Appendix F. Status Report on Columbia Basin Pacific Lamprey Projects and Needs

Severely declining Pacific lamprey populations throughout the Columbia River Basin has recently elevated the interest and concern of various entities. The tribes have expressed the most concern due to cultural significance and lost traditional fishing opportunities.

In 1994, the Northwest Power Planning Council (NPPC) approved the first lamprey project in the Fish and Wildlife Program. The project proposed by the Confederated Tribes of the Umatilla Indian Reservation (CTUIR), called for research and restoration of Pacific lamprey throughout tribal ceded lands. In 1995, an initial product (Status Report of the Pacific Lamprey in the Columbia River Basin) was completed. Since that time, the CTUIR has continued the lamprey project with efforts directed at mainstem abundance monitoring, Northeast Oregon tributary population abundance documentation (past & present), development of genetic baseline information, basic migratory behavior, and artificial propagation techniques (e.g., capture, transport, holding, spawning). This information has been essential for development of a pilot pacific lamprey restoration plan in the Umatilla Basin. The CTUIR hopes the plan, to be completed in 1999, will lead to lamprey restoration in the Umatilla and ultimately other subbasins.

Additional lamprey studies have been proposed which has created uncertainties regarding what are priority lamprey needs and projects. Due to these uncertainties and potential project duplication, the NPPC approved FY 99 funding for the CTUIR project but not the others proposed.

Since the initiation of the CTUIR lamprey research and restoration project, a Columbia Basin Pacific lamprey technical work group has been formed to discuss current issues and findings, coordinate ongoing project efforts, and define future project needs. Numerous state, federal, university, and tribal entities have met approximately twice a year for the last three years. The most recent meeting (entitled “Columbia Basin Pacific Lamprey Workshop”) took place in Mission, Oregon on October 22 & 23, 1998. This status report will utilize information presented at this meeting and information from FY 2000 proposals to discuss ongoing and proposed Pacific lamprey research and restoration efforts and will identify priority needs.

Brief Historical Facts

- Pacific lamprey are native to the Pacific Northwest and are believed to have inhabited most tributaries throughout the Columbia River Basin.
- Overall distribution of Pacific lamprey is from southern California to the Gulf of Alaska and inland to central Idaho.
- Former distribution was likely broader than anadromous salmonids due to the ability of lamprey to cling to rocks and pass around slides or falls.
- Pacific lamprey were and still are highly regarded culturally and religiously by Native American tribes. Former lamprey abundance provided tribal fishing opportunities throughout Columbia River Basin tributaries.

- Significant non-Indian lamprey collection at Willamette Falls for fish food processing in 1913 was documented at 27 tons. Commercial fishermen in the 1940's harvested 40 to 185 tons annually (100,000 to 500,000 adults) at Willamette Falls for use as vitamin oil, protein food for livestock, poultry, and fish meal.

Current Status of Populations and Fisheries

- The current potential distribution of Pacific lamprey in the Columbia River and tributaries extends to Chief Joseph Dam and to Hells Canyon Dam on the Snake River.
- Although adult lamprey counting at mainstem Columbia and Snake River dams is not standardized and was sometimes restricted to certain hours, population trends indicate precipitous declines (Table 1).

Table 1. Pacific Lamprey Counts at Columbia and Snake River Dams

Dam	Former Counts	1997 Counts
Bonneville	350,000 in early 60's	22,830
The Dalles	300,000 in early 60's	14,835
John Day	----	14,845
McNary	25,000 in early 60's	4,213
Ice Harbor	50,000 in early 60's	1,454
Lower Monumental	----	217
Little Goose	----	245
Lower Granite	----	1,274
Rock Island	----	2,321
Rocky Reach	17,500 twice in 60's	1,405
Wells	----	773

- Based on 1997 Corps of Engineers (COE) fish ladder passage estimates, there appears to be a 65% drop in Pacific lamprey abundance between Bonneville and The Dalles Dams which suggests a substantial portion of the lamprey spawn in the following tributaries - Wind, Little White Salmon, White Salmon, Klickitat, and Hood rivers.
- Based on 1997 COE fish ladder passage estimates, there appears to be another large drop (72%) between John Day and McNary Dam counts which suggests the John Day River may support a run of approximately 10,000 Pacific lamprey. Sampling of juvenile lamprey by CTUIR in NE Oregon streams has shown the John Day basin has the highest juvenile densities relative to other subbasins.
- In the mid-Columbia, there is approximately a 40% drop in counts between Rock Island and Rocky Reach Dams indicating a sizable Pacific lamprey population may persist in the Wenatchee River. However, fish counting at Tumwater Dam on the Wenatchee River during most of the last 10 years between May and September have not recorded lamprey movement. The fish could over-winter in the lower river and go upstream prior to salmon counting.
- Passage over the last dams in the Snake and Columbia rivers in 1997 appears to be seriously low. Only 3% of the Pacific lamprey that crossed Bonneville Dam were counted at Lower Granite Dam and approximately 6% crossed Wells Dam.
- Pacific lamprey population declines have reduced, eliminated, or relocated the once widespread tribal fisheries to Willamette Falls on the Willamette River. A small tribal fishery

also sometimes occurs at Sherars Falls on the Deschutes River, Fifteen Mile Creek and on the Klickitat River.

- The Oregon Department of Fish and Widlife (ODFW) currently issues permits for Indian and non-Indian subsistence and commercial fisheries at Willamette Falls
  - fishing occurs by hand-type methods only on the east side of the Horseshoe Falls area
  - of 55 permits issued in 1997, 17 of those people (about 45% Indian & 55% non-Indian) sold fish for commercial purposes
  - a calculation of catch through buyers records indicated about 28,000 pounds of lamprey were harvested commercially at Willamette Falls in 1997
  - the average, annual commercial harvest since 1990 is 22,000 pounds
  - since recent catch is remaining stable and the fishery is closed over one-half of the falls area, the ODFW has determined current harvest is not a biological problem.

Principle Problems Impacting Populations

Mainstem Passage at Dams - Similar to anadromous salmonids, hydroelectric dams along the Columbia and Snake rivers also create passage impediments for Pacific lamprey. Recent National Marine Fisheries Service (NMFS) studies (funded by COE) utilizing radio telemetry in the lower Columbia River indicates that 40% of adult Pacific lamprey migrating to Bonneville Dam do not move upstream past the fishways. This problem multiplied by several dams is likely the main reason for the severe declines or possibly extirpation of Pacific lamprey in most mid to upper Columbia and Snake River tributaries. Juvenile lamprey outmigrants are also subjected to high mortality rates at hydroelectric projects. Although mortality percentages are not known, it is believed to be higher than salmonids due to lesser swimming ability of lamprey and resultant poor avoidance and increased impingement on bypass screens.

Poor Habitat Conditions in Tributaries - Reduced instream flows in many tributaries have greatly impacted the natural production potential of Pacific lamprey. Dewatering or low flows in late spring and summer impacts adult upstream migration into tributaries. Low flows, poor riparian conditions and resultant high water temperatures have also reduced the quality and quantity of adult spawning and juvenile rearing areas.

Goals

Other than the Tribes, no entity has stated any specific lamprey restoration goals in fisheries management plans. The Wy-Kan-Ush-Mi-Wa-Kish-Wit states the goal: within 25 years, increase lamprey populations to naturally sustainable levels that support tribal harvest opportunities. The CTUIR is utilizing the Umatilla Basin as a pilot project to test lamprey restoration techniques with the ultimate goal of reestablishing self sustaining natural producing populations which also provide for tribal fishing opportunities at traditional locations within the subbasin.

Ongoing Projects

The Columbia Basin Pacific Lamprey Workshop identified the ongoing lamprey projects, sponsors, general tasks, and funding sources - See Table 1.

Proposed Projects

The Columbia Basin Pacific Lamprey Workshop also identified information relevant to proposed lamprey projects. This information in addition to that provided in the FY 2000 BPA lamprey proposals is presented in Table 2.

Critical Uncertainties/Lamprey Project Needs

Attendees at the Columbia Basin Lamprey Workshop identified the following critical uncertainties or study needs regarding Columbia Basin Pacific lamprey (all are priorities, no order identified):

A. Upstream migration - mainstem passage success
B. Estimate upstream migrant abundance at mainstem dams
C. Downstream juvenile migration - mainstem passage success
D. Adult migratory/homing behavior
E. Genetic database for population structure
F. Species identification techniques
G. Juvenile & adult life histories - habitat requirements
H. Artificial propagation success - hatchery practices
I. Pilot restoration actions in a tributary with associated M & E

To help assess the need for ongoing and proposed Pacific lamprey projects, a column was added in Tables 1 & 2 indicating which critical uncertainty or need listed above is addressed by each project.

Discussion of Proposed Project Needs and Priorities

If the long-range goal is to rehabilitate populations of Pacific lampreys in the Columbia River basin to a self-sustaining natural producing status which provide fishing opportunities at traditional locations, the following objectives need to be implemented:

1. Identify current numbers and distributions.
2. Identify the relative importance of factors limiting reproduction, primarily passage through dams (upstream and downstream) and habitat requirements of all life stages.
3. Develop rehabilitation plans that include methods for collecting, transporting, and culturing Pacific lampreys
4. Demonstrate rehabilitation is feasible by conducting controlled, designed studies in one stream.
5. Initiate a long term monitoring program on the numbers of Pacific lampreys entering the Columbia River to assess attempts to increase the population.

The critical uncertainties, A through I above, identified at the workshop are the subject of several ongoing and proposed projects that all have a high priority. The following listing provides a more complete listing of the studies that could be critical to a successful Pacific lamprey restoration program. Under each general objective (1-5), applicable critical uncertainties are identified (A-I) with appropriate specific study objectives (a,b,c, etc.)

1. **Identify current numbers and distributions**.
    a. Estimate upstream migrant abundance at mainstem dams
    b. Species identification techniques
    c. Survey ammocoete populations in tributaries and mainstem of the Columbia and Snake rivers
    d. Estimate abundance of downstream migrating Pacific lampreys at mainstem dams
    e. Estimate upstream migrant abundance in major tributaries

2. **Identify the relative importance of factors limiting reproduction, primarily passage through dams (upstream and downstream) and habitat requirements of all life stages**.
    a. Upstream adult migration - mainstem passage success
    b. Downstream juvenile migration - mainstem passage success
    c. Adult homing behavior
    d. Genetic database for population structure
    e. Juvenile & adult life histories - habitat requirements
    f. Estimate upstream migrant abundance in several coastal streams and at Willamette Falls
    g. Conduct a large scale PIT tag homing/ocean survival study
    h. Conduct studies to determine what devices or operational procedures will allow Pacific lampreys to migrate up and downstream through the dams without suffering excessive mortality
    i. Test aging techniques for larval lampreys and determine age composition and abundance of larval lampreys in a variety of streams and habitats (falls under G. above).

3. **Develop rehabilitation plans that include methods for collecting, transporting, and culturing Pacific lampreys**.
    a. Artificial propagation success - hatchery practices
    b. Measure the effects of temperature and water quality on the survival of various life stages of Pacific lampreys in lab studies

4. **Demonstrate that rehabilitation is feasible by conducting controlled, designed studies following pilot restoration actions in one stream**.
    a. Pilot restoration actions in a tributary with associated M & E
    b. Conduct instream survival studies for Pacific lamprey ammocoetes planted in the Umatilla River
    c. Monitor population abundance and distribution in the Umatilla River as the ammocoete populations are supplemented each year
    d. Conduct behavioral studies with upstream migrating Pacific lampreys to determine if they are attracted to the bile salts produced by the larval lampreys
    e. Estimate numbers of up and down stream migrating Pacific lampreys in the Umatilla River

5. **Initiate a long term monitoring program on the numbers of Pacific lampreys entering the Columbia River to assess our success or failure to increase the population**.
    a. Estimate upstream migrant abundance at mainstem dams
    b. Establish a long term monitoring program for estimating the upstream migrating Pacific lampreys at Bonneville, Willamette Falls, and an array of tributaries that are major contributors to reproduction in the Columbia River basin

c. Conduct electroshocking surveys to determine any changes in the distribution of Pacific lampreys in the basin

Restoration of Pacific lampreys and fisheries in the Columbia River basin will require a substantial effort in terms of dollars and time. Total restoration of Pacific lampreys is probably closely linked with restoration of salmon populations and all of the complexities of habitat changes both in the rivers and in the ocean. However, if we make a few assumptions about Pacific lamprey populations based on what we know of other species, we can develop plans and implement demonstration projects where individual tributaries to the Columbia River could have rehabilitated populations of Pacific Lampreys. At the workshop, there seemed to be a consensus that priorities of future work should be based on both the information needs for large scale rehabilitation and for rehabilitation of lampreys in the Umatilla River. Conducting studies that will benefit both objectives should be given highest priority. A systematic, logical progression of studies needs to be conducted to make the best use of limited research dollars leading to the most complete rehabilitation of Pacific lampreys that we can achieve.

Changes in aquatic habitats in the Columbia River Basin have resulted in declines in populations of several desirable fishes including Pacific lampreys. Because the wellbeing of Pacific lampreys is closely tied to the wellbeing of salmonids in other systems, it follows that if we improve conditions for salmonids in the Columbia River Basin, we will see an increase in the Pacific lamprey populations.

Passage of upstream migrating Pacific lampreys through fishways designed to pass salmonids is one issue that needs to be examined early in our plans. Problems encountered by downstream migrating Pacific lampreys might be similar to problems juvenile salmonids encounter.

This updated status report represents an initial assessment at what needs to be done concerning Pacific lampreys to facilitate their rehabilitation. As we learn more about lampreys in the Columbia River, we will likely need to modify our approach. Having a workshop periodically should allow that to happen. Having a meeting of researchers and others working on Pacific lampreys on an every other year schedule would keep the planning and evaluation process in an efficient mode. Producing lists such as those in Tables 1 and 2 on an annual basis will provide an index of how much progress we are making. A third table should be included that lists reports and publications that have been produced since the Pacific lamprey rehabilitation effort was begun. Eventually this information could be set up in a web site that would allow frequent updating of lists.

Table 1. Ongoing Columbia Basin Pacific Lamprey Projects

Sponsor	Funding	Project Title	General Project Actions	Critical Uncertainties & Needs Addressed
CTUIR/ CRITFC	BPA	Pacific Lamprey Research & Restoration (project #9402600)	• Monitor abundance & passage trends of adult lamprey at Columbia & Snake River dams • Develop a genetic database for determination of lamprey population structure in the Columbia Basin • Investigate adult lamprey homing fidelity back to initial capture sites • Document presence/absence and distribution of lamprey in NE Oregon & SE Washington subbasins • Develop pilot lamprey restoration plan for Umatilla subbasin • Begin initial restoration plan actions: 1) trap adults from John Day river; 2) evaluate lamprey hatchery practices while holding adults at USGS Cook, WA lab; 3) spawn adults, incubate eggs, rear & outplant prolarvea in Umatilla River; 4) monitor Umatilla River for juvenile survival and growth; 5) monitor lamprey migratory pheromone in water samples from the Umatilla & John Day rivers to better understand adult lamprey attraction into tributaries.	• Adult abundance monitoring • Adult homing behavior • Genetic database • Life histories & habitat req. • Hatchery practices • Pilot restoration actions - • M & E
NMFS/ U of Idaho	COE	Radio Telemetry of Adult Pacific Lamprey in the Lower Columbia River	• Evaluate passage of radio tagged adults below and at Bonneville Dam • Conduct laboratory evaluations of upstream movement through various augmented adult fishway structures	Adult upstream migration success
USGS CRRL	COE	Characteristics of Upstream Migration of Pacific Lamprey	Evaluate adult maturation & physiology of adult lamprey collected at Bonneville Dam	Adult upstream migration success

Sponsor	Funding	Project Title	General Project Actions	Critical Uncertainties & Needs Addressed
		in the Columbia River		Life histories
USGS CRRL	COE	Effects of Swimming & Exhaustive Stress in Pacific Lamprey: Implications for Upstream Migration Past Dams	Evaluate swimming performance, metabolic condition, and exhaustive stress to assess efficacy of current upstream fish passage facilities at Bonneville Dam.	Adult upstream migration success
USGS CRRL	USFWS	Evaluation of Tagging Techniques for Pacific Lamprey Ammocoetes & Macropthalmia	Evaluate effectiveness (tag retention & animal survival) of visible implant (V1) & PIT tags in juvenile lamprey.	Juvenile downstream migration success
USGS CRRL	USFWS	Validation of Statolith - based aging Techniques for Pacific Lamprey Ammocoetes & Macropthalmia	Validate statolith-based aging techniques in laboratory & compare results to wild lamprey samples.	Life histories
U of Idaho	Misc	Genetic Analysis Pacific Lamprey	Receive tissue samples and conduct genetic analysis (generally a subcontractor under other studies)	Genetic database

Table 2. Proposed Columbia Basin Pacific Lamprey Projects

Sponsor	Funding	Project Title	General Project Actions	Critical Uncertainties & Needs Addressed
IDFG	BPA	Evaluate Status of Lamprey in Clearwater River	• Determine life history characteristics • Determine habitat requirements • Determine juv. & adult distribution • Develop & implement strategies to minimize impacts to habitat	Life histories & habitat req.
USFWS	BPA	Evaluate Habitat Use and Population Dynamics of Lamprey in Cedar Creek	• Estimate adult abundance & determine migration timing • Determine larval lamprey distribution & habitat use	• Life histories & habitat req. • Adult homing behavior • Species indentification • Juv. tagging/migration

Sponsor	Funding	Project Title	General Project Actions	Critical Uncertainties & Needs Addressed
			• Determine outmigrant timing & abundance • Eval. homing fidelity, surv. rates & ocean residence with CWT s • Rear ammocoetes to verify species identifications • Evaluate effects of PIT tagging juveniles in lab • Evaluate adult spawning habitat requirements • Sample & cap redds to determine egg & larvea survival & developmental timing	success
USGS CRRL	BPA	Identification of larval Pacific lampreys, river lampreys, and western brook lampreys and thermal requirements of early life history stages of lampreys.	• Spawn three species in captivity & determine diagnostic characteristics of each • Collect ammocoetes and hold through metamorphosis to verify identification techniques • Evaluate temperature effects on the survival and early development of three species	• Species identification • Life histories & habitat req.
USGS CRRL	BPA	Upstream migration of Pacific lampreys in the John Day River: behavior, timing, and habitat preferences	• Trap adults and use radio telemetry to determine lamprey movement to spawning • Describe overwintering & spawning habitat of radio tagged fish	• Adult upstream migration success • Life histories & habitat req.
Battelle PNNL	COE	Evaluate juvenile lamprey passage at John Day Dam	Assess juvenile lamprey impingement and injury during screening/bypass and turbine passage	Juvenile downstream migration success