Confederated Tribes *of the*
Umatilla Indian Reservation
Department of Natural Resources
Administration

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October 8, 2010

Electronically Filed

Ms. Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First Street, N.E.
Washington, D.C. 20426

Re: Wells Hydroelectric Project, FERC No. 2149-152; MOTION TO INTERVENE, COMMENTS, RECOMMENDATIONS, PRELIMINARY TERMS AND CONDITIONS

Dear Secretary Bose:

Enclosed for electronic filing is the motion to intervene of the Confederated Tribes of the Umatilla Indian Reservation, and our comments, recommendations, and preliminary terms and conditions in response to the Federal Energy Regulatory Commission's "Notice of Application Accepted for Filing, Soliciting Motions to Intervene and Protests, Ready for Environmental Analysis, and Soliciting Comments, Recommendations, Preliminary Terms and Conditions, and Preliminary Fishway Prescriptions" for the Wells Hydroelectric Project, FERC No. 2149-152. Please contact me at (541) 429-7235 or carlmerkle@ctuir.com if there are any problems with the transmission of this filing. Thank you.

Sincerely,

/s/ Carl Merkle
Carl Merkle
Policy Analyst
Confederated Tribes of the Umatilla Indian Reservation

Enclosures

UNITED STATES OF AMERICA
FEDERAL ENERGY REGULATORY COMMISSION

PUBLIC UTILITY DISTRICT NO. 1 OF DOUGLAS COUNTY, WA	)	**PROJECT NO. 2149-152**
APPLICATION FOR NEW MAJOR LICENSE FOR THE WELLS HYDROELECTRIC PROJECT	)	**MOTION TO INTERVENE, COMMENTS, RECOMMENDATIONS, PRELIMINARY TERMS AND CONDITIONS**

MOTION TO INTERVENE, COMMENTS, RECOMMENDATIONS, PRELIMINARY TERMS AND CONDITIONS OF THE CONFEDERATED TRIBES OF THE UMATILLA INDIAN RESERVATION

I. MOTION TO INTERVENE

Pursuant to 18 C.F.R. §§ 385.212 and 385.214, the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) hereby moves to intervene in the above-captioned proceeding.

Service of process and other communications concerning this proceeding should be made to:

Carl Merkle
Policy Analyst
Confederated Tribes of the Umatilla Indian Reservation
46411 Timíne Way
Pendleton, OR 97801
carlmerkle@ctuir.com

II. MEMORANDUM IN SUPPORT OF MOTION TO INTERVENE

A. Description of the Project

The Wells Hydroelectric Project is located at river mile (RM) 515.6 on the Columbia River in Washington State, and is owned and operated by the Public Utility District No. 1 of Douglas County, Washington (Douglas PUD). The Project was originally licensed in 1962, and consists of: (1) a 1,130-foot-long and 168-foot-wide concrete hydrocombine structure with integrated generating units, spillways, switchyard and fish passage facilities; (2) a 2,300-foot-long and 40-foot-high earth and rockfill west embankment; (3) a 1,030-foot-long and 160-foot-high earth and rockfill east embankment; (4) eleven 46-foot-wide and 65-foot-high ogee-designed spillway bays with 2 vertical lift gates (upper leaf is 46-feet by 30-feet and lower leaf is 46-feet by 35-feet); (5) five spillways modified to accommodate a Juvenile Fish Bypass System; (6) ten generating units each housed in a 95-foot-wide and 172-footlong concrete structure with an installed capacity of 774.3 megawatts (MW) and maximum capacity of 840 MW; (7) five 14.4-kilovolts (kV) power transformers each connected to 2 generating units converting the power to 230 kV; (8) two 41-miles long 230-kV single-circuit transmission lines running parallel to each other; and (9) appurtenant facilities.

The presence and operation of the Project impact the treaty-reserved interests of the CTUIR. In particular, the Project affects anadromous fish stocks that originate above, within and below the Project's boundaries. Such stocks include salmon, Pacific lamprey and others of important historic and cultural significance to the CTUIR. These stocks are subject to the treaty-reserved fishing rights of the CTUIR and our members. The CTUIR moves to intervene in this licensing proceeding so that we can continue to advocate for the inclusion of appropriate protection, mitigation and enhancement measures in the new Project license.

B. <u>Interests of the Petitioners</u>

The CTUIR aboriginally occupied and utilized lands and waters in what are today the States of Washington and Oregon. These lands and waters, including the Columbia River and its tributaries, have been and continue to be impacted by the presence and operation of the Project. Protection of rivers and flows for anadromous fish and wildlife populations, as well as cultural resources and other resources, is critically important to the CTUIR.

The anadromous fish populations that originate above and within the boundaries of the Project and are impacted by it have significant cultural and religious significance to tribal members and provide us with subsistence for our health and well-being. The CTUIR actively co-manages fishery resources along with federal and state authorities, including implementation of management plans developed through the federal court-sanctioned *United States v. Oregon* process. The CTUIR is involved in state and federal salmon recovery planning and the implementation of protection and restoration projects throughout our ceded lands.

Among the species affected by the Project is Pacific lamprey (*Lampetra tridentata*), which is of particular significance to the CTUIR. As stated in the *Tribal Pacific Lamprey Restoration Plan for the Columbia River Basin*:

> Lamprey . . . abundance and distribution in the Columbia River Basin is declining precipitously, bringing the species dangerously close to regional extinction. Lamprey continue to decline despite, or in part because of, measures taken to protect and restore salmonid species. The plight of the Pacific Lamprey has garnered some attention, but little effective action.[1]

The CTUIR seeks to ensure that any new license that might be issued for the Project adequately protects and restores anadromous fish populations, including lamprey, and sufficiently mitigates for the Project's ongoing impacts on them. The CTUIR has treaty-secured rights and interests in lamprey and other species that will be affected by the outcome of this relicensing process. Our unique interests and stake in this licensing proceeding cannot be represented by any other entity.

III. COMMENTS, RECOMMENDATIONS, PRELIMINARY TERMS AND CONDITIONS

In 2002, certain parties to the Mid-Columbia Proceeding signed the Wells Anadromous Fish Agreement and Habitat Conservation Plan (HCP). The CTUIR did not agree to or sign the HCP. It was subsequently approved by the Commission in 2004 and incorporated into the Project license. The CTUIR is concerned that the HCP will be used solely and exclusively to inform and guide development of terms, conditions and fishway prescriptions for the Project, when in fact it fails to include or address Pacific lamprey in any manner. A new license must afford substantial protections to **both** salmonids **and** lamprey; salmon measures can and should be identified and implemented so as not to cause further harm to already-beleaguered lamprey populations.

[1] Nez Perce, Umatilla, Yakama and Warm Springs Tribes, Aug. 9, 2010 (Revised Draft with Final Translocation Guidelines).

Thus, to provide for the safe, timely, and effective upstream and downstream passage of fish at the Project, the licensee should provide for the construction, operation, maintenance, and effectiveness monitoring of upstream and downstream fishways for all affected species, including lamprey, not just so-called "Plan species." Furthermore, the CTUIR recommends that the Commission, in its draft Environmental Assessment or Environmental Impact Statement, analyze an alternative that incorporates, without material modification, measures to protect both salmonids and lamprey.

The same approach should be taken for upstream fishway operations criteria and bypass operations criteria. Furthermore, the upstream passage performance standard should be that of the best passage achieved at any mainstem Columbia River dam (i.e., 80% at The Dalles Dam, which is the standard in the in the *Tribal Pacific Lamprey Restoration Plan for the Columbia River Basin*). Finally, there are so few lamprey passing through the Project that it is difficult to nearly impossible to "demonstrate" passage impairment, so the burden of proof should not be placed on the lamprey, which is likely to result in no significant improvements.

IV. CONCLUSION

The CTUIR has significant interests that may be directly affected by the outcome of this licensing proceeding, and no other party can adequately represent these interests. This intervention is in the public interest, and we therefore respectfully move FERC to grant our motion to intervene in this proceeding.

Respectfully submitted this 8th day of October, 2010.

/s/ Carl Merkle
Carl Merkle
Policy Analyst
Confederated Tribes of the Umatilla Indian Reservation

UNITED STATES OF AMERICA
FEDERAL ENERGY REGULATORY COMMISSION

PUBLIC UTILITY DISTRICT NO. 1	**)**	**PROJECT NO. 2149-152**
OF DOUGLAS COUNTY, WA	**)**	
	)	**MOTION TO INTERVENE,**
APPLICATION FOR NEW MAJOR	**)**	**COMMENTS, RECOMMENDATIONS,**
LICENSE FOR THE WELLS	**)**	**PRELIMINARY TERMS AND**
HYDROELECTRIC PROJECT	**)**	**CONDITIONS**

CERTIFICATE OF SERVICE

I hereby certify that the foregoing document has this day been filed with the Federal Energy Regulatory Commission and served upon each person designated on the official Service List compiled by the Secretary for this proceeding.

Dated this 8th day of October, 2010.

/s/ Carl Merkle
Carl Merkle
Policy Analyst
Confederated Tribes of the Umatilla Indian Reservation

Document Content(s)

Tribal Pacific Lamprey Restoration Plan for the Columbia River Basin

August 9, 2010
Revised Draft with Final Translocation Guidelines

Nez Perce, Umatilla, Yakama and Warm Springs Tribes

TRIBAL PACIFIC LAMPREY *(Lampetra tridentata)* COLUMBIA BASIN RESTORATION PlAN

Executive Summary

Pacific Lamprey (*Lampetra tridentata*) abundance and distribution in the Columbia River Basin is declining precipitously, bringing the species dangerously close to regional extinction. Lamprey continue to decline despite, or in part because of, measures taken to protect and restore salmonid species. The plight of the Pacific Lamprey has garnered some attention, but little effective action.

For over 10,000 years the people of the Nez Perce, Umatilla, Yakama and Warm Springs tribes depended on lamprey (eels), salmon, and roots and berries. The tribal people used the eel for food and medicine and through the years many stories and legends surrounding the eel were passed down from generation to generation. Before The Dalles Dam, the river at Celilo Falls was black with eels and tribal members took just what their families needed for a year. Eels were plentiful in the Walla Walla River, Asotin Creek, Lolo Creek, the south fork of the Salmon River, Swan Falls, the upper portions of the Yakama River, and the tributaries of the upper Columbia.

Now these great rivers have no eels, or at best remnant numbers. The eel has vanished from the tribal longhouse tables. As eels disappear, younger tribal members are losing their collective memory for the species and the culture that it surrounds.

The tribes propose this plan for restoration of the species to numbers adequate for tribal use and ecological health of the region. The tribes believe action must be taken now, despite a general paucity of information about the life history and population dynamics of the species.

Achieving improvements in dam passage efficiencies and survival is of primary importance. Only about 50% of adult lamprey successfully pass a single dam. Improving dam passage will require a set of operational and structural modifications to the existing dams. These modifications are possible, practical, and should be undertaken immediately. They include the use of 24 hour video counting, installation of lamprey passage systems, altering existing fishway structures to prevent trapping, reducing velocity barriers, reducing/eliminating juvenile impingement on screens and reducing fishway flows at night.

Improving tributary and mainstem habitat for lamprey ammocoetes and macrophalmia is also important. This draft plan contains detailed subbasin plans by each tribe for achieving these goals. We also recommend the development of effective tagging technology and installation of devices preventing entrainment of juveniles into irrigation canals and tributary water diversion.

Lamprey supplementation using translocated adults has been tried and found effective as an emergency, interim action. Supplementation is recommended as a consideration for all subbasins, particularly those with no or low populations of juvenile lamprey. This is particularly crucial given evidence that suggests adult lamprey select spawning streams by following pheromones emitted by ammocoetes.

There must be a basinwide, coordinated effort to continue to fund and perform research, monitoring and evaluation. This must include marine, contaminant investigations and integration of climate change research. The data and results from such research needs to be collected and make widely available and accessible.

Implementation of the plan cannot succeed without a consistent, coordinated public education and outreach programs to communicate: 1) the plight of the eel, 2) the need for public infrastructure investments at all government levels for restoration actions, and 3) the consequences of failing to act.

There is no time to waste. The Pacific lamprey has been neglected and ignored for too long.

Introduction

The Pacific lamprey (*Lampetra tridentata)* or "eel" is an ancient, anadromous, native species that has suffered widespread decline throughout the Columbia Basin and the Northwest coast from California to Alaska. One of three lamprey species in the Columbia River Basin, they are the most important the tribes (Close et al. 2002). In addition, Pacific lamprey are a key indicator of the ecological health of the Columbia Basin and appear to be a choice food for avian, marine mammal and fish predators, and at times may be preferred over salmon smolts (Close 1995; Stansell 2006).

Once abundant with Pacific lamprey, most Columbia Basin rivers now have few or none. Like other lamprey throughout the world, the Pacific lamprey's decline in abundance is due primarily to human factors, including dams for hydropower and flood control facilities, irrigation and municipal water diversions, lost habitat, poor water quality, excessive mammal, avian and fish predation and the application of fish eradication chemicals. Besides these direct effects on mortality, reproductive success has also been impacted. Lamprey access to much of the historic spawning and freshwater rearing habitat has been blocked by mainstem and tributary dams and other obstacles.

The species decline has not gone unnoticed. For example, in 1993, the State of Oregon listed Pacific lamprey as a state sensitive species and in 1997 lamprey were given further legal protection (OAR 635-044-0130; Kostow 2002). In Washington State, lamprey are placed in a monitoring status, the lowest threat level of the state's "species of concern" list. In 1994 , after a precipitous decline in population numbers over 20 years, the United States Fish and Wildlife Service (USFWS) designated the species for listing as a Candidate 2 under the Endangered Species Act. In their 1994 Fish and Wildlife Program, the Northwest Power Planning Council noted the lamprey decline in the Columbia Basin and called for a status report (Close et al. 1995). The Oregon Natural Resources Council petitioned the USFWS to list the species under the Endangered Species Act (ESA) in 2002.[1] The USFWS denied consideration of the petition in 2004, finding that the petition did not present substantial scientific or commercial information to indicate the listing was warranted. Repeatedly the USFWS has noted the lack of information regarding the status and distribution of Pacific lamprey.

Nonetheless, the USFWS has remained open to submission of new information concerning the status of, or threats to, the species, stating that this information would help them monitor and encourage conservation of the species. Recently, the USFWS presented a "Coast wide Conservation Initiative" intended to bring focus on lamprey restoration. Since this Initiative's goals and objectives are very broad, the tribes have responded with this restoration plan which focuses on the Columbia Basin.
Lamprey are of great importance to Native American tribes for cultural, spiritual, ceremonial, medicinal, subsistence and ecological values. From a tribal perspective, the

[1] ONRC (Oregon Natural Resource Council). January 28, 2002. Petition for rules to list four Pacific lamprey species as Threatened and Endangered under the Endangered Species Act.

decline of lamprey continues to have at least three negative effects: (1) loss of cultural heritage, (2) loss of fishing opportunities in traditional fishing areas, and (3) necessity to travel large distances to lower Columbia River tributaries, such as the Willamette River, for ever-decreasing lamprey harvest opportunities. As a consequence of declining or elimination of harvest in interior Columbia River tributaries, many young tribal members have not learned how to harvest and prepare lamprey for drying. In addition, young tribal members are losing historically important legends associated with lamprey.

In part due to the image of sea lamprey as a nuisance species in the Great Lakes region, and a fundamental lack of education of the ecological and cultural importance of Pacific lamprey in the Columbia Basin, they have suffered a negative image among non-tribal peoples. Yet they are every bit as important as salmon and steelhead. The Columbia River Inter-Tribal Fish Commission's (CRITFC) member tribes recognize and stress that Pacific lamprey are an important part of the ecosystem, contributing to food web dynamics, acting as a buffer for salmon from predators, and contributing important marine nutrients to inherently nutrient-poor watersheds.

In 1855, CRITFC's member tribes relinquished many millions of acres of Columbia Basin lands in treaties to the United States but retained their rights to fish at "usual and accustomed places" on both their reservations and their ceded lands (Figure 1). Fish were not limited to salmon and steelhead, but include lamprey, sturgeon and other species. The U.S. Supreme Court recognized the importance of fish to the tribes early in the development of the treaty interpretation:

> *The right to resort to… fishing places…was a part of larger rights possessed by the Indians upon exercise of which there was not a shadow of impediment and which were not much less necessary to the existence of the Indians than the atmosphere that they breathed."*

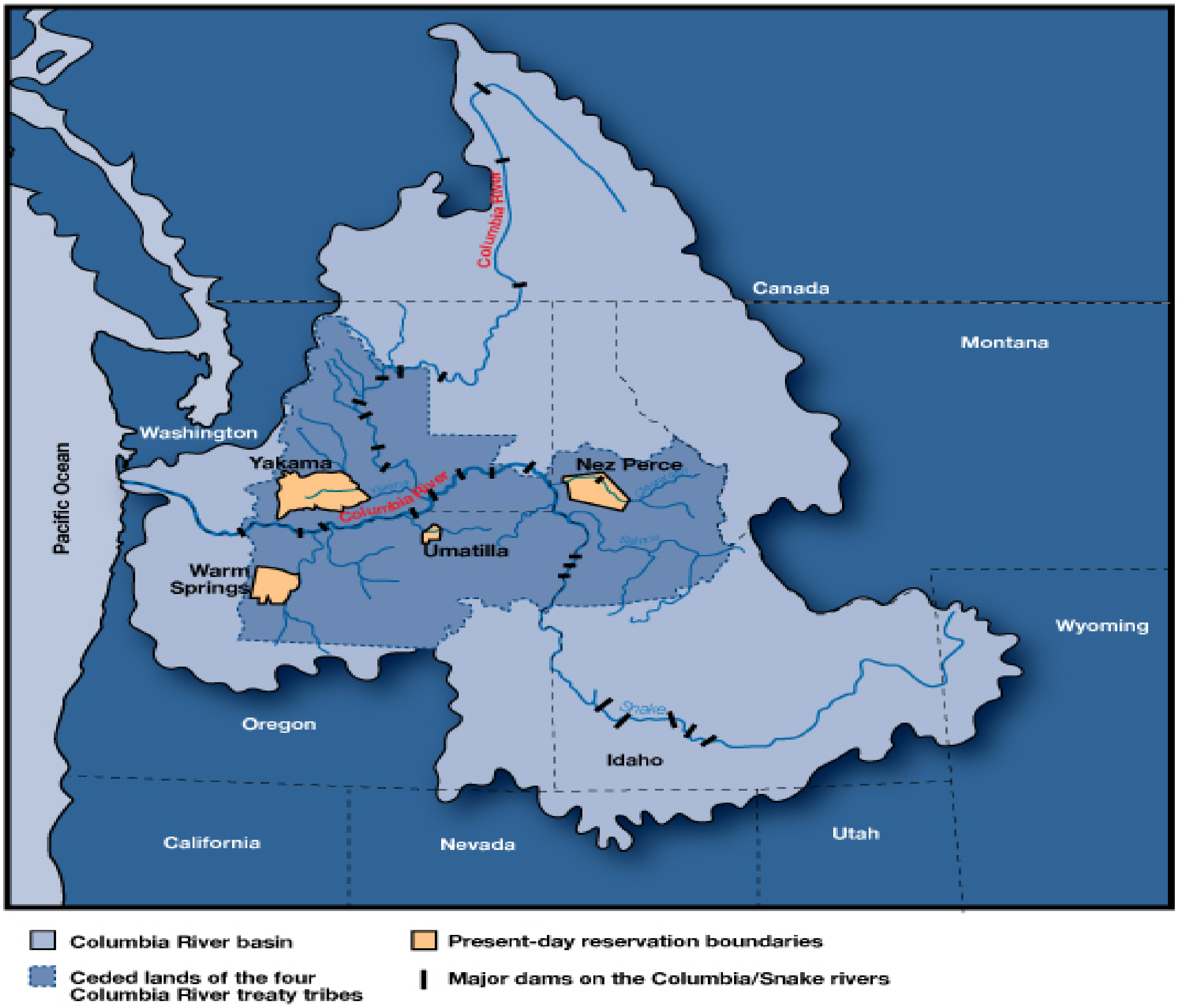

Figure 1. Map of Columbia Basin showing historical tribal ceded lands, current reservation boundaries and major federal and FERC licensed dams that affect Pacific Lamprey.

To the Columbia River Treaty Tribes, restoration of lamprey populations is as necessary to the restoration of the ecological health of basin watersheds as are salmon and other native fish populations. In the Columbia River treaty tribes' anadromous fish restoration plan, *Wy-Kan-Ush-Mi Wa-Kish-Wit* (Nez Perce et al. 1995), the tribes'objectives were to to halt the declining trends in salmon, sturgeon, and lamprey populations originating upstream of Bonneville Dam in 7 years, and to increase Pacific lamprey populations to naturally sustainable levels that also support tribal harvest opportunities within 25 years.

Firm substantive commitments to restore Pacific lamprey are crucial. In 2004, the member tribes of the Columbia River Inter-Tribal Fish Commission (CRITFC) sponsored a regional "Lamprey Summit" to focus on the severe decline of lamprey and to identify factors and critical uncertainties contributing to their decline. Tribal elders and researchers briefed representatives of federal and state agencies as to the importance and status of lamprey. The result was a consensus to take actions to restore lamprey. However, earlier priorities focused regional attention on restoring ESA listed salmon stocks, with the result that lamprey populations continued their serious decline. Currently only a few dozen adults manage to migrate past the uppermost passable dams on the Columbia and Snake Rivers where forty years ago, before the series of dams were completed on the Snake and Upper Columbia reaches, hundreds of thousands migrated to these areas. Unless effective action is taken immediately, the risk of local extirpation of lamprey from vast traditional tribal fishing areas is extremely high.

Although relatively few restoration actions have been implemented in the Columbia River Basin since the 2004 Lamprey Summit, there have been two important initiatives. First, the 2008 Columbia Basin Fish and Wildlife Authority's (CBFWA) submission to the Northwest Power and Planning Commission Amendment Process recognizes the severe downward trends in the Columbia River lamprey populations and recommends nine specific strategies, detailing numerous measures for implementation. These recent CBFWA recommendations are a product of the regional fishery managers collaborating to address this serious problem. The CBFWA's Lamprey Technical Working Group (CBLTWG) listed a number of important critical uncertainties in addressing lamprey passage, limiting factor analysis, population delineations and population dynamics. Second, the 2008 US Fish and Wildlife Service "Conservation Initiative" aims to "*facilitate communication and coordination relative to the conservation of Pacific lampreys throughout their range.*"

The tribes applaud these and other efforts and are committed to their success. However, the tribes also recognize that the lamprey's current dilemma demands a heightened level of political will, a change in institutional priorities and more technical innovation to realize a cost-effective and timely implementation of critical actions.

The tribes believe making necessary improvements at basin mainstem hydroprojects, resolving biological uncertainties, and improving lamprey productivity throughout the Columbia Basin will require a regionally coordinated effort from tribes, federal and state fishery agencies and closely coordinated funding contributions from federal and private/public hydroprojects licensed under the Federal Energy Regulatory Commission (FERC).

The Tribal Restoration Plan is a call to action. The rapid declines in lamprey populations challenge resource managers to accelerate coordination and collaboration, both in terms of establishing priorities and in acquiring necessary funding. While regional initiatives are being developed and adopted, substantive actions based on current knowledge must be implemented immediately to prevent the impending loss of Pacific lamprey across vast portions of its remaining range within the Columbia Basin.

The emphasis of this Tribal Restoration Plan is to provide an explicit and timely path, including specific actions that can be implemented in the next ten years for both the mainstem Columbia/Snake Rivers and associated tributary streams. The ultimate goal is restoration of Pacific lamprey to levels supportive of their unique cultural and ecosystem values. Our primary objectives include 1) improving mainstem passage and survival, 2) improving tributary habitat conditions, 3) implementing translocation/re-introduction actions and 4) continuing research to improve our understanding of their life history and biology.

While the plan's time line spans ten years, actions should be immediately taken. As one tribal fisheries manager put it, "For some of us our "ten years" was up ten years ago."

The Nez Perce, the Umatilla, the Warm Springs and the Yakama tribes' Pacific Lamprey Restoration Plan contains the key elements to achieve the stated goal and associated objectives. The need is even more crucial considering the increasing impacts of climate change and human population growth in the Columbia Basin (ISAB 2007a; ISAB 2007b; WGA 2008; NRDC 2008).

The Tribes strongly encourage the region to actively and collaboratively engage in further development and implementation of this Pacific Lamprey Tribal Restoration Plan.

***Clearly, the time to act is now*.**

Cultural Context

All lamprey are and have been of great importance to Native American tribes (Close et al. 1995; Close et al. 2001). Indigenous peoples from the coast to the interior Columbia and Snake rivers harvested lampreys for subsistence, religious, medicinal, spiritual and cultural purposes for many generations (Close et al. 1995). Today, these peoples have dwindling opportunities to harvest lamprey, with these opportunities restricted to the lower portions of the Columbia Basin (Close et al. 2002).

Historically, tribal people of the CRITFC's member tribes harvested adult lampreys in the mainstem tributaries of the Columbia and Snake rivers. Tribal members typically harvested enough lamprey at Celilo[2] and Willamette Falls to last families for a year. The lamprey were collected at night in areas where they accumulated at the falls, and were used for sustenance and trading for other food and clothing. Tribal members continue to refer to lamprey as "eels" Pre-treaty traditional fishing areas of the Umatilla, Walla Walla, and Cayuse tribes, for example, included the John Day, Umatilla, Walla Walla, Tucannon, Grande Ronde, and Powder rivers.

In the 1970s, tribal members began noticing declines in the numbers of lampreys migrating into the interior Columbia River basin. Two types of lampreys were harvested from spring through fall: the short brown type and the long dark type, which may have represented different species or subspecies of lamprey. Lamprey spawning distributions stretched from the mouth to the headwaters in the Umatilla,Yakima, Deschutes, Salmon and Clearwater rivers. Tribal members observed larval lampreys in the mud and sand areas of these rivers. Tribal members identified declines in lamprey from declining habitat conditions, fish poisoning operations and dams (Close et al. 2004).

When the few opportunities for harvest occur, younger tribal members, with training from adult tribal members, often collect eels for tribal elders. Without lamprey to catch and prepare and preserve, younger tribal members will lose the opportunity to gain associated technical knowledge and cultural experiences, including important connections with elders. The loss of traditional tribal fishing areas leads to the loss of how to catch and prepare lamprey. This, and the loss of other traditional knowledge surrounding eel myths and stories threatens loss of tribal culture (Close et al. 2002). One tribal elder stated:

The eels was part of the July feast.. because along with the salmon… this is what our older people tell us… that when the time began the foods were created. The foods were here before us…and they said that the foods made a promise on how they would take care of us as Indians and the eels was one of those who made a promise to take care of us. (Close and Jackson 2001).

A tribal story states:

I have heard it said that long ago, before the people, the animals were preparing themselves for us. The animals could talk to each other during this time. The eel and the sucker liked to gamble, so they began to gamble. The wager was their bones. The eel began to lose but he knew he could win. The eel kept betting until he lost everything. That is why the eel has no bones and the sucker has many bones (Close et al. 1995).

[2] Celilo Falls was probably the most significant tribal cultural site in North America for more than 10,000 years and was inundated by the backwaters of The Dalles Dam in 1957. It was the primary site for tribal lamprey and salmon harvest in the Columbia Basin.

Institutional Context

Changes in institutional priorities are needed. The region needs to acknowledge policy and institutional barriers that are independent from scientific and economic issues that prevent federal, state and local agencies from taking action to restore lamprey. Current institutions and policies fail to foster timely actions. Among other things, these agencies need to work with the tribes to educate the general public about the importance of lamprey as a vital part of the Columbia River ecosystem.

Conservation of Pacific lamprey within the Columbia Basin has not been a fisheries management priority. Instead, Pacific lamprey have often been lumped into a multispecies context—it has been assumed that measures taken to restore salmon species would carry along the less charismatic species. Although these primitive fish share many of the same habitats as anadromous and resident salmonids listed under the Endangered Species Act and are an integral part of ecosystems on which these fish depend, the Pacific lamprey have been little more than add-ons to species preservation plans. Unfortunately, the efforts to help salmon and other native fish have not resulted in flourishing lamprey populations and in fact, some bioengineering measures for salmon have proven detrimental to lamprey (Bleich and Moursund 2006).

Wy-Kan-Ush-Mi Wa-Kish-Wit (Nez Perce et al. 1995) recognized that lamprey restoration "*…depends on institutional structures that efficiently coordinate the actions and resources of relevant government agencies and enlist the support and energy of individuals and non-government agencies*". Redirection of funding and personnel by sovereign entities as well as local governments is needed in order to implement goals, objectives, actions, monitoring and evaluation in an active adaptive management framework (Walters 1986; Walters and Holling 1990;Hilborn 1987). When policy makers, technical experts or implementers differ on restoration approaches and actions, dispute resolution processes must be timely so that progress is not stalled.

Existing Columbia Basin management forums and processes established for salmon restoration must be expanded to include actions for Pacific lamprey. This includes but is not limited to the Northwest Power and Conservation Council's Fish and Wildlife Program, state programs for species of concern, license conditions issued by the Federal Energy Regulatory Commission, requirements for permits issued under the Clean Water Act, the Fish and Wildlife Coordination Act, the National Environmental Policy Act and the Corps of Engineers' Columbia River Fish Mitigation Program. The recent memorandums of agreements between three of CRITFC's member tribes and three federal agencies provide a good start toward working partnerships and actions to restore Pacific lamprey, but in themselves will not be enough to reverse the ongoing decline.

The inconsistency of conditioning dam passage goals and actions by the USFWS in FERC licensing is a particular problem that needs to be remedied. As the federal agency responsible for Pacific lamprey restoration, the USFWS should use their Section 18 authorities to condition FERC licenses to expedite structural and operational passage improvement at project dams and reservoirs. These authorities become mandatory license conditions and are much more defined and enforceable than Section 401 water quality certificates issued by the state water quality agencies.

As a first step toward making institutional reforms for lamprey recovery, we recommend that all federal and state agencies and FERC license holders establish specific funding streams and other resources to implement lamprey actions. Among other things, this includes expedited establishment of at least one full time scientist/manager who focuses entirely on lamprey restoration and who coordinates with tribes, other agencies and other basin forums such as CBFWA's Columbia Basin Technical Lamprey Working Group.

As is evident by the drastic reduction of eels observed in the upper portions of the Snake and Columbia rivers, the general state of our Pacific lamprey management can be characterized as simply watching these once strong populations dwindle to functional extinction. This must change—it is past time the lamprey received priority attention.

Tribal Harvest

Harvesting lamprey for ceremonial and subsistence use has been and is critically important to the four CRITFC tribes. The tribes adamantly desire to restore healthy abundant lamprey fisheries at all of the tribes' usual and accustomed fishing areas. Because of very limited adult lamprey abundance, the tribes' current fishing opportunities are restricted and most of the lamprey harvest is focused on traditional fishing opportunities at Willamette Falls where lamprey are still available in some abundance. The tribes have been fishing for lamprey at Willamette Falls since time immemorial.

Due to the extremely low numbers of adult lamprey in the Columbia River Basin, at this time the tribes will forego lamprey harvest for tribal consumption at all mainstem areas, including mainstem dams. As lamprey populations increase in the future, the tribes may decide to resume mainstem harvest at mainstem areas.

Life History of Pacific Lamprey

Due to the lack of information, the life history of Pacific lamprey is not as clear as salmon life history (Figure 2). There appears to be between and within-basin variation in time of spawning, metamorphosis, outmigration, ocean residency, and upstream migration. Fossil records indicate that lamprey existed 450 million years ago (Schawb and Collin 2005 and Bond 1996 in Cummings 2007). This compares to salmon that have a history of 40 million years in existence (Wilson and Williams 1992 in Cummings 2007).

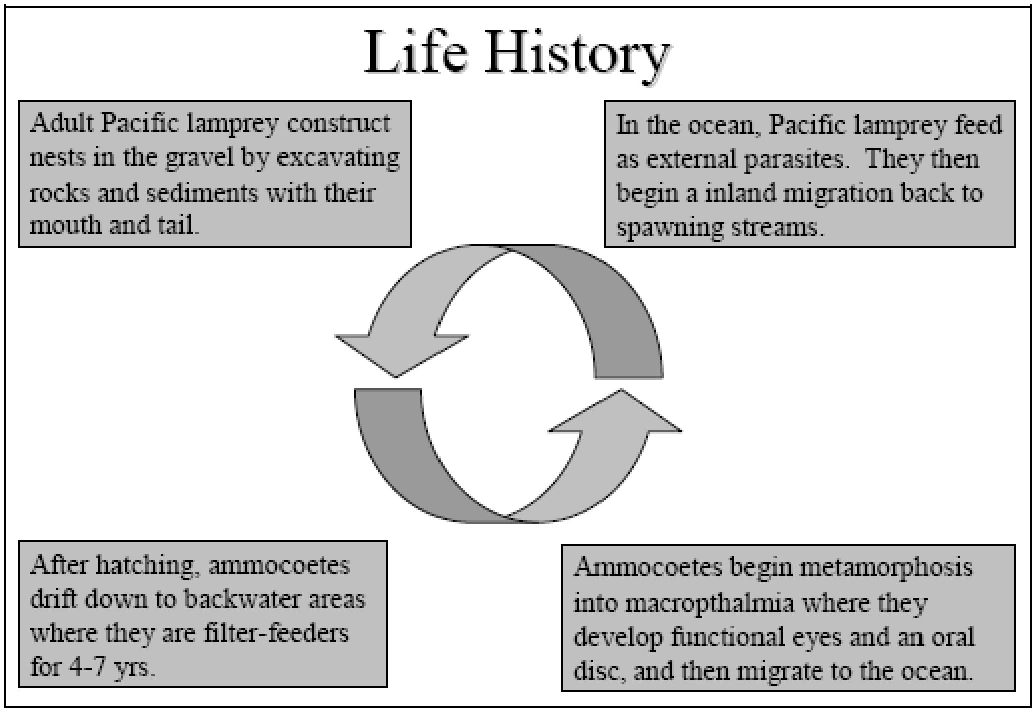

Figure 2. Generalized life history of Pacific lamprey (from Cummings 2007).

After feeding and growing in saltwater for about one year, Pacific lamprey migrate into freshwater to spawn (Cummings 2007). In the Columbia River adults migrating upstream have been observed entering freshwater as early as February (Kan 1975) and as late as September (Beamish 1980). Counts at Bonneville and The Dalles dams peak during June - August (Fish Passage Center 2008). Adult Pacific lamprey spend a winter prior to spawning becoming sexually mature in deep river pools with cover (i.e., boulders, organic debris) (Beamish 1980; Bayer et al. 2000). After over-wintering, adult lamprey have been observed spawning between March and July when the water temperature is between 10 and 15^{o}C (Beamish 1980; Beamish and Levings 1991; Close et al. 2003; Brumo 2006). Males and females cooperate to build redds by using their buccal funnel to remove and stack gravel substrate (Pletcher 1963). Spawning activity is not affected by light (Pletcher 1963; Kan 1975). Absolute fecundity varies between 98,000 – 238,400 eggs per female (Kan 1975). Unlike salmon, eggs are released in a series of short spawning events, with generally 100 – 500 eggs per event. During copulation eggs are fertilized by the male and then covered with fine substrate before another spawning event is initiated (Pletcher 1963). Adult lamprey die within 3-36 days after spawning (USFWS 2006).

Age at time of spawning is difficult to estimate due to life history plasticity, difficulties in aging ammocoetes, and lack of information on ocean residency time and migration behavior. For these reasons it is difficult to track individual year-classes throughout their life cycle, and thus modeling population dynamics is challenging. A literature search did not yield techniques to age adult lamprey. Some adult river migrants may be as old as ten or eleven years, as they can be seven years old when out-migrating to the ocean. There is also evidence that age at time of maturation varies depending upon geographic location in the basin (i.e.where they reared as ammocoetes and macropthalmia; Kostow 2002).

Depending on water temperature, eggs hatch after approximately 15 days and spend another 15 days in redd gravels until they emerge and drift downstream to suitable rearing habitats (Pletcher 1963, Brumo 2006). Dispersion from redds to suitable burrowing habitat is dependent upon flow and stream gradient (Potter 1980). Ammocoetes move downstream during high flow and scouring events, generally observed during the spring and winter (Graham and Brun 2006).

In general, ammocoete habitat occurs in low velocity, low gradient areas containing soft substrate and organic materials (Pirtle et al. 2003; Graham and Brun 2006). Ammocoetes will remain burrowed in soft substrates for up to 7 years (Close et al. 1995). While burrowed, ammocoetes are blind and sedentary. They filter feed on diatoms and other organic material suspended in the water column (Moore and Mallatt 1980). In filter feeding, ammocoetes produce mucus from the pharynx that entraps food particles that flow over rearing beds (Moore and Mallatt 1980).

Similar to salmonids, lamprey ammocoetes go through a “smolting” process where they undergo morphological and physiological changes to prepare for ocean life and the predatory phase of their life history (Close et al. 1995). Ammocoetes develop eyes, an oval mouth, functional teeth and a tongue, and the size of their oral disc increases (Yousson and Potter 1979). Internal changes include foregut development for osmoregulation (Richards 1980; Richards and Beamish 1981), blood protein changes (Richards 1980), disappearance of the bile duct and gallbladder (Bond 1979), and development of a unidirectional respiratory system (Lewis 1980). Metamorphosis generally occurs between July and October (Richards and Beamish 1981; Hammond 1979). Once metamorphosis is complete, ammocoetes are considered macropthalmia or juvenile lamprey. Before outmigration, macropthalmia appear to change their habitat preference to larger cobble sized substrate and faster water (Beamish 1980).

After metamorphosis macropthalmia migrate to the Pacific Ocean between fall and spring, taking advantage of periods of high river discharge (Richards and Beamish 1981; Beamish and Levings 1991; van de Wetering 1998; Graham and Brun 2006; Bleich and Moursund 2006). Pacific lamprey are thought to remain in the ocean, feeding parasitically on a variety of fish, for approximately 18–40 months before returning to freshwater as immature adults (Kan 1975; Beamish 1980). Pacific lamprey use olfactory perception, vision, and electroreception to choose their prey (Close et al. 1995). Feeding occurs when an adult lamprey attaches itself on prey using its oral disc, rasps through prey tissue, injects anticoagulant, and feeds upon removed blood and fluids. Beamish (1980) found walleye pollock (*Theragra chalcrogramma*) and Pacific hake (*Merluccius productus*) were the majority prey of Pacific lamprey. Lamprey have also been observed feeding on marine mammals (Scott and Crossman 1973).

It is uncertain how or even if lamprey home back to their natal streams. While there is some research in this area, more needs to be done (Lin et al. 2007). Researchers at

Michigan State and Humboldt State universities are investigating stream attractants perhaps driven by genes or pheromones, that determine lamprey spawning locations. Adult Pacific lamprey, like sea lamprey appear to be attracted to spawning sites by pheromones released by ammocoetes based upon their production of bile acids (Bergstedt and Seelye 1995 *in* Lin et al. 2007).

Goodman (2006) analyzed 81 tissue samples from lamprey along the Pacific Ocean coastline and found no evidence of genetic variability among drainages. Lin et al. (2007) analyzed muscle and fin tissue from seven different Northwest rivers including four in the Columbia Basin for genetic DNA differences. While they, like Goodman (2006), found no statistically significant differences between the Columbia and Klamath basins, they found statistically significant differences among samples within those basins. They concluded that Pacific lamprey showed a geographical divergence pattern across the range of Northwest samples but there was no clear pattern of geographical structure within the Northwest, based upon the samples. They hypothesized that lamprey from different rivers disperse and mix in aggregations at sea and could be carried for hundreds of miles by prey and ocean currents. That and the absence of natal homing could lead to temporal unstable genetic differences between spawners. They concluded that more genetic, physiological and demographic studies of lamprey migration will be able to better resolve genetic and geographical separation hypotheses.

Ecological Significance

Evidence suggests that Pacific lamprey integrated well into the native freshwater fish community and had positive effects on the system. In all probability they were and continue to be a significant contributor to the nutrient supply in oligotrophic streams of the basin as adults die after spawning (Beamish 1980). Lamprey were and continue to be an important part of the food chain for many species such as sturgeon, northern pike minnow, trout, sea lions, whales, gulls and terns (Close et al. 1995). Close et al. 1995 suggested that lamprey were and are an important buffer for upstream migrating adult salmon from predation by marine mammals. From the perspective of a predatory sea mammal it has at least three virtues: (1) they are easier to capture than adult salmon; (2) they are higher in caloric value per unit weight than salmonids and (3) they migrate in schools. The lamprey is extraordinarily rich in fats, much richer than salmon. Caloric values for lamprey ranges from 5.92-6.34 kcal/gm wet weight (Whyte et al. 1993); whereas, salmon average 1.26-2.87 kcal/gm wet weight (Stewart et al. 1983).

Further, Roffe and Mate (1984) revealed that the most abundant dietary item in seals and sea lions are Pacific lamprey. As a result of dwindling lamprey stocks, marine mammal predation on salmonids may be more severe. Larval stages and spawned out carcasses of lampreys were important dietary items for white sturgeon in the Snake and Fraser Rivers (Ken Witty, ODFW retired, personal communication, Galbreath 1979; Semkula and Larsen 1968). Juvenile lampreys migrating downstream may have buffered salmonid juveniles from predation by predacious fishes and sea gulls (Merrell 1959).

Lampreys are found in the diets of northern pike minnow *(Ptychocheilus oregonensis)* and channel catfish *(Ictalurus punctatus)* in the Snake River system (Poe et al. 1991). Merrell (1959) found that lampreys were 71% by volume of the diet of gulls and terns below McNary Dam during early May. Close et al. 1995 suggests that juvenile lampreys may have played an important role in the diets of many freshwater fishes. Clanton (1913) reported that ground up "eel" (lamprey) was the dietary constituent that led to the best growth of hatchery salmonid fry. Pfeiffer and Pletcher (1964) found emergent ammocoetes and lamprey eggs were eaten by salmonid fry. Close et al. 1995 speculated that wild juvenile salmonids may have found lamprey to be important prey during the spring.

Historical Abundance and Status

Over the last 30 years abundant lamprey populations have dramatically declined concurrent with the construction and operation of mainstem and tributary dams, irrigation and agricultural projects, urban development, and habitat loss (Close et al. 1995; Moser and Close 2003; Kostow 2002).

Investigators have used oral histories of Pacific lamprey from tribal elders to gauge the relative decline of lamprey populations (Close and Jackson 2001). These oral histories provide a baseline to measure lamprey decline that predates other methods. Oral histories have documented consistent historical lamprey distribution and abundance throughout the basin.

In the 1840's, harvests of 40 – 185 tons (i.e.100,000-500,000 adults; E. Crow, 2007 pers. com) were documented for commercial eel fisheries at Willamette Falls. During the late 1800's Pacific lamprey were described as completely covering Willamette Falls, Oregon (ONRC 2002). There is documentation at Willamette Falls of collection of lamprey for processing for non-tribal use of 27 tons in 1913 (E. Crow. 2007 pers. com.). Records of adult lamprey passage began at Bonneville Dam in 1938. Counts ranged between about 50,000 to about 400,000 between 1938 and 1969 (Close et al. 1995). The Corps of Engineers (Corps) did not count adult lamprey at their dams between 1969 and 1993 (Close et al. 1995). Close et al. (2002) documented that in the early 1960's adult counts reached 300,000-350,000 at The Dalles Dam, 25,000 at McNary Dam and 17,500 at Rocky Reach Dam.

Typically, lamprey numbers decrease significantly as the run moves upstream. For example, Jackson et al. (1997) found a 65% reduction in numbers from Bonneville to The Dalles, a 72% reduction between John Day and McNary dams and a 40% reduction between Rock Island and Rocky Reach dams. The main causes of the declines are believed to be mortality and turnoff into tributaries. In some instances, lamprey counts at upstream dams have been greater than downstream dams, perhaps indicating that lamprey pass some dams undetected. For example, Jackson et al. (1996 in Bioanalysts 2000) reported 593 adults passing Rocky Reach Dam compared to 979 adults passing Wells Dam in 1996.

Although historical adult abundance estimates are incomplete and not rigorous, it is hard to deny that adult lamprey counts at mainstem dams have been in serious decline, with Snake River and Upper Columbia estimates at only a few dozen individuals (FPC 2006). These meager counts indicate that in recent times only very small numbers of adult lamprey pass the upper most dams in the Lower Snake and Upper Columbia. For example, in 2009 only 9 adult lamprey were counted passing Wells Dam in the upper Columbia and only 12 adults were counted passing Lower Granite Dam in the Snake River (Figure 3 from Kostow 2002 and Table 1; FPC 2009).

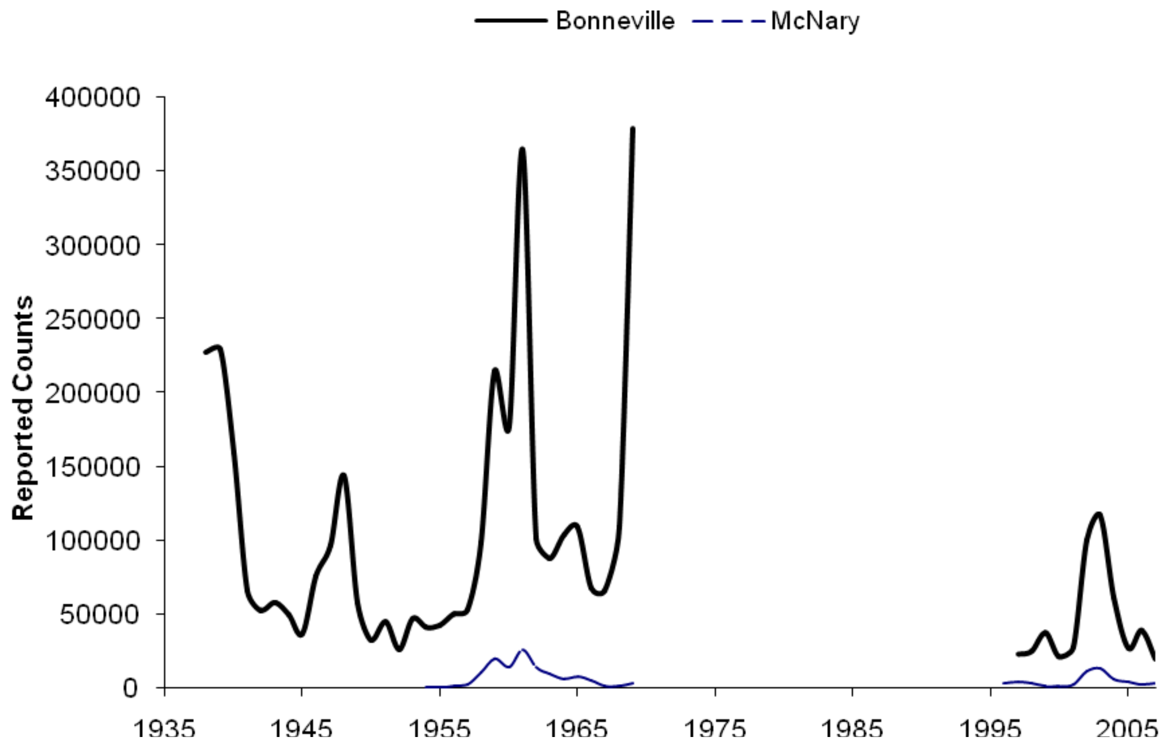

Figure 3. Historical lamprey counts at Bonneville and McNary dams (Kostow 2002)

Cummings (2007) noted that based upon the current trajectory, Pacific lamprey will soon reach unsustainable levels through much of the Columbia Basin. The tribes believe that this is already the case. For example, of 38,941 adults counted at Bonneville Dam in 2007, only 35 passed Lower Granite Dam in the Lower Snake River, seven dams above Bonneville and only 32 passed Wells Dam in the upper Columbia River, eight dams above Bonneville.

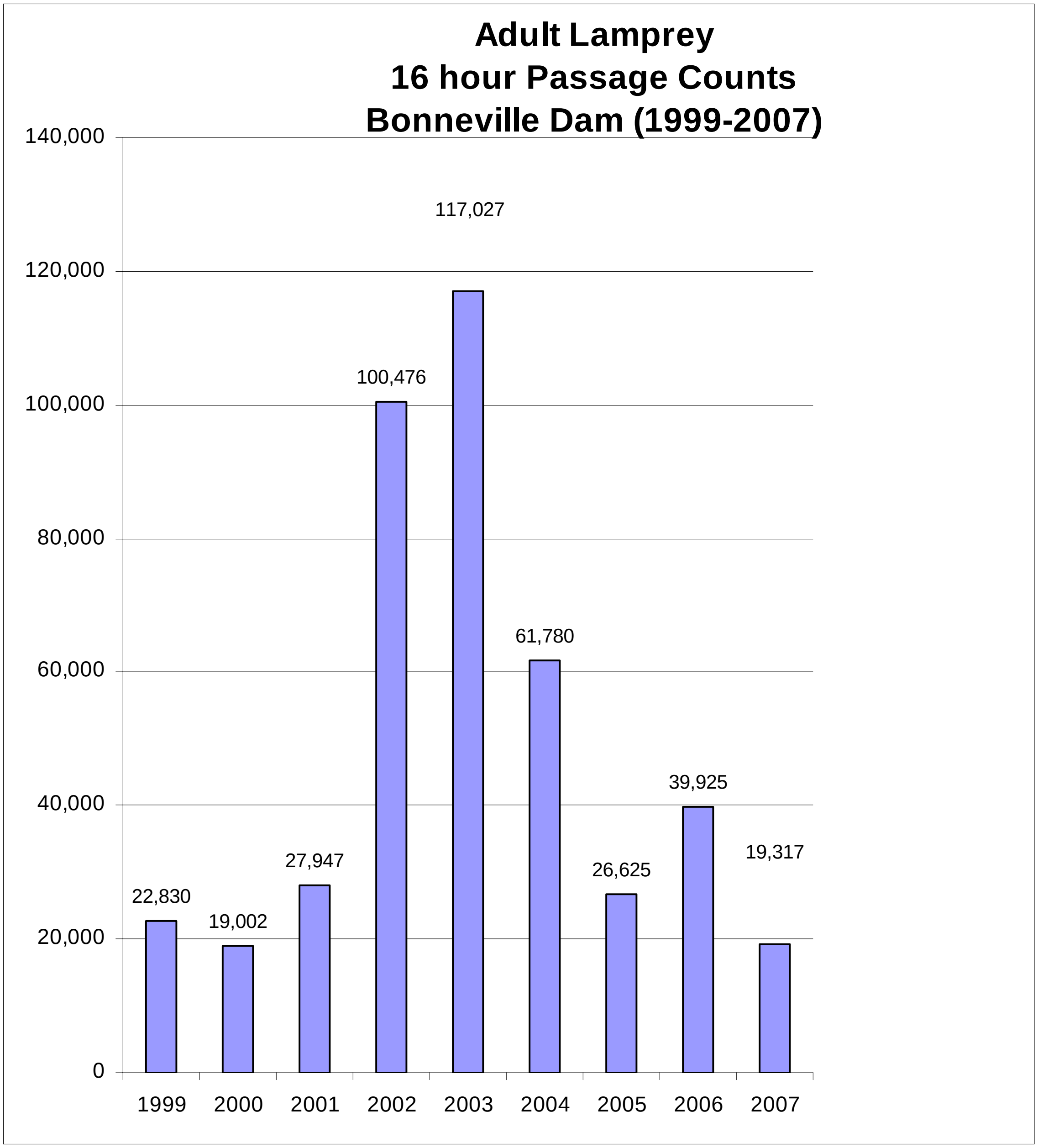

Figure 4. Recent adult lamprey 16 hour counts (daytime) at Bonneville Dam. Data from Fish Passage Center.

Table 1. Recent adult lamprey counts at Corps and Mid-Columbia PUD dams (FPC 2009)

Year	Bonn	McN	Priest	Wells *	IH	LWG
2000	19,001	1,281	1,468	NA	315	28
2001	27,947	2,539	1,624	261	203	27
2002	100,476	6,116	4,007	338	1,127	128
2003	117,027	13,325	4,339	1,408	1,702	282
2004	61,780	5,888	2,647	291	805	117
2005	26, 625	4,158	2,598	212	461	40
2006	39,925	2,139	3,273	21	255	35
2007	37, 170 *	3,389	3,419	32	288	81 *
2008	45,104 *	1530	5,083*	7	266	61*
2009	19,429 *	676	2714*	9	57	12*

* denotes 24 hour counts; all others 16 hour counts
2009 are counts as of 10/30/09

With respect to juvenile lamprey declining abundance, little is known except for gross observed declines, particularly in the Snake River Basin. Tribal and non-tribal accounts documented plentiful juvenile abundance and widespread distribution in the 1970's (E.Crow pers.com. 2007; S. Petitt, pers. com. 2000). There have been some studies of juvenile lamprey abundance and distribution in the Snake River Basin, the Umatilla Basin, the Deschutes River Basin and the Willamette River Basin and tribal efforts are expanding these surveys into the Klickitat, Yakima, and Methow basins.

Plan Vision: *Pacific lamprey are widely distributed within the Columbia River Basin in numbers that fully provide for ecological, tribal cultural and harvest utilization values.*

Plan Goal: *Immediately halt population declines and reestablish lamprey as a fundamental component of the ecosystem by 2018. Restore Pacific lamprey to sustainable, harvestable levels throughout the historical range and in all tribal usual and accustomed areas.*

Objective 1: Improve mainstem lamprey passage efficiency, survival and habitat

Considering dam count data and adult tagging studies, the tribes believe that passage is the most urgent problem facing lamprey in the Columbia River Basin. As has been found in other river systems such as the Great Lakes (Haro and Kynard 1997) and in Europe (Laine et al. 1998), passage impediments throughout the basin considerably impact upstream production. In its report on critical uncertainties for lamprey, the Columbia Basin Lamprey Technical Working Group (CBLTWG 2005) prioritized passage improvements as a second rank critical uncertainty in the overall effort to restore lamprey.

Millions of dollars have been spent on dam fishways, juvenile passage systems and irrigation screening systems that were designed and constructed for adult and juvenile salmon.. Unfortunately, the biological and swimming capacities of lamprey were never considered. In general, all of the existing research and literature indicate that lamprey as aguilliform type swimmers are not as efficient as teleost-type swimmers such as salmon (CBLTWG 2004).

As research and evaluation provides information on dam impacts to lamprey, this paradigm is slowly changing. In their 1999 review of the Corps of Engineers Columbia River Fish Mitigation Program, the Independent Scientific Advisory Board of the Northwest Power Planning Council (ISAB) advocated for creating a "biodiversity standard" of which passage fixes for all fish should be considered. They recommended passage standards and targets, passage designs and evaluations that focus on protecting biodiversity and that best fit natural behavior patterns and river processes (ISAB 1999). Among other things, the ISAB recommended against installation of extended length, fixed (not rotating) bar turbine screens at John Day Dam because of the demonstrated impacts of the screens on juvenile lamprey. Unfortunately, these recommendations have not been acted upon and passage structures, especially for juvenile fish migrants, continue to be focused on salmon.

Specific Passage Metrics

There are key metrics that are used to evaluate dam passage success. Lamprey passage efficiency is defined as the number of lamprey that successfully pass a dam to upstream areas divided by the number of lamprey that approached the dam (Moser et al. 2002). Passage timing is another important metric of passage success and refers to the time it takes an individual animal to pass a dam (Mesa et al. 2007). Reduction of passage timing is important with respect to conservation of limited bioenergetic reserves. Laboratory bioenergetics studies corroborated radio telemetry studies and concluded that lamprey must use significant energy reserves to successfully negotiate such fish ladders (Mesa et al. 1999; Mesa et al. 2003). Loss of energy reserves could ultimately affect spawning success. Adult lamprey are not known to feed during their freshwater migration, which can last for up to a year (Kostow 2002).

It is important that passage methods that have proven successful at mitigating impacts to lamprey at certain dams be immediately implemented, monitored and evaluated at upstream dams in an active adaptive management context (Walters and Holling 1990; Hilborn 1992). For example, reducing nighttime fishway flows at Bonneville Dam appears to facilitate adult lamprey passage, without affecting adult salmon, which don't pass fishways at night. This action should be expedited at other upstream dams.

The overarching goal of this objective is to achieve the same rate of juvenile and adult passage survival through the hydrosystem area without delayed passage impacts as if the hydrosystem was not present.

Sub-objective: A Adult Passage and Habitat

Determine adult passage rates for each route of passage at each mainstem dam

It is important to secure accurate adult lamprey counts at mainstem dams to provide an index of population abundance over time. Multiple studies and existing video counting records indicate that most adult lamprey pass dams during night time hours (Moser et al. 2002a; Moser et al. 2002b). However, currently most lamprey passage counts at dams only occur during the day (Moser et al. 2000; Moser and Close 2003; Moser et al. 2006). Adult lamprey counts at most mainstem Columbia and Snake River dams are only performed on a 16 hour basis, from 0400-2000 hours. An exception is at Lower Granite, where 24 hour counts are required for ESA listed Snake River sockeye.

The night time passage of adult lamprey was discovered using radio telemetry studies and PIT-Tag monitoring of adults at Bonneville Dam. Results showed that 67% of tagged adults passed between 2200 and 0600 hours (Close and Moser 2003). The daytime/nighttime passage counts at Lower Granite in 2007 confirmed this approximate distribution; 55 adults passed during nighttime hours while only 34 passed during daytime hours. Based upon preliminary review of videotapes of fish count windows at Bonneville Dam, the total 24 hour count increased over the daytime count by 28% in May and by 67% in June 2007 (Clabough et al. 2007).

CRITFC begin video counting investigations in 1995 and 1996 at several Corps dams using a stratified systematic sampling design to improve counting accuracy (Hatch and Parker 1997). During these years, the Umatilla Tribes counted lamprey at Bonneville Dam using these techniques (Hatch and Parker 1997). Unfortunately, funding was not provided to continue and refine these efforts. In 2007, the Corps sent CRITFC 24 hour fish recording tapes for McNary Dam which are presently being manually counted. There is an opportunity to use video counting technology developed by CRITFC to facilitate more timely and less labor intensive counts.

Obtaining accurate counts at Lower Columbia River dams, particularly at Willamette Falls and Bonneville Dam where the largest remaining lamprey populations still pass, have proven problematic due to the following, described by Fryer (2007) and Clabough et al. (2008).

- High shad passage during nighttime hours in June and July clogs fishways and makes counting difficult.
- Lamprey passage is highest during night time hours during some periods in the summer.
- Lamprey tend to hang in the viewing window for hours making them difficult to count.

- Count inaccuracies can occur when a portion of lamprey pass the counting station out of the field of view on the other side of the window crowder.
- Lamprey tend to move along the bottom of the ladder below the window, which, when complicated by poor lighting, adds to the difficulty in counting.

These problems need to be addressed on a counting station by counting station basis. Many of these problems are not significant issues because of low numbers of adults at upstream dams. The use of half duplex PIT-tag and radio telemetry techniques can be incorporated with dam counts to provide more assessment of lamprey dam passage accurate counts (Peery 2007).

Currently there has been few adjustments in counting or monitoring practices to consider the lamprey. Thus, there is an immediate need to establish and maintain, as a very high priority, 24 hour counts for adult lamprey at all mainstem dams. The Corps, Mid-Columbia PUDs and ODFW [3] need to commit to obtaining these counts.

Determine individual and cumulative impacts of mainstem hydroprojects (dams and reservoirs) on lamprey

Over the last decade basic passage research has been conducted at several Columbia Basin dams. Radio-telemetry and half duplex PIT- tag techniques have been utilized to track adult lamprey passage thorough the Lower Columbia River dams since 1997. Most of these studies found that upon release below a dam, most of the adults did not stray but immediately sought passage routes in dam tailraces (Mesa et al. 2007; Moser et al. (2002). Vella et al. (2001) noted that of 130 adults detected at the Bonneville Dam tailrace, only 29 were detected at The Dalles. Other radio-tagging studies conducted at fish ladders at Corps' Lower Columbia River dams found only 38% to 82% passage efficiency for adult lamprey (Moser et al. 2002), and passage times ranged from 4-5 days. Only 3% of adults tagged at Bonneville Dam reached areas above John Day Dam (Moser et al. 2002a). Cummings et al. (2006) found that 43% of radio-telemetry and half duplex PIT-tagged lamprey released below McNary Dam were able to ascend the dam, while 63% of tagged adults below Ice Harbor were able to pass that dam.

The use of PIT-tags has been coupled with radio tags and adult counts to better quantify passage blockage areas and overall passage success through fishways and river reaches. Recent developments have included the use of half duplex PIT-tags that are surgically implanted in adult lamprey (Figure 4). These tags are larger than full duplex tags used for tagging juvenile salmon, so they allow for separate detections in fishways and other sites.

[3] ODFW owns and operates the fish ladder and provides fish counts at the Willamette Falls Hydroelectric Project. To date, no attempt has been made to institutionalize lamprey counts at the fish ladder.

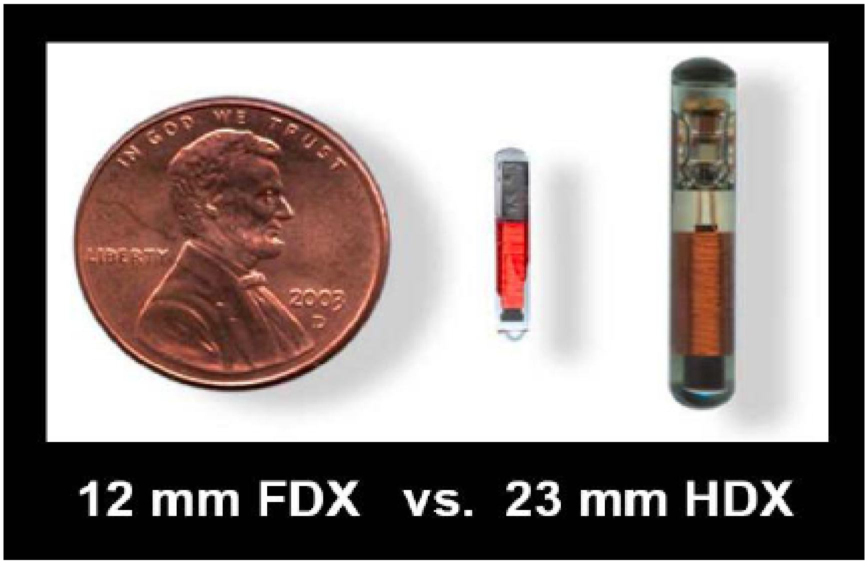

Figure 5. Full duplex (left) and half- duplex PIT-tags (Cummings 2007).

A few studies have assessed passage efficiency and rates at FERC licensed public utility dams in the Mid-Columbia. Nass et al. (2003) concluded that there was no consistency of passage efficiencies between years for specific fishways at Priest and Wanapum dams, as measured efficiencies ranged between 46-100%. However, studied samples sizes were small, limiting between year comparisons, and a large proportion of the total sample did not make it to the fishway entrance. Bioanalysts (2005) found that 55% of radio-tagged adult lamprey released below the dam exited the fishway at Rocky Reach Dam but the fallback rate over the dam for lamprey was 12.7%, higher than rates observed at Corps' lower Columbia dams and Priest and Wanapum dams.

Tracking adult lamprey passage and migration can be a complex and challenging task (Figure 5). At the Willamette Falls Hydroelectric Project, Mesa et al. (2007a) found 35% and 23% of adults passed the dam in 2005 and 2006, respectively. No adults were found to have passed the falls, even during periods when flashboards were not installed. Median passage times through the Project fishways ranged from 4-74 hours.

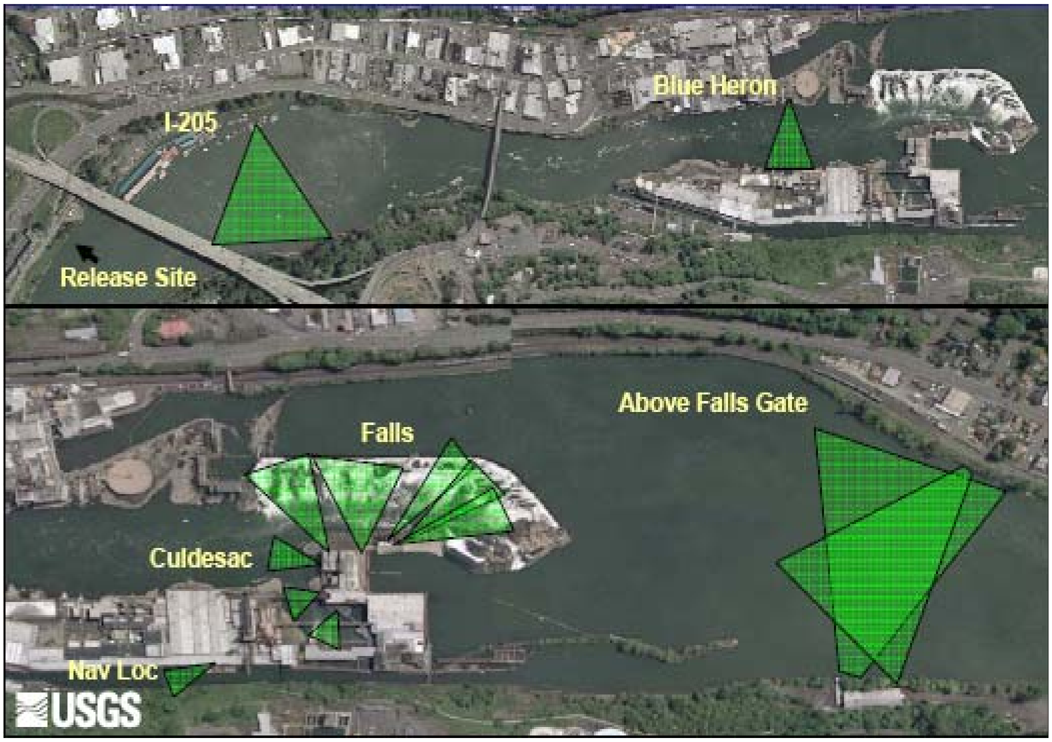

Figure 6. Radio telemetry arrays for the USGS adult lamprey study at the Willamette Falls Hydroelectric Project (USGS 2006).

These studies identified several features common to most fishways that appeared to hinder lamprey passage. While lamprey have sufficient burst speeds, they need access to surfaces which are conducive for oral disc attachment in order to rest (CBFWA 2004). Negotiating 90 degree turns in fishways appears difficult for lampreys. Other problem areas include diffuser gratings, junction pools, fish counting windows,[4] areas around picketed leads, vertical slots in fishway entrances, blind cul-de-sacs and cracks in the fishways themselves (Figure 6). High velocity sections, such as fishway entrances, gate slots upstream of fishway entrances, submerged orifaces and serpentine weirs have been identified as key problem areas (Figure 7).[5] Also, adult lamprey can slip through too-large gratings to become trapped below floor diffusers during fishway dewatering. (Figure 8). This occurred in November 2002, when over 5,000 lamprey were trapped at John Day; of these about 1,140 were lost due to human error (CTUIR 2003).

These studies are supplying a wealth of information important to the preservation of Pacific lamprey. It is important they be continued and expanded to all dams and reservoirs in the basin. To date little to no passage studies have been conducted at dams

[4] In the past, counters at windows actively used jets and brushes to remove lamprey from counting windows because they restricted visibility necessary for counting adult salmon.
[5] While lamprey can obtain burst speeds up to 3.9 m/s for a few seconds, they cannot maintain this effort for long enough to successfully pass high velocity areas such as ladder entrances, submerged orifaces and serpentine weir sections, unless they are able to attach to surfaces to provide a sequential passage route (Moser et al. 2002; Moser pers com. 2007).

at the upper ends of the basin (i.e. Wells and Lower Granite). Further, to date, little if any research has been conducted combining adult dam passage studies and evaluating the effects of passage on spawning success into tributaries. These remain key research needs.

Figure 7. Counting station at the John Day Dam fishway. Note the picketed lead on the right side of the picture below the netting (Richards 2007).

Figure 8.. Serpentine weir section at Bonneville Oregon Shore fishway (Moser et al. 2004).

Figure 9. Floor diffuser grating and submerged orifice at the dewatered John Day Dam fishway (Richards 2007).

Identify and apply scheduled structural and operational improvements to achieve volitional adult passage standards approximating the best known achievable rates at mainstem dams and reservoirs (i.e. 80% passage efficiency at The Dalles)

The region lacks specific, consistent qualitative and quantitative performance standards for upstream and downstream (fallback) adult lamprey passage among mainstem hydroelectric project, due in part to information deficits. During several recent FERC relicensing proceedings, these standards were identified as key areas for the USFWS to pursue, but little has occurred to date to rectify these deficiencies. Instead, in several recent FERC settlement agreements (that have subsequently been incorporated into FERC licenses), the parties have adopted a placeholder phrase: "safe, timely and effective qualitative goal without serious injury or mortality" (see the 2004 Willamette Falls Hydroelectric Project Settlement Agreement).

In general, FERC staff and the FERC Commission have generally ignored or discounted lamprey restoration actions in environmental impact statements and license conditions. This is especially problematic given the dire state of lamprey and the fact that licenses are awarded for a 30-50 year time period. Passage goals and objectives in the 401 Water Quality Certifications for the new licenses are often more rigorous than FERC staff mandated conditions, largely due to tribal pressure on state water quality agencies. For example, the overall goal established for the Rocky Reach Hydroelectric Project is a "no net impact"[6] goal with an adult passage objective to achieve passage rates at that project similar to that the best known achievable rates at other mainstem dams in 7 years after issuance of a new license. However, 401 water quality conditions are not consistent among FERC licensed hydroprojects. For example, the 401 certificate for the Priest Rapids license does not establish an explicit goal of meeting adult passage rates similar to the best known achievable rates at other mainstem dams. As mentioned in the above institutional context section of this plan, the inconsistency of conditioning dam passage goals and actions by the USFWS in FERC licensing is a particular problem that needs to be remedied.

A small subgroup of the CBFWA Lamprey Technical Working Group was charged to develop passage objectives and related performance standards (CBLTWG 2007). Preliminary objectives included:

- The range of system passage and survival should be similar to that of steelhead (although there was a question about strong natal fidelity of lamprey to make them comparable to steelhead)
- Passage at each dam should be at least equal to that of the dam with the best current passage

Complicating these objectives was the lack of knowledge regarding the proportion of adult lamprey passing a dam that actually intend to spawn, since most lamprey likely over winter before spawning. The group recommended that a workshop be conducted to

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[6] "No net impact" refers to a condition in which passage impacts are minimized to the extent possible and all unavoidable losses are mitigated through off site projects.

develop interim passage objectives and develop a list of passage needs. This workshop has yet to occur but remains a key priority.

Identify and apply scheduled improvements to individual and system operations to facilitate adult lamprey migration

From 2001-2007 the Corps of Engineers funded adult lamprey passage research and implemented some structural modifications as efforts to identify structural remedies for fishway problem areas. The Corps' Portland District created draft passage management plans, focusing on the Portland District dams (Clugston 2004; Corps 2007). Stansell (2002), Moser et al. (2002a) and Daigle et al. (2006), and Moser (2006) devised structural alterations in the Oregon and Washington shore fishways at Bonneville Dam to facilitate passage.

These changes included installation of ramps, plates over diffuser areas, modifying head differentials over weirs, rounding sharp corners, and more recently installing long, fabricated, metal boxes (Lamprey passage systems or LPS) that allow lamprey passage access over difficult passage areas such as serpentine weirs in fish ladders and wall dividers (Moser et al. 2006; Moser et al. 2007; Figure 9). Lamprey passage through the LPS systems is significant and has ranged from 7,365 adults at Bradford Island (Oregon shore) fishway (4% of tagged all tagged fish passing the dam) to 2152 adults at the Washington shore fishway (7% of all tagged fish passing the dam). This compares to 38,941 lamprey counted at Bonneville Dam fishway stations over 16 hours in 2006. Based on experiments at Bonneville Dam, reduction in diffuser gratings from 1 inch to ¾ inch has resulted in virtually eliminating trapping of adults below main fishway channels (Moser et al. 2007b). This structural modification has been successfully applied at the John Day north shore fishway counting station and needs to be duplicated at other dam fishways. To date no specific passage plans have been established at the Walla Walla District dams. This remains a critical area needing immediate attention.

Figure 10. LPS structure at the Bonneville Dam Oregon Shore fishway. A lamprey passing upstream can be seen at the upper portion of the bottom of the structure (Moser et al. 2004).

In 2007, in conjunction with FERC relicensing, Portland General Electric completely rebuilt the fishway at the River Mill Dam (the lowest dam on the Clackamas River) incorporating features, such as rounded weir corners, that were demonstrated at other dams to be beneficial for adult lamprey passage. At the Willamette Falls Hydroelectric Project, experimental lamprey ramps have been installed after flashboard installation. To date, no passage over these structures has been observed (Figure 9), however, a new ramp design will be evaluated in 2008.

Figure 11. Lamprey passage ramps installed at Willamette Falls after flashboard installation (CRITFC 2004).

In 2006, Grant County Public Utility District installed a slotted “key hole” fishway entrance at Priest Rapids Dam (Figure 11). This structure effectively modifies fishway entrance velocities over a range of dam tailwater elevations. The Corps of Engineers proposes to install a similar entrance at John Day and other Corps dams as warranted in the near future.

Figure 12. Slotted “key hole” fish ladder entrance installed at Priest Rapids Dam (Lauver 2006).

Fishway operational changes are being evaluated as ways to improve passage efficiency and reduce passage times. At the Bonneville Dam Washington shore fishway, flows at night were reduced to 4 feet per second and head differentials were reduced to 0.5 feet. Johnson et al. (2007) found that the fishway entrance efficiencies increased with the reduced flows (29% for reduced flows vs. 2% at normal flows). However, at other fishway entrances improvements in entrance efficiencies, while still increased under the reduced flow condition, were of a lesser magnitude. Because few if any salmon are known to pass fishways at night, this operation was considered to have little, if any negative impact on salmon passage.

Implement flow regimes to benefit adult lamprey passage and survival

Similar to adult salmon, adult lamprey returning from sea may fix on freshwater cues in the Columbia River estuary plume intensified by the spring freshet. Peak passage periods coincide with the peak hydrograph. Thus, managing flows to a peaking hydrograph will not only benefit salmon, but will also benefit adult lamprey. Flow augmentation, reducing water withdrawals, reservoir draw down, and achieving upper rule curves at storage reservoirs before the spring freshet are all potential tools to increase flows and establish a peaking hydrograph (CRITFC 2008). The additional stressor of climate destabilization will likely require consideration of modifying flood control rule curves through improved forecasting methods to create additional storage for spring and summer flow augmentation (WGA 2008).

Determine water quality impacts of hydroprojects on lamprey and implement actions to reduce these impacts.

Water temperature changes determine timing and adult migration and spawning (CBTLWG 2004). Adult migration data indicate that as temperatures increase during the summer, adult migration rates also increase, peaking around July 24 at Bonneville Dam. However, as with adult salmon, high temperatures can act as a thermal block for adult lamprey migration. Ocker et al. (2000, cited in CBTLWG 2004) noted that fewer adult lamprey successfully passed Bonneville Dam when temperatures exceeded 19.5 C. More research is needed in this area.

Many of the water quality improvements recommended for adult salmon will likely benefit adult lamprey. For example cool water releases from storage dams, fishway temperature controls, gas abatement structures, and reductions of oil in dam seep holes are actions that should be taken to improve water quality for adult lamprey (CRITFC 2008).

Little is know about effects of total dissolved gas and toxic inorganic and organic pollutants on adult lamprey from agricultural and industrial sources. More research is needed in this arena.

Assess and address impacts of irrigation water withdrawal structures on adult lamprey. Assess and address irrigation related water quality impacts on adult lamprey.

Millions of dollars have been spent in the Columbia Basin to keep juvenile salmon out of irrigation canals. Primarily, drum screen structures are implemented to address this need, however, the true impacts of these screens have not been well documented. While some monitoring work has occurred in California, none has been conducted in the Columbia Basin. The Bureau of Reclamation (BOR) staff proposed to inventory and create a database of BOR project impacts on lamprey dedicating $100,000 and four years to the project. The elements of the proposal include:

> *The first objective of this research is to inventory Reclamation facilities where the lamprey species exist. This will involve gathering background information of western river basins where lamprey are known and determine what lamprey species may inhabit the basin. Site specific background information will be included (if available) demonstrating the known or recorded occurrence of lamprey, e.g. lamprey passing through adult salmonid fish counting stations. As a key part of this research, a list of Reclamation facilities within the basins will be compiled and a determination made if there are any possible lamprey issues related to the operation of these facilities. Specific information, if available, will be cited as to exactly how the Reclamation facility affects the lamprey (i.e. inhibits adult upstream migration, inhibits juvenile outmigration, loss of habitat, thermal pollution, etc.) (Bark 2008).*

Once this work is in progress, the tribes recommend prompt implementation and evaluation of mitigation efforts. In particular, additional emphasis should be placed on the passage impacts at irrigation withdrawal projects to monitor impacts and to facilitate technological (and other) advances to protect lamprey at these sites.

Inventory and protect spawning habitat in reservoirs

Little is know about adult spawning in Columbia Basin hydrosystem reservoirs. Determining the extent of spawning and developing measures to protect habitat in these areas is an important sub-objective.

Implement actions to address excessive hydro-related avian, piscivorous and marine mammal predation.

Over the last few years the Corps of Engineers has documented accelerating predation of adult lamprey by California and Stellar sea lions below Bonneville Dam (Figure 12). Recently, under an amendment of the 1972 Marine Mammal Protection Act and court orders, the States of Washington and Oregon have gained authority to capture and kill, if necessary, limited numbers of particularly problem animals that prey upon salmon, sturgeon and lamprey in the Bonneville Dam tailrace. It is important that this effort be maintained and perhaps even expanded to areas above and below Bonneville Dam.

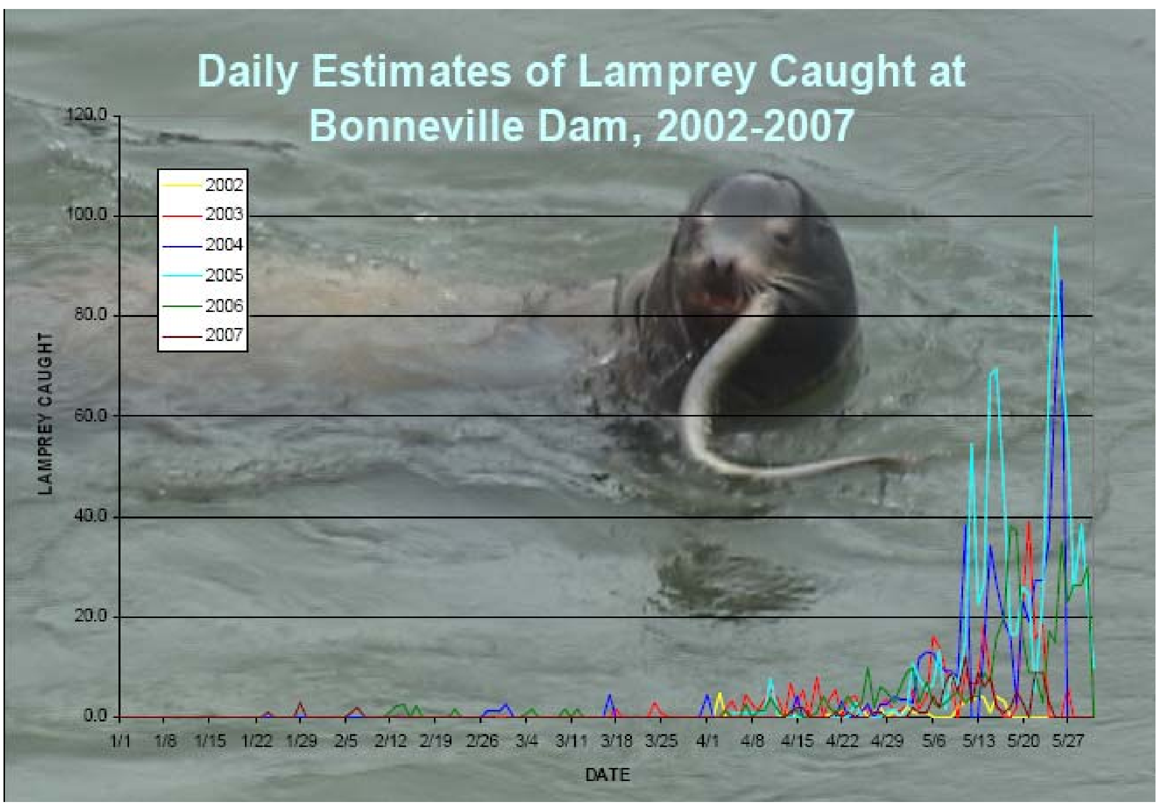

Figure 13. Lamprey predation estimates from Corps of Engineers observations at Bonneville Dam (Stansell 2006).

Figure 14. Avian predation on juvenile lamprey on Cresent Island in the Mid-Columbia River (A. Evans 2008).

Avian predation on lampreys has been observed near dams, but to date there has been no quantification of the impact. There appears to be little data obtained at bird colonies with respect to lamprey predation, but there is evidence that it occurs (Figure 13). This remains a critical uncertainty that should be addressed at all mainstem and tributary dams.

Adult Passage Structural and Operational Improvements-
General and Specific Actions

The tribes have identified improvement of passage efficiency and reducing the time and energy expenditure spent in passage as the first priority for lamprey restoration . To determine effective methods for accomplishing this, we've examined the dams with the highest existing passage efficiencies and compared these dams to all others in the Columbia Basin. From this analysis, the following are the specific steps recommended for all dams. Specific actions and schedules for implementation at FERC licensed dams should be developed and reflect coordination of license holders, tribal, state and federal agencies. These actions and schedules should be consistent with those found in Table 2 as appropriate. All of the following actions should be reflected in the Corps of Engineers Annual Fish Passage Plans and annual operations plans of FERC licensed hydroprojects. Adult passage at The Dalles Dam appears the best from current information. An investigation should occur to determine what structures or operations facilitate passage at

The Dalles to see if these can be transferred to other dams. Table 2 gives the recommended schedule for the implementation of the recommendations for each dam. Much of the schedule and priority for actions will be modified as knowledge about specific dam and fishway passage impediments are obtained.

1. Fishway surveys

All fishways should be surveyed and inventoried for structural improvements such as rounded corners, plates covering diffusers, closures of blind end fishway areas, cracks, counting stations, transition pools and picketed leads. All fishways should be evaluated for installation of lamprey passage systems (LPS) and appropriate modifications to fishway entrances. The dam operators should be solicited for information including anecdotal, qualitative or quantitative. Information from pass salvaging efforts should be sought and documented. Detailed passage reports should be written and submitted to peer-review. The results should be improved passage success, reduced injuries, shortened passage times and reduced energy expenditures which should lead to increased reproductive success.

2. Inspections

Protocols should be established at all dams for formal inspection and annual lamprey passage reporting. The reports and recommendations should be reviewed by regional peers.

3. Prioritization

There should be standardized and peer reviewed protocols for prioritizing needed actions. There should be standardized methods for evaluating the results of instituted changes.

4. Grating replacement

All 1 inch gap diffuser gratings should be replaced with ¾ inch gap grating. Of highest priority is the replacement of grating in fish counting areas and auxiliary water systems (AWS). This will reduce lamprey stranding and mortality, especially during ladder de-watering and in blind areas such as auxillary water system (AWS) channels.

5. Counting

Twenty-four hour video counting for lampreys should be initiated. All count stations should be examined and modified as necessary to ensure accurate counting. This will provide information to create an index of adult lamprey abundance and a means for tracking sub-basin stock productivity over time.

6. Night time fishway flow rates

Implement and evaluate decreased nighttime fishway flows. Make these changes permanent if appropriate. This will likely result in improved lamprey passage efficiency by increasing passage success, decreasing passage times and decreasing energy expenditures during passage.

7. Corners

Blunt or round off all corners at slots and orifices. This will allow for shortened passage times and allow lamprey to attach and rest in high velocity areas.

8. Plates

Install plates over diffusers along the bases of walls and weirs and evaluate for any benefit. Make permanent if appropriate; it is not known, but these modifications are suggested for improving passage success and to reduce passage times.

9. Ramps

Install ramps at sills and lips and evaluate. Make permanent if appropriate. It is suggested that ramps may allow for more attachment sites in high velocity areas. This would improve passage success.

10. Ladder dewatering

Ladder dewatering procedures should be evaluated and improved with an eye toward protecting lamprey. Weir blocking devices should be evaluated and flushing maintained. Provisions should be made for salvage tanks and enough skilled personnel to make sure trapped lamprey are salvaged for translocation up river. These modifications should work to protect trapped lamprey from injury and mortality. If modifications do not prevent entrapment, entrapped lamprey can be translocated to reestablish upriver populations.

11. Fishway entrances and transition pools

Entrances and transition pools should be modified to improve lamprey passage. Keyhole entrances should be assessed and implemented if practical and effective. All altered fishway entrances should be monitored and passage rates quantified. The lowered head of keyhole entrances reduces passage fallout, shortens passage times and promotes success at entry.

Table 2. Specific Actions and Schedules for Adult Lamprey at Federal Dams

ACTIONS AND SCHEDULE FOR FEDERAL DAM IMPROVEMENTS	BONN DAM	THE DALLES DAM	JOHN DAY DAM	MCNARY DAM	ICE HARBOR DAM	LOWER MONUMENTAL DAM	LITTLE GOOSE DAM	LOWER GRANITE DAM
Survey Fishways	2009	2009	2009	2009	2009	2009	2009	2009
Peer-reviewed reports	2009-2018	2009-2018	2009-2018	2009-2018	2009-2018	2009-2018	2009-2018	2009-2018
Annual Inspection Protocols/Reports	2009-2018	2009-2018	2009-2018	2009-2018	2009-2018	2009-2018	2009	2009
Prioritization	2009-2018	2010	2009-2018	2009-2018	2009-2018	2009-2018	2009-2018	2009-18
Grating Replacement	2009-2012	2012	2010	2011	2012	2012	2012	2012
24 hour Video Counting	2008-2018	2008-2018	2008-2018	2008-2018	2009-2018	2009-2018	2009-18	2018
Reduce Fishway Night Flows	2009-2018	2018	2009-2018	2009-2018	2009-2018	2009-2018	2009-18	2009-18
Rounding Corners	2009-2012	2012	2011	2011	2012	2012	2012	2012
Plate installations	2009-2010	2012	2010	2010	2012	2010	2010	2010
Ramp Installations	2012	2012	2012	2012	2012	2012	2012	2012
Ladder Dewatering Improvements	2009-2018	2009-2018	2009-2018	2009-2018	2009-2018	2009-2018	2009-2018	2009-2018
Fishway Entrance Improvements	2009-2012	2012	2010	2011-2013	2011-2013	2011-2013	2011-13	2011-2013
LPS installations and evaluations	2009-2011	2012	2010	2011	2012	2013	2013	2013

<u>Sub-objective: B Juvenile Passage and Habitat</u>

Determine discrete and cumulative impacts of hydro projects (dams and reservoirs) on lamprey populations.

On their seaward journey, juvenile lamprey migrate past dams and reservoirs in two life history forms, ammocetes and macrothalmia,. There is considerable variation in passage rates and run timing through dams but available data indicates that, as with juvenile salmon, peak passage rates coincide with the late spring/early summer freshet (Figures 14 and 15. Compared to juvenile salmon, juvenile lamprey are relatively weak swimmers. Laboratory trials indicate that average juvenile burst speed is 2/3 ft/sec or 5.2 body lengths/second (Moursund et al. 2000). Lamprey take advantage of stream power for migration, a strategy that reserves energy for physiological transition to saltwater

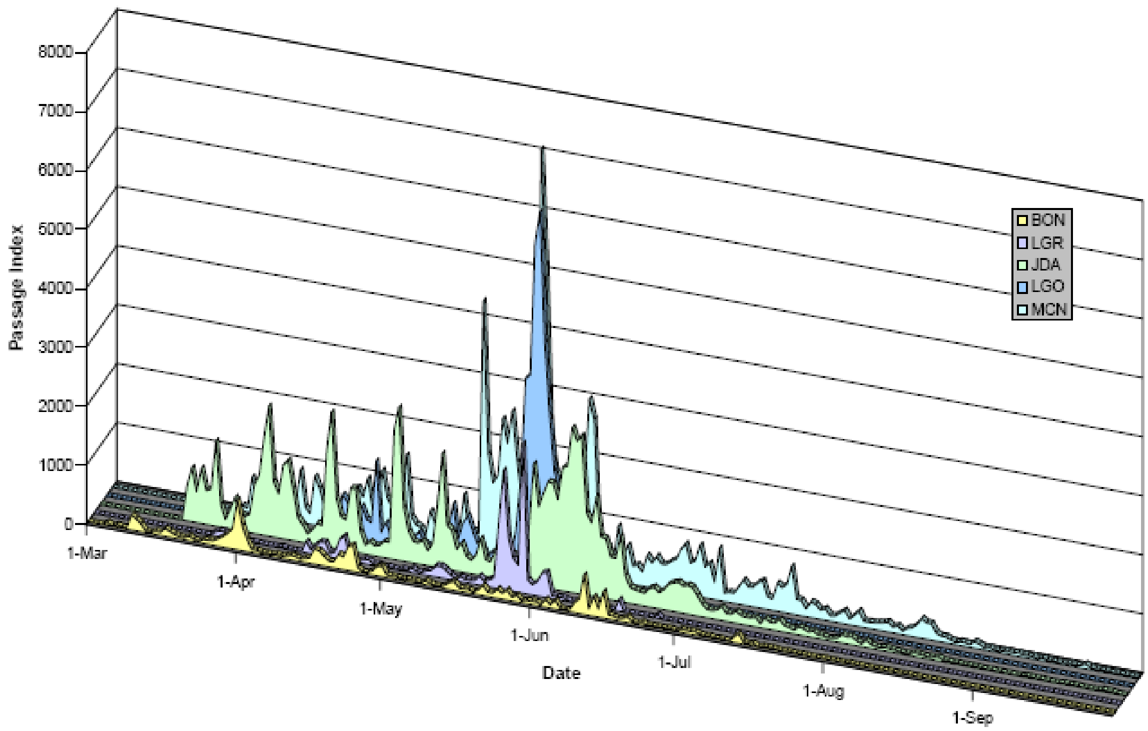

Figure 15. 1998-2002 average juvenile lamprey run timing at five Lower Snake and Lower Columbia dams (Bleich and Moursund 2006).

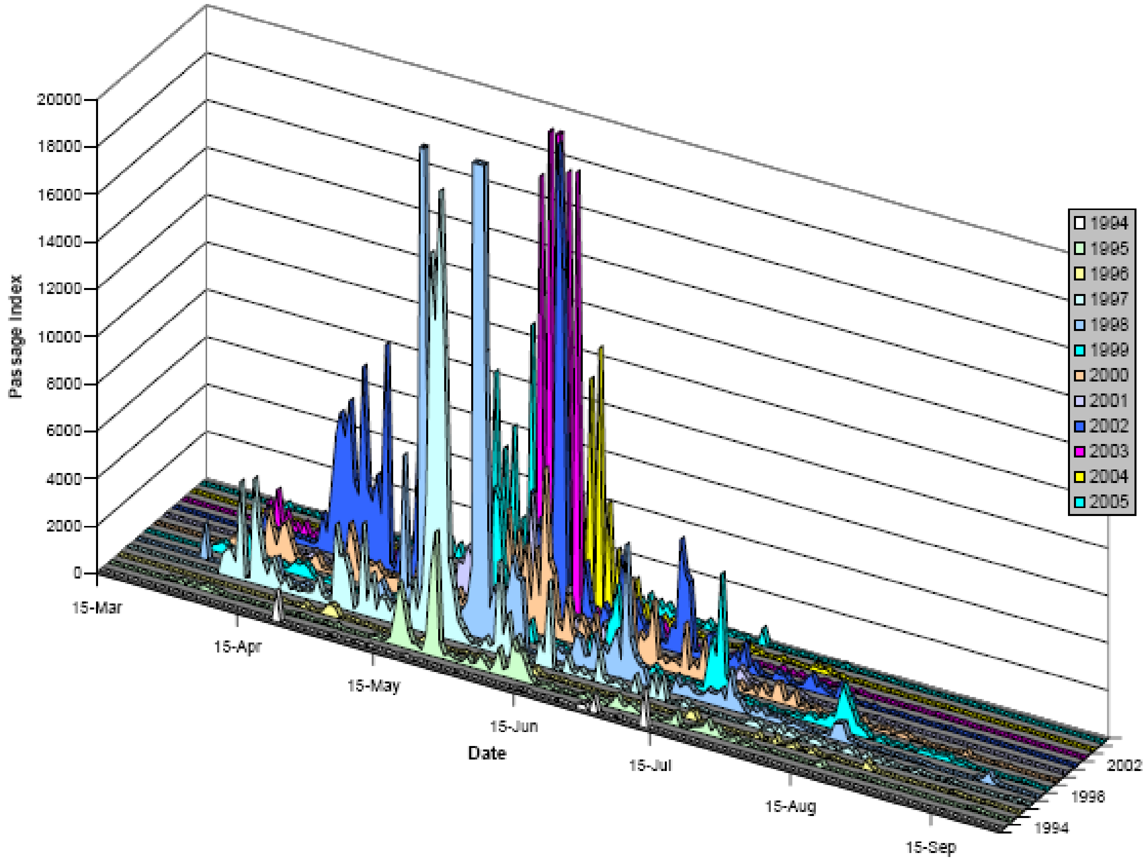

Figure 16. Juvenile lamprey run timing at McNary Dam from 1994-2005 (Bleich and Moursund 2006).

Little research has been funded for juvenile lamprey, but some specific migration data exists. For example, using PIT-tag technology, Bleich and Moursund (2006) found evidence that the travel time of juvenile lamprey of 5-16 days from McNary Dam to John Day Dam was similar to that of subyearling Chinook. They also observed that in the very low flow year of 2001 juvenile lamprey and subyearling Chinook migration times were much longer, lasting 10-28 days. This indicates that juvenile lamprey likely have a water particle/fish travel time relationship similar to that for juvenile salmon (Schaller et al. 2007; Connor et al. 2003a; Connor et al.2003b).

Thus, improving flow regimes appears to be a good restoration strategy to speed juvenile lamprey to saltwater. Additionally, greater flow rates probably contribute to juvenile lamprey survival by increasing water turbidity, helping to conceal the juveniles from predation as well as decreasing duration of exposure to predators, disease and increasing water temperatures.

Regarding dam passage efficiency and survival specifically, current information is limited to fyke net observations, PIT-tags, samples in salmon screen bypass systems and underwater and surface observations (Figure 16).

Figure 17. Fyke net removed from a turbine gatewell at John Day Dam (Moursund et al. 2003).

For many years the common assumption was that most juvenile lamprey travel along the bottom of the river during their approach to dams and pass through turbine intakes under turbine intake screens (Figure 17). Among other things, this conclusion arose from the fact that juvenile lamprey lack a swim bladder, in contrast to juvenile salmon. However, in several cases, data from lamprey trapped on fyke nets placed in turbines behind turbine intake screens and on the screens themselves indicate that they travel higher in the vertical water column than previously believed. For example, fyke net tests at Priest Rapids Dam indicate that juvenile lamprey were found nearly equally distributed from the top to the bottom of the turbine gatewell slot (Carlson 1995 unpublished data). Moursund et al. (2003) found that 86% of juvenile lamprey found on the John Day Dam extended length turbine screens were within the top 10% and bottom 10% of the screen face (Figure 18). They also documented 91% of PIT-tagged lamprey and 14% of run-of-river lamprey were captured at fyke net levels 1-4 behind the turbine intake screen.

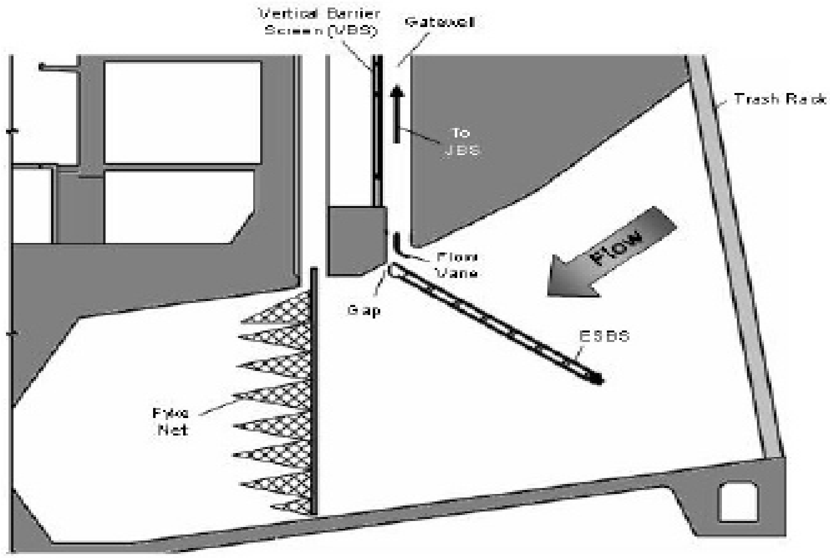

Figure 18. Sectional diagram of turbine unit, with location of extended length bar screen, gatewell, vertical barrier screen and trash rack (Moursund et al 2003).

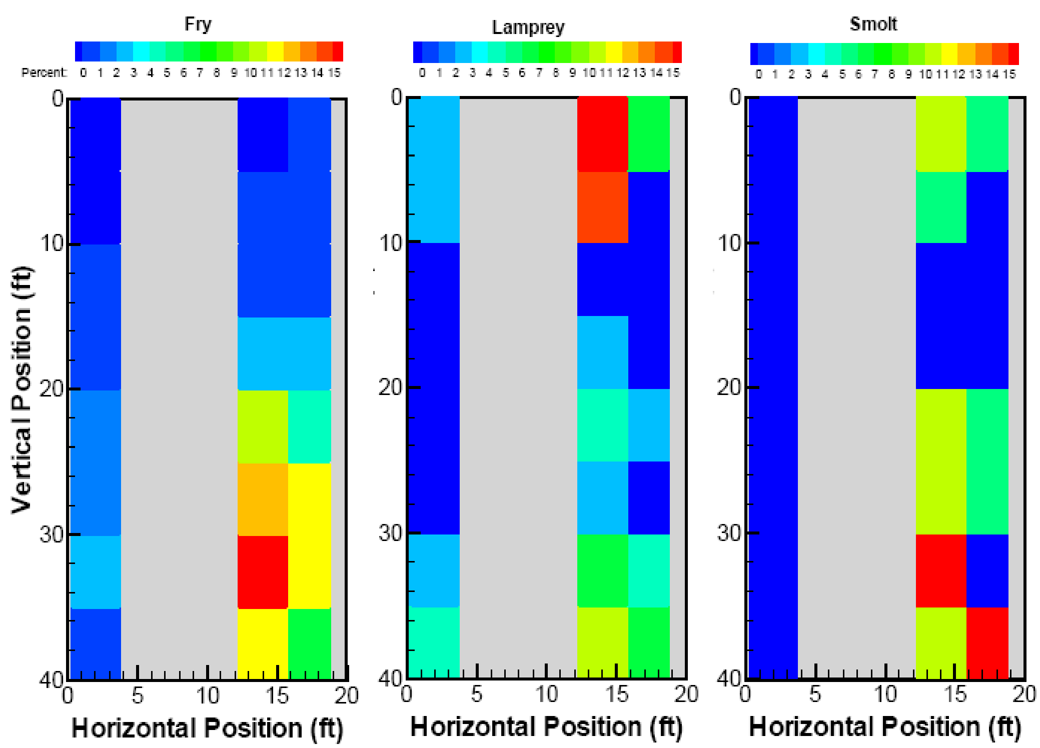

Figure 19. Juvenile salmon and lamprey vertical and horizontal distribution on a turbine screen as denoted by underwater cameras. Gray areas not sampled. Units in feet (Moursund et al. 2003).

Significant impingement of juvenile lamprey on turbine and gatewell screens designed for juvenile salmon passage was first observed in the mid 1990's. Starke and Dalen (1995) first noted and then in 1998 photographed the impingement on 40 foot extended length bars screens at John Day Dam (Figure 19). Juvenile lamprey swimming ability is too limited to avoid contact with the screens. The impingement was not restricted to the lower portion of the screen but was vertically distributed equally over the screen face. A conservative estimate from the photographs was that 200 lamprey were impacted (Lorz 1998). Brushes on the screen designed to scrape debris from the face also scraped off the juvenile lamprey, routing them to the turbines. Since the observation was made in February, a time of low juvenile migrants, it is likely that the impact would be much greater during the peak migration times.

Figure 20. Impingement of juvenile lamprey on John Day extended length bar screen (Starke and Dalen 1998).

In response to this observed impact, the Corps conducted underwater camera observations of extended length screens at McNary Dam and conducted impingement studies at John Day. Initially, problems with the camera prevented an accounting of the impact. Subsequently, the Corps funded studies at McNary and John Day to further address the issue (Moursund et al. 2000; Moursund et al. 2002; Moursund et al. 2003;

Bleich and Moursund 2006). Research indicated that 98% of lamprey were unable to free themselves from screen impingement at typical screen face velocities (Moursund et al. 2000). As evidence of impingement persisted, recommendations were made to mitigate these impacts by reducing screen gap size from 3.175 mm to 1.75 mm (Bleich and Moursund 2006). Due to several issues, the 40 foot extended length screens were never installed at John Day Dam, but had already been installed at McNary, Lower Granite and Little Goose dams with the smaller gaps that cause impingement. The tribes requested that the Corps remove the screens during the peak of the juvenile migration as an interim measure before the screens could be replaced. Replacing the existing turbine intake screens with larger gaps turbine intake screens could cost tens of millions of dollars. At this point, the screens remain and are likely a limiting factor for lamprey restoration.

In laboratory studies, Moursund et al. (2000) and Moursund et al. (2001) concluded that juvenile lamprey were not affected by simulated turbine sheer or pressure changes. However, turbine blade strike and cumulative effects were not examined. To date, no studies have been conducted regarding juvenile lamprey survival through actual dam turbines or spill.

It appears that juvenile lamprey that survive passing into collection channels of bypass systems will pass in high numbers through the rest of the system (Bleich and Moursund 2006). The inadvertent transportation of juvenile lamprey with juvenile salmon downstream in trucks or barges has an unknown impact on lamprey. Moser et al. (2008) attempted to use light to segregate lamprey juveniles out of the collection channel facilities, and found that macrothalmia were stimulated by bright light, but only for short periods. They concluded that vertically oriented stainless steel mesh screens may function best to separate juvenile lamprey in bypass raceways. Juvenile lamprey are often observed *en mass* at downstream screens of transportation raceways. Corps biologists have concentrated on finding methods for routing these lamprey safely into tailrace areas. More work is needed in these areas.

Aggressively pursue development of juvenile lamprey tag technology. Determine juvenile passage and survival rates via each route of passage at each dam.

As stated above, for juvenile lamprey, there are no current estimates for general and route specific dam passage rates and survival. These deficiencies can be attributed primarily on gaps in tagging technology, which in turn can be attributed to the fact that juvenile lamprey have the body diameter of a pencil or less, Schreck et al. (2000) conducted a review of tags that might be appropriate for juvenile lamprey. They conducted laboratory studies with both internal and external tags including radio tags, PIT-tags and even harmonic radar (Figure 20). They found that battery size was a limiting factor for internal radio tags; PIT-Tags could not be detected with current systems over large expanses such as turbines or spillways, lamprey were able to wriggle out of external tags and, finally, the physical properties of water prevented transmission ranges needed to track juvenile lamprey.

Figure 21. Inserting a PIT-tag into a juvenile lamprey for passage studies (Bleich and Moursund 2006).

For the near term, CRITFC has suggested rigging a combination of inflatable Hi-Z turbine tags with external radio tags to obtain passage and survival estimates. These combinations are used routinely to obtain juvenile salmon passage and survival estimates through turbines and spillways. While there would be obvious behavior effects on lamprey, the tests take only 10-15 minutes to perform and recapture efficiency is very high.

More funding emphasizing expedited lamprey tag development is a critical need. Over the longer term, ongoing development of the JSATS acoustic tags for small juvenile salmon by Corps'contractors holds promise for juvenile lamprey studies. Another alternative is to expand the range of half duplex PIT-tag transceivers to detect lamprey through large areas such as turbines or spillways.

Implement flow regimes to benefit juvenile lamprey passage and survival.

Given that juvenile lamprey travel time is related to water particle travel time, increases in freshet flows will likely reduce lamprey travel time. Thus, managing flows to a peaking hydrograph will benefit juvenile lamprey as well as juvenile salmon. Flow augmentation, reducing water withdrawals, reservoir draw down, and achieving upper rule curves at storage reservoirs before the spring freshet are all potential tools to increase flows and establish a peaking hydrograph (ISG 1996; ISAB 2001; Bunn and Arthington 2002). A future consideration is climate destabilization, as it may complicate efforts to augment flow rates to improve passage efficiency. It will probably be necessary to modify flood control rule curves through obtaining better runoff forecasting to create additional storage for spring and summer flow needs (ISG 1996; ISAB 2001; ISAB 2007).

Develop structures and project operations at each dam and reservoir to facilitate juvenile lamprey passage and survival and reduce migration delays. Establish juvenile passage standards.

The apparent first priority for increasing juvenile lamprey survival is to immediately modify or remove dam structures demonstrated to impact lamprey, such as turbine intake and vertical barrier screens.

The lack of knowledge of the route specific passage and survival rates for juvenile lamprey does not preclude taking steps immediately to modify or remove dam structures known to impact lamprey, such as turbine intake and vertical barrier screens. The need to establish those rates is critical, and should be expedited by using current technology and developing effective tags as fast as possible. In the meantime, some basin hydro projects have established passage survival goals for salmon fry as high as 98%. There is no reason not to expect the same for juvenile lamprey and adopt this rate as a goal and standard.

Determine water quality impacts of hydro projects on juvenile lamprey populations.

Many of the water quality impacts on juvenile salmon are likely to negatively affect juvenile lamprey. Efforts to mitigate the elevated temperatures found in reservoirs and fish bypass systems would likely benefit juvenile lamprey. Examples of these efforts include the installation of temperature control structures or modified operations at Grand Coulee and Brownlee dams (BOR 2003a; NPT 2008).

Assess impacts of irrigation water withdrawal structures and correct defective structures.

Drum and other screens in basin irrigation facilities have been installed over the last decade or more to reduce juvenile salmon entrainment into irrigation conveyance structures, such as ditches and canals, small hydroelectric facilities and other small diversion structures (Figure 21). Unfortunately, the exclusionary devices were not designed to protect juvenile lamprey. Ostrand (2004) conducted laboratory tests on lamprey macrothalmia on screens that met salmon criteria and found that lamprey tended to adhere to the screens and were likely to be crushed by cleaning devices used to clear the screens of debris. At the low water velocities tested, the screen velocity criteria seemed appropriate for juvenile lamprey, however; even then, lamprey did tend to group in areas where attachment was facilitated.

Again, the lack of information determining real damage and impact to juvenile lamprey passage and survival is no reason not to act. Inventories of these impacts are slated to begin in summer 2008, in the meantime tribal biologists have observed that many juvenile lamprey are already lost in the current operations as is. Suggested modifications include spray or bubble devices that would cause lamprey to detach from the screens.

Figure 22. Drum Screen at irrigation diversion (BOR 2003b).

Belt screens may provide better protection for juvenile lamprey (Howerton pers com. 2008). They have a steeper angle making it more difficult for lamprey to travel over the structure to end up in irrigation facilities or fields (Figure 22). In any case, much effort and funding should be expedited to examine and mitigate impacts of screen diversions throughout the Columbia River Basin.

Figure 23. Traveling belt screen (BOR 2003b).

Inventory and protect rearing habitat in reservoirs.

To date, little work has been conducted in hydro system reservoirs to inventory juvenile lamprey. Juvenile lamprey have been captured in Mid-Columbia reservoirs during seining work for sturgeon (B. Parker pers. com. 2007), so it is likely that lamprey are using main stem reservoirs for rearing. More research effort is need in this area.

Implement actions to address excessive hydro-related avian, piscivorous and marine mammal predation on juvenile lamprey.

Little is known about predation rates on juvenile lamprey. Because of their fat content, lamprey are highly desirable as prey items. Moursund et al. (2006) found that two PIT-Tags from 679 lamprey that were tagged in the McNary Dam screened bypass collection channel were detected in the two McNary Dam fishways less than 24 hours later—the speed that tags traveled in the fishway indicated they were taken by fish that had preyed upon the lamprey. Roby (pers com. 2007) using guano analysis reported evidence of bird predation on juvenile lamprey in the Columbia River Estuary. It is likely that predation measures established for salmon, such as reductions of pikeminnow, bass and walleye and of tern and cormorant populations will benefit juvenile lamprey.

Table 3. Summary of Juvenile Passage and Mainstem Habitat Actions

Action	Schedule	Benefit
Expedite development of juvenile lamprey tagging technology and support regional research	2008-2012	Enable acquisition of baseline and post action data to gauge impacts and monitor and evaluate mitigation actions
Use existing tagging technology and other tools to determine dam impacts on juvenile lamprey	2008-2010	Establish baseline data for impacts in near term
Survey reservoirs for juveniles and rearing habitat	2009-2012	Determine presence and absence of juveniles
Implement improved flow regimes	2009-2018	Reduce fish travel time and increase survival
Develop route specific dam passage and survival estimates	2009-2018	Establish baseline information for improvements
Remove or modify turbine intake screens that cause impingement	McNary 2009; Snake River dams 2010	Reduce juvenile direct mortality
Assess impacts of irrigation screens and tributary blockages and make improvements	2009-2018	Reduce juvenile mortality
Determine water quality impacts and seek improvements	2009-2018	Reduce juvenile mortality
Create annual peer-reviewed progress reports	2009-2018	Reduce juvenile mortality

Objective 2: Protect and restore tributary habitat and passage

(Note: Actions are summarized for the tribal basin-wide ceded areas in the Tributary Actions Plans Appendix)

Sub-objective A: Tributary Passage

Identify priority tributary passage needs.

Develop, implement and evaluate specific tributary passage actions

Sub-objective B: Tributary Habitat

Identify priority tributary spawning and rearing habitats

Develop, implement and evaluate specific tributary habitat restoration and protection actions.

Objective 3: Supplement lamprey by reintroduction and translocation in areas where they are severely depressed or extirpated (Note: Actions are summarized for the tribal basin-wide ceded areas in the Tributary Action Plans Appendix)

Implement and monitor translocation or supplementation programs from mainstem dams to upstream watersheds

As discussed previously under Objective 1, the tribes believe that the most urgent problem lamprey face is surviving upstream and downstream passage. It is essential that fishway modifications that have proven successful at certain dams be immediately implemented and evaluated at upstream dams in an active adaptive management context (see discussion under Objective 1).

According to CBFWA (2008), available indices indicate severely declining numbers and precarious status. This is especially true for the interior Columbia River Basin, such as the Snake River Basin in Idaho and the Umatilla and Walla Walla rivers. As noted in the above objectives, information on adult Pacific lamprey passage efficiencies past main-stem dams indicates successful passage rates through the hydro system are about 50% on average and that passage success is poorer for smaller lamprey. For example, Cochnaer and Clarie (2002) found only 541 ammocetes in sampling 70 sites in five major tributaries of the Lower Snake River. Moreover, in 2009, only 10 adult lamprey passed Lower Granite Dam, a record low count.

In view of the depressed status of the lamprey in those Idaho streams still accessible to anadromous fish, Cochnauer et al. (2005) proposed that translocation of pre-spawn adults from downstream Columbia River locations as well as supplementation with hatchery spawned ammocoetes into suitable habitat is a recovery strategy that should be reserved as is necessary. This proposal was made prior to the record low daytime count of 10 adults passing Lower Granite Dam in 2009. Beginning in 2000, the tribes began the first Columbia Basin translocation efforts for adult Pacific lamprey for restoration efforts

Compounding the concern for the fate of lamprey in the Snake River Basin, is that the migration of adult lamprey to tributary spawning locations may be influenced by pheromone cues. Adult sea lamprey do not select their natal streams for reproduction (Bergstedt and Seelye 1995), but instead prefer streams that contain higher densities of larval lampreys that produce higher concentrations of the migratory pheromone attractant (Moore and Schleen 1980). If Pacific lamprey are attracted to pheromone cues, the downward spiral of adults returning to the Snake River and upper Columbia basin to spawn may reflect the severely reduced presence of juvenile lamprey available to emit attractants that draw adults into the spawning tributaries. This potential problem also exists in many other basin watersheds in which passage is a considerable problem or where productivity is low or non-existent due to other environmental factors or simply because there are not enough adults to seed these areas.

Assuming that Pacific lamprey homing is pheromone-oriented, the above suggests an appropriate action would be to translocate lamprey adults to selected tributaries to bolster ammocoete production and to preserve the pheromone attractant mechanism that guides adults to spawning habitat. In view of the depressed status of the lamprey in those Idaho streams still accessible to anadromous fish, Cochnauer et al. (2005) proposed that translocation of pre-spawn adults from downstream Columbia River locations as well as supplementation with hatchery spawned ammocoetes into suitable habitat is a recovery strategy that should be reserved as is necessary. Cummings (2007) found that trapping and translocating adult lamprey did not appear to affect their migration success to spawning areas after release. She suggested that the absence of negative translocation impacts was evidence that lamprey, unlike salmon, may not home to natal areas but instead may use other environmental cues to find appropriate spawning habitat. Moser et al. (2007a) suggested that such cues include temperature, discharge, photoperiod and olfactory markers.

The above suggests there is a need to translocate lamprey adults to selected Snake River and other upper basin tributaries to bolster ammocoete production and to preserve the pheromone attractant mechanism that guides adults to spawning habitat. Cummings (2007) found that trapping and translocating adult lamprey did not appear to affect their migration success. She suggested that the absence of negative translocation impacts was evidence that lamprey, unlike salmon, may not home to natal areas but instead may use other environmental cues to find appropriate spawning habitat. Moser et al. (2007a) suggested that such cues include temperature, discharge, photoperiod and olfactory markers.

Disease could be a concern in translocating adults. However, Cummings (2007) found that of 20 adult lamprey collected at Bonneville and McNary dams during the early summer migration season, only two bacterial pathogens were found and only one was identified (*A. hydrophila)*. No viral pathogens or parasites were found on these lamprey.

Disease could be a concern if water temperatures were beyond lamprey upper tolerance levels; however, most adults from dam fishways for tribal translocation programs are removed from dam fishways during winter dewatering or late spring/early summer periods.

By implementing the translocation effort, tribes will at least preserve the potential for future harvestable returns of adult lamprey to the remaining accessible areas traditional fished by the Nez Perce and Umatilla tribes. This is the goal at the heart of this endeavor. The uncertainties and risks associated with lack of knowledge on mechanisms guiding adult lamprey to suitable spawning locations only emphasizes the need to act now to avoid local extirpation in poorly recruited portions of its range, such as the Snake River Basin and the Umatilla River subbasin.

In response, in the late 1990s the Umatilla Tribes and in 2006 the Nez Perce Tribe initiated Pacific lamprey translocation programs as a safety-net measure to maintain some level of lamprey production in target spawning streams. It appears that translocation, as an interim strategy until adult and juvenile passage is improved, may be an appropriate way to “spread the risk” in the face of uncertainties. Another use of translocation is to initiate lamprey production through reintroduction when dams or other passage barriers are removed. For example, Condit and Powerdale dams in lower Columbia tributaries are slated to be removed in 2010. Adult translocation may likely be needed until improvements to main stem passage increases the recruitment of spawning adults into the Middle Columbia subbasins and the Snake Basin, the threat of local extirpation is addressed, and restoration objectives are achieved.

Key questions include what proportion of the entire migration and at what location should adults be taken for translocation. For example, the CTUIR’s past lamprey collection for translocation ranged from 0.1% to 1.5% of total estimated returns to Bonneville Dam during 2000-2008 based upon incomplete adult counts. Based on a current adult lamprey survival estimate of 50-70% past each mainstem dam, this amount of collection would likely have been exceeded by lamprey loss at the next dam if they had continued their upstream migration.

Adult counts are important to determine the appropriate proportion of adult lamprey to be translocated. For the first time, in 2008 total day and night counts were available at Bonneville Dam (45,104) and The Dalles Dam (9,938). This indicated many more adults passed Bonneville Dam than originally thought, but also indicated a large loss of lamprey between the dams, with the causes of this loss uncertain to date, since radio telemetry studies have not indicated the presence of these lamprey in Lower Columbia tributaries. It could be that these lost lamprey are spawning in the Bonneville Pool and research in 2010 is directed to this effort.

Guidelines for Pacific Lamprey Transplantation and/or Artificial Propagation

The tribes recognize valid questions raised by others in the basin about adult collection for translocation and if this collection represents a significant impact on the donor group and potential lost productivity. Tribes are sovereign nations and all tribes may not agree with all of the translocation strategies. However, the CRITFC tribes are in agreement with the following guidelines.

Prior to implementing translocation efforts each year, representatives from each member tribe will present a proposal including all pertinent information (e.g. collection location, timing of collection, number of adults to be collected, release location, monitoring actions, consistency with Columbia Basin Accords), to CRITFC policy representatives for review and comment. Translocations plans should be provided to the March CRITFC Commission meeting each year for review of the number of adult lamprey and location of collection for each Tribe.

For lamprey targeted for translocation, especially during the active migration season from mainstem dams, the following guidelines will be applied:

1) The target or recipient subbasin formerly (or currently) sustained a Pacific lamprey population. Because data is lacking in many cases tribal oral histories are being used.

2) The problems which lead to the reduction or demise of Pacific lamprey in a recipient subbasin have been or are being addressed (dewatering, passage barriers, chemical treatments, etc.) Tribes have a checklist for each translocation site; these are contained in the Appendix with individual ceded area plans.

3) The existing recipient subbasin Pacific lamprey population has been determined to be below a level which could recover to self-sustainability with harvest.

4) Implement the following to minimize impacts on donor populations:

    a) Collection of donor lamprey for translocation/artificial propagation should occur at mainstem dam locations which are near as possible to receiving tributary locations. It is understood that collection at Snake River and upper Mid-Columbia dams is likely not possible due to extremely low counts in recent years.

    b) Maximize the opportunities to collect lamprey at current specific locations within mainstem dams which have reduced likelihood of resulting in successful migration thorough the dams (e.g. behind picketed areas or "pockets" where lamprey migration may be delayed or blocked). As passage actions remove these impediments, these opportunities should diminish.

c) Total collection of adult lamprey during the active migration at Columbia River dams by the CRITFC tribes shall not exceed 4% of the two-year running average of the total adjusted count[7] of upriver annual adult lamprey population based on total counts past Bonneville Dam (1% per tribe per year). Should additional adult lamprey be available from dewatering dam passage facilities, these may be in addition to the 4% collection rate.

d) At any project other than Bonneville Dam (because the 4% applies to Bonneville Dam), the total collection of adult lamprey during the active migration at any Columbia River dam by the CRITFC tribes shall not exceed 10% of the two-year running average of the total estimated upriver annual adult lamprey population based on total estimated counts past that dam. Should additional adult lamprey be available from dewatering dam passage facilities, these may be in addition to the 10% collection rate.

Considering the above guidelines (a-d), each year CRITFC Commissioners will review the four tribes' specific translocation collection plans.

e) If Columbia River mainstem lamprey counts continue to decline, tribes implementing translocation may collect at least 100 lamprey each to maintain programs as long as the sum of the annual tribal proposals reviewed by the CRITFC Commission does not exceed the 4% guideline in 4.c. above.

f) If the sum of the annual tribal proposals reviewed by the CRITFC Commission exceeds the 4% guideline 4.e. above (translocation programs cannot receive a 100 lamprey minimum), the CRITFC Commission will convene a discussion to consider use of the Willamette River as a source for lamprey translocation above Bonneville Dam.

g) The CRITFC Lamprey Task Force will review Bonneville Dam counts for an in-season run size update. Collection levels might be adjusted if historic data indicates that the actual returns will significantly more or less than the 2-year average on July 7.

5) Disease clearance or screening has been conducted before translocation takes place on the donor population and results have been approved by fish pathologist (similar to salmonid transfers). Ongoing translocation projects doing this new translocation programs will incorporate this safeguard.

6) Regulatory requirements have been addressed (NEPA, ESA, fish collection permits, Corps FPOM, etc.) - if applicable.

[7] Adjusted count refers to the total adult lamprey passing count over Bonneville Dam via multiple passage routes including 24 hour night counts at fish counting stations and LAPS counts.

Nez Perce Tribe Translocation Program

To enter the expansive spawning areas in the Snake River Basin adult lamprey must successfully pass eight main stem dams on the Columbia and Snake rivers. The cumulative impact of successive poor dam passage efficiencies results in very few adult lamprey annually migrating into the Snake Basin to spawn. Recent surveys by IDFG failed to detect the presence of ammocoetes in many Clearwater River tributaries known to have supported traditional lamprey fisheries (Claire 2004). Absence of smaller size ammocoetes in Clearwater River tributaries streams still containing lamprey indicate little or no recent spawning recruitment. These data, together with the drastically low annual counts of adult lamprey passing Lower Granite Dam suggest a serious threat of local extirpation (Claire 2004).

Current data on the presence, densities and age structure of ammocoetes support concerns that they are in serious decline. Presence-absence survey findings in 2000-2005 indicate that Pacific lamprey ammocoetes and macropthalmia are not numerous or widely distributed in Idaho river basins. Historically, Pacific lamprey distribution was confined to the lower reaches of Red River below rkm 8.0, the S. F. Clearwater River, Lochsa River (Weir Creek to mouth), Selway River (Bear Creek to mouth), M. F. Clearwater River, the Clearwater River (downstream to Potlatch River), M.F. Salmon River and the main stem Salmon River downstream of the N.F. Salmon River (Cochnauer et al. 2005). Currently, Pacific lamprey populations persist in the Selway and Lochsa River subbasins where the instream rearing habitat is largely considered good to excellent; however, excellent habitat quality in spawning and rearing streams is considered incapable of adequately compensating for the limited number of returning adult Pacific lamprey passing Lower Granite Dam (Cochnauer et al. 2005). Cochnauer et al. (2005) could not speculate whether populations of Pacific lamprey throughout the Clearwater River drainage are approaching a critical unrecoverable threshold. Nonetheless, they did report that over the 300 presence-absence/trend monitoring samples taken and numerous stream reaches sampled, only a few produced Pacific lamprey.

Purpose and rationale

In view of the depressed status of the lamprey in those Idaho streams still accessible to anadromous fish, Cochnauer et al. (2005) proposed that translocation of pre-spawn adults from downstream Columbia River locations as well as supplementation with hatchery spawned ammocoetes into suitable habitat is a recovery strategy that should be reserved as is necessary. This proposal was made prior to the record low count of 10 adults passing Lower Granite Dam in 2009 that portends an imminent crisis stage for Snake River lamprey.

In response to this critical immediate need in the late 1990s the Umatilla Tribes and in 2006 the Nez Perce Tribe initiated Pacific lamprey translocation programs as a safety-net measure to maintain some level of lamprey production in target spawning streams. Continuance of these translocation initiatives on an annual basis is included as an integral piece of Pacific Lamprey Restoration Plan. Adult translocation will be needed until improvements to main stem passage increases the recruitment of spawning adults into the Middle Columbia subbasins and the Snake Basin, the threat of local extirpation is addressed, and restoration objectives are achieved.

Tasks to implement the Nez Perce translocation initiative include:

- Coordinate with US Army Corps of Engineers main stem dam fishway dewatering activities for the salvage and collection of adult lamprey. Establish a tribal-Corps technical team with both the Portland and Walla Walla District biologists and dam operators.

- Establish adult collection facilities at select main stem projects to facilitate translocation efforts.

- Target 500 adult Pacific lamprey to be translocated from main stem dams to Snake River tributaries annually.

- Hold transported adults for over wintering at the Nez Perce Tribal Hatchery within the Nez Perce Reservation.

- Release over-wintered adults in the spring into target spawning streams. A subset of the target streams will be stocked on an annual, ongoing basis. Use radio-telemetry methods to monitor and evaluate passage and, where possible, spawning success for a sample of these individuals.

- Collect ammocoete data to evaluate effectiveness of the translocation efforts.

<u>Umatilla Tribes Translocation Program</u>

In 1995, a status report was completed for Pacific lamprey by the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) as directed by the Northwest Power and Conservation Council (NWPCC). The status report identified measures that needed immediate implementation for reintroduction of lamprey along with recommendations for research and data gathering.

In 1998, a juvenile electrofishing survey in NE Oregon and SE Washington was conducted to document current abundance and distribution in the CTUIR ceded lands. The Umatilla, Walla Walla, Tucannon and Grande Ronde rivers had negligible lamprey presence suggesting extremely low or extirpated lamprey populations for those basins. The John Day River had the best lamprey production of NE Oregon/SE Washington rivers sampled, with juvenile lamprey documented throughout the basin.

In 1999, a restoration plan for Pacific lamprey in the Umatilla River was developed and peer-reviewed as directed by the NPCC. The CTUIR detailed a plan to reintroduce lamprey into the Umatilla River where they were once an integral part of the basin. This plan called for: 1) locating an appropriate donor stock for translocation, 2) identifying suitable and sustainable habitat within the basin for spawning and rearing, 3) outplanting up to 500 adult lampreys annually, and 4) long-term monitoring of spawning success, juvenile growth, juvenile density increases, juvenile outmigration, and adult returns. In 2000, CTUIR began implementing the restoration plan. The Umatilla River was chosen primarily for reintroduction because it once supported an abundant population of lamprey and a traditional lamprey fishery, and donor stocks where geographically close for translocation. In addition, numerous habitat improvements had been completed for salmonids.

Tasks to implement the Umatilla translocation plan include:

- Coordinating with US Army Corps of Engineers mainstem dam fishway dewatering activities for the salvage and collection of adult lamprey
- Establishing adult collection facilities at select mainstem projects to facilitate translocation effort
- Targeting 500 adult Pacific lamprey to be translocated from mainstem dams to the Umatilla River and tributaries annually.
- Holding transported adults for overwintering at the South Fork Walla Walla River Adult Lamprey Holding facility and Minthorn Springs Adult Lamprey Holding facility
- Releasing over-wintered adults in the spring into the Umatilla River Basin
- Long-term monitoring of translocation success

Objective 4: Status monitoring and research
(Note: Actions are summarized for the tribal basin-wide ceded areas in the Tributary Action Plans Appendix)

It will be important to reestablish the CBFWA Lamprey Technical Working Group and expand the focus to dam passage, mainstem habitat, genetic work and consideration of an aquaculture facility. Consistent participation of regional lamprey expert scientists in this forum and specific passage forums such as the Corps Anadromous Fish Evaluation Program is very important.

Sub-objective A: Status Monitoring

Monitor lamprey population status and trends

No effort to restore a species can be complete without attention to evaluating and monitoring effectiveness. This plan aims for an adaptive management framework. Adaptive management cannot be done without measuring both the progress and effect of plan actions. Each step described previously included recommendations for monitoring after implementation, but a larger more global effort is needed. Similarly, a more global effort is needed to integrate this plan as seamlessly as possible with others initiated by other agencies and institutions.

In the 2007-2009 Northwest Power Conservation Council's Fish and Wildlife Program solicitation of new projects, Mesa et al. (2007b) submitted a comprehensive proposal to study the relative abundance, distribution, and population structure of lamprey in the Columbia River Basin (CRB). This research directly addresses the highest ranking critical uncertainties for anadromous and resident lamprey in the CRB, as described in the 2005 report of the Lamprey Technical Work Group (LTWG) entitled "*Critical uncertainties for lamprey in the Columbia River Basin: results from a strategic planning retreat of the Columbia River Lamprey Technical Workgroup*". This group, a subcommittee of the Anadromous Fish Committee of the CBFWA, was created to provide technical review, guidance, and recommendations for activities related to lamprey conservation and restoration. The LTWG has been charged with identifying critical uncertainties regarding lamprey conservation, establishing lamprey research, monitoring, and evaluation needs, prioritizing research, reviewing new proposals and existing projects, and disseminating technical information. This work should be funded.

Establish regional data protocols for collection, storage and analysis.
Develop means to widely access and share information.

Data Management Plan (Schmidt 2008)

The Lamprey Management Plan envisions adopting the following approaches to collecting and managing the data that will be utilized to assess and monitor the health, abundance and distribution of lamprey populations. The intent is to make all key data compatible regardless of origin. These steps will be taken collaboratively with all cooperating tribes and agencies:

1. Identify and agree on the specific key metrics needed to measure lamprey abundance and distribution.

2. Identify and agree on the specific sampling methodologies that will be employed by all cooperating tribes and agencies to measure the various key metrics.
3. Develop a common list of data definitions and codes for use in recording and managing the data related to the key metrics.
4. Develop a data management plan that outlines the approaches to managing the resulting data, including:
    a. Where the data will reside
    b. How to consolidate data for wide scale analysis
    c. What data quality assurance procedures will be employed
    d. How the data will be maintained and updated (process used) and who will be responsible
    e. What formats and platforms will be used
    f. How the data will be shared and with whom, and whether there are any limitations on dissemination of the data.
    g. Procedures for summarization and analysis of the data
5. Develop metadata (information describing the data) for each data set related to the key metrics.
6. Develop standard data recording forms for use by all samplers for each key metric. Develop a standard data entry template for data collected in the field, and explore the feasibility of using mobile tools for direct data entry in the field.
7. Explore the feasibility of developing a common database system to house the data resulting from these sampling efforts. Features to consider include: the ability for data originators to directly enter, review and manage their data;

The data management approach developed under this plan is intended to serve as a platform for range-wide work with all lamprey species, so the program will be developed collaboratively with the direct partners and with input from other interested agencies and parties in the Pacific Northwest, including USFWS, WDFW, IDFG and ODFW, FERC license holders and other appropriate parties if they wish to participate.

<u>Sub-objective B: Research</u>

Expand existing knowledge on limiting factors and critical uncertainties

Every recommendation of this plan is made with the understanding that there is a severe deficit of definitive knowledge of the status, ecology and biology of the species. This plan does not ignore this fact; instead it attempts to rectify the deficit while recognizing the very real need for immediate action. Integrated with every step of this plan are recommendations for concurrent investigations designed to address the deficiencies.

Determine genetic structure and maintain genetic integrity

The plan recognizes and calls for research into the genetic makeup of the species and particularly the genetics of the remaining populations with a goal of maintaining genetic integrity of those populations.

Lack of information about population structure, behavior and genetic philopatric status throughout the Columbia Basin can compound potential management considerations and options. Goodman et al. (2008), using mitochondria DNA markers, did not find much evidence of genetic differentiation among Pacific Northwest Coast lamprey that could be explained by lack of homing ability. However, in contrast, Lin (2007) found genetically significant differences between lamprey in the John Day and Deschutes Rivers. In subsequent work, Lin et al. (2008), found that across their range, adult Pacific lamprey were genetically differentiated and that gene flow among aggregations of Pacific lamprey from their natal region to other regions decreased as the distance to these locations increased. They noted that this level of gene flow could occur through attraction mechanisms such as migratory phremones or stream flows as long as ocean migration distances were restricted and habitats and historical aggregations of lamprey remained intact (Lin et al. 2008). The tribes are collaborating with experts at the University of British Columbia and others to further determine genetic linkages, if any, of lamprey groups throughout the Pacific Northwest.

Evaluate the need for a lamprey aquaculture facility based upon a limiting factor analysis

An additional specific research focus is to develop the technology for the establishment of a lamprey aquaculture facility. Initial work was conducted by the CTUIR at the USGS Cook, Washington laboratory (Bayer et al. 2000). Currently many researchers obtain juvenile lamprey for research from the John Day Dam salmon juvenile bypass system. The tribes are concerned about the impact of these actions on remaining juvenile lamprey from the John Day River and other lower Columbia nursery areas. Creation of an aquaculture facility would enable culture of juvenile lamprey for potential supplementation of extirpated or extremely depressed areas and basin research without impacting remaining wild populations.

Evaluate lamprey marine life history

Little is know about the estuary and ocean life history of Pacific lamprey and it is a critical uncertainty with respect to restoration. Acoustic tags and detection nodes are in development that, when completed, may be placed in juvenile lamprey to track these animals in the estuary and near ocean environment, similar to those for salmon (Welch 2008). Coastwide genetic analyses may also be helpful in determining marine ranges of Pacific lamprey.

Objective 5: Establish, coordinated public education and other outreach programs to communicate and establish: 1) an awareness of the importance of Pacific lamprey and their current status and, 2) the need to implement

actions in this plan to restore them throughout the Columbia River Basin, 3) the consequences of failing to act.

Unlike salmon, there is a general public lack of awareness and appreciation for Pacific lamprey. This is a key barrier that must be overcome if actions in this restoration plan are to be successful. The following are key objectives for a coordinated public education and outreach program:

- The importance and status of lamprey must be consistently communicated to the public, elected officials and public servants in agencies in the context of restoring the Columbia River ecosystem (ISG 1996). As one agency representative recently stated, "salmon restoration will not happen without lamprey restoration." This will involve increasing public understanding of lamprey science and cultural significance of lamprey to tribal peoples.

- Bring people and constituencies together to foster learning networks; create credibility for lamprey restoration through sound science and constituencies relating on-the-ground experiences for federal, state and private lands; explain any uncertainty about restoration actions particularly in the face of additional impacts of climate change and population growth. Explain the risk to species, ecosystem services, economies, cultural values, and social values as a consequence of failing to act.

- Make institutional and investment commitments to collaborate on developing a scientific understanding of lamprey responses to restoration actions at the scale of the entire Columbia Basin.

Objective 6: Evaluate and Reduce Contaminant Accumulation in Lamprey

It is not known at this time what affect toxic contaminants in the lamprey environment may be a limiting factor to lamprey populations. A key objective of this Plan is to evaluate toxic pollutant levels in lamprey throughout the basin, assess the health impact of tribal ingestion of lamprey, and take actions to reduce toxic pollutants in lamprey.

The Columbia River is water quality limited for DDT, DDE, PCBs, arsenic, mercury and PAHs. These contaminants have been found in various fish species in rivers throughout the Columbia River Basin The states, tribes and federal government and non-governmental organizations (NGOs) are all engaged in efforts to restore and improve the water, land and air quality of the Columbia River Basin and have committed to work together to restore critical ecosystems. The Columbia River Toxics Reduction Working Group, a multi-entity group led by EPA, helped determine the list of contaminants that will be sampled for this project.

The prevalence of toxic pollutants in traditional foods held sacred by Native Americans has been an increasing concern for tribal members throughout the Pacific Northwest. In the early 1990's initial surveys performed by the Columbia River Inter-Tribal Fish

Commission (CRITFC) indicated that tribal members consumed 6-11 times more salmon and other fish than non-tribal members and that tribal members might be facing an increased health risk in consuming fish that contained dioxin and other toxic pollutants (CRITFC 1994).

The health implications to tribal members from ingesting Willamette River Pacific lamprey containing toxic accumulations has been studied. In 2004, the Siletz Tribe, through a EPA grant, requested that the Oregon Department of Human Services (ODHS) through the Superfund Health Investigation and Education Program investigate the risks to tribal members from ingesting lamprey collected at Willamette Falls (Siletz 2004). Samples were taken, preserved on dry ice and shipped to a laboratory for analysis. Several pollutants were identified in the samples, with levels of mercury, DDT, Chlordane, Dieldrin and PCBS considered a health risk, particulary to pregnant women and children.

CRITFC is engaged in a 2009 collaborative study with EPA and the Oregon Department of Environmental Quality to build upon the foundation work of other studies such as that conducted by Siletz (2004) that evaluate the toxic load in lamprey and possible impacts to tribal members that consume Pacific lamprey. A total of 10 adult lamprey composite samples from Willamette Falls (3 samples), John Day (4 samples) and Shears' Falls on the Deschutes River (2 samples), of 5-7 lamprey in each composite sample were obtained during July and August, 2009. These composite samples will be analyzed for the key toxic contaminants targeted in the 2009-2010 Mid-Columbia QAPP and past studies by ODEQ in association with the 2009-2010 Mid-Columbia Toxics Study. In turn, these analyses will assist in : 1) deriving potential health implications on tribal members for ingestion of these animals and, 2) assessing the potential ecological effects of these toxics on lamprey.

Tribal members and staffs from CRITFC's member tribes are involved in obtaining composite samples. The Oregon Department of Human Services will collaborate with CRITFC and ODEQ in reviewing the sampling design and on specific issues related to toxics and human health. Further work is needed to assist in defining and reducing contaminant loading impacts on lamprey health, and productivity.

Summary and Conclusion

The take home message from this draft plan is that ***action is needed now***. Pacific lamprey are teetering on the brink of extinction. While the Pacific lamprey may lack the charisma of salmon, they remain an important entity in the Columbia River Basin in their own right. For the tribes who value the species as essential to their culture, losing lamprey is "not an option". Lamprey feed whole streams with their degrading carcasses and they act as a buffer for predators that prey on fish that many value more. In short, all members of the Columbia River Basin community, not just tribes, will be hurt if lamprey are lost—the species has played a vital part in the ecosystem for hundreds of millions of years. If history is any guide, we and future generations will miss them much more than we currently expect.

This draft Pacific lamprey restoration plan is a unique document that contains a high level of detail describing specific objectives and actions. No plan like this has ever been developed before. There are five objectives, of which the first- improving mainstem passage- is of primary and urgent importance. The actions to achieve passage improvements must be implemented immediately. Next, and of high priority, is to protect and supplement existing juvenile lamprey groups in the mid and upper portion of the basin with translocated adults from the lower basin. These immature forms are obviously important for recruitment, and may also be essential to attracting adults to upstream spawning sites. Research and monitoring directed toward understanding the lamprey abundance, distribution and life history of the species has been sorely neglected and is also a vital objective of this draft plan. Effective systems of communication and data acquisition, management and sharing must be developed and implemented. Finally, but most important, public education outreach and communication programs addressing lamprey status, importance and the consequences of failing to expediently take restoration actions must be developed and implemented. Despite existing uncertainties and lack of knowledge it bears repeating that action on all objectives must be initiated as soon as possible to halt the present decline.

The tribes recognize that this plan is a work in progress, with potential for modification as our knowledge base increases. As we actively strive to restore this humble, yet essential, species, we welcome and expect support from the entire Columbia River community. Finalizing and implementing this draft plan must be a collaboration—it lives only if the tribes can gain the participation, cooperation and coordination of federal and state agencies, the public, NGOs and FERC license holders. After all, the test of any community is how it regards and considers all of its members—even those least revered such as lamprey.

It is in this spirit of inclusiveness that the tribes offer this draft plan.

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Document Content(s)

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August 14, 2007

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Re: Wells Hydroelectric Project (FERC No. 2149); Comments on Proposed Study Plans

Dear Mr. Bickford:

The Confederated Tribes of the Umatilla Indian Reservation (CTUIR) appreciates this opportunity to respond to the request by the Douglas County Public Utility District (Douglas) for comments on proposed studies for the Wells Hydroelectric Project (Project) relicensing under FERC's Integrated License Process (ILP). This request was made at the June 15, 2007, public meeting concerning Wells Hydroelectric Project relicensing.

The CTUIR has reviewed the May 2007 Study Plans (Plans) issued by Douglas. We believe that the scope of proposed studies may not fully and adequately assess and evaluate the full extent of Project impacts on natural resources. Therefore, we propose that Douglas fund and conduct the following studies, in consultation with the CTUIR, the Columbia River Inter-Tribal Fish Commission (CRITFC),[1] and other appropriate resource management agencies.

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[1] CRITFC was established in 1977 by formal resolution of the governing bodies of the four Columbia River Treaty Tribes: the Confederated Tribes of the Umatilla Indian Reservation, the Confederated Tribes of the Warm Springs Reservation of Oregon, the Yakama Nation and the Nez Perce Tribe. The Commission is comprised of elected and appointed officials who are members of their respective tribal fish and wildlife commissions and committees. The Commission's technical and legal resources are employed to assist the tribes in protecting and enhancing our treaty-secured trust resources.

Adult Salmon and Steelhead Passage Studies

Currently there are no adult salmon and steelhead passage studies in the Plans. The presence and operation of the Project negatively affects adult passage. Impacted salmonid species include two ESA-listed stocks (Upper Columbia Spring Chinook, Upper Columbia Steelhead) and several stocks not listed but in poor status, including Mid-Columbia Summer Chinook and Okanogan Sockeye.

A new Biological Opinion (BiOp) for the Federal Columbia River Power System (FCRPS) is currently being developed. It is important for Project studies to evaluate conditions in a manner that enables non-federal projects such as Wells Dam to operate consistently and in coordination with FCRPS operations, as the entire hydrosystem is linked and its impacts on salmonids are intertwined. The 2000 Biological Opinion (BiOp) for the Federal Columbia River Power System (FCRPS) has, as part of its Reasonable and Prudent Alternative (RPA) to avoid jeopardy, a per-project (dam and reservoir) adult survival standard for Upper Columbia Spring Chinook and Upper Columbia Steelhead of 98.1 % and 97.3%, respectively (NMFS 2000). The Habitat Conservation Plan for the Project assumes a 2% mortality rate for adult salmon and steelhead, but this has not been verified by any recent studies. There has not been an adult passage study at the Project since 2001 for steelhead (English et al. 2002), since 1992 for sockeye (Swan et al. 1994), and since 1993 for spring and summer Chinook (Stuehrenberg et al. 1994).

The goal of adult passage studies would be to evaluate current passage rates and timing, to establish a baseline for adult passage improvements. The ultimate goal is to achieve adult passage survival standards consistent with those established for the FCRPS, and to reduce adult passage duration through the Project. Reduction of passage times is important to reduce delayed mortality and to assure that salmon have adequate energy reserves for successful spawning in natal areas above the Project (Geist et al. 2000).

The objectives of adult steelhead and salmon passage studies are consistent with past studies at mainstem Columbia River hydroelectric projects, and include:

- Determine survival rates for adults passing through the dam and reservoir
- Determine passage times for adults passing through the dam and reservoir
- Identify problematic areas for adult passage through the dam that may cause delay and identify possible structural/operational improvements to improve passage
- Determine potential thermal barriers within the ladder that may delay and affect adults
- Determine gross adult behavior characteristics as they pass through existing dam fishways
- Determine the efficiency and passage rates and times of fishway entrances, fishway exits and tailraces
- Determine proportion, incidence and magnitude of adult fall backs and fall out from ladder entrances and compare these to rates at other Columbia Basin mainstem hydroelectric projects
- Determine the fate of adults that fall back over Wells Dam.
- Assess steelhead kelt timing, survival and passage rates through the project and compare these metrics to other Columbia mainstem hydroelectric projects

The results of these studies will assist in establishing a baseline for project effects on adult passage and inform decision-making about potential operational/structural changes to the Project that will reduce these effects, leading to achievement of survival and passage timing goals.
The Columbia River Treaty Tribes' anadromous fish restoration plan, *Wy-Kan-Ush-Mi Wa-Kish-Wit* (Nez Perce et al. 1995) calls for consideration of modifying adult fishways at all Mid-Columbia PUD dams. This plan, formally adopted by the CTUIR and the other three Treaty Tribes, states that the Mid-Columbia PUDs, in consultation with tribal, state and federal resource agencies, should finish ongoing structural analyses of all mainstem fishways and take corrective actions including:

- Improve existing fishway attraction flows, install additional pumps and gravity flow systems, and modify ladder exits to reduce occurrence of adult fallback
- Evaluate and implement new ladder designs including modifications to weirs, baffles and pools; emphasize designs that integrate fish swimming and leaping abilities with fluid dynamics and designs that are based on fish responses as recommended by Orsborn (1987)
- Implement hydraulic evaluations of all fishways, make operational and structural corrections and combine these evaluations with limited radio-telemetry studies that can provide focus on specific problem areas

These measures should increase the numbers of adult salmon successfully completing their upstream migration and reduce delay through the mainstem hydroelectric projects. The measures should also decrease pre-spawning mortality, contribute to increased spawning distribution with appropriate timing, and increase spawner success.

As stated above, existing adult passage studies and results of those studies related to the Project are very dated and may not represent current conditions. While the Project's fishways have PIT-Tag detectors, this methodology is very gross and cannot provide the data necessary to identify and improve specific areas in fishways and Project in general that are vital to reduce passage delay and increase passage success, such as radio-telemetry.

For example, Sturenberg et al. (1993) found that low negative net entrances were recorded for spring and summer Chinook attempting to enter the Wells fishway and that 21.2% of adult fall Chinook fell back over the dam. In comments on Sturenberg et al. (1993), Basham (1995) noted that the National Marine Fisheries Service recommended moving diffusers at the Wells ladder closer to the base of the ladder to create better hydraulic conditions for fish passage.

Swan et al. (1994) noted that the fallback rate for sockeye salmon was 13%. They concluded that additional radio-telemetry studies should be conducted at the Project focusing on fallback and its effects. They also recommended that more effort was needed to determine the extent of spawning, and that carcass counts for the area directly above the Project should be conducted.

English et al. (2002) noted that 11.9% of radio-tagged steelhead fell back over the dam and that this occurred during September-October when there was minimal to no spill for juvenile passage. Fallback has been demonstrated to result in fish death or injury, migration delays and reduction in spawner success through greater exposure to poor environmental conditions (Boggs et al.

2004). This is particularly true for the Project in that temperatures in the Wells reservoir are extreme in the summer and late fall, particularly in the backwaters to the Okanogan River. Fallback re-ascension and other delays at dams is energetically expensive and could result in reduction of spawner success (Boggs et al. 2004). English et al. (2004) noted that fishway entrance passage times accounted for the majority of delay, particularly for the right bank fishway. They reported that these extended passage times were likely the result of flow and head differential in the collection area as a result of aquatic buildup of vegetation blocking diffuser flow into these areas.

Radio-telemetry has been a standard tool for assessing adult passage success and survival in the Columbia Basin for almost two decades (Peery and Bjornn 2002; Keefer et al. 2004.). Tagging and tracking technology has improved since the time the last studies were conducted at the Project. We anticipate that tagging 50 to 75 adults for each salmon/steelhead stock at Rocky Reach Dam and/or Wells Dam at existing traps would provide detailed passage information. Temperature sensitive radio tagging techniques have been improved and should be used for summer and early fall adult migrants to determine migratory paths through the Project and potential areas in the fishways that may be thermal blocks (Peery and Bjornn 2002). Tracking adults would be accomplished by mobile means (boats, planes, foot) and fixed receivers in dam fishways, forebays and tailraces, tributary mouths and in spawning areas. Electromyogram telemetry is a recently developed tool that can be used to assess adult active swimming ability and with concurrent hydraulic evaluations in the fishways can be used to identify problem passage areas needing improvement (Brown et al. 2006). There is no existing data on migration temperatures or swimming ability for adults passing through the Project.

Ideally, these telemetry and concurrent hydraulic studies would be conducted for low, medium and high flow years for each adult salmon and steelhead stock to encompass the range of environmental variability around results. However, this would be costly in terms of Douglas' resources. Alternatively, we propose that a baseline telemetry and concurrent hydraulic study be conducted for one year for each salmon and steelhead stock, beginning in 2008, to describe baseline conditions necessary for structural and operational improvements for adult passage at the Project. Draft reports should be circulated to tribal, state and federal agencies and FERC in 2009 with a final report out in 2010. Comparative studies cost in the range of $750,000-$1,000,000.

Adult Pacific Lamprey Studies

The goals of Pacific lamprey studies are to 1) document baseline survival and passage success through the Project, and identify problem areas that need to be improved to increase survival and passage success, and 2) identify adult lamprey spawning and holding habitat within the Project area and upstream of the Project in tributaries.

Improvement of adult lamprey passage has been identified as a key need by the Columbia Basin Fish and Wildlife Authority's Lamprey Technical Working Group (2006). Lamprey is an imperiled species throughout the western U.S. and only 21 adults were recorded passing the Project in 2006.

Several radio tagging studies conducted at fish ladders on mainstem Columbia River dams found 38 to 82% passage efficiency for adult lamprey (Moser et al. 2002). These studies identified several features common to most dam fishways that appeared to hinder adult lamprey passage, including diffuser gratings, junction pools, counting windows, and fishway entrances. Laboratory bioenergetics studies have also concluded that lamprey must use significant energy reserves to successfully negotiate such fish ladders (Mesa et al. 1999). This loss of reserves could ultimately affect their spawning success, as adult lamprey are not known to feed during their freshwater migration, which can last for up to a year (Kostow 2002). Adult lamprey passage through the Project could be a serious concern, as it is with most other mainstem Columbia River hydroprojects.

Douglas should utilize existing radio-telemetry and/or PIT-Tag methods as appropriate for adult studies. Lamprey should be tracked into tributary areas and spawning success should be monitored if feasible. Douglas should evaluate delayed mortality or post-Project effects by monitoring lamprey after they leave the Project boundaries, particularly where they hold and spawn in tributary streams. Furthermore, Douglas should develop operations and maintenance procedures that would avoid lamprey impacts from dewatering fishways and other dam operations.

The CTUIR supports the proposed study of Pacific lamprey, but believe that study modifications are necessary. It is important to complete at least one year of a baseline study with at least 50 tagged lamprey to discern individual passage bottlenecks within the dam. Consistent with management plans for other recently relicensed FERC projects at Willamette Falls and Rocky Reach, a walk through the Project's fishways after winter dewatering with regional lamprey passage experts from the Columbia Basin Technical Lamprey Workgroup should occur in the winter of 2007-2008 to visually identify potential passage problem areas and develop recommendations for operational and/or structural modifications. In addition, a hydraulic analysis of the fishway at key areas (entrances, weirs and exits) should be conducted concurrently with the radio-telemetry assessment. While we understand the difficulty of trapping sufficient adults due to extremely low numbers passing the Project, we are concerned that studies will not be conducted in the relicensing time frame due to this problem. Indeed, in 2006 only 21 adults were recorded passing Wells Dam, and this year's adult lamprey count at Bonneville Dam is at a historical low. We recommend that adult lamprey from another source in the downstream Columbia River be obtained, transported and acclimated below the Project and released in order to attempt to discern passage metrics at the fishway. Adult lamprey should be tracked to spawning areas, and if possible, monitored for spawning success. This was recently accomplished by the University of Idaho for the Nez Perce Tribe in the Snake River Basin (Peery, pers. comm., 2007).

Douglas should also begin investigations in 2008 within upper Columbia tributary streams to enable you to identify more clearly where adult lamprey spawn and what habitat conditions are preferred. We recommend at least one year of baseline data for each tributary. Methods described in Stone (2006) should be used to accomplish this study. A report on the study results should be available to the tribal, state and federal fish agencies and FERC by 2009. Based on other lamprey studies in the Columbia Basin, the cost of this study should range between $200,000 and $400,000.

Juvenile Pacific Lamprey Studies

The goals for juvenile lamprey impacted by the Project include: 1) identifying passage routes and specific impacts through the dam; 2) assessing the impacts of project operations, such as pool drawdown, on juvenile lamprey survival and habitat; and 3) identifying juvenile lamprey presence and habitat in tributaries above the Project.

At the June 15, 2007, Project study public meeting, an incident was described where numerous juvenile lamprey, likely ammocetes, were dessicated after a drawdown of the Wells Pool. We believe this warrants further examination. A planned drawdown of the Wells Pool, particularly at the tributary mouths that are impounded by the Pool such as the Methow and Okanogan, should occur and monitoring of sediments for presence of lamprey, using electrofishing methods described by Luzier (2007), should be implemented and evaluated.

The success of downstream juvenile lamprey passage through the Project is an important piece of information that is currently missing. Douglas should: 1) implement a baseline study in 2008 or 2009 to examine juvenile passage through Project-specific routes; and 2) assess dam structures and operations to increase juvenile lamprey survival through the Project.

Specific tags to evaluate juvenile lamprey passage and survival are still under regional development; however, Douglas should move forward in assessing the indirect mortality and injury rates for the juvenile Pacific lamprey that pass through the Project by implementing route specific pilot passage and survival studies in coordination with the Lamprey Technical Working Group. Hi-Z balloon tagging coupled with radio-tag technology is available for juvenile salmon and could be used for juvenile lamprey for route specific dam passage studies (Scott Heppell, OSU, pers. comm.). Schreck et al. (2000) found that an external radio tag placed on juvenile lamprey remained on 75% of the lamprey for 3 days.

The U.S. Geological Survey is in the process of developing specific tags to evaluate juvenile lamprey passage (Mesa, pers. comm. 2005). The tagging protocols for release into turbines or screen systems only require that tags remain on fish for 20 minutes to one hour, as the fish are quickly recovered in the tailrace with the inflated balloon after passing through selected powerhouse routes. Using these tagging techniques and using microscopy to examine for internal injuries and holding subjects for examination for delayed mortality are important to fully assess the impacts of passage routes. Final decisions on improvements to or selection of passage routes necessary under the new license should take into account all mortality and passage information through the Project.

Finally, a study in 2008 or 2009 should be implemented by Douglas to enable you to identify where juvenile lamprey are located within the tributary streams above the Project and what habitat conditions are preferred. Methods identified by Claire (2000) and Luzier (2007) should be used for this work.

Conclusion

The Confederated Tribes of the Umatilla Indian Reservation thanks you for your request for comments on your proposed studies for the Wells Hydroelectric Project. We hope that the above comments will be helpful as you further modify and refine your study plan, and that you will take them into consideration. If you have any questions, please contact me, or Carl Merkle at (541) 276-3449.

Sincerely,

/s/ Jay Minthorn

Jay Minthorn
Chairman
Fish and Wildlife Commission

JM: DNR: EP/RP: cm

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