentation key with a 20X Nikon Field Microscope. Individual weights were taken using OHAUS Portable scale for each fish to the nearest 1/10 gram. Then placed into a recovery bucket, then returned to the river safely. The time spent at each site differed depending on presence and abundance of larval lamprey.

Methods 2011

Although there is merit to this systematic approach used in 2010, the YNPLP found that significant time was being spent locating and accessing sites that had little potential to hold fish. This was because of the elevated water temperatures in the lower river, or just the lack of Type I or Type II habitat types. Keeping in mind the vast amount of geography of interest to the YNPLP and because our primary objective is to first establish a general knowledge of where lamprey are - or not in the Yakama Nation ceded lands, and more specifically in the Yakima River - we adjusted our sampling strategy to better accommodate (expedite) this primary objective. Samples were spread throughout the mainstem Yakima and in some key tributaries, but with less emphasis in regularity of sampling locations. We also placed less emphasis on the multiple pass effort recognizing that the added

time did not significantly contribute towards better accuracy in relative abundance or general confidence in "presence / absence". Rather, we clearly recognize that obtaining greater confidence in a determination of "absence" and "relative abundance / density" will require greater rigor in our sampling strategy, which we will endeavor in the 2012 field season. This refinement allowed the YNPLP to enhance our focus on surveying more sites containing Type I habitats and improve our chances of finding lamprey, either Western brook or Pacific lamprey, if present.

In both 2010 and 2011, a substantial number of sites were sampled (approximately 200 total). Locations of these sites and where lamprey were found are illustrated in Figure 5 and Figure 6 on the following pages.

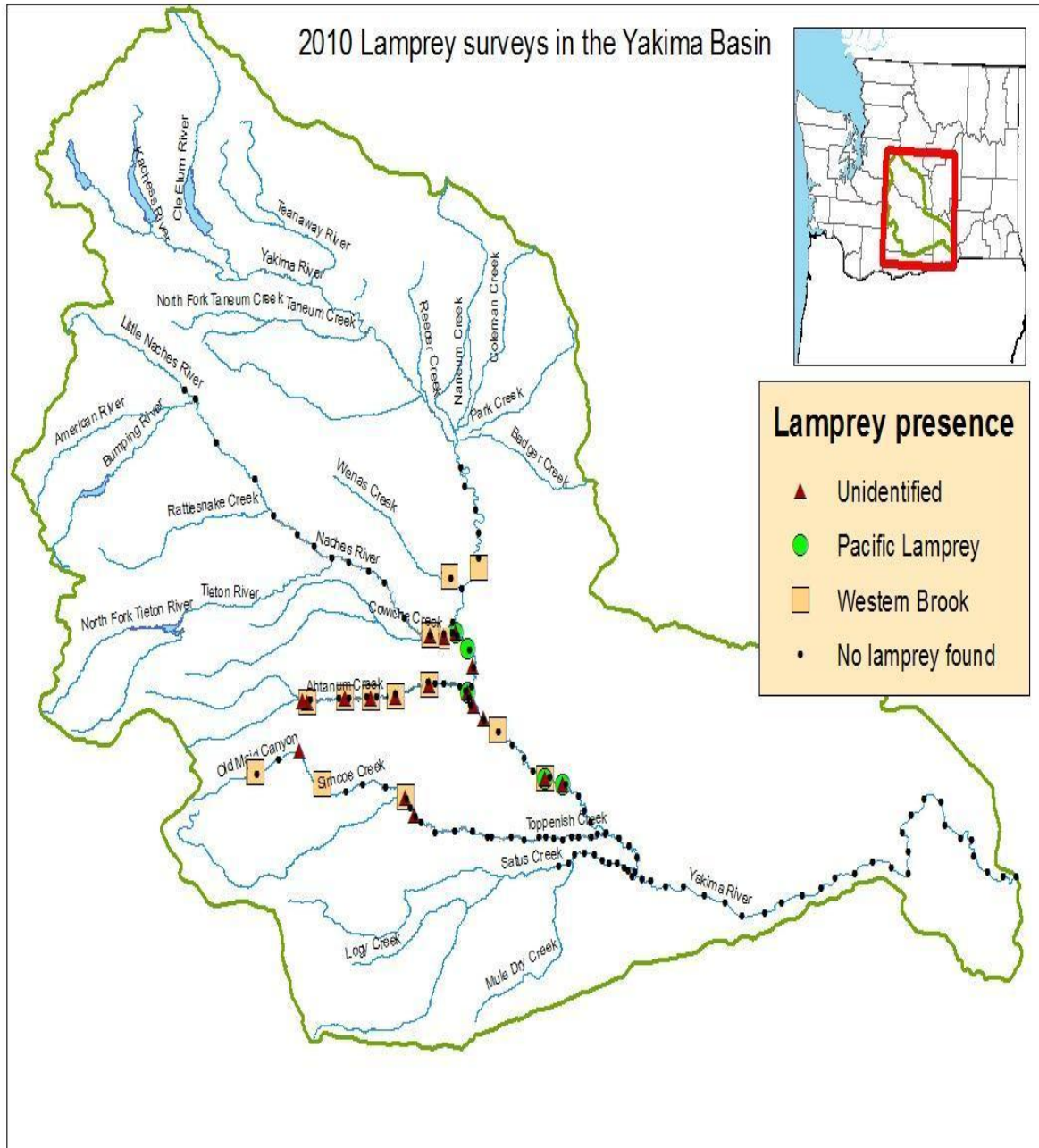


Figure 5. Juvenile Pacific lamprey survey points for 2010 field season.

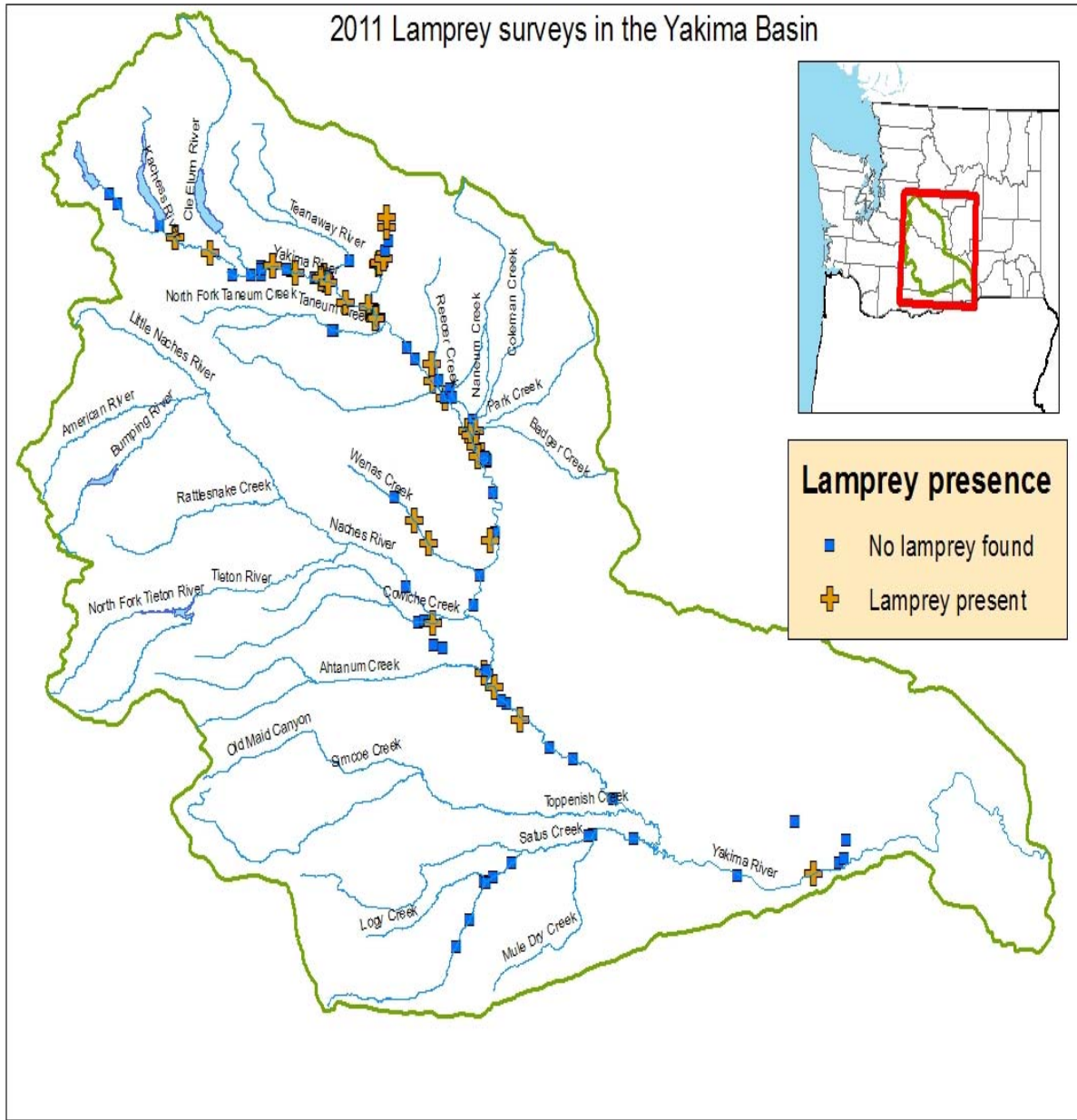


Figure 6. Juvenile Pacific lamprey survey points for 2011 field season.

RESULTS

Results from 2010 Surveys

In 2010, a total of 106 sites were sampled beginning in June through December 2010. Figure 7 (below) illustrates where lamprey were found during this field season.

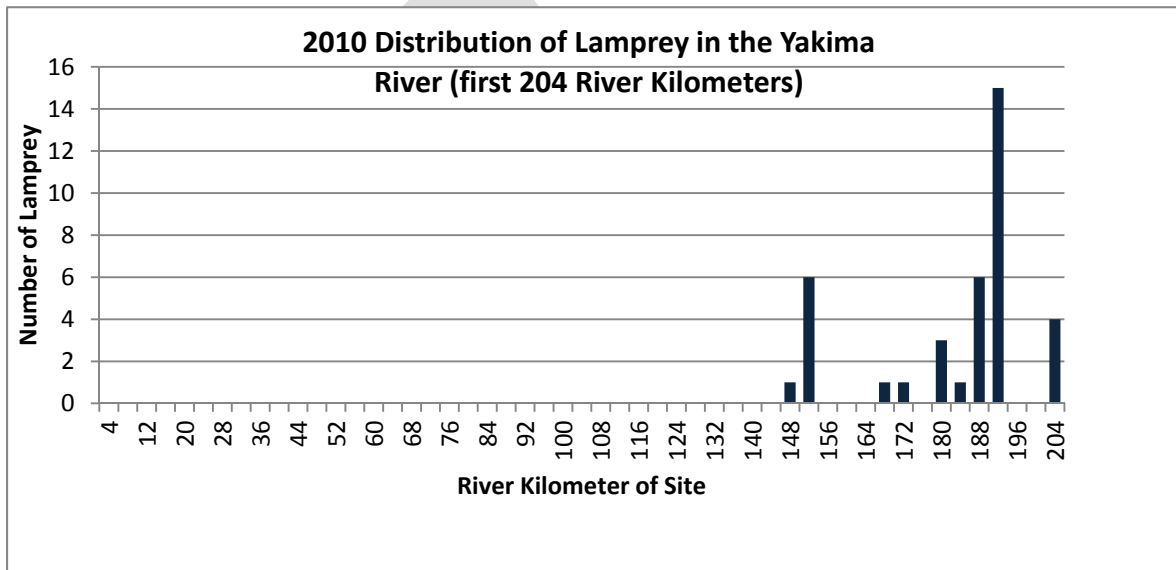


Figure 7 Distribution of larval lamprey in the Yakima River from 2010 surveys

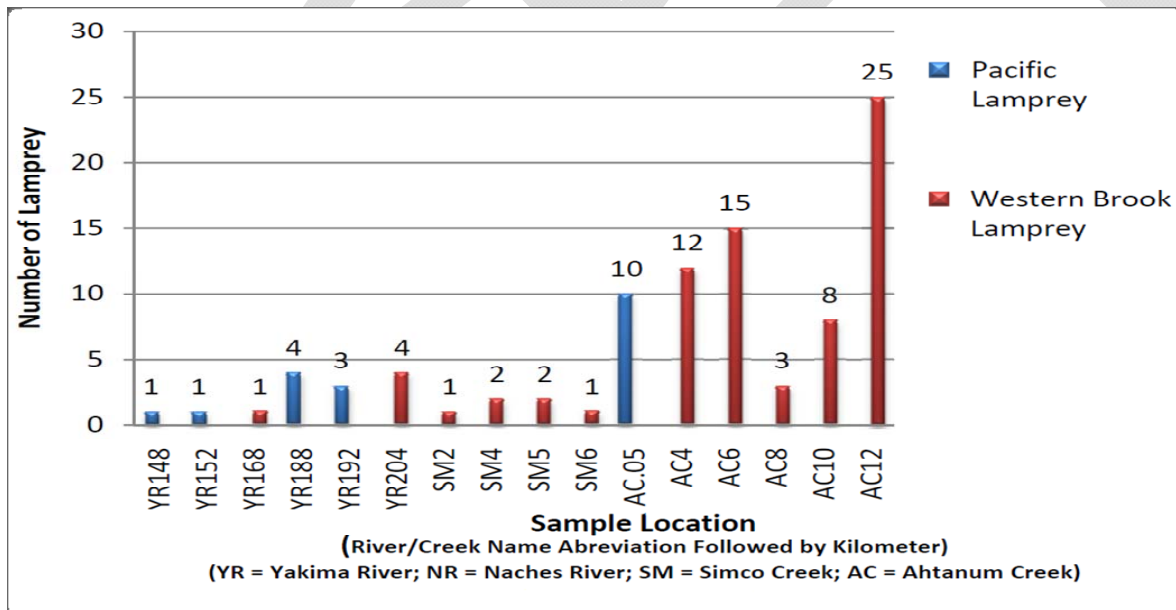


Figure 8. YN 2010 lamprey survey results, summarized by sampling locations.

In Toppenish / Simco creeks 21 sites were sampled; in Ahtanum Creek, 12 sites were sampled and in the Naches River 14 sites were sampled. Tables 1, 2 and 3 (below) illustrate these findings. In Satus Creek, 12 sites were sampled but no lamprey were found in 2010.

Table 1 Summary of data collected from juvenile lamprey surveys in the Toppenish/Simco Creek.

Sample	Pacific lamprey	Western brook	Undefined YOY
Minimum Length (mm)	0	57	0
Average Length (mm)	0	77	0
Maximum Length (mm)	0	103	0
Minimum Weight (g)	0	0.35	0
Average Weight (g)	0	1.05	0
Maximum Weight (g)	0	1.83	0
Number Captured (n)	0	6	4

Table 2 Summary of data collected from juvenile lamprey surveys in the Ahtanum Creek.

Sample	Pacific lamprey	Western brook	Undefined YOY
Minimum Length (mm)	48	0.23	0
Average Length (mm)	55	82	0
Maximum Length (mm)	67	185	0
Minimum Weight (g)	0.28	0.23	0
Average Weight (g)	0.4	0.95	0
Maximum Weight (g)	0.64	3.64	0
Number Captured (n)	10	63	29

Table 3 Summary of data collected from juvenile lamprey surveys in the Naches River.

Sample	Pacific lamprey	Western brook	Undefined YOY
Minimum Length (mm)	0	0	0
Average Length (mm)	0	0	0
Maximum Length (mm)	0	0	0
Minimum Weight (g)	0	0	0
Average Weight (g)	0	0	0
Maximum Weight (g)	0	0	0
Number Captured (n)	0	0	204

Results from 2011 Surveys

In 2011 surveys were implemented from early June through early December. A total of 96 sites were surveyed over this time. The extent (time allocation) of the sampling varied among sites but generally consisted of approximately of 10-15 minutes (not including set up and data recording. An effort was made to quantify habitat quality and quantity but was not feasible due to time constraints. A summary of findings is noted below in Tables 4, 5, 6, 7 and 8.

Table 4. Summary of data collected from juvenile lamprey surveys in the lower Yakima River

Reach and Tributary	Survey Points	Pacific lamprey	Western brook	Undefined YOY
Snipes Creek	2	0	0	0
Spring Creek	2	0	0	0
Chandler Canal	1	0	0	0
Horn Rapids Canal	6	0	0	0

Table 5. Summary of data collected from juvenile lamprey surveys in the mid-Yakima River

Reach and Tributary	Survey Points	Pacific lamprey	Western brook	Undefined YOY
Wide Hollow Creek	4	0	0	0
Marion Drain Canal	11	0	0	0
New Rez Canal	10	0	0	453
Sunnyside Canal	12	0	0	224

Table 6. Summary of data collected from juvenile lamprey surveys in the upper Yakima River

Reach and Tributary	Survey Points	Pacific lamprey	Western brook	Undefined YOY
Yakima River mainstem	45	13	139	15
Teaway River	3	0	18	0
Wenas Creek	3	0	27	3
Cabin Creek	1	0	0	0
Cherry Creek	1	0	10	2
Cle Elum Slough	2	0	0	0
Fiorita Pond	1	0	0	0
Swauck Creek	8	0	35	1
Taneum Creek	4	0	0	0
Tillman Creek	1	0	0	0
Umptanum Creek	1	0	6	1
Ball Ditch Diversion	1	0	0	0
C Town Ditch Diversion	1	0	13	1
Roza Dam Diversion	1	0	5	29
Selah-Moxee Diversion	1	0	5	38

Table 7. Summary of data collected from juvenile lamprey surveys in the Naches River

Reach and Tributary	Survey Points	Pacific lamp- rey	Western brook	Undefined YOY
Cowiche Creek	3	0	0	5
Eschbauch Park	1	0	0	0
Wapatox Canal	1	0	0	98

Table 8. Summary of data collected from juvenile lamprey surveys in the Toppenish Creek

Reach and Tributary	Survey Points	Pacific lamprey	Western brook	Undefined YOY
Satus Creek	8	0	0	0
Logy Creek	1	0	0	0

DISCUSSION

As can be seen from Figures 5 and 6, the Yakama Nation Pacific Lamprey Project (YNPLP) has "touched" a considerable amount of the Yakima River basin in the past two years. In 2010, we emphasized the lower Yakima basin, then in 2011 we emphasized the upper portion of the basin. Our primary objective was to begin identifying areas (streams or reaches) where we *believe* Pacific lamprey are present and where we *believe* they are absent. We have not yet attempted to "quantify" either relative or absolute abundance at any spatial scale.

It is important to bear in mind these surveys are considered preliminary in nature. For example, we have little idea of the densities of juveniles anywhere within the basin, but density appears to be low throughout most of the basin. If this is true, it is likely that a particular survey may indicate no Pacific lamprey are present, when they actually could be. To some degree, this situation was realized in the 2010 and 2011 surveys, where no lamprey were found in some portions of the upper-Yakima River (near or within the Yakima Canyon) in 2010, but were found in nearby locations during the 2011 survey. For this reason, we are not yet at a place to draw conclusions. However, drawing from our existing information, it is reasonable to speculate that:

- juvenile Pacific lamprey populations within the Yakima River are at very low abundance,
- the majority of Pacific lamprey juveniles are located within the "Wapato Reach" - or mid-section Yakima River (Granger to City of Yakima) with small local populations in a couple key tributaries of this Reach,
- lower Yakima, Naches and upper Yakima (above Roza Dam) rivers appear to have juvenile populations that are so low, they are functionally, if not literally extirpated from these areas, and

- Western brook juveniles are found in many parts of the basin, at considerably higher abundance than Pacific lamprey.

These observations are supported by adult counts at both Prosser and at Roza Dam fish counting stations. At Prosser, very few adults have been counted since 2003. With counts numbering less than 10 adults passing Prosser, it seems entirely possible that males and females may not be able to find each other, providing no contribution to the next generation. At the Roza fish counting station, no adults have been reported since operation began several years ago.

During both 2010 and 2011, the YNPLP worked closely with the BOR to initiate surveys in various irrigation canals within the Yakima basin. Results of these surveys are noted above in Tables 4, 5, 6, and 7. Indeed many juvenile lamprey were found behind fish screens (3/32 mesh - within compliance of salmonid criteria). It is not at all understood how these lamprey are getting through, or over these screens. Interestingly, multiple length classes are found. Work specific to these surveys is summarized in Appendix A. This work will continue, in close coordination with BOR and other private irrigation districts over the next few years.

An important observation during the 2011 field season cannot be overlooked. The upper Yakima River, above the confluence with the Naches River is subject to a management condition known as "flip-flop". In essence, the bulk of irrigation water used in the lower basin is shifted from the upper Yakima reservoirs to the Naches / Tieton system. This event occurs in early September, and is completed on or before September 10, each year. The primary objective of flip-flop is to benefit overall spawning / incubation conditions for Spring Chinook. However, as a result, the upper Yakima River is "ramped-down" over a relatively quick timeframe, a few days - one week, approximately. The environmental consequences are widely known, as vast shoreline areas are littered with aquatic macro-invertebrates that are left on the beach of the receding water, only to desiccate

and die. What has not been widely considered are the impacts to lamprey. It is possible that in some areas, lamprey are also isolated from the receding waters, and unable to move back into the stream flow. This is an important area for study and consideration.

Over the next couple years, the YNPLP will work closely with the USFWS and other tribes in the development of survey techniques that, hopefully, will provide statistical confidence in determination of "absence" from a given area. We believe this method will be similar to those recently employed, but will provide greater consistency and intensity. It is conceivable that this same method will be very consistent with information needed to establish confidence in long-term status and trend, as well as gaining reasonable estimates of relative abundance, if not "absolute" abundance (at very local scales).

CONCLUSION

The completion of the 2011 field season provided the Yakama Nation Pacific Lamprey Project a first, overall glimpse of the state of Pacific lamprey within the Yakima River basin. In short, we believe it is reasonable to speculate, if not conclude that Pacific lamprey are essentially extirpated from this subbasin. We will continue surveys over the years to come, providing better information about this local population.

If this speculation / preliminary conclusion is valid, the obvious question is: "How do we go about recovery of Pacific lamprey in the Yakima River basin?" Indeed, the first step is to identify, as best we can the primary limiting factors affecting this species destined for or residing in the basin. This activity has been initiated and is contained in Appendix 2 (Yakima River Action Plan). The Action Plan is considered a DRAFT, and a "living" document, with the intent to update it every couple years, as appropriate.

Our recovery efforts will also include substantial, if not aggressive research into the appropriate use of supplementation into the Yakima basin. We firmly believe it will take many years for adequate passage to be realized at the lower FCRPS mainstem dams. We also speculate that juveniles do provide a chemical (pheromone) scent necessary to motivate adults to return to headwater streams to spawn. Given both, we believe that progress must be made on investigating supplementation as viable and potentially necessary tools to recovery lamprey populations in the Yakima River, and elsewhere, within the foreseeable time. We will focus on both juvenile and adult supplementation, through artificial propagation and through translocation. These efforts have already gotten underway, to a relatively small degree during 2011. Specifically, the YNPLP has been involved with the capture of lamprey at the lower mainstem FCRPS Projects and collected approximately 200 eels. Many of these fish were transferred to the Nez Perce tribes for their translocation efforts. Approximately 50 eels were retained and used in a radio-telemetry study of adult passage over diversion dams in the Yakima River, and a few remaining eels have been used in very preliminary efforts to develop artificial propagation techniques. We look forward to these, and other related efforts to become well established and a significant component of our overall Project.

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APPENDIX A

Confederated Tribes and Bands of the Yakama Nation
Department of Natural Resources, Fisheries Resources Management Program
Yakama Nation Pacific Lamprey Restoration Project

Assessment of lamprey presence in irrigation diversions and canals in the Yakima Basin



Prepared for:

Bureau of Reclamation

Annual Update Preliminary Report

Prepared by:

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Introduction

Historically, Pacific lamprey were found throughout much of the Columbia River Basin (Kan 1975; Hammond 1979; Vella et. al.1999). Populations have drastically decreased over the last 50 plus years due to a variety of factors, including but not limited to dam passage, habitat degradation, and potential entrainment of juveniles into irrigation diversion canals and ditches.

There are two species of lamprey in the Yakima subbasin. Pacific lamprey (*Entosphenus tridentatus*) is anadromous, their life cycle includes time in both the freshwater and the ocean environments. The second is the Western brook *Lampetra richardsoni*, a resident lamprey whose life cycle never leaves freshwaters. Unfortunately, resource managers know less about these species than most other fishes, both native and non-native within the basin. To the Yakama people Pacific lamprey have a long history of legends, of cultural importance as a staple, and for medicinal purposes.

Within the last few years, observations from regional biologists have indicated that tributary irrigation dams may create passage barriers for returning adults moving into headwater spawning areas and may also entrain juveniles into irrigation ditches as they migrate downstream. As a result, the Bureau of Reclamation (BOR) and the Yakama Nation (YN) are working together to evaluate potential issues associated with lamprey movement past irrigation diversions in the Yakima River Basin. For the purposes of this report, we focus primarily on potential issues associated with juvenile entrainment into diversion ditches and past existing fish screens.

Existing fish screens were design to keep salmonids and other larger fish from entering the irrigation canal systems. However, it is becoming increasingly evident that lamprey are getting behind

some of these screens. Currently, there is no empirical information to indicate the magnitude of this potential issue. Studies by the YN within the Yakima River Basin over the past two years (2010 and 2011) were designed to be exploratory in nature, intended to simply identify, in a qualitative context, if lamprey were present in various canals. Much of this "presence / absence" information has been established and future surveys will be designed to address these issues in a more quantitative manner.

In 2010, the YN performed preliminary surveys in front and behind diversion screens at the Prosser/Chandler, Sunnyside, Wapato/NewRez, Selah/Moxee, and Roza irrigation diversions. The results indicated that larval lamprey were present behind some screens, which justified additional surveys to be conducted in the 2011 field season. In 2011, eight diversions and four canals were surveyed from Horn Rapids dam up to Roza Dam of the Yakima River. These surveys were coordinated with YN and BOR staff during the dewatering events at each of the canals. The intent of these surveys has been to obtain baseline information addressing two basic questions:

1. are juvenile lampreys found behind diversion screens, and if so,
2. which canals contain the greatest number of lamprey?

Over the next two or three years, the YN will continue to survey all major canal systems in the Yakima River Basin. These surveys will help determine relative abundance of lamprey in various canals, indicate size classes found, distribution throughout certain canals, and species composition.

Purpose and scope

The purpose of these surveys is to determine the extent that juvenile lampreys are found behind the fish screens within various irrigation canals. Upon verifying presence, we are interested in 1) estimating how many lampreys are entering the canals each year, 2) understanding how lampreys are distributed in the canals and 3) what age groups are present. Over the next few years, additional surveys will be performed to estimate the number of juvenile lampreys getting behind these screens and determining how they are getting behind these screens.

Study Area

Figure 1 displays the study area and major irrigation diversion dams in the lower Yakima River Basin.

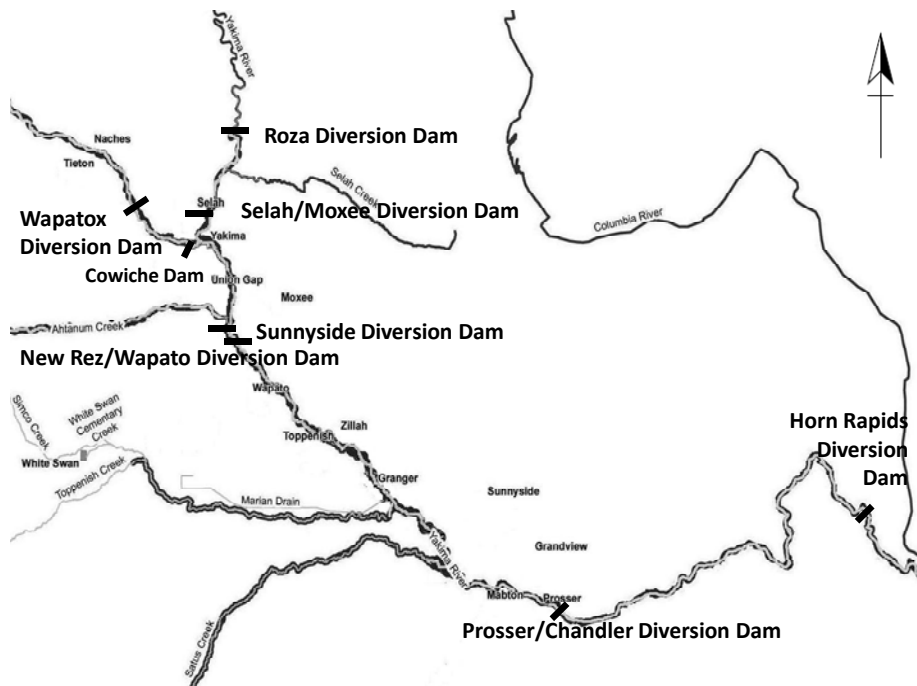


Figure 1 – Over view of the study area and major diversions (indicated by solid bars) in the Yakima River Basin.

Description of Sample Sites

Yakima River

- Horn Rapids (Wanawish) diversion is in Benton County at river mile 18 from the Columbia River.
- Prosser/Chandler diversion is in Benton County at river mile 47 from the Columbia River at Prosser, Washington. Chandler canal entrance is on the left bank of Prosser dam.
- Sunnyside Dam and diversion is location in Yakima County at river mile 103 on the left bank and the canal runs 60 miles eastward to Prosser.
- Wapato-Parker/New Rez diversion is located in Yakima County at river mile 104 upstream of Sunnyside diversion and is on the right bank approximately 1.4 miles southwest, and north-west of Parker.
- Selah/Moxee diversion is located in Yakima County, and the water is diverted from the mainstem Yakima near the township of Selah.
- Roza dam and diversion is located in the Yakima County at river mile 127.8 on the right bank about 10 miles north of Yakima.

Naches River

- Cowiche Creek diversion is located in Yakima County approximately 3.4 miles west-southwest of Yakima, and 6 miles west of Cowiche.
- Wapatox diversion is located in Yakima County about 7.4 miles upstream from the Yakima River and 0.5 miles below Tieton River near the township of Naches.

Methods and Materials

Surveys took place from late October to mid November for both 2010 and 2011 seasons after coordinating with Bureau of Reclamation staff on planned dewatering periods. Roza, Selah/Moxee, Wa-

pato, Sunnyside, Cowiche and Horn Rapids were sampled in the 2010 and 2011 field seasons, with the addition of Wapatox in 2011.

Initial locations of sampling sites were determined using Google earth software. Actual sample locations were modified based on "on the ground" conditions. Sampling at sites began from the downstream side working upstream insuring water would not be clouded during sampling. Type I habitats¹ were the preferred sampling locations. The only exceptions to these criteria were when we could not get sampling gear into some inaccessible areas (through steep inclines, large basalt boulders or fissures, and/or concrete gorges).

At each sample site, a 7.5-m² plot was measured, and a backpack model Abp-2 specialized lamprey electrofishing unit (Engineering Technical Services, University of Wisconsin, Madison, Wisconsin) was used to determine if lamprey larvae were present. 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. Surveys were done in water <0.1 meter in depth. If any lamprey were found during the first 90 second pass, we continued with two more 90 second samples consecutively. If more fish were found, electrofishing continued across the entire canal to initiate a fish salvage effort. Following collection random subsamples of larvae were anaesthetized in MS-222 at 50 mg/L (tricane methanesulfonate). Larvae were identifying using the caudal ridge / pigmentation assessment (Goodman et al. 2008) with a 20X Nikon Field Microscope. Our sampling effort concentrated

¹ Type I habitats are those containing significant portions of mud/sand mixture with detritus materials preferred for rearing juvenile lamprey.

on the capture of each fish observed, then placed into buckets, then into aerated coolers to be transported back into the mainstem of the Yakima River.

Results

Both 2010 and 2011 field surveys observed juvenile lamprey above and below fish screens in various canals. A total of 526 and 248 lamprey were caught in front of the screens from various diversions in 2010 and 2011, respectively, and 1901 and 584 lamprey were caught behind the screens during the 2010 and 2011 surveys, respectively. Table 1 summarizes these results.

TABLE 1. - Number of lamprey caught at eight diversions during the 2010 and 2011 field seasons.

YEAR	2010		2011	
	Front	Behind	Front	Behind
	n = 2427		n = 832	
Diversion	Front	Behind	Front	Behind
YAKIMA				
Horn Rapids	0	0	0	0
Prosser/Chandler	0	0	0	0
Sunnyside	0	1292	0	224
Wapato/New Rez.	325	358	83	360
Selah/Moxee	0	0	38	0
Roza	0	24	29	0
NACHES				
Cowiche	201	227	0	0

In 2010, most samples were taken near each of the fish screens within the various diversions. However, in 2011 a greater emphasis was placed on understanding if juveniles were moving lower into the canal systems. Initial findings suggest that most lamprey are found in the upper portions of these irrigation canals. This question will continue to be investigated in the 2012 survey season. Figure 2 shows the 2011 sampling sites in the four major diversions in the lower Yakima River. Color dots indicate each of the individual canals and specific locations of sample sites from Horn Rapids up to Roza. The sites that had lamprey are indicated in red box in this Figure.

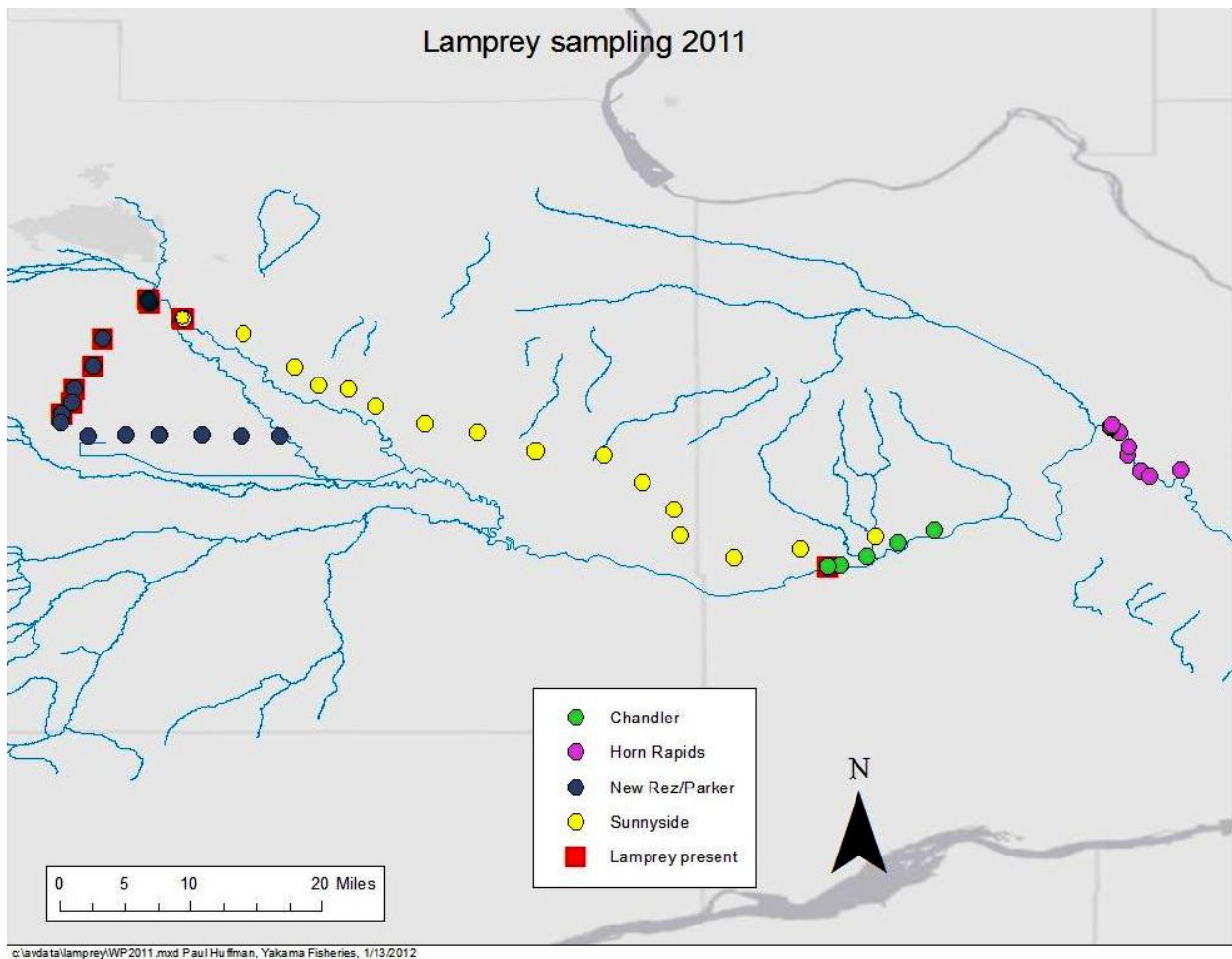


Figure 2 - Overview of the 2011 sample sites of diversions and canal distribution.

Discussion

These initial surveys are the first completed during the annual dewatering of these canals. These surveys are preliminary but indicate that lamprey are getting behind certain screens, although it is not yet clear how they are getting past the screens. Lamprey of various size classes are found in front and behind these screens, suggesting some lamprey actually survive the dewatering period and live in portions of the canal throughout the full year. Alternatively the screen system actually allows multiple age classes to pass below, into the canal.

For example, in 2010, 240 length and weights measurements were taken from juveniles from the Wapato/NewRez sites. Figure 4 (below) illustrates the length classes that were found. This information clearly shows several age classes ranging from fish less than 40 mm (likely young of the year) to transforming individuals greater than 100 mm. The entire subsample of 240 individuals were identified as Western brook lamprey. There were no Pacific lamprey positively identified during the entire sampling time.

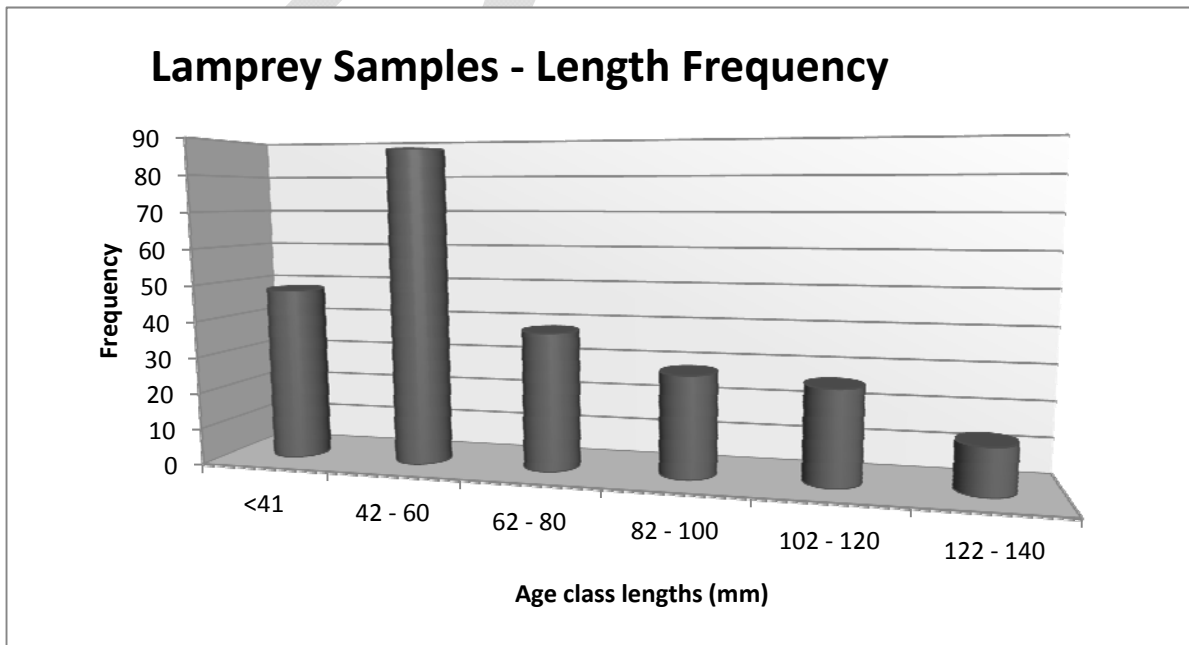


Figure 4 - Length Frequencies of juveniles lamprey found at diversion at Wapato/NewRez 2010.

One of the key problems is the difficulty to confidently determine species in the field. Determination between Pacific and Western brook lamprey at smaller size classes (approximately <50 mm or smaller) is extremely difficult. Genetic samples could be obtained to make this determination. Regardless of species, it is obvious that juvenile lamprey are getting behind diversion screens, warranting concern that entrainment of lamprey into these conveyance canals could be an issue in recovering Pacific lamprey populations in the Yakima River Basin. Our sampling approach was ap-

appropriate for establishing preliminary baseline data at this time. In future years additional studies will be conducted to (1) determine a better estimate of relative abundance and (2) the manner in which lamprey are entering into these canals.

Recommendations

1) Surveys should continue in future years to determine presence and relative abundance of juvenile lamprey and specific age classes found within all major canal systems in the Yakima River Basin. Given the substantial number of canals within the Yakima Basin and the overall extent of these systems, this will require greater efforts to obtain this important information in a timely manner.

2) Methods should be developed to determine how juvenile lamprey are entering into the canal system with a focus on identifying if, or how different age classes are moving past these screens. It appears likely that lamprey are also overwintering in some of the canal systems. It is recommended that future surveys look at areas within the canals that contain water throughout the winter to evaluate this potential.

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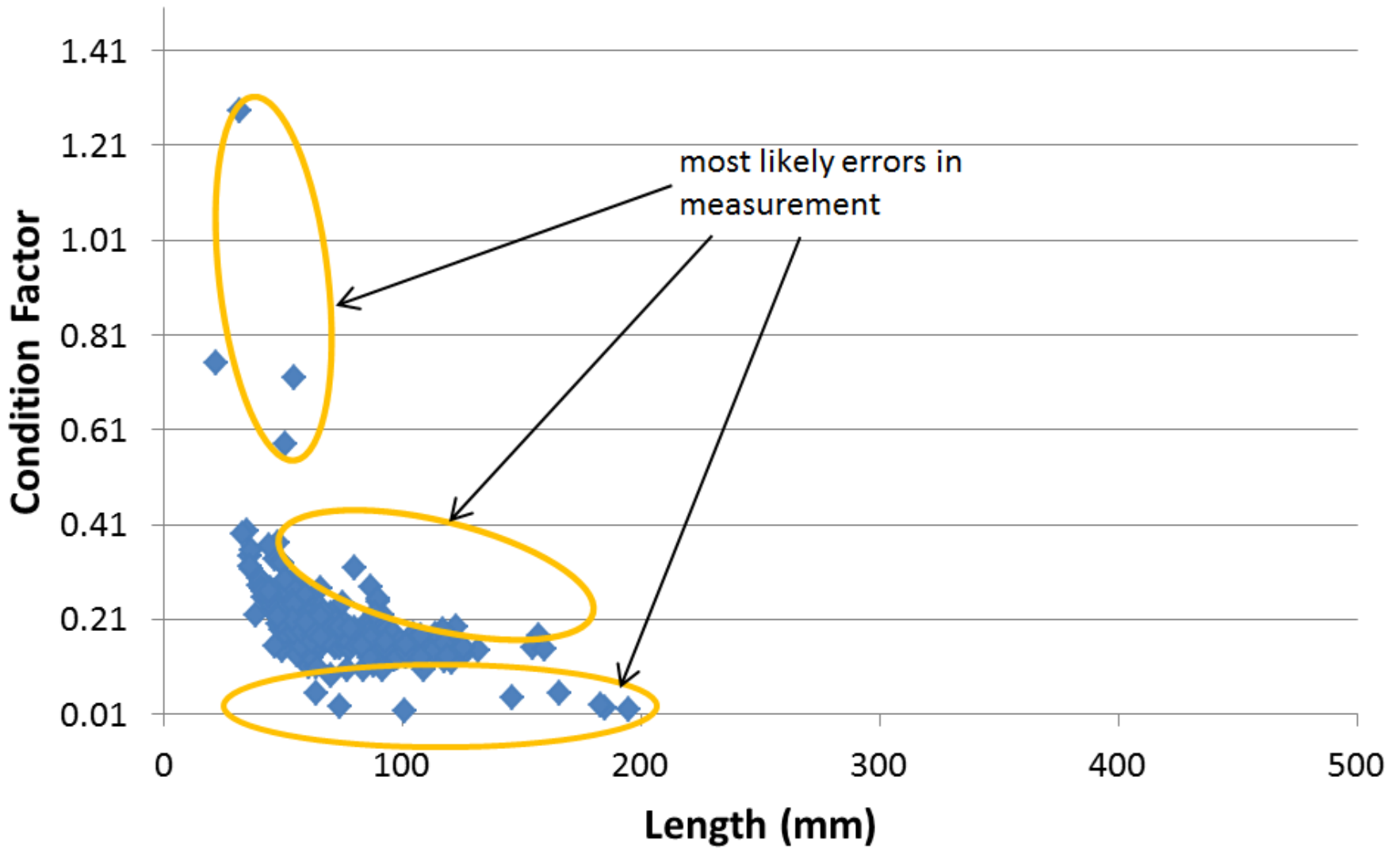
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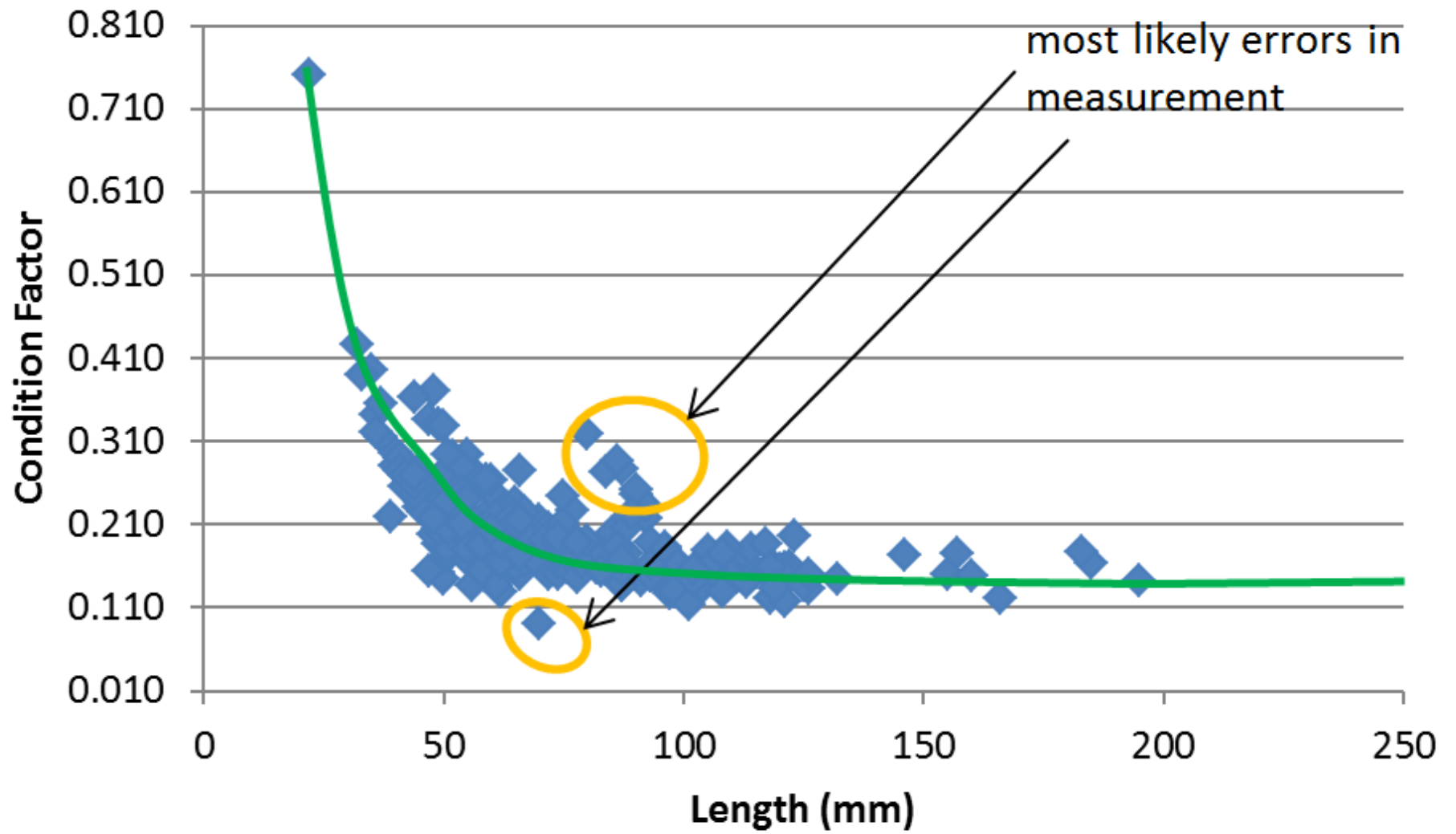
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Appendix B
Summary of DRAFT Data Tables
in Association with the 2010 and 2011 Field Surveys
Yakima River Basin

The Tables contained on the following pages are DRAFT and reflect very preliminary tools for future data analysis. These are provided primarily to inform interested readers of the types of information we are collecting and to encourage others to review these graphics and provide insights towards its interpretation. These graphics will be updated and formalized during this next 2012 field season and reported in PISCES at the earliest possible time. All raw data is available upon request.

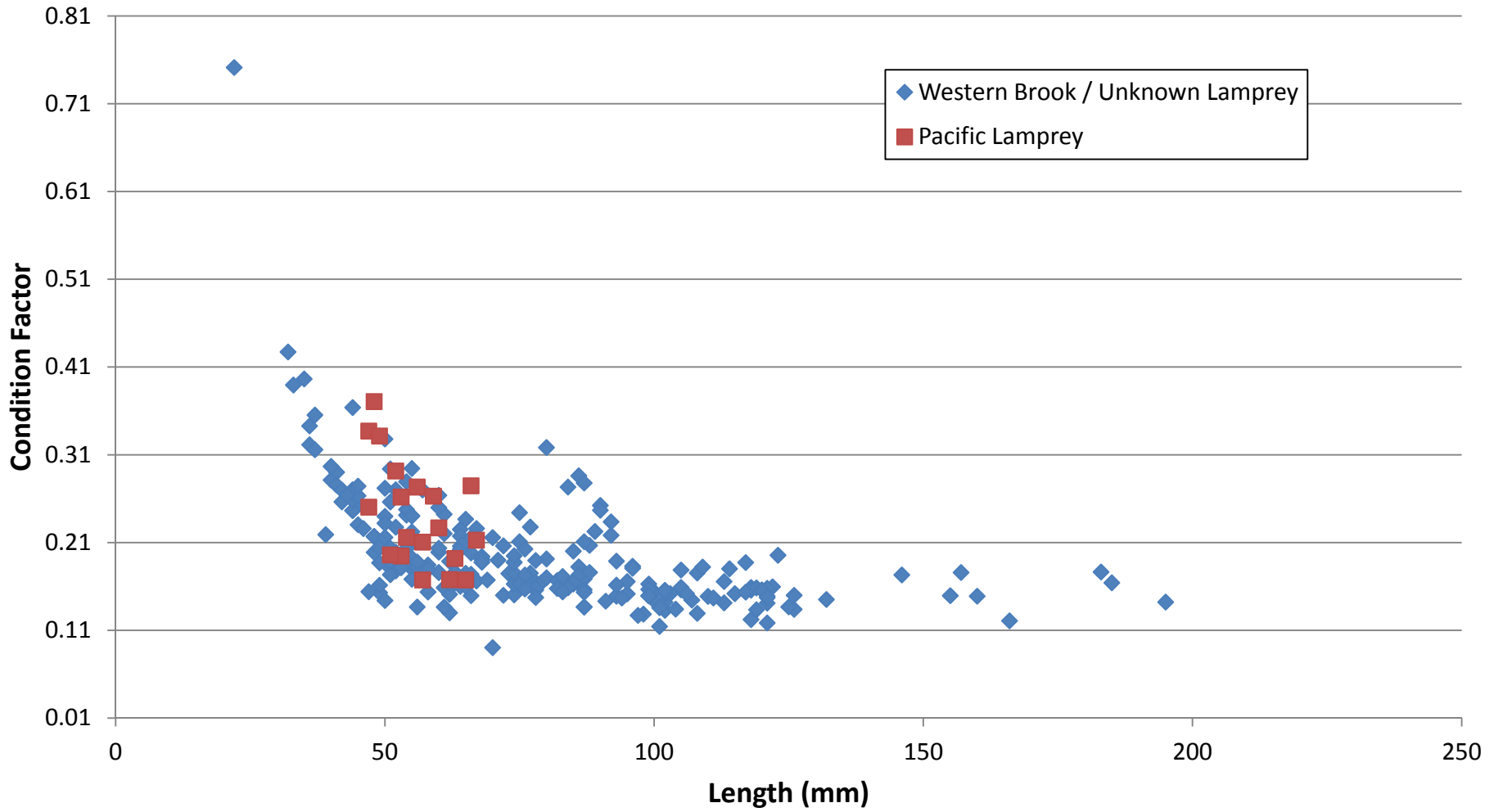


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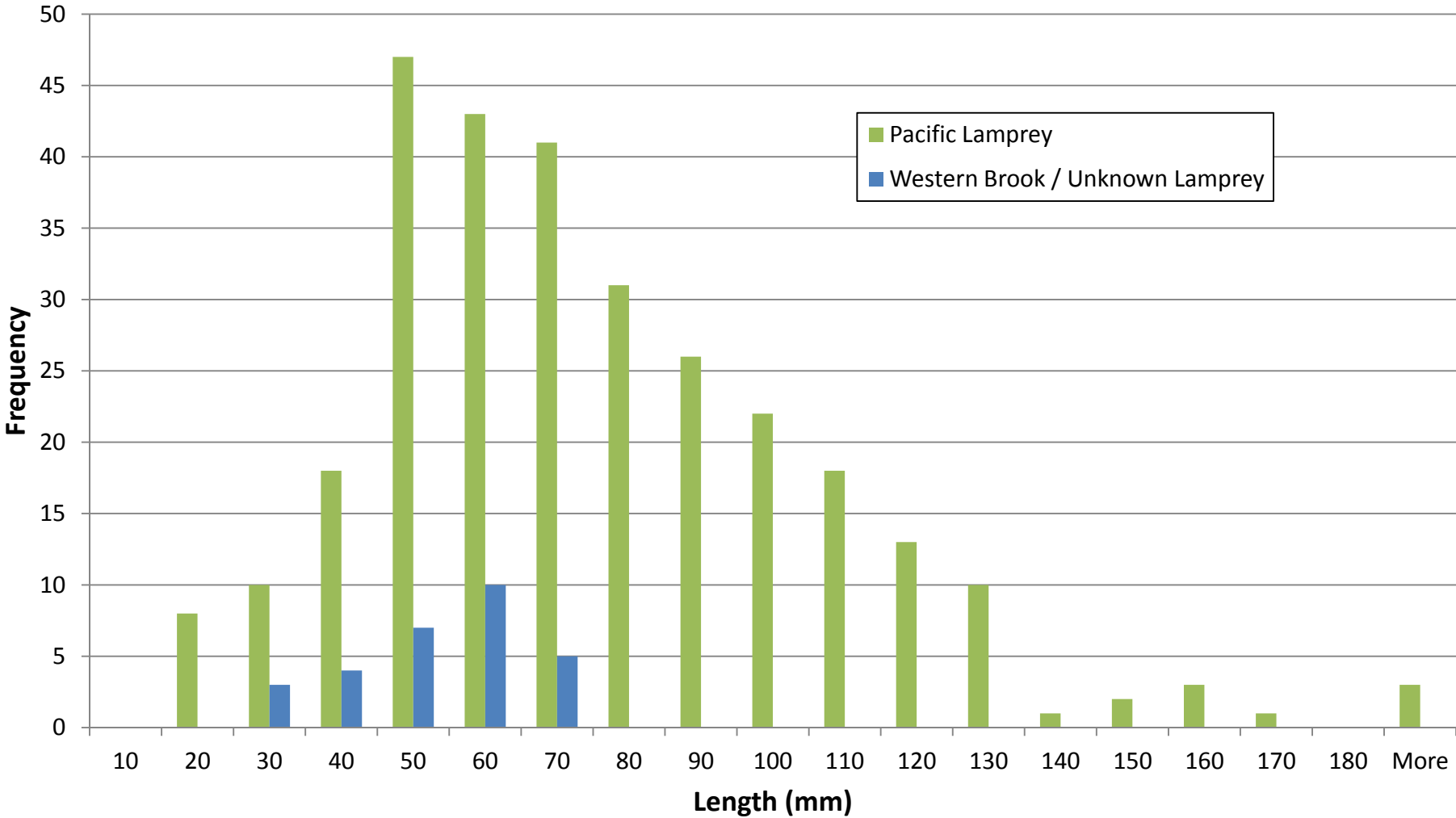


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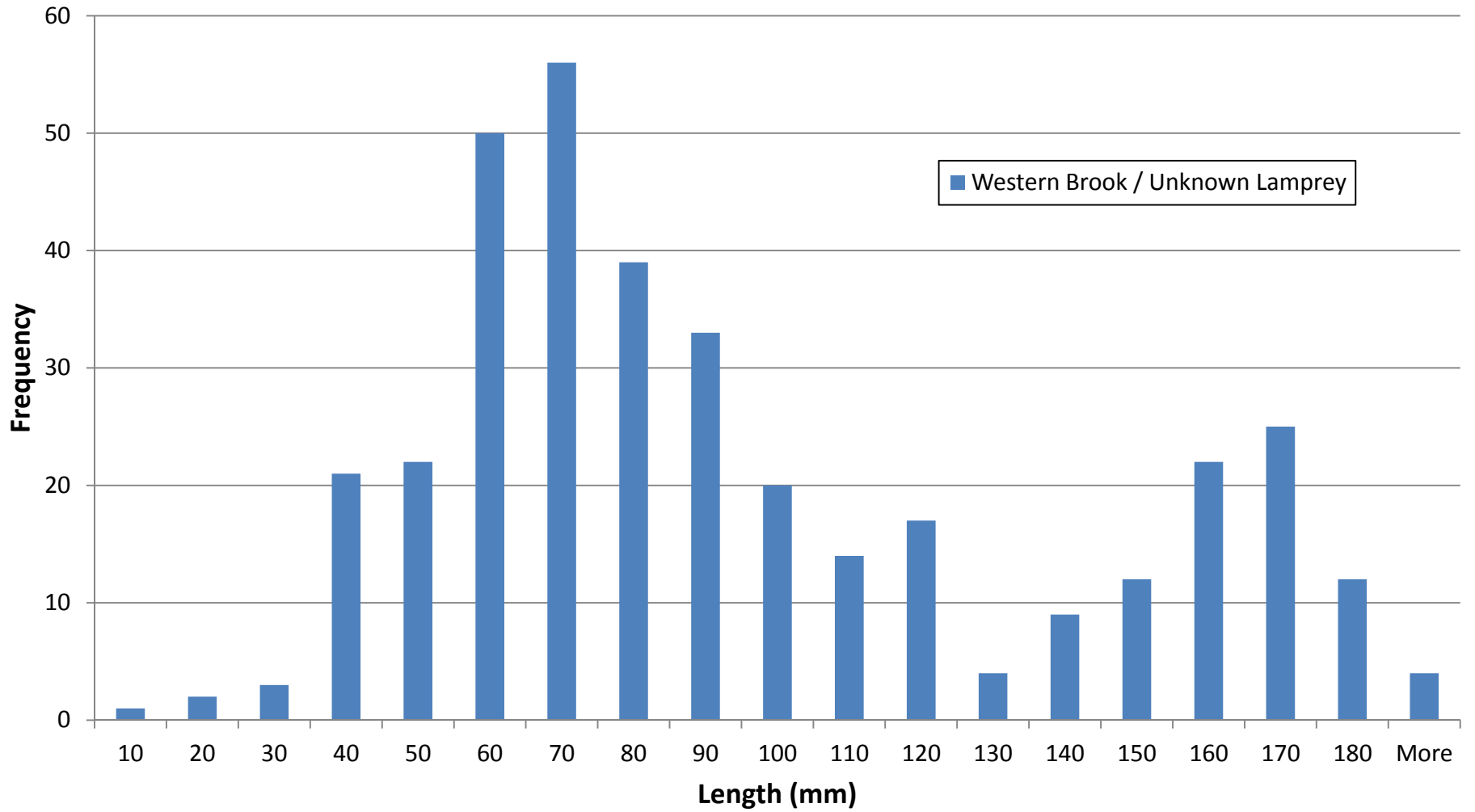
Length vs. Condition Factor by Species (2010 Data)



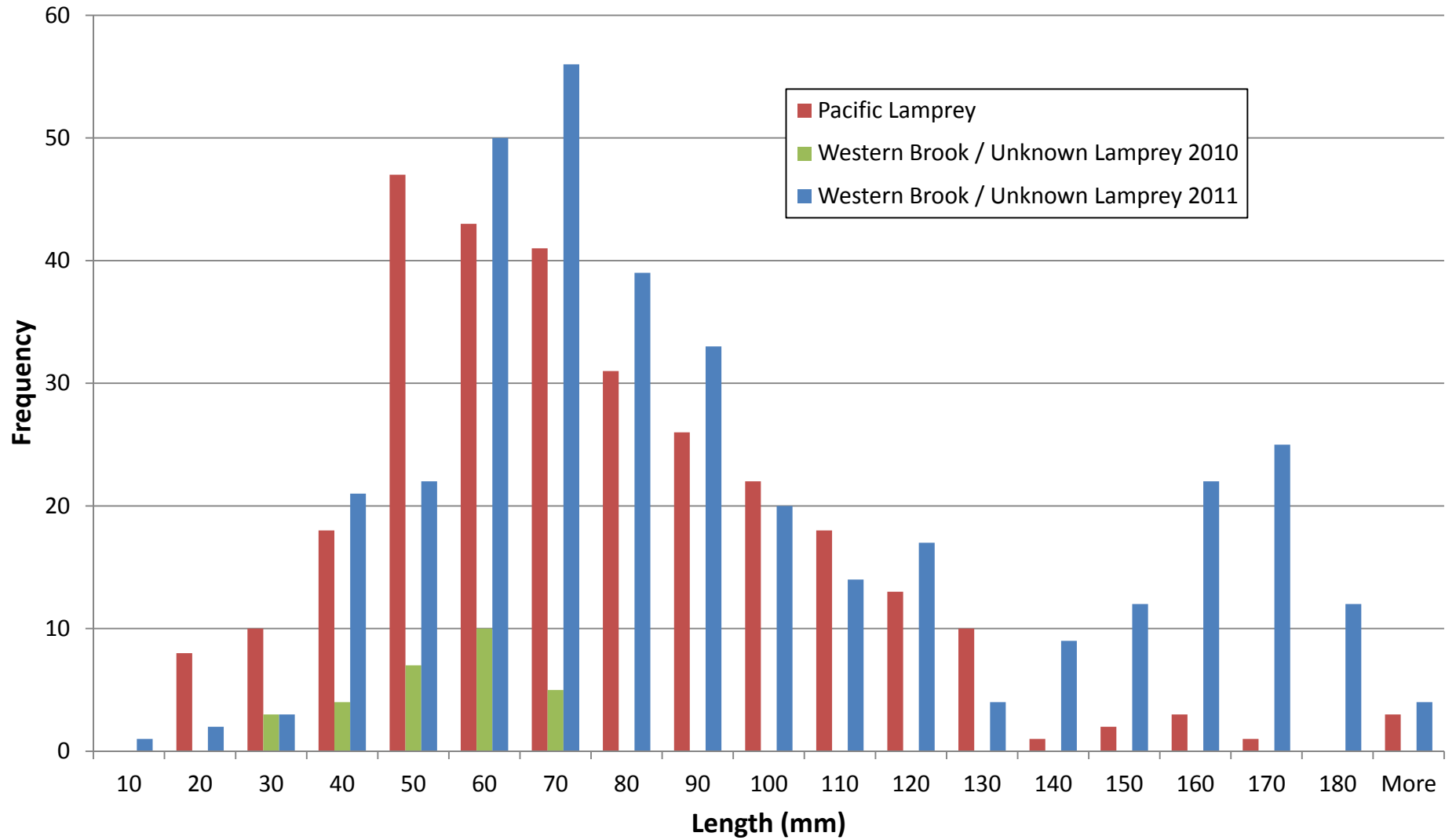
Length Histogram (2010 Data)



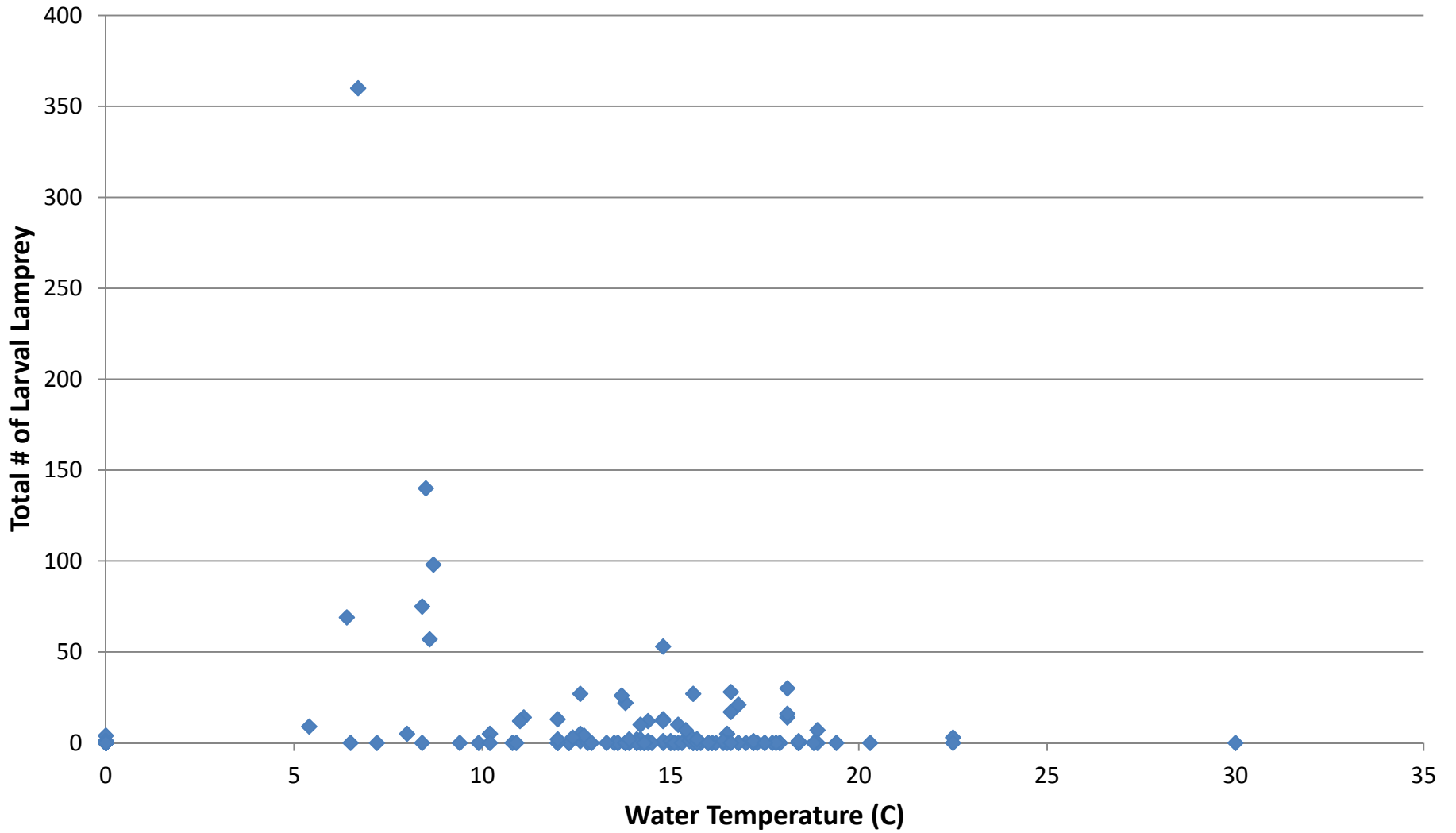
Length Histogram (2011 Data)



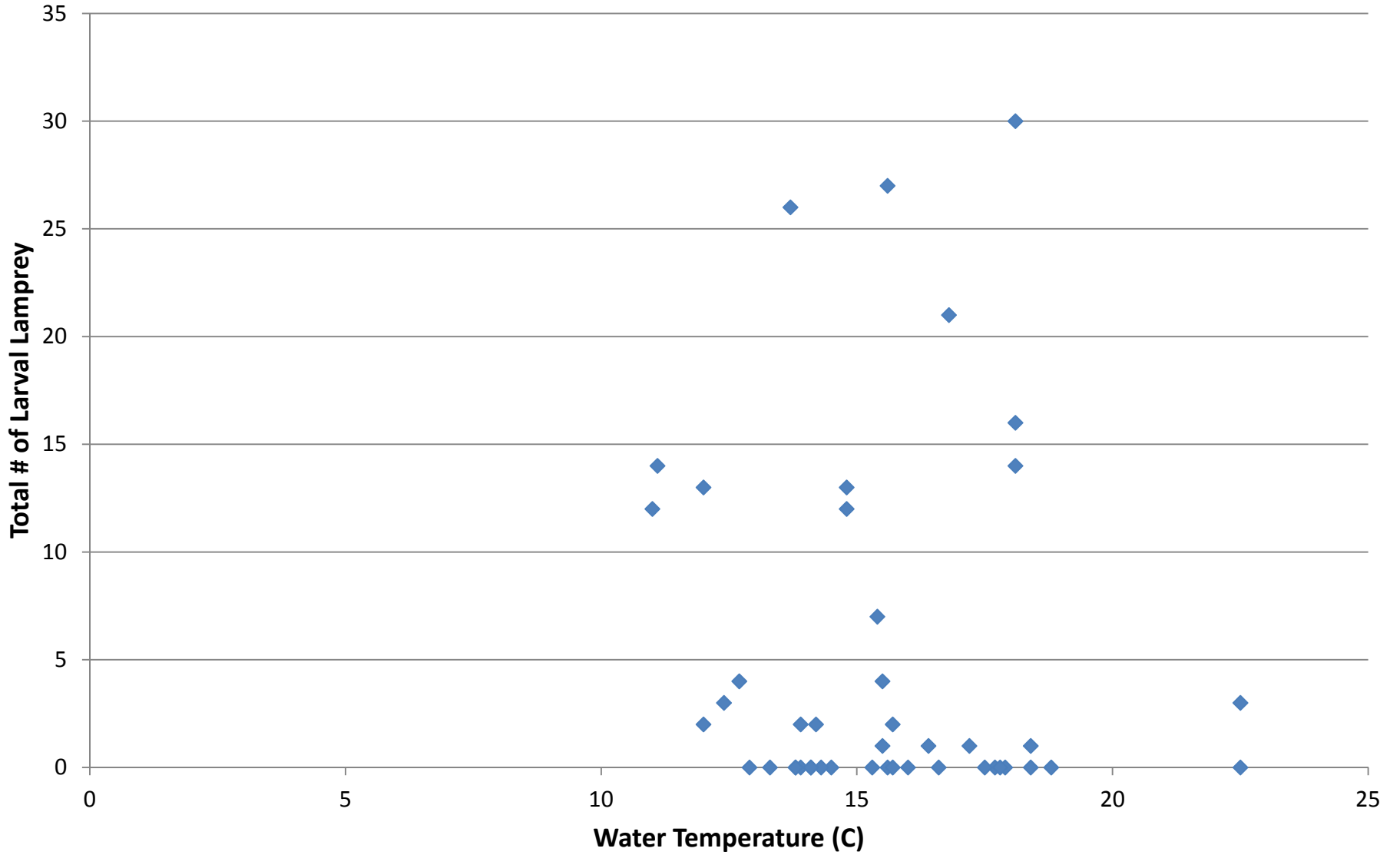
Larval / Juvenile Lamprey Length Histogram (2010-2011 Data)



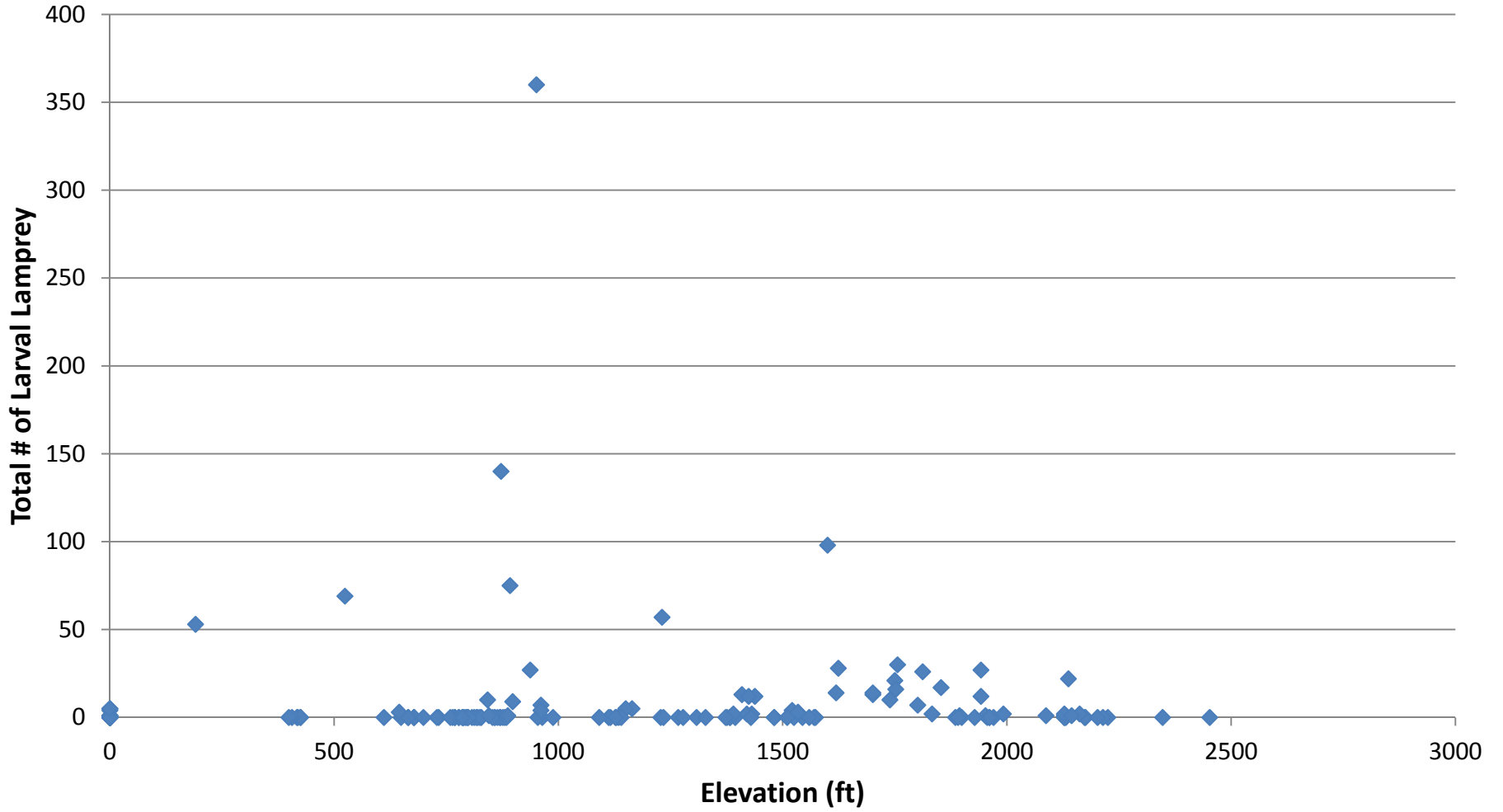
Survey Summary 2011 Data



Yakima River Survey Summary 2011 Data

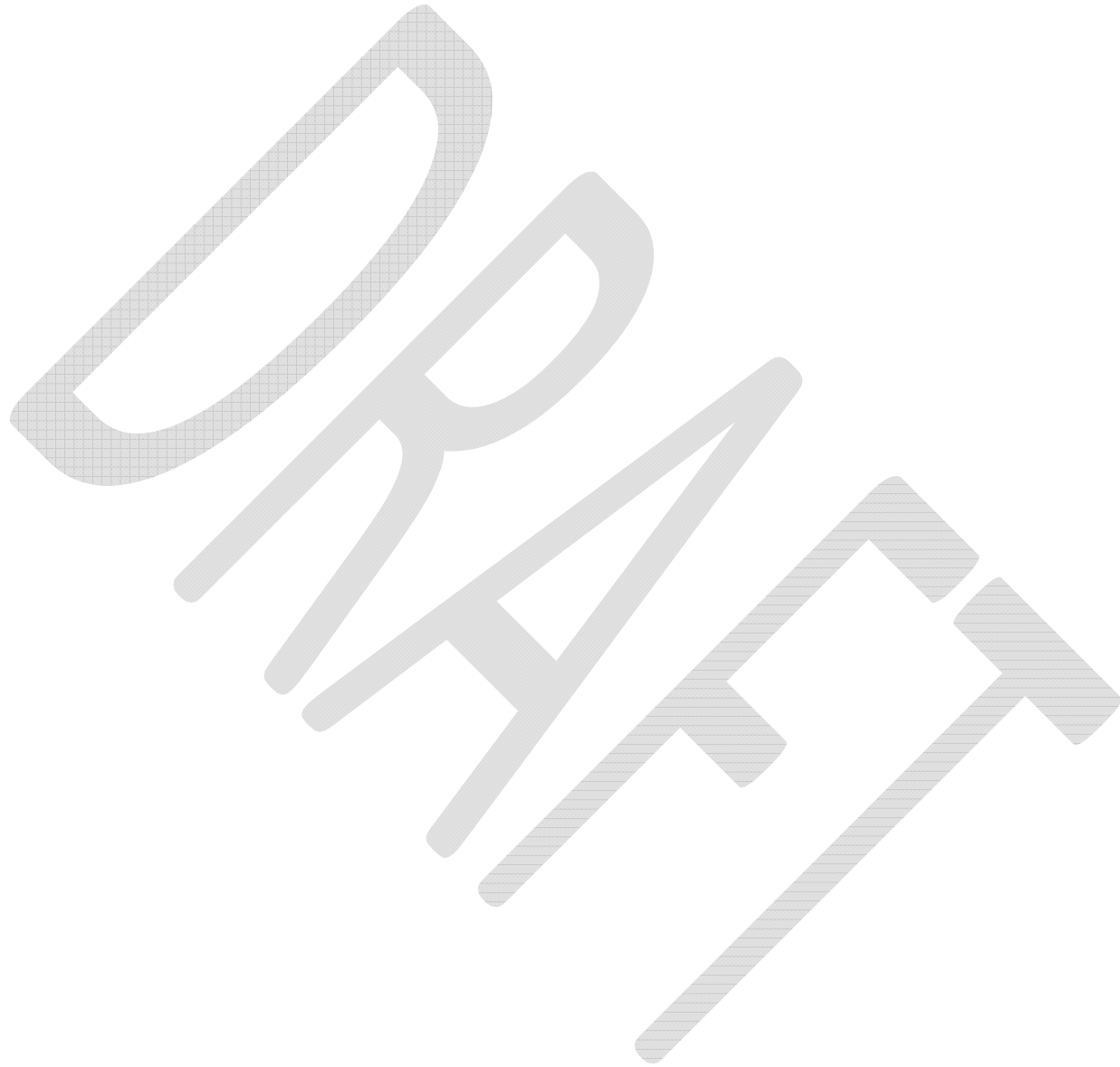


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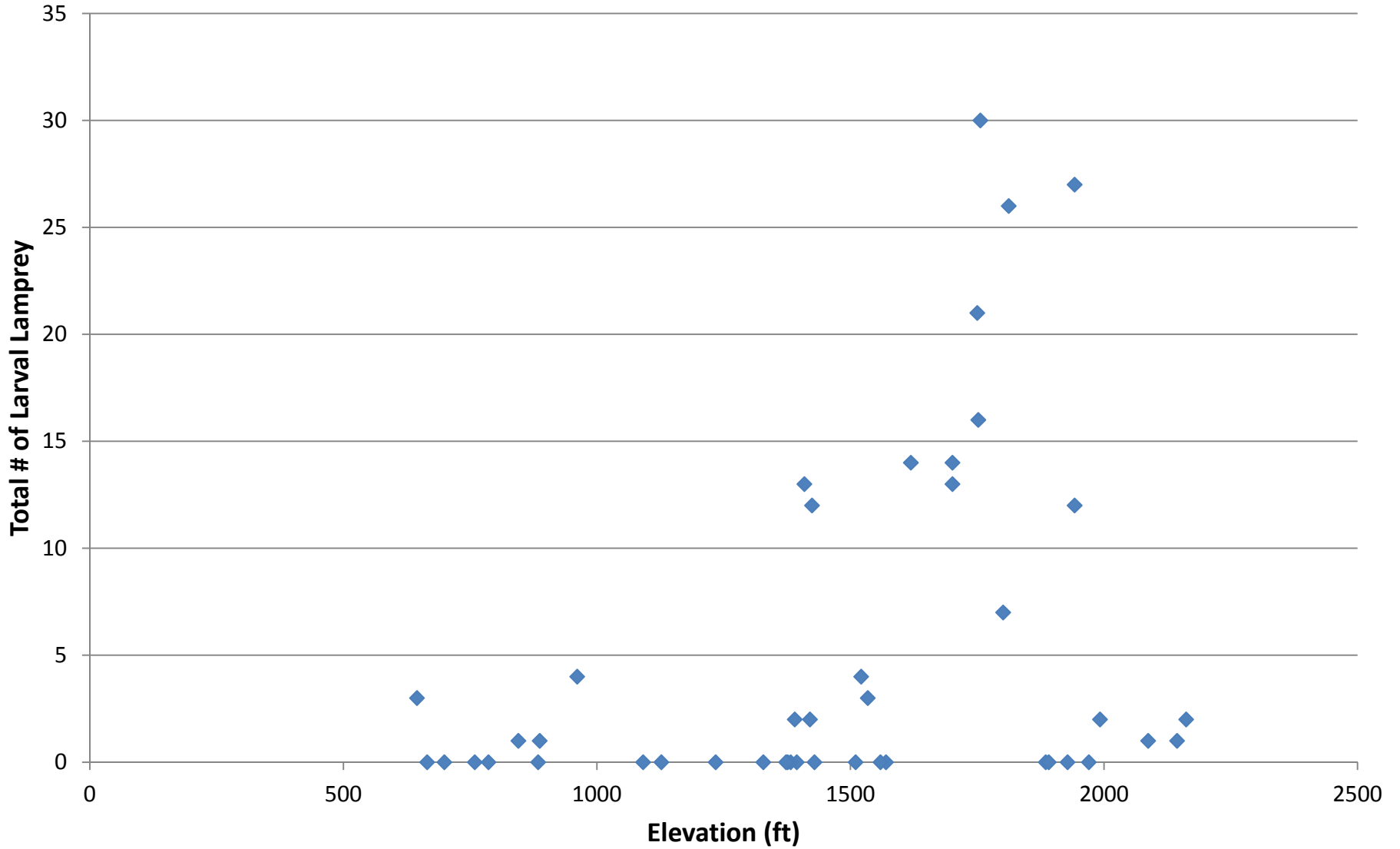


Dewatering Surveys in canals

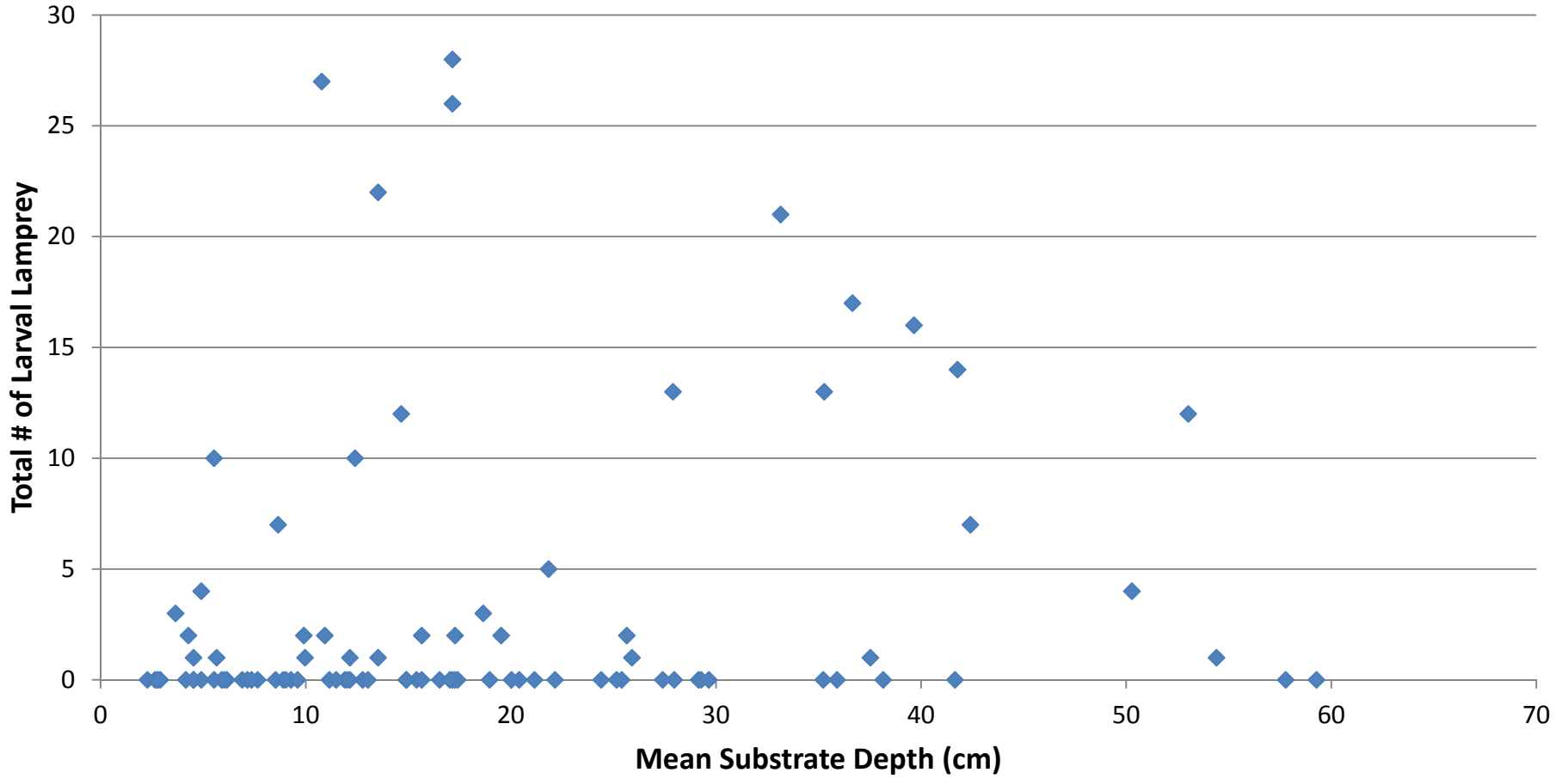




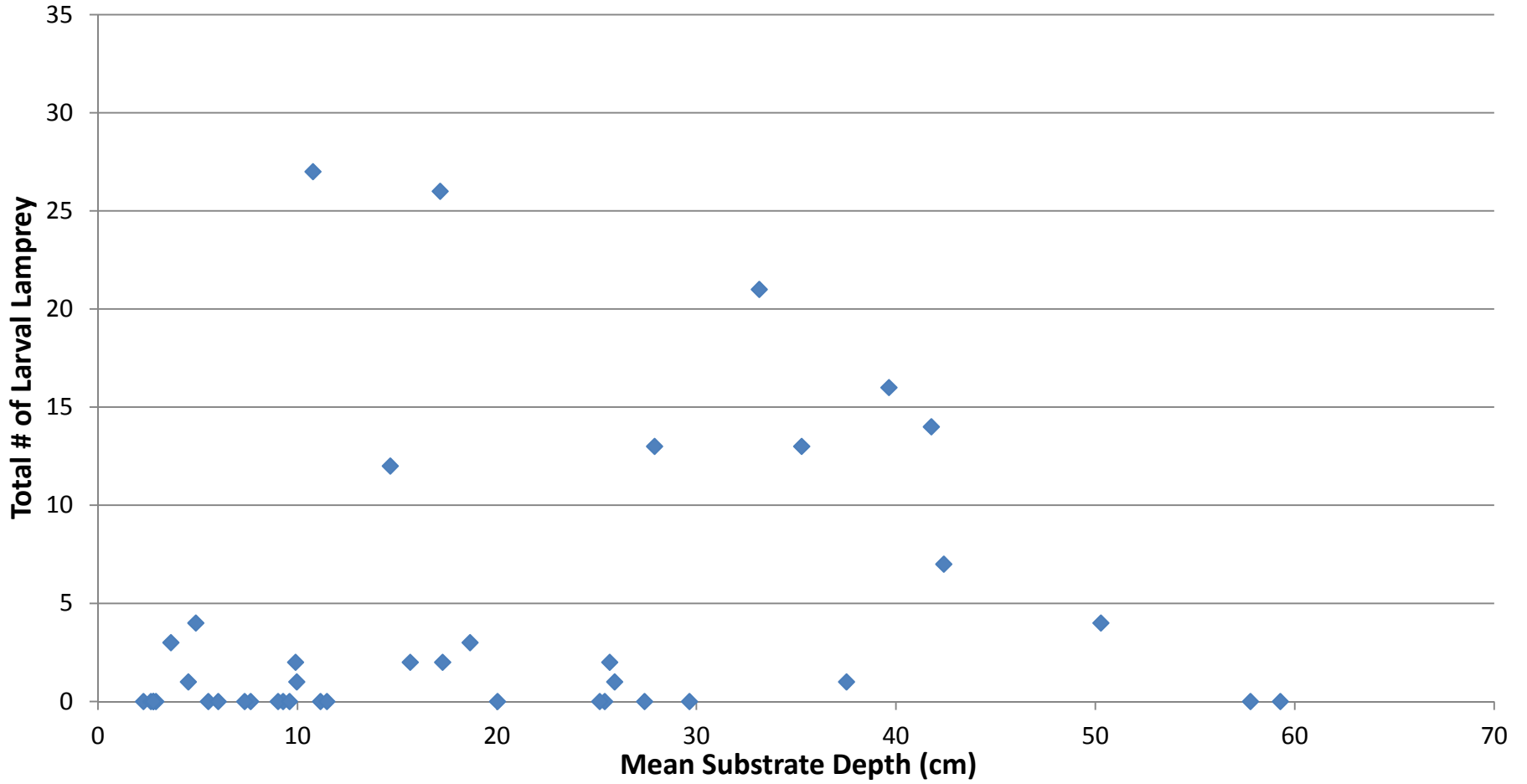
Yakima River Survey Summary 2011 Data



Survey Summary 2011 Data



Yakima River Survey Summary 2011 Data



Appendix C

Evaluation and Coordination of Pacific Lamprey Activities
in the Yakima River Basin

Progress Report

Project Year 1

September 26, 2011 - May 31, 2012

Collaboration between

Yakama Nation

and

Bureau of Reclamation

Under the 2008 Fish Accords

Prepared by

Yakama Nation

Fisheries Resource Management Program

Pacific Lamprey Project

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Introduction

On September 26, 2011 the Yakama Nation (YN) and Bureau of Reclamation (Reclamation) established the Cooperative Agreement No. R11 AC 17 069 (Agreement) Associated with the Evaluation and Coordination of Pacific lamprey Activities in the Yakima River Basin. From this Agreement Reclamation provides to the YN financial assistance *to support investigations of potential effects from Reclamation operations and/or facilities in the Yakima River Subbasin, and identify and plan measures for fish passage remedies to address identified impacts.*

Purpose: The purpose of this Annual Progress Report (Project Year 1) is to provide Reclamation and YN a brief summary of progress obtained since the initiation of this Agreement on September 26, 2011.

The Goal of the Yakama Nation is to restore natural production of Pacific lamprey to a level that will provide robust species abundance, significant ecological contributions and meaningful harvest throughout the Yakama Nations Ceded Lands and in the Usual and Accustomed areas.

Summary: Activities in Project Year 1

From the initiation of this Agreement (September 26, 2011) through mid-January, 2012, very little activity occurred and no funds associated with this Agreement were expended. In January, 2012, the Yakama Nation Fisheries Resource Management Program (FRMP) hired onto our staff a Lamprey Research Biologist, whose position is primarily supported by funding provided by this Agreement. With the onset of this new position we began development and in some cases implementation of the Tasks identified. Substantial coordination of various activities have occurred at both the local (Yakima River Basin) and regional (Columbia River Basin) levels. Communication and coordination between Reclamation and YN has been close and continuous, resulting in an effective and desired relationship.

General activities that have been initiated, and will be reported in greater detail below, include 1) collection of adult lamprey at the Columbia River hydroelectric projects, 2) development of adult lamprey holding tanks at both Yakama Nation Prosser and Marion Drain hatchery facilities, 3) juvenile sampling and salvage operations in Reclamation irrigation facilities, 4) preliminary attempts to artificially propagate lamprey, 5) initial investigations in better understanding water quality / toxicant issues within the Yakima River and 6) continued cooperation with USFWS, Reclamation and USACE in a radio telemetry study of adult lamprey movements within the lower Yakima River, relative to potential passage issues at various irrigation dams. Each of these activities are anticipated to be greatly expanded upon during Project Year 2.

Cost Share Relationships: A significant attribute of our progress to date, is the continued development in cost-share relationships. The FRMP has integrated the Bonneville Power Administration (BPA) 2008 Fish Accords funding into the interests contained with this Cooperative Agreement. Also, funds solicited by the FRMP and provided by the US Army Corps of Engineers (Seattle District: Public Assistance to the States funding agreement) have been a foundation for a radio telemetry study for adult passage over irrigation diversions in the lower Yakima River. This telemetry study

is being supported by the expertise from the US Fish and Wildlife Service. These funds are expected to contribute approximately \$180,000 towards this effort into Project Year 3 (of this Agreement) plus a significant internal contribution from the USFWS. Finally, the FRMP secured additional cost-share funding from the North Wasco County People's Utility District (PUD) to provide support for additional radio tags, receivers, maintenance and miscellaneous equipment, such as cables, antennas, etc. Funding amount is \$50,000.

Budget and Carry Over from Project Year 1: Initiation of this Cooperative Agreement has been an exciting challenge for the FRMP. Each of the Tasks identified present an array of technical issues, uncertainties and opportunities. Several of these Tasks, specifically those involved with juvenile entrainment, juvenile salvage and sampling in canals and evaluations of potential adult passage issues will continue to require close coordination between Reclamation and the FRMP.

Because of the relatively late start in the initiation of activities, and an initial uncertainty in how best to proceed at this early stage of this Agreement, not all funds allocated in Project Year 1 were used, with an estimated carryover of approximately \$28,800 dollars. These funds are anticipated to be used in Project Year 2, primarily in the development of propagation facilities, evaluations of water quality in selected areas and development of strategies for evaluations in juvenile entrainment.

Summary - General Study Objectives: This Agreement provides for four general study objectives (summarized below). Activities associated with these objectives are being implemented by the Yakama Nation Pacific Lamprey Project (YNPLP). The YNPLP is funded primarily by Bonneville Power Administration (BPA) through the 2008 Columbia River Basin Fish Accords. Existing funds are limited relative to the need. With this Agreement and other cost-share arrangements the YN has increased capacity, through staffing and additional materials, to better address these four objectives.

- **Objective 1 - Adult Fish Passage:** Radio telemetry is being used to help identify potential adult passage issues. This work is being completed by the US Fish and Wildlife Service, through direct funding by Reclamation and a cost-share match between the Yakama Nation and the US Army Corps of Engineers (Seattle District). A successful pilot study was initiated in 2010. During 2011 this study has been expanded both in the numbers of Pacific lamprey being captured, radio-tagged and released, and in the geographic scope with six different stations (including three lower diversion dams) having receivers in place supporting the objectives of this work. This study is expected to continue through 2013.
- **Objective 2 - Juvenile Migration and Entrainment:** The primary activities associated with this objective have been surveys within dewatered irrigation ditches using an electro-shocker and nets to collect juvenile fish samples. From these surveys we have found areas behind fish screens with considerable numbers of lamprey, consisting primarily of Western Brook lamprey; no Pacific lamprey were positively identified but many were unidentifiable to species. These initial efforts were primarily oriented to establish "presence / absence". In following years we will refine our surveys to better understand (1) relative abundance within each of the ditches and (2) determine how lamprey are able to get below existing fish screening devices and into the irrigation ditches.

- **Objective 3 - Propagation:** Most efforts towards this objective during Project Year 1 have been associated with planning and preparation. However, the YNPLP did initiate propagation efforts during April and May of this year successfully fertilizing eggs with the results of many thousands of Pacific lamprey larvae. Facilities employed include Prosser Fish Hatchery and the Marion Drain Sturgeon Hatchery, both owned and operated by the Yakama Nation. Clearly, these efforts are very preliminary but much was learned that will substantially inform and benefit future activities.
- **Objective 4 - Administration, Coordination and Reporting:** The Yakama Nation continues to be substantially involved in all local and regional activities associated with Pacific lamprey research and recovery efforts. These include, but are not limited to activities undertaken by the US Army Corps of Engineers (both Walla Walla and Portland Districts) associated with adult and juvenile passage at the FCRPS mainstem hydroelectric projects, Mid-Columbia Public Utility District FERC license implementation of associated Pacific Lamprey Management Plans, through all activities within the CRITFC, including the recent development and submission of the Tribal Pacific Lamprey Recovery Plan (December 2011), support and development of the USFWS Pacific Lamprey Conservation Initiative, support and development of Reclamation's *Effects on Pacific Lamprey (Lampetra tridentata)* and Reclamation's Pacific Lamprey Plan, and with the CBFWS Lamprey Technical Work Group. These coordination activities are in addition to our regular work associated with habitat and juvenile surveys, focused primarily within the Yakima River subbasin and development of local "Action Plans" towards lamprey recovery.

The following outlines ongoing activities associated with each of the specific deliverables and milestones identified during Project Year 1, from September 26, 2011 - May 31, 2012.

Progress Report by Tasks

Task 1a: Adult Lamprey Collection in the Yakima River

No activities under this Task have been completed during this Project Year 1, except development of a Scope of Work with the Washington Department of Fish and Wildlife to initiate a pilot project this August - September, 2012. The Draft Scope of Work for this proposal is attached as Appendix 1. Funding for this activity is requested to be carried-over to Project Year 2. The YNPLP anticipates that this effort will be ongoing through 2014 and will work in close coordination with the USFWS to support the ongoing radio telemetry study with adult lamprey collected from this effort.

Task 1b: Adult Lamprey Collection in the Columbia River.

The YNPLP collected 285 adult Pacific lamprey from the lower mainstem Columbia River during 2011. Collection was closely coordinated with the USACE (Portland District) and the Confederated Tribes of the Umatilla Indian Reservation (CTUIR). Approximately 49 of these fish were used in the autumn months (2011) for radio-telemetry studies in the Yakima River (see below) and an addi-

tional (approximate) 40 were used in the spring of 2012 for this same study. The remainder of these fish are being used for both pilot / research efforts towards artificial propagation and adult supplementation within the Satus Creek watershed.

Approximately \$25,000 was spent on planning, staff time, travel and equipment in order to collect these adult lamprey. This is in addition to associated costs incurred by our cost-share partnership with the CTUIR. All costs associated with this collection were charged to the YNPLP - BPA Fish Accords project. The YNPLP is currently planning to undertake a similar collection effort, with the CTUIR, during the summer of 2012.

The YNPLP also received approximately 20 ripe adult Pacific lamprey from Oregon State University. These fish are of Willamette River origin, were used for initial, experimental propagation efforts. These progeny will not be put back into the Columbia Basin River system. The primary use of these juveniles is to initiate research efforts to rear pro-larval lamprey through this early life history and into a juvenile life history stage, evaluating relationships between foods and growth.

Task 1c: Development and Installation of Adult Holding Facilities

All fish collected by the YNPLP were transported and kept at the Prosser Fish Hatchery, Prosser, WA. Fish are kept in four 8-foot circular tanks. Columbia River and Willamette River fish were kept separate. Three additional circular tanks are now available and are intended to be used during the 2012 collection season. Water supplied to these vessels is temperature regulated. These vessels each have the ability to use well water (approximately 13 degrees Celsius) and / or Yakima River water. Most of the holding period (September - May) we intend to maintain fish primarily on Yakima River water.

Approximately 25 adults were taken and held at Marion Drain for sexual maturation in preparation to our initial efforts towards artificial propagation. Both Marion Drain and Prosser facilities are owned and operated by the Yakama Nation. Although the existing situation is adequate, facilities at both Prosser and Marion Drain could be substantially improved by protecting tanks from direct sunlight / weather, providing greater temperature control and to provide for a more "natural" environment within the tanks as adults are being kept for extended time periods (up to 10 months).

Some consideration has been given to develop temporary adult holding facilities at or near Horn Rapids dam. A "facility" is envisioned to be a very simple and temporary structure, for example, a 200 - 300 gallon holding tank located and secured in an accessible, appropriate location, potentially within the irrigation canal. Lamprey would be kept in this tank for a day or two, and transferred to more permanent facilities at Prosser, as convenient.

It is envisioned that conceptual designs and partial implementation of these designs will occur during the Project Year 2 period. These considerations remain very much in their initial stages at this time. The FRMP will continue to work closely with Reclamation and appropriate irrigation districts if and when these designs are being developed.

Task 2.a: Juvenile Sampling and Salvage in Irrigation Canals

Juvenile survey planning and sampling within Yakima River basin irrigation canals was initiated during dewatering periods in 2011. Planning between representatives of the YNPLP and Reclamation was initiated in October and sampling occurred primarily in November through mid-December, 2011, a period of approximately five weeks.

Approximately \$10,000 dollars were used to fund these activities, including surveys, equipment, transportation and reporting. All costs associated with this collection were charged to the YNPLP - BPA Fish Accords project, which allows for a non-federal cost-share benefit to be realized. Funds from this (Project Year 1) line item will be carried over into Project Year 2 budgets and will be used primarily to support the development of propagation facilities, evaluations of water quality in selected areas and development of strategies for evaluations in juvenile entrainment.

A brief summary of findings is provided below. Please reference Appendix 2 for additional information. ("Juvenile lamprey" refers to either unidentified or western brook lamprey; no Pacific lamprey were positively identified.)

- Prosser: No juvenile lamprey found in front of or behind screens in both 2010 and 2011 survey years.
- Sunnyside: Approximately 1292 juveniles were reported in 2010 surveys and 224 juveniles found behind screens in 2011 surveys.
- Roza: Approximately 24 juveniles were found behind the screens in 2010 (Zero reported in front of screens) and 29 reported in front of screens in 2011 (zero reported behind the screens).
- Easton: Not surveyed in 2011.
- Wapatox: Approximately 325 juveniles were reported in front of screens and 358 behind the screens in 2012 and in 2011, approximately 83 were reported in front of the screens and 360 reported behind the screens.
- Yakima-Tieton Diversion Dams: Not surveyed in 2011.

Task 2b: Entrainment Studies

Due to late timing in hiring a Lamprey Research Biologist, very little activity has occurred associated with this Task. Preliminary site visits have been made at the Prosser, Sunnyside and Wapato projects. These visits were for orientation purposes only and were not intended, and have not produced any planning documents or recommendations. A study plan is expected to be developed during the Project Year 2 with pilot investigations potentially occurring in summer of 2013. These investigations will be highly dependent upon gaining approval and access to appropriate sites with appropriate equipment, including but not limited to structures supporting small-meshed fyke nets.

To date, the YNPLP believes the most appropriate location to begin these studies is at either Sunnyside or Wapato irrigation facilities. This is based upon initial surveys within these canals identify-

ing that juvenile lamprey are in fact found behind fish screens. We envision the majority of these pilot studies beginning June / July of 2013. We intend to use young of the year lamprey from our propagation efforts for these entrainment studies. Additionally, lamprey caught from the natural environment might also be used for these evaluations.

Although a study plan has not been developed, we envision introduction of juvenile lamprey of various age/size classes directly in front of representative screens, with a fine-mesh fyke net set up behind the screens to capture juveniles that somehow pass over or through the screens being tested. This work will be done in close coordination with the USGS and Reclamation, particularly in light of the current USGS efforts to evaluate juvenile lamprey behavior associated with different screen types / configurations, funded in part by Reclamation.

Task 3a: Propagation

Considerable planning has occurred in preparation of pilot propagation research activities. The YNPLP is working in close coordination with the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) in the development of a broad scale Research, Monitoring and Evaluation Framework towards Pacific lamprey supplementation generally and artificial propagation specifically. Although a great deal of work remains before this Draft Framework is available for technical review by the Columbia River Basin Pacific Lamprey Technical Workgroup, it is our intention to develop this document over the next year and to submit for wide distribution and review. We anticipate this Framework document will be the basis from which the tribes move forward for additional research and funding towards potential future supplementation and lamprey recovery efforts. A brief summary of the Table of Contents of this Framework is included as Appendix 3 of this Annual Progress Report.

Over the past year, the YNPLP has co-sponsored the "*First International Forum for the Propagation and Recovery of Lamprey*" held in Portland, Oregon in April, 2011. From this forum, relationships and ideas have emerged that have contributed significantly to recent YNPLP activities. We have communicated extensively with both Japanese and Finnish researchers who have significant experience with various aspects of lamprey propagation. From these contacts we have obtained and translated (to English) "handbooks" developed from each countries practical experience. This work, combined with other related technical and "grey" literature has been consolidated in the development of a Draft YNPLP handbook, which is included in Appendix 4 of this Annual Progress Report. Over the next year, as we gain experience in propagation techniques, this new handbook will be updated and circulated to other interested individuals and organizations.

In February, 2011 the YNPLP initiated our first steps towards lamprey propagation research by completing several site visits to three fish hatchery facilities owned and operated by the Yakama Nation, including the Cle Elum and Prosser salmon hatcheries and the Marion Drain sturgeon hatchery. Each of these facilities were evaluated for availability of resources focusing primarily on

space, appropriate water (including temperature control) and interest of existing staff to support lamprey propagation. A brief summary of these findings is provided below:

- Cle Elum Fish Hatchery is located in the upper Yakima River near excellent lamprey spawning and rearing habitat. Sufficient water, equipment and space is available for incubation. Space is available for rearing, however some facilities are being used for other purposes, and access to these facilities will improve over the next couple years. The Cle Elum facilities will not be used in the foreseeable future primarily due to excessive distance from Toppenish, WA. However, this facility has excellent potential.
- Marion Drain Sturgeon Hatchery is located approximately 15 minutes from the Toppenish fisheries offices and is ideally suited for future developments. It is anticipated that lamprey propagation research would re-use water from the sturgeon facilities, in which there will be sufficient supplies. Well water is also available. This facility is located on approximately 20 acres of crop-land with sufficient room to support a significant development, if warranted. Eight to ten, 6-foot circular tanks are currently available and were set up for initial propagation efforts. Planning for future use and developments at Marion Drain will be initiated during the summer, 2012 with preliminary, conceptual designs available for review by the end of Project Year 2 of this Agreement.
- Prosser Fish Hatchery is located approximately 25 minutes from the Toppenish fisheries offices and is ideally suited for future developments. Fresh well and river water is available as is substantial quantities of water re-used from existing salmonid aqua culture. Much of the emphasis of this facility is for summer and fall Chinook salmon, thus, propagation space and equipment is readily available during times for lamprey propagation. Sufficient enclosed space with temperature control is available to set up aquaria for research purposes.

Due to facilities and proximity, we choose to initiate this pilot research using both Marion Drain and Prosser facilities. During the months of April and May 2012, the YNPLP was able to set up equipment and successfully propagate juvenile lamprey at our Marion Drain facilities. At this time, many of these larval fish are being transported to be reared at the Prosser facility, imitating our investigations into early life history rearing. Eggs were successfully stripped from approximately 10 females and sperm taken from approximately 10 males (propagation efforts still in progress). Also during this time we have cooperated with the CTUIR in their initial propagation research resulting in a small, but successful effort fertilizing eggs from one or two female lamprey. We anticipate over the next couple months to continue our coordination and developing infrastructure for this and related research primarily associated with juvenile feeding and growth.

Task 3b: Water Quality/Toxicants Effects Evaluation

The primary objective of this task is to establish baseline information concerning the potential exposure and effects of toxic materials on Pacific lamprey, primarily within the lower Yakima River Basin (below Roza Dam). Although only preliminary work on this Task has been accomplished, we

anticipate water quality, substrate and biologic tissue samples will be taken in June, 2012 from various sites considered important towards the re-establishment of lamprey. It is anticipated that samples will be taken primarily in early summer months when agricultural chemicals are most widely used, although a fully developed sampling scheme has not yet been described.

During this Project Year 1, an initial review of literature and a Water Quality Sampling Strategy has been developed and is included in Appendix 5. Our intention is to obtain approximately three years of water quality, substrate and tissue samples, from which to draw conclusions about risk to lamprey from these substances. These samples will be taken at approximately the same time each year to better understand potential environmental variation. Sampling strategies will be closely coordinated with the Washington Department of Ecology and Reclamation. The YNPLP intends to use Reclamation facilities and expertise for evaluation of samples whenever possible, and will subcontract sample analysis to other laboratories as needed.

Task 4a: Coordination / Administration / Reporting

The Yakama Nation Pacific Lamprey Project is involved with Pacific lamprey coordination at both local and regional scales. Provided below is a brief summary of various activities that we have been involved with during Project Year 1 of this Agreement:

Army Corps of Engineers: The YNPLP meets quarterly with the US Army Corps of Engineers, CRITFC and CRITFC member tribes to evaluate and prioritize adult and juvenile lamprey issue associated with the Federal Columbia River Power System. These meetings are a direct result of the 2008 Fish Accords with the primary issue discussed involving both adult and juvenile passage over these facilities. Another key element of these meetings is the identification and development of additional research topics that the ACE / Tribal workgroup supports through the annual Study Review Work Group for future funding from the Columbia River Mitigation Funds.

Mid- Columbia Public Utility Districts: Each of the three Public Utility Districts (Grant, Chelan and Douglas counties) have Pacific Lamprey Management Plans as a component of their FERC licenses. Although these management plans pertain specifically to the Project Areas of the individual PUDs there is a strong linkage regionally to these activities. The YNPLP meets monthly with each of the PUDs to review progress and to initiate new activities associated with the Management Plan objectives

USFWS Conservation Assessment and Agreement: The YNPLP has worked closely with the USFWS during the development of the Conservation Assessment and more recently with the development of the Conservation Agreement, which will be a primary topic for the upcoming Lamprey Summit, co-sponsored by the CRITFC and the USFWS.

CRITFC Tribal Pacific Lamprey Recovery Plan: In December, 2011 the CRITFC released a Final Tribal Pacific Lamprey Recovery Plan - which is a comprehensive approach towards lamprey recovery throughout the anadromous habitats of the Columbia River Basin. Representatives of the YNPLP worked very closely with the CRITFC and member tribes and diligently over a years time in the development of this document. We are now working closely with USACE and USFWS towards a collaborative approach in the implementation of our Tribal Plan.

Pacific Lamprey Technical Work Group: The YNPLP is an active member of the Pacific Lamprey Technical Work Group - a technical body under the guidance of the Columbia Basin Fish and Wild-

life Authority. We intend to work closely with this group through the development of the Supplementation Framework discussed above.

Washington State Water Resource Association Conference: In December, 2011 the Yakama Nation and Bureau of Reclamation provided staff to jointly present to the annual State convention for the Washington Water Resources Association. This presentation focused on activities associated with lamprey passage at irrigation facilities within both the Yakima and Umatilla river basins. This was an important component to our much needed out-reach efforts and the presentation was much appreciated by this Association.

Yakima - Umatilla River Rapid Assessments: YNPLP worked closely with CRITFC and Reclamation in the initial development of a "rapid assessment", with the intention to develop a relatively quick, site-specific evaluation of potential juvenile and adult passage issues at Reclamation irrigation facilities and provide potential alternative solutions. The over-arching objective of this rapid assessment is to anticipate potential funding needs, such that steady progress can be made in correcting passage issues as they are identified. In March, 2012 a team of local and regional biologists and engineers was assembled for approximately two days and evaluated both Prosser and Sunnyside irrigation diversions. These evaluations are very preliminary and considerable work remains during this next couple years towards this end.

The YNPLP is working closely with the USFWS towards the implementation of an annual radio-tagging study of adult Pacific lamprey. The primary objective of this study is to identify adult movement and passage characteristics within the Yakima River and at irrigation facilities, respectively. The USFWS is primarily responsible for implementation of this study - which is being funded through a cost share agreement between the YN, USFWS and the USACE (Seattle District). The USACE provided to the USFWS approximately \$90,000 to implement this study, in addition to direct funding of approximately \$50,000 from Reclamation. A similar arrangement and funding level is anticipated for the years 2012-2013. Interim findings for this study can be found in Appendix 6, *Passage of Radio-tagged Adult Pacific Lamprey at Yakima River Diversions 2011 Annual Report*.

Conclusions

Over the past year, the YNPLP has grown and benefited substantially from the Cooperative Agreement between the Bureau of Reclamation and the Yakama Nation. To be sure, this is a new Project with many technical challenges ahead of us due to a wide variety of critical uncertainties to be addressed. All of the activities and tasks identified in this Cooperative Agreement are important, if not fundamental to the recovery of Pacific lamprey in the Yakima River. But of primary concern for the YNPLP, at this time, is the need to 1) better understand and address juvenile entrainment into the many irrigation canals within the Yakima River Basin and 2) understand and address if irrigation diversion dams provide a significant passage barrier / deterrent to returning adult lamprey. We look forward to a continued close and effective relationship with Reclamation in the coming years as we progress towards the successful implementation of this Agreement.

Appendix D

Draft Planning Framework for Continued Research in Pacific Lamprey Supplementation and Recovery

Translocation and Artificial Propagation

November 21, 2011

PROBLEM STATEMENT AND PURPOSE OF PLAN

NEED STATEMENT

- Mid to upper Columbia Basin lamprey are depressed or extirpated
- Need to implement artificial production tools to supplement populations

PURPOSE OF PLAN

- To define supplementation tools and approaches as a critical component of Pacific Lamprey restoration in the Columbia Basin.

ONGOING RESTORATION AND ADDITIONAL NEEDS

OVERVIEW: COMPREHENSIVE APPROACH

- Comprehensive lamprey restoration must address all limiting factors
- Additional restoration need is supplementation – present basic rationale.
- Also mention need to provide additional research lamprey.

MAINSTEM RESTORATION: COLUMBIA / SNAKE RIVER

1. ADULT

- Ongoing Activities
- Key Management Questions
- Additional Needs

2. JUVENILE

- Ongoing Activities
- Key Management Questions
- Additional Needs

TRIBUTARY RESTORATION

1. ONGOING ACTIVITIES

- Screen Design
- Passage Studies - Implementation / RECLAMATION
- Ongoing salmonid restoration

2. *KEY MANAGEMENT QUESTIONS*

3. *ADDITIONAL NEEDS*

SUPPLEMENTATION RESEARCH AND ADDITIONAL NEEDS

1. *ONGOING ACTIVITIES*

2. *KEY MANAGEMENT QUESTIONS*

- Population and Genetics
- Nutrition - Growth and Density

3. *CONTAMINANTS AND TOXICANTS*

4. *HOMING AND FIDELITY*

5. *ADDITIONAL NEEDS*

EXISTING SUPPLEMENTATION/ARTIFICIAL PROPAGATION KNOWLEDGE & GAPS

OVERVIEW: USE OF SUPPLEMENTATION AS MANAGEMENT TOOL

- Summarize various knowledge such as life history, genetics, homing, etc

TRANSLOCATION: SUMMARY OF ONGOING EFFORTS

1. *UMATILLA SUBBASIN*

2. *CLEARWATER SUBBASIN*

3. *YAKIMA SUBBASIN*

ARTIFICIAL PROPAGATION: SUMMARY OF ONGOING EFFORTS

- Literature review/personal citations on Great Lakes, Finland and Japan artificial propagation

1. *GREAT LAKES REGION*

2. *JAPAN*

3. *FINLAND*

KEY KNOWLEDGE GAPS: KEY RESEARCH NEEDS

1. *NUTRITION – GROWTH – DENSITY*

2. REARING VESSEL OPERATION AND MAINTENANCE

3. ALTERNATIVE REARING STRATEGIES

4. JUVENILE SUCCESS AND CONDITION: HATCHERY - REINTRODUCTION

5. TEMPERATURE, PHOTOPERIOD, WATER CHEMISTRY ON VARIOUS LIFE STAGES

SUPPLEMENTATION APPROACHES

GENERAL APPLICATION OF SUPPLEMENTATION TOOLS

1. ADULT TRANSLOCATION

- Expansion into additional watersheds / subbasins

2. PROPAGATION

- Collection and Spawning Protocol

- Juvenile rearing and tributary out-planting (larval - 6 month age)

- Juvenile rearing and tributary out-planting (1 year - 3? years age)

SELECTED PILOT SUPPLEMENTATION PROJECTS

SPECIFIC STRATEGIES, SITES AND TIMELINES

1. SUBBASINS / WATERSHEDS FOR CONTINUED SUPPLEMENTATION EFFORTS

2. SUBBASINS / WATERSHEDS FOR APPLIED SUPPLEMENTATION RESEARCH

3. "REACH-SPECIFIC" RELEASE LOCATIONS - ESTIMATED RELEASE NUMBERS

RATIONALE FOR STRATEGIES

ANTICIPATED BENEFITS : NEAR- AND LONG-TERM

RESEARCH, MONITORING AND EVALUATION

PRIORITY LABORATORY RESEARCH TO INFORM FIELD APPLICATIONS

MONITORING OF SUPPLEMENTATION PROJECTS:

1. *APPLIED HATCHERY HOLDING, SPAWNING AND REARING OPERATIONS*
2. *APPLIED FIELD MONITORING POST RELEASE OF JUVENILES*

ADAPTIVE MANAGEMENT: PROCESS TO INCORPORATE FINDINGS AND IMPROVE RESULTS

These do not need to be extensive -

They need to demonstrate that we have thought about it - have enough information to move forward, and will "incorporate information by reference".

(a lot of copy - paste and organization of existing information)

Appendix A

Consolidation and Synthesis of Existing Lamprey Propagation Information

Appendix B

Equipment and Protocol for Adult Collection, Holding and Pre-fertilization Preparation

Appendix C

Equipment and Protocol for Egg Take, Fertilization and Incubation

Appendix D

Equipment and Protocol for Early Juvenile Rearing (Egg hatch to 4-months)

Appendix E

Synthesis of Genetics and Population Structure and the Application towards Adult Collection and Juvenile Out-Planting

Appendix F

Summary of Monitoring Tools, Protocol, Analysis Reporting

Appendix E

**DRAFT Yakima River Subbasin
Pacific Lamprey Recovery Action Plan**