

# FY 2008-2009 F&W Program Accords (MOA) Proposal Review

## Narrative

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**Table 1. Proposal Metadata**

<b>Project Number</b>	2007-007-00
<b>Proposer</b>	The Confederated Tribes of the Warm Springs Reservation of Oregon
<b>Short Description</b>	This project will monitor the status of lamprey, at a variety of life stages, in the Fifteenmile Creek and Hood River basins. Project funds will also be used to identify factors limiting production and work cooperatively with interested parties to restore lamprey populations.
<b>Province(s)</b>	Columbia Gorge
<b>Subbasin(s)</b>	Fifteenmile Creek and Hood River
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### Information transfer:

#### A. Abstract

Pacific lamprey (*Lampetra tridentata*) populations throughout the Columbia River Basin (CRB) are in decline. Multiple reasons for the decline have been identified including passage at mainstem CRB dams and habitat degradation; however, little is known about limiting factors within CRB tributaries. Declining lamprey populations is of primary concern to the Confederated Tribes of Warm Springs Reservation, Oregon (CTWSRO) due to their high cultural and environmental value. Accordingly, the project intent is to expand knowledge of lamprey populations in Fifteenmile Creek and Hood River Subbasins. The ultimate project goal is to establish, conserve and/or maintain harvestable populations for perpetuity. Seufert Falls (rkm 0.4) on Fifteenmile Creek is an important Pacific lamprey harvest location for CTWSRO tribal members; yet little information is available on their status. Likewise, very little is known about historical or current distribution of Pacific lamprey in the Hood River subbasin. Lamprey were once widely distributed throughout the Hood River basin (USFS 1996); however, lack of adequate passage facilities at Powerdale Dam (rkm 7.2) is believed to have eradicated lamprey from areas upstream. Project objectives include:

1. Estimate adult Pacific lamprey escapement in Fifteenmile Creek;
2. Evaluate the feasibility of estimating Pacific lamprey spawner escapement to Hood River;
3. Characterize adult Pacific lamprey use of Fifteenmile Creek;
4. Describe Pacific lamprey spawning distribution in Fifteenmile Creek and Hood River Subbasins;
5. Describe redd characteristics and habitat within stream reaches in Fifteenmile and Hood River Subbasins;
6. Determine larval lamprey distribution and associated habitat in Fifteenmile Cr. and Hood River Subbasins;
7. Determine out-migration timing and relative abundance of larval lamprey in Fifteenmile and Hood River Subbasins; and

8. Identify factors limiting Pacific lamprey production within Fifteenmile and Hood River Subbasins.

Information obtained from this project will be used to develop Pacific lamprey management plans for Fifteenmile and Hood River subbasins and guide restoration activities within the CRB.

### **B. Technical and/or scientific background**

For Native American tribes, Pacific lamprey are a valued subsistence, ceremonial and medicinal resource (Pletcher 1963; Hunn and Selam 1991; Close et al. 1995; CRITFC 1996). The CTWSRO considers lamprey (referred to as “eels” by CTWSRO members) culturally significant, as described in Tribal Ordinance No. 68 and Warm Springs Tribal Code 490.510. Tribal members historically harvested lamprey at multiple locations throughout the CRB, including but not limited to Celilo Falls on the Columbia River, Fifteenmile Creek at Seufert Falls, and in the Deschutes River at Sherars Falls. After construction of The Dalles Dam during the 1950s, Celilo Falls was inundated and a culturally significant collection site for the people of Warm Springs was lost. The loss of fishing sites as well as insufficient numbers of Pacific lamprey on tribal lands have forced tribal members to supplement their subsistence needs at Willamette Falls, on the Willamette River, Oregon City, Oregon. Lamprey is an important cultural food; however, is frequently absent from celebrations due to an inability to harvest adequate numbers.

The Pacific lamprey is an anadromous, endemic species to the CRB (Beamish 1980). Since the 1940’s, declining trends in CRB dam counts have been observed (Kan 1975; Wydoski and Whitney 1979; Close et al. 1995; Kostow 2002).

Little is known about Pacific lamprey life-history and distribution in the CRB. As such, the principal reasons for their decline are unclear. The inability of adult lamprey to navigate upstream through fish passage ladders at Columbia River dams is cited as a major cause for the decline (Long 1968; CRBLTW 1999; Vella et al. 1999a; Vella et al. 1999b; Kostow 2002). Lack of “lamprey friendly” screening for out-migrating lamprey may also present a problem at hydroelectric and water withdrawal facilities (Kostow 2002). Degraded tributary habitat, including decreased flows, increased water temperatures and poor riparian habitat may also explain the apparent decrease in abundance (CRBLTWG 1999; Close et al. 1995).

Information about Pacific lamprey adult escapement, harvest rates, migration timing, spawning locations and associated habitats, and larval distribution and associated habitats in Fifteenmile Creek and Hood River Subbasins is extremely limited (Kan 1975, Hammonds 1979, Beamish 1980; Coccoli 2004; WCSWCD 2004). In order to formulate an effective recovery plan for lamprey in these basins, basic information on status and life history must first be collected and analyzed.

### **C. Rationale and significance to regional programs**

The Columbia River Basin Accords recognize the need to protect lamprey. This understanding is based on the cultural importance of the species as well as be active in restoration thus precluding an Endangered Species Act listing. As a commitment to the resources, BPA committed to funding the proposed project as identified in Attachment B.4. Improvements to mainstem Columbia River dams

The 2000 NPPC Fish and Wildlife Program documents the need to obtain information necessary to begin restoring lamprey populations as a regional biological objective for anadromous fish

(NPPC 2000). The need to determine status and limiting factors for anadromous and resident lamprey is identified in the draft Columbia River Basin Research Plan (NPCC 2005).

The need to “Obtain the information necessary to begin restoring the characteristics of healthy lamprey populations” is cited as an objective for biological performance of anadromous fish losses in the 2000 Fish and Wildlife Program (NPPC 2000). This project relates specifically to sections 7.5F and 7.5F.1 of the NPPC Fish and Wildlife Program (NPPC 1994) which noted the apparent decline of the Pacific lamprey in the CRB and requested a status report to identify research needs. Section three of the resulting report (Close et al. 1995) outlines these research needs (in part): section III.A, abundance studies; section III.B, current distribution; and section III.D, determine habitat limiting factors.

An effective recovery plan can only be formulated by determining status of lamprey and identifying factors limiting their survival within Fifteenmile Subbasin. This premise is mentioned several times in the Fifteenmile Subbasin Plan (WCSWCD 2004). While lamprey are considered a focal species in the plan, lack of information on carrying capacity, abundance and life-history within the subbasin precludes establishment of biological performance objectives. Recommended actions to address these problems are listed in the subbasin plan’s Prioritized Strategies for Aquatic Focal Species and include: determining basin-wide distribution; determining adult escapement and harvest rates; and identifying critical spawning and overwintering habitat (WCSWCD 2004). The need to address these priorities is also recommended in the Oregon Guidance: Fifteenmile Subbasin Fish and Wildlife Priorities (WCSWCD 2004).

In August 2000, a chemical spill of the herbicide oxyfluorfen occurred 0.25 mi upstream of the mouth. During lamprey salvage efforts, more than 5,000 dead larval lamprey were collected, suggesting that this section of the stream contained considerable densities of lamprey and suitable rearing habitats. Adults have been observed spawning in Fifteenmile Creek and its tributary Eightmile Creek. Tribal harvest occurs yearly at Suefert Falls. Larval and juvenile lamprey are collected in rotary screw traps throughout the subbasin during steelhead monitoring by ODFW.

Once status of the Pacific lamprey is determined within Fifteenmile Subbasin, necessary protective and/or restoration actions can be added to existing management plans. These management plans include: The Fifteenmile Subbasin Plan (WCSWCD 2004); Fifteenmile Watershed Action Plan (Fifteenmile Watershed Council 1997 and 2005); Columbia Basin System Planning – Fifteenmile Subbasin, Salmon and Steelhead Production Plan (ODFW and CWSRO 1990); and Fifteenmile Basin Fish Habitat Improvement Implementation Plan (ODFW and USDA Forest Service 1987).

It is believed lamprey have been extirpated upstream of Powerdale Dam in the Hood River due to lack of fish passage; however adult lamprey have been observed downstream of the project (Cocolli 2004). In 1963, the Oregon Game Commission reported lamprey throughout Hood River Subbasin (USFS 1996). Lamprey were identified in the Hood River Subbasin Plan (HRSP) as a focal species due to their ecological and cultural significance. The plan identifies risks to lamprey within the basin including habitat degradation (i.e., water temperatures, riparian cover), diversion screening and fish passage barriers (Cocolli 2004). Because lamprey are present downstream of Powerdale Dam, there is potential they will naturally re-colonize areas they currently do not use. The restoration of lampreys in the Hood River was identified as an objective (PL-1) in the HRSP. Within this objectives were multiple task including: 1) larval

surveys prior to Powerdale Dam removal; 2) assess the potential for re-colonization; and 3) identify habitat needs within the basin (Cocolli 2004).

In recent years steps have been taken to increase protection for Pacific lampreys. In 1993, the state of Oregon listed Pacific lamprey as a sensitive species with increased protection status in 1996 (OAR 635-044-0130) (Kostow 2002). The Oregon Native Fish Status Report found Pacific lamprey to be “at risk” (ODFW 2005). Risk was defined as a species’ sustainability for the next 5 - 10 years. Criteria used to determine risk identified in the Oregon Native Fish Conservation Policy include: habitat use, distribution, abundance, productivity, hybridization, and reproductive independence. In 2003 conservation organizations throughout Oregon, Washington, and California petitioned the United States Fish and Wildlife Service (USFWS), for Pacific lamprey (as well as river lamprey, western brook lamprey, and Kern brook lamprey) to be listed as a threatened or endangered species throughout their range. A 90-day finding precluded the listing of Pacific lamprey due to lack of sufficient information and USFWS resources (Federal Register 50 CFR Part 17).

In 1992, CTWSRO and the Bureau of Indian Affairs (BIA) completed two Integrated Resource Management Plans (IRMP) for forested and non-forested reservation lands. These plans established goals and objectives for sustaining or improving fish and aquatic resources within the boundaries of Warm Springs Reservation and adjacent waters within tribal ceded lands (CTWSRO 1992a; CTWSRO 1992b). A primary goal of these plans is to maintain and enhance populations of resident and anadromous fish to meet the cultural, subsistence and recreational needs of tribal members.

In 1995, Columbia River Inter-Tribal Fish Commission (CRITFC), of which the CTWSRO is an active member, put forth a plan to restore anadromous fish populations to historic levels (CRITFC 1996). Two major objectives in the *Wy-Kan-Ush-Mi-Wa-Kish-Wit*, Spirit of the Salmon plan are to: (1) Within 7 years, halt the declining trends in salmon, sturgeon, and lamprey populations originating upstream of Bonneville Dam; and (2) Within 25 years, increase sturgeon and lamprey populations to naturally sustainable levels that also support tribal harvest opportunities. While salmon populations have generally increased since formulation of this plan lamprey numbers continue to decline. In October of 2004 and 2008, CRITFC held Columbia River Basin Lamprey Summits which brought together high level policy makers from tribal, federal, and state resource management agencies to discuss the current technical knowledge of lamprey and future of the resource. An overall vision was developed to restore lamprey to sustainable levels. The group also agreed that additional research was needed to increase our knowledge about lamprey biology, life history, habitat, and passage in order to develop a comprehensive management plan.

The objectives proposed in this study are consistent with the five year vision and address critical uncertainties identified by the Columbia River Basin Lamprey Technical Workgroup (CRBLTWG 2005). The CRBLTWG consists of representatives from federally recognized tribes, state and federal agencies, academic institutions, and other interested parties that work collaboratively to identify and address information gaps in order to formulate an effective basin-wide recovery plan. In 2005 the workgroup outlined a plan to guide lamprey research priorities for 2005-2010 (CRBLTWG 2005). The goal within this time period is to better understand the status, distribution and genetic structure of lamprey within the CRB. This project will directly answer questions about lamprey status considered “imminent” by the CRBLTWG, as well as conduct limiting factor analysis which is considered “highly important”. The results of this

project will be used to address another “important” uncertainty—habitat restoration in Fifteenmile Subbasin. As an active participant in the CRBLTWG, CTWSRO will be able to present abundance, distribution and limiting factor information from Fifteenmile Subbasin to the group. This information will be used to further understand lamprey in the CRB and hasten the formulation of a more refined basin-wide recovery plan.

Many agencies have made efforts in 2008 to bring lamprey to the forefront of fisheries issues within the Columbia River Basin. Actions include the drafting of a tribally based restoration plan by the member tribes of CRITFC identifying the need for immediate action to recover Pacific lamprey populations (unpublished, draft, 2008). The USFWS also developed a draft initiate to act as a clearing house for all information available about Pacific lamprey and assist with recovery efforts (unpublished, draft, 2008).

**D. Relationships to other projects**

Survey methods developed during implementation of BPA funded Project 200201600 “Evaluate the Status of Pacific Lamprey in the Deschutes Basin” will be modified for use in the Fifteenmile Subbasin. Specifically, methods developed for estimating adult escapement and tribal harvest in the Deschutes River will be utilized at Seufert Falls in Fifteenmile Cr. Methods of determining larval lamprey distribution and habitat associations used in the Deschutes Subbasin will also be applied in Fifteenmile and Hood River subbasins.

BPA funded project 19930400 “Fifteenmile Habitat Restoration Project” will provide assistance in meeting objectives proposed in this project through spawning habitat characterization and water temperature and stream flow monitoring. Determining larval outmigration timing using rotary screw traps is dependant upon implementation of BPA funded project 199304001, “15-Mile Creek Steelhead Smolt Production”.

In the Hood River, projects will be coordinated with the existing habitat and monitoring projects. These projects include Hood River M&E (199805303 & 199805304) as well as the Hood River Habitat project (199802100). These projects will assist in meeting the project objectives including limiting factor analysis (e.g., water temperature monitoring, barrier identification) and status monitoring (e.g., rotary screw trap operations).

Table 2. Relationship to existing projects

<b>Funding Source</b>	<b>Project #</b>	<b>Project Title</b>	<b>Relationship (brief)</b>
BPA	19930400	Fifteenmile Habitat Restoration Project	Can assist with data collection through thermograph and flow data
BPA	199805305 199805304	Hood River M&E	Assist with status monitoring including rotary screw trap operations
BPA	199802100	Hood River Habitat Program	Help address limiting factors (e.g., water temps, potential identification of barriers)
BPA	199420600	Pacific Lamprey Research and Restoration Project	Complimentary project which can help with information exchange and coordinate efforts when applicable.

<b>Funding Source</b>	<b>Project #</b>	<b>Project Title</b>	<b>Relationship (brief)</b>
BPA	200201600	Evaluate the Status of Pacific Lamprey in the Deschutes Basin	Complimentary project – information can be exchanged between project staff and sampling plans developed for the Deschutes will be utilized.

**E. Project history (for ongoing projects)**

New project

**F. Proposal biological/physical objectives, work elements, methods, and metrics**

The goal of this project is to determine the status of Pacific lamprey in Fifteenmile and Hood River subbasins and identify limiting factors that preclude restoring them to historic abundance. Proposed objectives will address the lack of basic biological and population information regarding Pacific lamprey in both systems.

**Objective 1. Estimate adult Pacific lamprey escapement in Fifteenmile Creek.**

*Work element 157: Estimate adult lamprey abundance.*

Adult lamprey abundance estimation has never been attempted in Fifteenmile Creek. Seufert Falls is located just upstream from the mouth of Fifteenmile Creek at Rkm 0.6. Numerous small waterfalls and chutes present multiple adult lamprey collection opportunities during their spring spawning migration. The location of the falls is downstream of all known spawning habitat therefore it presents a good opportunity to estimate adult Pacific lamprey escapement to the entire Fifteenmile Subbasin.

In the first year of the study we will conduct a mark-recapture feasibility study at Seufert Falls to estimate the escapement of adult Pacific lamprey to Fifteenmile Creek. We will identify a specific site to mark and recapture lamprey. Methods of safely collecting adult lamprey will be investigated. Because lamprey are nocturnal and congregate in constricted areas such as fish ladders and at the base of waterfalls, safety of personnel is a primary concern. The utility of dip nets and live traps to capture adults will be evaluated. Additional logistics of conducting an escapement estimate such as run timing, marking protocols and recapture rates will be determined.

After the feasibility phase is completed, a mark-recapture population estimate will be generated. Lamprey will be systematically collected from the marking site using a long-handled dip net and/or live traps throughout the run. To capture adult lamprey with dip nets, we will collect lamprey once per half-hour, 5 - 6 hours per night, four nights per week. We will use an elapsed time dipping protocol to standardize effort. If live traps prove feasible we will deploy them near the fish ladder for 6 - 24 hours at a time.

Collected adult lamprey will be inspected for tags and measured. Unmarked lamprey will then be fitted with an external, sequentially numbered floy tag, an internal half duplex PIT tag and fin clipped. Fin clips will be preserved and cataloged for genetic analysis to be performed at a later date. Once marked, lampreys will be transported downstream approximately 0.2 Rkm and released.

All lamprey collected during subsequent first event sampling and by tribal fishers will be examined for tags and fin clip. Recaptured lamprey will be recorded. The use of an additional mark (i.e. fin clip) will allow us to calculate floy tag retention in adult lamprey.

Work element 157: Creel survey to estimate harvest

Tribal fishers collect adult lamprey at Seufert Falls for subsistence and ceremonial purposes during late-spring; however little is known about tribal harvest rates and effort. A statistical creel survey will be conducted at Seufert Falls in conjunction with the mark-recapture escapement estimate to estimate tribal harvest of adult lamprey.

A simple, random site creel survey will be conducted by the CTWSRO to estimate harvest in the tribal fishery. Four days will be randomly selected to sample each week. Samplers will check all harvested fish for marks and record total lengths. The number of unmarked and marked fish harvested (non expanded numbers) will be recorded. Creel numbers will be expanded to estimate total harvest.

Work element 162: Abundance Estimate

Chapman's modification of the Peterson method (Seber 1982) will be used to estimate escapement of adult lamprey and variance in Fifteenmile Creek above Seufert Falls. The assumptions of this methodology are:

1. All adult lamprey have an equal probability of being marked or;
2. All adult lamprey have an equal probability of being inspected for marks or;
3. Marked lamprey mix completely with unmarked fish in the population between sampling events and;
4. There is no recruitment to the population between sampling events and;
5. There is no sampling-induced behavior or mortality and;
6. Lamprey do not lose their marks and marks are recognizable.

Mark and recapture events will occur simultaneously. Since marked fish will be released downstream of the primary collection site they may be recaptured during subsequent marking efforts. Sampling effort will remain constant during lamprey immigration. This should provide a relatively equal probability of capture and recapture (assumptions 1 and 2) for all lamprey passing by the tagging site.

To test the assumption that there is minimal size selectivity during marking and recapturing (assumptions 1, 2 and 3), mean total lengths of marked and unmarked fish will be stratified by week. Kolmogorov-Smirnov (K-S) and chi-square tests will be used to determine if the total length of marked fish is significantly different from captured unmarked lamprey. Recruitment of adult Pacific lamprey into the experimental population is unlikely (assumption 4) since tagging will occur throughout the run.

Emigration from the experimental population will result in an upwards bias and reduced precision in the escapement estimate. To test the assumption that all marked adults are vulnerable to recapture all adult lamprey collected during first event sampling will be fitted with a half duplex PIT tag. A PIT tag detector will be installed near the confluence of Fifteenmile Cr. with the Columbia River. All marked PIT tagged adults passing downstream of the detector and not re-ascending Fifteenmile Cr. will be censored from the first event sample.

Assumption 5 should not be violated. There has been no mortality observed during dip net sampling in the Deschutes R. and we expect similar results at Seufert Falls. While indirect mortality cannot be evaluated, we assume it will be negligible because only fish in good condition will be marked and released.

Fin clipping to mark lamprey should prevent problems relating to tag loss (assumption 6). The mark-recapture estimate of population size will be obtained using Chapman's modification of a simple Petersen estimate:

$$N^* = \frac{(M+1)(C+1)}{(R+1)} - 1$$

Variance will be approximated by:

$$V(N^*) = N^2(\mu^{-1} + 2\mu^{-2} + 6\mu^{-3})$$

$$\text{where } \mu = MC / N$$

Work element 162: Harvest Estimate

Total effort and harvest will be expanded from each sampling day by:

$$\text{Total Effort: } \hat{E} = \sum_{i=1}^n (e_i / \pi_i)$$

$$\text{Total Catch } \hat{C} = \sum_{i=1}^n (c_i / \pi_i)$$

Variance will be approximated each sampling week by:

$$Var(\hat{E}_1) \approx N_1^2 Var(\bar{e}_1)$$

The weekly variance will be summed to estimate total variance of the harvest estimate.

Work element 162: Escapement Estimate

Escapement of adult lamprey in Fifteenmile Creek will be calculated by subtracting the mark-recapture population estimate from the estimated tribal harvest of lamprey at Seufert Falls. Any fish determined to have left Fifteenmile Creek, based upon PIT tag detection, will be censored from the escapement estimate prior to calculating a final estimate.

**Objective 2: Evaluate the feasibility of estimating Pacific lamprey spawner escapement to the Hood River.**

Work element 157: Estimate adult lamprey abundance.

After Powerdale dam is removed in 2010, methods to estimate escapement into the HRB will be devised. Adult lamprey abundance estimation has never been attempted in Hood River Subbasin and likely areas for doing so have not yet been determined. One promising location is Punchbowl Falls at RM 0.1 on the West Fork Hood River.

Once a mark and recapture site has been identified, methods for safely collecting adult lamprey will be investigated. Because lamprey are nocturnal and congregate in constricted areas such as fish ladders and at the base of waterfalls, safety of personnel is a primary concern. The utility of dip nets and live traps to capture adults will be evaluated. Additional logistics of conducting an escapement estimate such as run timing, marking protocols and recapture rates will be determined.

Assuming feasible capture locations and techniques are found, implementation of escapement estimates will occur in subsequent years using mark-recapture population estimates. Lamprey will be systematically collected from the marking site using a long-handled dip net and/or live traps throughout the run period. If dip nets are determined a viable technique, we will collect lamprey once per hour for 5-6 hours per night, 4 nights per week. We will use an elapsed time dipping protocol to standardize effort. If live traps prove feasible we will deploy them for 5-6 hours per night.

Collected adult lamprey will be inspected for tags and measured. Unmarked lamprey will then be fitted with an external, sequentially numbered floy tag, an internal half duplex PIT tag and a fin clip. Fin clips will be preserved and cataloged for genetic analysis to be performed at a later date. Once marked, lampreys will be transported downstream approximately 0.2 Rkm and released.

All lamprey collected during subsequent first event sampling will be examined for a tag and fin clip. Recaptured lamprey will be recorded. The use of an additional mark (i.e. fin clip) will allow us to calculate floy tag retention in adult lamprey.

Work element 157: Creel survey to estimate harvest

Currently we do not believe any harvest occurs within the Hood River Basin; however if harvest is identified, a simple, random creel will be conducted.

Work element 162: Abundance Estimate

Chapman's modification of the Peterson method (Seber 1982) will be used to estimate escapement of adult lamprey and variance in Hood River. The assumptions of this methodology are:

1. All adult lamprey have an equal probability of being marked or;
2. All adult lamprey have an equal probability of being inspected for marks or;
3. Marked lamprey mix completely with unmarked fish in the population between sampling events and;
4. There is no recruitment to the population between sampling events and;
5. There is no sampling-induced behavior or mortality and;
6. Lamprey do not lose their marks and marks are recognizable.

Mark and recapture events will occur simultaneously. Since marked fish will be released downstream of the primary collection site they may be recaptured during subsequent marking

efforts. Sampling effort will remain constant during lamprey immigration. This should provide a relatively equal probability of capture and recapture (assumptions 1 and 2) for all lamprey passing by the tagging site.

To test the assumption that there is minimal size selectivity during marking and recapturing (assumptions 1, 2 and 3), mean total lengths of marked and unmarked fish will be stratified by week. Kolmogorov-Smirnov (K-S) and chi-square tests will be used to determine if the total length of marked fish is significantly different from captured unmarked lamprey. Recruitment of adult Pacific lamprey into the experimental population is unlikely (assumption 4) since tagging will occur throughout the run.

Assumption 5 should not be violated. There has been no mortality observed during dip net sampling in the Deschutes R. and we expect similar results in Hood River. While indirect mortality cannot be evaluated, we assume it will be negligible because only fish in good condition will be marked and released.

Fin clipping to mark lamprey should prevent problems relating to tag loss (assumption 6). The mark-recapture estimate of population size will be obtained using Chapman's modification of a simple Petersen estimate:

$$N^* = \frac{(M+1)(C+1)}{(R+1)} - 1$$

Variance will be approximated by:

$$V(N^*) = N^2(\mu^{-1} + 2\mu^{-2} + 6\mu^{-3})$$

$$\text{where } \mu = MC / N$$

### **Objective 3: Characterize adult Pacific lamprey use of Fifteenmile Creek.**

Mainstem Columbia River dam passage is commonly referred to as one of the largest limiting factors for lamprey production in the CRB. The mouth of Fifteenmile Creek is directly downstream from The Dalles Dam. We theorize Fifteenmile Creek may act as refuge and/or alternative spawning location for fish unable to ascend the dam.

#### Work element 158: Passive Integrated Transponder (PIT) tag adult lamprey

Lamprey captured during the mark and recapture study will be used for this objective. A minimum of 100 fish will be PIT tagged. Tagging will be based on procedures in the CBFWA tagging standards (CBFWA 1999).

Captured lamprey will be anesthetized, measured and weighed. Each fish receive a half duplex, PIT tag (23 x 4 mm). Tags will be surgically implanted into the body cavity. After tagging and recovery, fish will be released upstream of Seufert Falls.

Work element 157: Establish two PIT tag interrogation sites

Half duplex PIT tag arrays will be installed near the confluence of Fifteenmile Creek and upstream of Seufert Falls. The standard for lamprey detection in the Columbia River Basin is half duplex tags; fish tagged at Bonneville Dam can be recovered in Fifteenmile Creek. Also, detection of fish ascending The Dalles Dam can be monitored.

Half duplex tags can be recorded at a greater distance from the receiver than half duplex tags. In-stream interrogation sites will consist of a reader, data logger unit, and antenna tuner connected to flow-through antennas that span the width of the stream channel. Antennas will be constructed from loops of high gauge braided copper cable, with the lower portion of the loop running along the stream substrate and the upper portion at depth of below or at the stream surface.

Project specific details will be in cooperation with the University of Idaho and NOAA Fisheries.

Work element 162: Determine the number of fish using Fifteenmile as a refuge prior to ascending The Dalles Dam.

The number of marked lamprey leaving the experimental population will be determined to adjust the first event sample size. Analysis of variance will be performed among years to determine annual variance in emigration (dip-in) rates. The results may provide a method of adjusting first event sampling data, if necessary, in years when PIT tagging is not used.

Work element 162: Determine the number of fish using Fifteenmile as a spawning location because they were unable to ascend The Dalles Dam.

Data collected from the in-stream PIT tag detectors will be compared with PIT tag readings at The Dalles Dam. Fall-back fish from the dam will be counted when they enter and remain in Fifteenmile Creek. The percentage of fish unable to ascend The Dalles Dam that enter Fifteenmile Creek and remain through the spawning period will be enumerated.

Work element 161: PTAGIS reporting

Integrate information collected in Fifteenmile Creek into the PTAGIS database.

**Objective 4: Describe Pacific lamprey spawning distribution in the Fifteenmile Creek and Hood River subbasins.**

Work element 157: Fifteenmile Spawning Ground Surveys

Multiple pass lamprey spawning ground surveys will be conducted from late April through July. All streams with larval lamprey present during distribution surveys will be foot surveyed for lamprey redds. Previous lamprey redd observations from USFS and ODFW during steelhead redd counts will be integrated in determining redd counting reaches. Surveys will be conducted upstream to determine the upstream extent of spawning. In subsequent years, once the upper most spawning distribution has been identified, surveyors will start at the upstream end of the reach and walk downstream sighting and recording redds. Surveys will proceed downstream to the confluence of the stream with a tributary or its mouth. Numbered flagging will be placed next to each lamprey redd to avoid double counting during later passes. Redds will be tallied and presence of live adults and their total lengths (cm) will be recorded. Locations of redds will be recorded with GPS.

Work element 157: Hood River Spawning Ground Surveys

After removal of Powerdale dam, reaches within the basin containing high quality spawning habitat will be determined. Systematic spawning surveys will be conducted from late April through July to monitor recolonization by adult lamprey.

Multiple pass lamprey spawning ground surveys will be conducted from late April through July in each year. Surveys will be conducted upstream to determine the upstream extent of spawning. In subsequent years, once the upper most spawning distribution has been identified, surveyors will start at the upstream end of the reach and walk downstream in or along-side the river channel sighting and recording redds. Surveys will proceed downstream to the confluence of the stream with a tributary or its mouth. Numbered flagging will be placed next to each lamprey redd to avoid double counting during later passes. Redds will be tallied and the presence of live adults and their approximate total lengths (cm) will be recorded. The locations of redds will be recorded with GPS.

Work element 162: Fifteenmile spawning distribution

Work element 162: Hood River spawning distribution

Spawning distribution will be mapped in GIS. The numbers of redds and locations will be stratified by sampling week and compared among survey years.

The data will be analyzed using descriptive statistics and analysis of variance to detect annual changes in spawning locations and timing. We will attempt to detect trends in redd numbers by conducting a one-tailed power analysis after the final redd surveys in 2009 have been completed. A fish per redd ratio will be estimated based upon the estimated number of adults spawning within the basin.

#### **Objective 5: Describe redd characteristics and habitat within stream reaches in Fifteenmile and Hood River subbasins.**

Work element 157: Fifteenmile Redd Characteristics

Work element 157: Hood River Redd Characteristics

Lamprey redd characteristics and spawning habitat will be recorded for a subset of observed redds in each stream. Because we do not know how many redds will be observed, sample sizes will vary annually, but we will attempt to measure a minimum of 30 redds. Redds to be sampled will be randomized from the total number observed in each stream. Thermographs, installed and maintained by USFS and ODFW will record temperatures throughout the spawning season.

For redds the following measurements will be collected:

- Nest dimensions (length, width and depth to nearest cm)
- Current velocity (recorded 5 cm from substrate and 60% depth for head, middle and tail of the redd)
- Water depth (recorded at head, middle and tail)
- Substrate type (% composition at head, middle and tail)
- Temperature
- Distance from adjacent redds

For spawning habitat the following measurements will be collected:

- Total area available
- Average water depth
- Bankfull width

- Wetted channel width
- Channel type
- Substrate composition
- Riparian composition
- Canopy cover

Spawning habitat characteristics will be compared among all documented spawning sites to determine if lamprey demonstrate an affinity for certain stream habitat types. If specific habitat preferences are observed we will use existing stream survey data to determine where additional suitable spawning habitat exists.

*Work Element 162: Redd habitat analysis*

Descriptive statistics will be used to summarize redd and spawning habitat characteristics. Spawning habitat characteristics will be compared among all documented spawning sites to determine if lamprey demonstrate an affinity for certain stream habitat types. An analysis of variance will be performed to detect changes among spawning groups by stream. When significant habitat relationships are found the data will be fitted to a model to predict lamprey-spawning habitat.

Data collected will be compared with a project currently (Portland General Electric, Deschutes River FERC lamprey project) underway in the lower Deschutes. If it is found there are differences in spawning habitat preferences, a model will be developed from Fifteenmile Creek data. If lamprey do not naturally recolonize Hood River, one of the models (Hood River or Fifteenmile) will be used to determine locations in which lamprey outplanting efforts may be feasible.

**Objective 6. Determine larval lamprey distribution and associated habitat in the Fifteenmile Cr. and Hood River subbasins.**

*Work element 157: Fifteenmile Distribution and Presence-Absence Surveys*

*Work element 157: Hood River Distribution and Presence-Absence Surveys*

Prior to implementing surveys, suspected suitable larval lamprey habitat will be identified using existing stream surveys in all perennial tributaries within Fifteenmile and Hood River subbasins. Once suitable habitat has been identified, electrofishing will be conducted starting at the mouth and continue upstream until the upper bounds of the larval lamprey distribution has been identified. Due to potential patchy distribution, surveys will be conducted up to 1 Rkm above where the distribution is believed to stop. Once larval distribution has been mapped, a hierarchical stratified sampling design will be used to determine habitat use. The sampling design was developed and successfully utilized in the Deschutes Subbasin by Graham and Brun (2004). It will consist of three tiers- Level I: stream reach, Level II: transect and Level III: sub-sample.

Level I: Each stream will be divided into 5 km reaches from the mouth to the upstream extent of perennial stream flow or impassible barriers. Reaches will be identified using 1:75,000 quadrant maps digitized in ArcView®. Suspected suitable habitat within each reach will be identified using existing stream surveys. Within each reach, one 60 m long sampling point will be randomly selected in portions of the reach containing suspected suitable habitat. The location of each sample reach will be recorded with Global Position System (GPS) equipment.

Level II: Six latitudinal transects from the left bank to the right bank will be placed 10 m apart within the sampling point.

Level III: Two sub-samples will be surveyed along each transect. A 1 m<sup>2</sup> area sub-sample will be randomly selected within the first 3 wadeable meters of each stream bank. If the stream is less than 3 m wide (wetted channel width) sub-samples will be located successively in an upstream direction with approximately 1 m between sub-samples.

An AbP-2 Wisconsin electrofishing unit, specifically designed to capture larval lamprey, will be used to sample each Level III sub-sample (O'Neal 1987). The electrofisher will be set to deliver a constant current of 125 V at a rate of 3 pulse/s (25% duty cycle) and at 30 pulses/s to stun emerging larvae. Two electrofishing passes of 90 seconds will be applied to each sub-sample. Captured lamprey will be anesthetized with MS-222 and

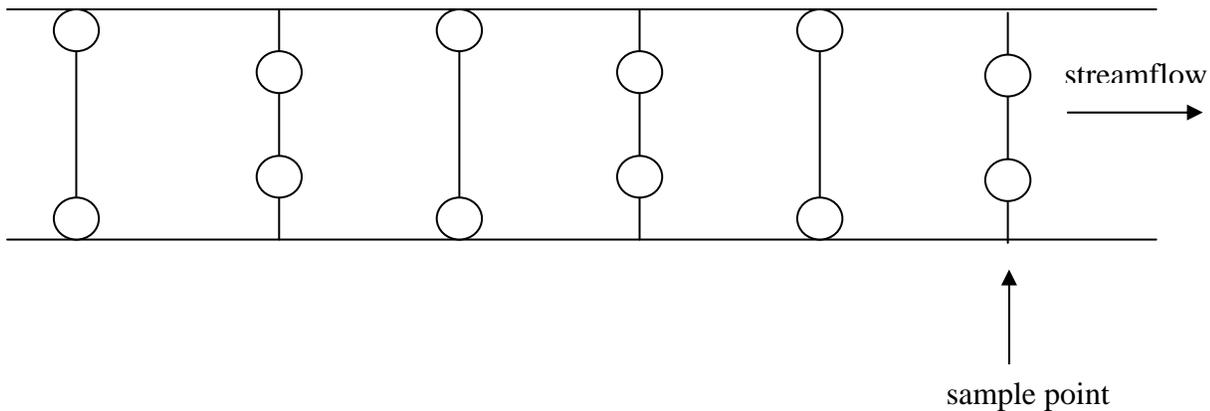


Figure 1. Level II and III larval lamprey habitat association sampling design. Open circles indicate Level III sub-sampling points along Level II transects (vertical lines) spaced 10 m apart along a hypothetical stream. Horizontal lines represent right and left stream banks.

measured for length to the nearest mm and weighed to the nearest 1/100 gram. Fish will be released at the sampling point after recovering from anesthesia.

Larval lamprey distribution and habitat data from Level I, II, and III sampling will be integrated with previously collected Hankin and Reeves (1988) physical habitat data in the geographical information system (GIS). A GIS map will be generated displaying distribution of larval lamprey within surveyed streams.

Work element 157: Fifteenmile Habitat Data Collection

Work element 157: Hood River Habitat Data Collection

Habitat and water chemistry data, shown in Table 1, will be collected at level I, II and III tiers (Figure 1) during larval lamprey presence-absence surveys.

Level I sampling locations will be determined and a crew of two will survey Level I, II and III tiers. Approximately 20 reaches will be sampled per year. Data quality will be ensured by the crew leader. Annual survey data will be error checked and entered into a database.

Work element 157: Fifteenmile Habitat Analysis

Work element 157: Hood River Habitat Analysis

Level I habitat and water quality data will be summarized using basic descriptive statistics.

Potential associations between larval lamprey presence and physical habitat characteristics will be evaluated at Level II and III using multiple logistic regression and multivariate analyses.

Results will relate distribution of larval lamprey to stream characteristics within the range of available habitats.

Table 1. Habitat and water quality data to be collected at each sampling tier in the Fifteenmile Subbasin,

Habitat and Water Chemistry Parameters	Level I Sample Reach	Level II Transect	Level III Sub-Sample
Water Temperature	X		
Dissolved Oxygen (%)	X		
Dissolved Oxygen (mg/L)	X		
Conductivity	X		
Specific Conductivity	X		
Slope	X		
Wetted Channel Width		X	
Bankfull Channel Width		X	
Canopy Density			X
Mean Water Depth <sup>a</sup>			X
Velocity			X
Mean Fine Depth <sup>b</sup>			X
Habitat Classification (Pool, Fast Water, Glide)			X
Presence of Wood			X
Presence of Depositional Area			X
Substrate Composition			X
Substrate Type <sup>d</sup>			X

<sup>a</sup> Average of 5 readings, one in each corner of the quad and one in the middle.

<sup>b</sup> Average of 10 readings randomly taken in the quad.

<sup>c</sup> I	<i>Preferred</i>	<i>Sand, fine, organic matter including detritus &amp; aquatic veg.</i>
II	<i>Acceptable</i>	<i>Shifting sand, gravel, rubble, little or no organic matter</i>
III	<i>Unacceptable</i>	<i>Bedrock, hardpan clay with rubble and coarse gravel</i>

<sup>d</sup> *Wolman pebble count.*

Findings will be compared to results from surveys in the Deschutes and Hood River subbasins to determine if there are inter-basin differences in larval lamprey habitat preference. A predictive model for larval lamprey presence based upon habitat variables is under development by the CTWSRO for the Deschutes Subbasin. When the model is finalized, data from this work element will be input to assess the model's utility for predicting lamprey presence in the Fifteenmile Subbasin.

**Objective 7: Determine out-migration timing and relative abundance of larval lamprey in Fifteenmile and Hood River subbasins**

*Work element 157: Fifteenmile Watershed Rotary Screw Traps Operations*

Rotary screw traps (1.5 m diameter) will be fished in Fifteenmile Cr., Eightmile Cr., Fivemile Cr. and Ramsey Cr. near their mouths. Traps will be operated 5 days/wk, 24 hrs/day from April 1 through June 15. Lamprey will be collected from the live boxes daily and anesthetized in MS-222. They will be measured to the nearest mm (total length) and weighed to the nearest 0.01 gram. Hardisty and Potter's (1971) methods will be used to classify stages of metamorphosis to determine whether the fish are ammocoetes, metamorphosing, or macrophthalmia. Water temperature and stream flow will be monitored daily throughout the trapping season.

In the first year of operation, one time per month trap holding efficiency will be evaluated. Fifty ammocoetes of multiple length classes will be collected using a backpack electrofisher. Collected lampreys will be anesthetized, total length measured, weighed, marked with elastomer dye and placed in the screw trap holding boxes for 24 hours. After 24 hours, marked lampreys will be collected from the holding boxes and the number of lamprey with elastomer marks enumerated. If trap holding efficiencies are found to be sufficient, all individuals captured in the traps during subsequent efforts will be marked with an ink dye. Marked fish will be released approximately 500 m upstream of the traps on the same day of capture. All recaptured fish will be recorded and released downstream of the trap.

*Work element 157: Hood River Watershed Rotary Screw Trap Operations*

Following removal of Powerdale dam in 2010, after adult lamprey have had an opportunity to spawn in the upper basin, outmigration and movement will be monitored at several locations using rotary screw traps operated by CTWSRO and ODFW. Data on lamprey outmigration will likely be collected at traps on the mainstem Hood River, the East Fork, the Middle Fork, and the West Fork. Each of these traps is located within 5 RM of stream mouths.

Depending on flow conditions, traps will be operated 5 days/wk, 24 hrs/day from late March or early April through late October or early November in each year. Lamprey will be collected from live boxes daily and anesthetized with MS-222. Fish will be measured to the nearest mm (total length) and weighed to the nearest 0.01 grams. Hardisty and Potter's (1971) methods will be used to classify stages of metamorphosis to determine whether fish are ammocoetes, metamorphosing, or macrophthalmia. Water temperatures and stream flow will be monitored daily throughout the trapping season.

In the first year of operation, one time per month trap holding efficiency will be evaluated. Fifty ammocoetes of multiple length classes will be collected using a backpack electrofisher. Collected lampreys will be anesthetized, total length measured, weighed, marked with elastomer dye and placed in the screw trap holding boxes for 24 hours. After 24 hours, marked lampreys will be collected from the holding boxes and the number of lamprey with elastomer marks enumerated. If trap holding efficiencies are found to be sufficient, all individuals captured in traps during subsequent efforts will be marked with an ink dye. Marked fish will be released approximately 500 m upstream of the traps on the same day of capture. All recaptured fish will be recorded and released downstream of the trap.

Work element ? : Feasibility of calculating an emigration rate for larval and juvenile lamprey.

The number of emigrant lamprey, stratified by developmental stage, leaving Fifteenmile Creek and Hood River watersheds will be estimated using the following formula:

$$N(\text{Week } i) = C_i / E_i$$

where  $N_i$  is the estimated number of lamprey emigrating during Week  $i$ ,  $C_i$  is the number of unmarked fish captured in Week  $i$  and  $E_i$  is the trap efficiency for Week  $i$ . Trap efficiency will be estimated using the formula:

$$E(\text{Week } i) = R_i / M_i$$

where  $R_i$  is the total number of marked fish captured in Week  $i$  and  $M_i$  is the total number of marked fish released in Week  $i$  (van de Wetering 1998). Weekly estimates by developmental stage will be summed to provide an emigrant estimate for the total sampling period. Variance for  $N_i$  during each weekly period will be determined by the bootstrap method (Efron and Tibshirani 1986) and summed to obtain a variance for the entire sampling period.

Work element 162: Fifteenmile rotary screw trap analysis timing

Work element 162: Hood River rotary screw trap analysis timing

Out-migration timing by developmental stage will be plotted by week and month. Water temperatures and stream flows will be compared with emigration timing using linear regression to determine if significant relationships exist.

**Objective 8. Identify factors limiting Pacific lamprey production within Fifteenmile and Hood River Subbasins.**

Work element 115: Passage Barriers

With assistance from ODFW and USFS, we will use existing culvert inventories to map culvert locations within the Fifteenmile Subbasin. Information from larval lamprey distribution and redd surveys will be used to determine lamprey presence upstream of the culverts.

If lamprey are not present upstream of culverts we will use habitat preference data from larval and redd distribution surveys as well as ODFW/USFS stream survey data to determine if suitable spawning and rearing habitat is present. Stream reaches containing suitable but unoccupied lamprey habitat will be plotted on a GIS map. Stream reaches upstream of culverts containing substantial lamprey habitat will be identified. This work element will be completed during 2009.

Work Element 115: Screening

Use existing information to locate irrigation diversions. Methods used during larval lamprey surveys will be employed to determine if lamprey are present in irrigation ditches. If lamprey are found in the diversions determine their distribution within the diversion.

A GIS map will be produced identifying lamprey presence and distribution within irrigation diversions. A determination will be made as to whether or not there is the potential for larval lamprey to enter the diversion based upon upstream habitat availability.

#### Work Element 157: Stream Flow and Temperature

Stream flow and temperature data will be compared with distribution surveys to determine relationships between presence and a variety of life stages. This information will also be compared with published literature about life history needs (e.g., egg development, hatch timing) to determine if temperature is a limiting factor. If relationships are found it will allow us to identify suitable habitat which is currently un-occupied, and work towards re-establishment of lamprey in that area.

Where temperature information is not available, continuously recording thermographs (Onset Computer Corporation, Hobo Water Temp Pro™) will be placed. Temperatures will be monitored year around to assist in describing temperatures within all potential lamprey.

#### Work element 162: Stream flow and Temperature Analysis

Data from individual thermographs will be grouped by life history use, i.e., up- and downstream migration, over-wintering, and spawning/rearing areas within each stream identified during larval distribution surveys and adult telemetry studies. Seven day minimum, maximum, and mean temperatures (°C) for each stratum will be graphed based on available timing information collected from on-going projects.

The annual variance for each stratum will be examined to identify annual temperature fluctuations within each stream. The results will be coupled with larval and adult spawning habitat data to determine if suitable habitat exists in unoccupied streams. This will be used for future re-introduction efforts. The data will be used by tribal managers to update stream reach water temperature criteria for lamprey in the tribal water quality standards.

### **H. Facilities and equipment**

Currently CTWSRO does not have facilities for this project; therefore, a field office and associated utilities will need to be set-up. In order to meet project goals, we will also need to lease a vehicle and purchase field gear. Field gear will include but not be limited to: a water quality meter, thermographs, and PIT tag equipment (e.g., antenna, receiver, tags). We anticipate subcontracting the installation and maintenance of the PIT tag equipment. In order to assess the impacts of irrigation diversions of stream flow in Fifteenmile Creek, we will work with Oregon State Water Resources Department to cost share flow meter purchases. A computer and software will also need to be purchased.

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## **J. Key personnel**

### **JENNIFER GRAHAM, PROJECT MANAGER**

This project will be implemented by the CTWSRO Department of Natural Resources personnel. Jennifer Graham will administer the BPA contract, coordinate with basin managers, provide logistical support, assist with data analysis and take the lead for project reporting.

### **Education**

South Dakota State University, BS Biological Sciences – Wildlife and Fisheries Sciences

### **Professional Experience**

*Research and Monitoring Program Manager  
Confederated Tribes of Warm Springs, 2006-present*

Provide professional, scientific, technical and administrative guidance and oversight for the professional and technical staff of the research and monitoring program. Plan, organize, and direct the work of subordinates. Develop goals and objectives of the fisheries research and monitoring program for anadromous and resident fish, and lamprey. Continue to develop fisheries research and monitoring programs both on and off the Reservation. Pursue and develop new funding sources, projects and staff development opportunities. Provide administrative oversight including contracting, contract compliance, preparation and review of technical reports and the overall coordination of each of the individual elements within the program. Provide tribal policy representatives with information and recommendations for policy decisions regarding all aspects of fish management on the Reservation, Ceded, Usual and Accustomed fishing areas, and aboriginal lands. Prepare annual operating program budgets.

#### *Fisheries Biologist*

##### *Confederated Tribes of Warm Springs, 2002-2006*

Responsibilities include research project design, direction, and implementation for lamprey; supervise technical and field staff; planning and managing multiple budgets, technical report writing, data analysis and interpretation; conducted field sampling; represent the Confederated Tribes of Warm Springs Reservation of Oregon as a technical liaison for hydro-relicensing and superfund lamprey concerns, as well as the Columbia Basin Lamprey Technical Workgroup; identification of lamprey research needs and potential funding sources; assisting with project funding solicitation; work collaboratively with inter- and multi-agency efforts to address lamprey concerns; and effectively communicate with Tribal constituents.

#### **Recent Publications**

Fox, M. and J. C. Graham. 2008. Determining lamprey species composition, larval distribution and adult abundance in the Deschutes River, Oregon, Subbasin. 2007 Annual Report. Bonneville Power Administration, Portland, Oregon.

Brumo, A. F. and J. C. Graham 2008. Electrofishing for Ammocoetes (Larval Lamprey): An Efficiency Study. 2007 Annual Report to Portland General Electric, Portland, Oregon.

Fox, M. and J. C. Graham. 2008. Determine Pacific lamprey spawn timing, over-wintering, and spawning habitat in the lower Deschutes River. 2007 Annual Report. Bonneville Power Administration, Portland, Oregon.

Graham, J. and C.V. Brun. 2007. Determining lamprey species composition, larval distribution and adult abundance in the Deschutes River, Oregon, Subbasin. 2006-2007 Annual Report. Bonneville Power Administration, Portland, Oregon.

Graham, J. and C.V. Brun. 2006. Determining lamprey species composition, larval distribution and adult abundance in the Deschutes River, Oregon, Subbasin. 2005-2006 Annual Report. Bonneville Power Administration, Portland, Oregon.

#### **TO BE HIRED, PROJECT BIOLOGIST**

A biologist will be hired to provide technical oversight. They will also assist in designing survey protocols, supervise data collection, analyze data and assist with report preparation.