



# United States Department of the Interior

FISH AND WILDLIFE SERVICE  
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Portland, Oregon 97232-4181

In Reply Refer to:  
FWS/RI/AFR

APR 4 2008

Bill Booth, Chairman  
Northwest Power and Conservation Council  
851 SW Sixth Avenue, Suite 1100  
Portland, Oregon 97204-1348

Dear Mr. Booth:

Thank you for the opportunity to provide our comments and recommendations as you begin the process for amending the Columbia River Basin Fish and Wildlife Program in 2008. We support the Council's goal of sustainable, naturally reproducing fish and wildlife populations that support tribal and non-tribal harvest and cultural and subsistence practices, as outlined in the Northwest Power Act.

Our recommendations are enclosed along with a brief justification. We do not expect our recommendations to be adopted into the 2008 Fish and Wildlife Program verbatim. Rather, our recommendations represent "areas-of-emphasis" that should be incorporated into the Program, as appropriate, to highlight specific areas of conservation and management of important fish and wildlife resources. These include Pacific lamprey conservation, hatchery reform and best management practices, aquatic nuisance species prevention and management, a fish and wildlife stronghold concept, double-crested cormorant management, and reintroduction of anadromous salmonids into blocked areas. We believe the Council should consider these recommendations as they develop the 2008 Fish and Wildlife Program.

Thank you for the opportunity to provide these comments and recommendations. We look forward to working with the Council as they amend the Columbia River Basin Fish and Wildlife Program. Should you have further questions or concerns, please do not hesitate to call Mark Bagdovitz at 503-736-4711.

Sincerely,

*David Wesley*  
Acting Regional Director

Enclosure

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## Pacific Lamprey Conservation

**Recommendation:** The Council should update the Fish and Wildlife Program to increase the focus on Pacific lamprey biology, conservation, and management. This should include historic significance, current status, biological objectives, limiting factors, threats, and critical uncertainties.

**Justification:** Two species of anadromous lampreys are native to the Columbia River Basin, Pacific lamprey (*Lampetra tridentata*) and river lamprey (*Lampetra ayresi*). Abundance indices of Pacific lampreys are exhibiting significant downward trends in the Columbia River Basin (Attachment 1).

The U.S. Fish and Wildlife Service believe that improving the abundance and productivity of anadromous lampreys throughout their range is an important conservation goal. We believe the Fish and Wildlife Program should outline the biological goals, objectives, strategies, limiting factors, and threats to anadromous lampreys. The Program should also outline potential conservation actions that can contribute to improving the abundance and productivity of anadromous lampreys. In addition, we acknowledge and support the recommendations for Pacific lamprey conservation and management outlined in the comments from the fish and wildlife managers in the submission from the Columbia Basin Fish and Wildlife Authority.

Although all anadromous lampreys are at risk throughout their range, we believe the Fish and Wildlife Program should focus primarily on Pacific lamprey in the Columbia Basin since they are directly affected by the operation and maintenance of the hydropower system (Federal and non-Federal projects). In addition, the Fish and Wildlife Program should reflect the current and historic importance of Pacific lamprey in the Columbia Basin, primarily to Native American tribes. Historically, these fish were a critically important food source for Native American tribes in the Columbia Basin. The importance of these fish continues to this day and their significance should be reflected in the Council's Fish and Wildlife Program.

Perhaps the most important limiting factor in lamprey conservation is the inadequate information of its status, distribution, and basic biology (e.g., numbers of spawners; survival rate of juveniles, etc.). Scientific information of Pacific lamprey status in the Columbia River Basin is restricted primarily to adult numbers at dams and juveniles caught incidentally during juvenile salmon sampling. In most cases, these sampling methods were designed for counting salmonids, not lampreys. However, available indices for adults indicate severely declining numbers, extirpations in some areas, and an overall precarious status (Attachment 1, Fig 1). This is especially true for the interior Columbia River Basin, such as the Snake River Basin in Idaho (Fig 2). Recently, juvenile lamprey presence/absence, density, and size distribution data have been collected in selected tributaries to augment information about their status.

The long-term objective of restoring and developing self-sustaining anadromous lamprey populations throughout their historical range requires basic life history information and an understanding of the cause for the current downward trend. The U.S. Fish and Wildlife Service and our partners have developed strategies and several measures to address limiting factors and threats to production and sustainability of anadromous lampreys in the Columbia River Basin. We recommend the Council adopt these strategies and measures into the Program, in a manner similar to other anadromous fish (Attachment 1).

### **U.S. Fish And Wildlife Service Pacific Lamprey Conservation Efforts**

We are currently engaged in a comprehensive, proactive conservation effort targeted at Pacific lamprey. This effort is known as the Pacific Lamprey Conservation Initiative. This is a partnership-driven effort to restore and sustain Pacific lamprey populations throughout their historic range (Columbia Basin and beyond) by coordinating conservation efforts among the States, Tribes, Federal agencies, and other interested parties. The primary objectives of the initial phase of conservation efforts is to implement actions known to benefit Pacific lampreys, to minimize threats to their existence, and improve understanding of them to restore their abundance and distribution. Participation in this plan and any subsequent conservation agreements will rely on voluntary participation from a variety of entities.

The overall strategy will involve the U.S. Fish and Wildlife Service as the coordinating agency to engage entities willing to participate, to coordinate conservation efforts, to facilitate increased knowledge about distribution, abundance, population structure, and threats; and to work with partners in the development of strategies for restoring Pacific lamprey populations. We are willing to work with the Council to ensure the 2008 Fish and Wildlife Program compliments our Pacific Lamprey Conservation Plan.

### **Hatchery Reform And Best Management Practices**

**Recommendation:** We recommend the Council amend the Fish and Wildlife Program to request the appropriate agencies to develop and implement Hatchery Reform Best Management Practices (BMPs). The result of applying Hatchery Reform BMPs will be increased overall salmon abundance, increased fishing opportunity to hatchery returns, and reduced negative effects of hatchery salmon on wild salmon populations.

**Justification:** Long-term conservation needs of natural salmonid populations and their inherent genetic resources require a reexamination of the role of hatcheries in basin-wide management and conservation strategies. Hatcheries must be viewed as part of the environmental and ecological landscape to help achieve both conservation and harvest goals. These goals need to be part of an integrated strategy that combines habitat, hydropower, and harvest needs for conserving and managing fishery resources. These strategies must establish short- and long-term goals for both hatchery-propagated and naturally-spawning populations.

To ensure our hatchery programs are meeting conservation and harvest goals, we are conducting a comprehensive review of 24 National Fish Hatcheries and other U.S. Fish and Wildlife Service funded facilities in the Columbia River Basin and the Olympic Peninsula in Washington. The

goal of this review is to ensure all National Fish Hatcheries, and other U.S. Fish and Wildlife Service funded hatchery programs, operate in accordance with best scientific principles, and contribute to sustainable fisheries and the conservation of naturally-spawning populations of Pacific salmon, steelhead and other aquatic species. Our review process is modeled after the recently completed Puget Sound and Coastal Washington Hatchery Reform Project. We plan to complete our evaluations by the end of 2009.

In addition, the Hatchery Scientific Review Group (HSRG), which is funded by NOAA-Fisheries, guides a systematic, science-driven redesign of how hatcheries will be used to achieve the goals of helping to recover and conserve naturally spawning populations, and support sustainable fisheries. The HSRG process in the Columbia River Basin is an important and critical effort to provide information on hatchery fish abundance and its effect on long-term population viability for primary, contributing, and stabilizing populations of associated Endangered Species Act (ESA) listed stocks. HSRG recommendations are providing a new model that focuses on brood stock management and on ensuring consideration of both the genetic integrity of hatchery and wild stocks and impacts to natural ecosystems. However, implementation of the HSRG program is limited by current hatchery characteristics, including large differences in the fitness of hatchery and wild salmon and steelhead stocks.

Development of Hatchery Reform BMPs to improve fitness, and also address concerns with genetics, behavior, physiology, and life history characteristics will ensure salmon hatcheries successfully contribute to conservation and sustainable fisheries goals. BMPs need to provide information on specific hatchery operations that affect salmon genetics, behavior, physiology, life history characteristics, and ultimately fitness. Practices to control the effects of adult hatchery fish in natural habitats (e.g., differential harvest strategies and properly functioning weirs) require refinement. Development of the scientific basis for Hatchery Reform BMPs will help ensure reduced negative effects of hatchery salmon on wild salmon populations and result in increased overall salmon abundance.

In addition, the HSRG has identified the need to increase differential harvest of hatchery fish through the use of in-river selective gear and weirs to minimize interactions of hatchery and wild fish on spawning grounds. However, these processes need to be refined. Development of a better understanding of the mechanisms creating differences in wild and hatchery fish will allow proper determination of whether individual hatchery populations should be integrated with, or segregated from, wild fish populations. Development of detailed information on Hatchery Reform strategies and guidelines will ensure scientifically defensible actions. It is expected that refinement of information for Hatchery Reform BMPs will reduce negative effects of hatchery salmon on wild salmon populations and result in increases in overall salmon abundance.

The U.S. Fish and Wildlife Service is active in the HSRG to provide scientific expertise and to ensure our review of National Fish Hatcheries, and related hatchery programs, is compatible with the HSRG process. We plan to remain active in these hatchery reform processes and will continue to provide our scientific expertise.

## **Best Management Practices For Marking And Tagging Pacific Salmon And Steelhead**

**Recommendation:** We recommend the Council amend the Fish and Wildlife Program to request the appropriate agencies to include the development and implementation of Best Management Practices (BMPs) for marking and tagging of Pacific salmon and steelhead in the Columbia River Basin.

**Justification:** Marking and tagging of salmon and steelhead released in the Columbia River Basin provides the basis for a great majority of the fisheries information available to researchers, managers, and scientists throughout the region and is essential for a scientifically sound program for evaluating hatchery performance and life-cycle survival. This includes in-season management of mainstream and tributary fishery harvests, evaluating alternative fish culture practices, determining post-season compliance with harvest regimes, determining environmental variability on salmon survival, to determine progress towards rebuilding and ESA recovery goals, estimating the hatchery and wild composition of adults on the spawning grounds, estimating the number and origin of hatchery fish that stray onto spawning grounds, and many other parameters.

Regardless of the rationale, all hatchery programs require accurate and precise estimates of the number and fate of mature salmon and steelhead that return each year that originated from the many hatcheries in the Columbia and Snake River basins. Marking and tagging BMPs cannot be categorically defined since each hatchery program has unique characteristics and needs which preclude a broad definition of BMPs. However, tagging a representative sample of fish from all hatchery programs is the basis for the BMPs.

Given the importance of the information, we believe all hatchery programs in the Columbia Basin should include a representative sample of juvenile fish that are tagged (coded wire tags and/or PIT tags, depending on the management needs and benefits of the tagging programs) prior to release. In addition, the Council should include a reference to the Congressional mandate to mass-mark (adipose fin clip) all fish that are produced in federally funded or federally administered hatchery programs. This Congressional mandate applies to many of the Columbia River Basin hatchery mitigation programs and should be identified as a program constraint where applicable. The purpose of marking/tagging these fish is to ensure all hatchery programs are monitored and evaluated on an on-going basis, to provide information for long-term life-cycle monitoring, to better facilitate hatchery/wild stock assessments, to facilitate hatchery brood stock management, and to enable mark-selective fishery opportunities. When establishing BMPs, it is important to consider sample size, overall cost, existing infrastructure, biological objectives, time constraints, and legal requirements.

## **Invasive Species Prevention And Management**

The current Fish and Wildlife Program emphasizes native species for protection, mitigation, and enhancement, but does not explicitly address the threat posed by invasive species on the health of Columbia Basin ecosystems. Invasive species are now recognized as a leading cause for the decline of biodiversity and has played a role in the majority of aquatic species extinctions in the last century. Aquatic invasive species already found in the Columbia Basin, such as New

Zealand mud snails, reduce habitat value for native fish, and can diminish restoration efforts. Potential invaders like zebra mussels or silver carp can cause harmful changes in food webs and other ecological processes if introduced to the Columbia Basin. Therefore, the Council should recognize this threat in both the Fish and Wildlife Program, and by extension, the Council's upcoming Sixth Power Plan.

**Recommendation:** The Council should recognize that invasive species are a priority stressor to the ecological health of the Columbia River Basin, and a threat to the restoration of native aquatic species. The Council should incorporate this recognition into the Fish and Wildlife Program, including implementation and criteria for project selection.

**Recommendation:** The Program should promote a diverse set of tools to identify and interdict invasive species introduction pathways, including outreach, technology development, and use of the Hazard Analysis and Critical Control Point planning process.

**Recommendation:** The Program should support early detection and rapid response planning as a critical second line of defense against invasive species. This should include enhancement of dedicated and opportunistic monitoring, and development of rapid response plans and associated funds. In addition, the Council should support long-term monitoring and control of existing invasive species in the Columbia Basin. Specifically, the Council should link the fish and wildlife program measures for invasive species to the approved State plans for invasive species.

**Justification:** We believe that aquatic invasive species are a major threat to the fish and wildlife resources of the Columbia Basin and they could adversely affect the power supply system in the Pacific Northwest. Once established, it is extremely difficult and expensive to control many aquatic invasive species. Complete elimination is often impossible. For example, the state of Idaho is spending millions of dollars each year to control Eurasian water milfoil, and millions more are spent to control nonnative fish populations, reduce damage from nutria, and control riparian weeds. Preventing the spread of invasive species to new water bodies in the Columbia Basin is a less expensive and more effective strategy.

The Fish and Wildlife Program should actively promote use of a wide range of prevention tools to reduce the probability of invasive species becoming established. Education and outreach is one key strategy to reduce the spread of invasive species by the large number of individuals where a regulatory approach is less feasible. For example, the 100<sup>th</sup> Meridian Initiative is a national campaign, with many agency partners, that provides written materials, presentations, displays, and other educational resources to boaters who may unknowingly transport zebra mussels and quagga mussels to uninfected waters. The Columbia Basin Team of the 100<sup>th</sup> Meridian Initiative carries out a variety of specific prevention projects, such as outreach to marina owners. Supporting the outreach objectives of prevention programs like the 100<sup>th</sup> Meridian Initiative is a much more cost-effective way for the Fish and Wildlife Program to reduce harmful ecological impacts of zebra mussels and other aquatic invasive species than projects that simply seek to mitigate existing invasions.

Restoration, monitoring, and other natural resource management projects supported by the Fish and Wildlife Program can also become pathways for aquatic invasive species introductions. For

example, movement of personnel and materials to survey salmon spawning or remove fish passage barriers can unknowingly spread New Zealand mud snails from a contaminated watershed, like the Deschutes River, to an uncontaminated watershed, like the Wenatchee River. The U.S. Fish and Wildlife Service and other agencies have adopted the Hazard Analysis and Critical Control Point (HACCP) process to identify and reduce such risks. Recently, we have established a policy requiring approved HACCP plans for any projects funded by the U.S. Fish and Wildlife Service under our fish passage partnership programs. The Council's Fish and Wildlife Program should consider a similar requirement in their recommendations for project funding to ensure those projects are not contributing to the spread of invasive species in the Columbia Basin.

Although prevention is ideal, stopping all new invasive species introductions in the Columbia Basin is likely not feasible. The limited history of successful eradication of aquatic invasive species points to the necessity for early detection, reporting, and on-the-ground control. One important source of early detection is regular, widespread monitoring of vulnerable watersheds. For example, an initial network of dedicated routine plankton and settlement substrate sampling and analysis is in place within the Columbia Basin to enhance early detection capacity for zebra and quagga mussels. Given limited resources, opportunistic early detection and monitoring is also vital. Programs to educate agency field crews, anglers, boaters, and the general public regarding "least wanted" invasive species can significantly increase the odds of finding new introductions early.

The benefits of rapid detection and reporting of new introductions are negated if there is not capacity to respond swiftly. A recent project to develop and test a zebra/quagga mussel rapid response system for the Columbia River Basin has revealed major gaps in preparedness for all species: a lack of adequate rapid response tools, the need for advance documentation to support the significant environmental compliance/permitting issues associated with some response tools, and the uncertainty of available funding to finance a major eradication effort. Addressing these gaps is another way the Fish and Wildlife Program can reduce the potential for new invasions.

Ignoring existing invasive species in the Columbia Basin perpetuates their impacts on native fish and wildlife, often detracting from efforts to recover those species and their habitats. For example, nutria cause significant damage to streamside planting projects in lower Columbia River tributaries, and invasive riparian and aquatic weeds can choke out native vegetation if left unmanaged. Monitoring existing invasions also provides critical feedback on the effectiveness of management programs (including prevention), as well as information that can guide prioritization of risk management. Although several baseline surveys of the Columbia mainstream have occurred in the last five years, there are no resources to revisit those baseline sites and examine trends; moreover, much of the Columbia Basin has yet to even be surveyed initially.

The states of Oregon, Washington, Idaho, and Montana have developed state aquatic invasive species management plans, complemented in some cases by overall statewide invasive species strategies. Linkage with these state programs can enhance regional coordination.

## **Recognize The Efforts To Restore Pacific Salmon And Steelhead Into Blocked Areas Of The Columbia River.**

**Recommendation:** The Council should recognize, and monitor, the current efforts to reintroduce Pacific salmon and steelhead into blocked areas of the Columbia River.

**Justification:** Hydropower development on the Columbia River has resulted in a significant loss of anadromous fish habitat from historically productive habitat upstream of Federal and non-Federal dams. However, the Council has recognized that elimination of Pacific salmon from large areas of the Columbia Basin does not need to be an irreversible decision that was made 50+ years ago. In the current Fish and Wildlife Program, the Council recognizes there may be opportunities to restore Pacific salmon to some of their historic range in the Columbia Basin. The current Fish and Wildlife Program recommends the reintroduction of Pacific salmon and steelhead into blocked areas, if it is feasible (2000 Fish and Wildlife Program, 2003 Mainstream Amendments, Intermountain Province Sub basin Plan). The stated purpose of this reintroduction is to increase the diversity, complexity, and productivity of mainstream salmonid habitat.

In response, State, Tribal, and Federal fishery managers are reintroducing anadromous fish into several blocked areas in Columbia Basin tributaries. These efforts are associated with non-Federal hydropower projects licensed by the Federal Energy Regulatory Commission. The most notable restoration efforts are being implemented on the Deschutes River in central Oregon, on the Cowlitz River and the Lewis River in southwest Washington, and on the Clackamas River near Portland. Hydropower projects on these rivers are complete blockages to anadromous fish passage. Restoration efforts are currently being implemented by private power companies, the fish and wildlife managers, non-governmental organizations, and concerned citizens. These restoration efforts are both exciting and rewarding as Pacific salmon and steelhead are on the verge of returning to historic areas where they have been absent for many years.

We believe the Council should recognize that restoration of Pacific salmon and steelhead into blocked areas is actively being pursued in the Columbia Basin, and should monitor and evaluate these reintroduction programs to document progress, evaluate the results, develop lessons-learned, and highlight the successes.

### **Salmon Stronghold Partnerships**

**Recommendation:** The Council should consider the concept of fish and wildlife strongholds in the Columbia Basin as an innovative means to protect, mitigate, and enhance fish and wildlife populations affected by hydropower development. Further discussion and clarification of this concept is needed. However, if the concept is incorporated into the Fish and Wildlife Program, potential project sponsors could take these stronghold areas into consideration when developing and submitting projects for consideration during the project solicitation process.

**Justification:** The Council should consider making fish and wildlife “strongholds” a focus in the 2008 Fish and Wildlife Program. A “stronghold” refers to a watershed, multiple watersheds, or other defined spatial units (tributaries or focal action areas) where fish and wildlife populations are strong, diverse, and includes areas that provide critical life-cycle requirements.



Stronghold habitat has a high intrinsic potential to support a particular species, or suite of species, and is expected to afford a measure of productivity and resilience to important fish and wildlife resources under predicted scenarios of human population growth and climate change.

The North American Salmon Stronghold Partnership is an example of an initiative that focuses on protecting and restoring habitats in watersheds where salmon remain productive and reasonably healthy. In the Pacific Northwest, their purpose is to protect and restore the most productive watersheds for Pacific salmon. Currently, the partnership is working to:

- Identify the most resilient strongholds for salmon in the Pacific Northwest.
- Identify and address immediate threats to the biological integrity of the ecosystem.
- Work with scientists and local communities; build on existing conservation efforts to develop goals for a healthy ecosystem.
- Develop an action plan that is a synthesis of existing plans, adding additional conservation measures that may be needed to achieve the healthy ecosystem goals.
- Seek resources to implement action plans and provide long term protection for salmon stronghold watersheds.
- Monitor the health of the salmon stronghold watersheds over time.

### **Removing Obsolete Infrastructure To Improve Fish Habitat In The Columbia Basin**

**Recommendation:** We recommend the Fish and Wildlife Program be updated to promote projects that identify and remove obsolete infrastructure as a means to improve the quality and quantity of resident and anadromous fish habitat. Obsolete infrastructure should be identified and feasibility studies should be undertaken to determine whether and how removal could occur. The Program should also emphasize the need to monitor and evaluate the physical and biological responses from these efforts.

**Justification:** Removing obsolete dams and other unnecessary infrastructure from rivers and streams could be a cost-effective means to improve both the quantity and quality of fish habitat in the Columbia Basin. The Fish and Wildlife Program should specifically identify infrastructure removal as an important opportunity to restore ecological processes and improve fish habitat.

For example, two major dams were removed in the Columbia Basin in 2007. These include Milltown Dam on the Clark Fork River in Missoula, Montana, and Marmot Dam on the Sandy River near Portland, Oregon. Removing these projects has restored natural river processes and increased the quantity and quality of fish habitat for resident and anadromous fish.

There are several other dams in the Columbia Basin that are being considered for removal. These include Condit Dam on the White Salmon River (Washington), Hemlock Dam on the Wind River (Washington), and Powerdale Dam on the Hood River (Oregon). If these projects are removed, natural river processes will be restored and this will likely improve habitat for resident and anadromous fish. In addition, there may be other structures, gates, channels, dams, and diversions on Columbia Basin tributaries that are no longer necessary and could be removed. We recognize there are risks to such actions, including the possibility of inadvertently increasing

the range and impacts of local invasive species. Nevertheless, identifying and removing these obstructions could be a cost-effective habitat improvement measure and should be considered for inclusion in the 2008 Columbia Basin Fish and Wildlife Program.

### **Double-Crested Cormorants**

**Recommendation:** We recommend the Council and other interested parties be cautious when contemplating potential future management actions for double-crested cormorant populations in the Columbia Basin.

**Justification:** We recognize that double-crested cormorants are a source of mortality for juvenile Pacific salmon and steelhead in the Columbia Basin. However, we do not believe there is sufficient scientific understanding of the relationships between cormorants and their prey to fully recognize the management implications of a program to reduce cormorant numbers in the Columbia Basin.

Given the results for Caspian terns in the Lower Columbia estuary, it is understandable that management actions may be contemplated for cormorants to improve survival of juvenile salmon. However, the biology, diet, and life history characteristics of cormorants are considerably different than Caspian terns. Therefore, any management actions to address cormorant populations warrant careful deliberation. For example, cormorants feed exclusively on aquatic organisms, primarily fish, including resident fish species that feed extensively on juvenile salmon and steelhead as adults. These may include northern pikeminnow, smallmouth bass, and walleye. Any management action designed to reduce cormorant populations would also need to consider how resident fish populations might respond to reduced predation from cormorants. Additionally, cormorants can nest in a variety of habitats (e.g., on the ground, on cliffs, in trees or shrubs, or under bridges). This presents a particular challenge if future management actions focus on management of cormorant nesting habitat in the Columbia River estuary.

However, we stand ready to provide technical assistance in the event that any agency or entity seeks a permit under the Migratory Bird Treaty Act to address issues related to bird predation on juvenile salmon and steelhead in the Columbia Basin.

### **Additional Information On Pacific Lamprey**

We are providing the following information on biological objectives, status, limiting factors, threats, strategies, and measures to assist the Council in highlighting Pacific lamprey conservation and management in the 2008 Fish and Wildlife Program. We encourage the Council to use the information, as appropriate, in developing the Program.

#### **Biological Objective:**

Restore and maintain self-sustaining populations of anadromous lampreys throughout their historical range in the Columbia Basin.

#### **Current Status:**

Two species of anadromous lampreys are native to the Columbia River Basin, Pacific lampreys (*Lampetra tridentata*) and river lampreys (*Lampetra ayresi*). Abundance indices of Pacific lampreys are exhibiting significant downward trends in the Columbia River Basin. The status of river lampreys is unknown.

Knowledge of Pacific lamprey status in the Columbia River Basin is limited primarily to counts of adults at dams and juveniles as incidental catch in smolt traps. In most cases, these facilities were designed for counting salmonids and counts were not conducted for lampreys each year; therefore, counts of lampreys are incomplete. However, available indices for adults indicate declining numbers and precarious status (Fig 1). This is especially true for the interior Columbia River Basin, such as the Snake River Basin in Idaho (Fig 2 and Fig 3). In some areas Pacific lampreys have been extirpated.

Little is known about the status of anadromous lampreys (e.g., numbers of spawners; survival rate of juveniles, etc.), although larval Pacific lamprey presence/absence, density and size distribution data have been collected recently in selected tributaries to augment knowledge regarding their status.

The long-term objective of restoring and developing self-sustaining anadromous lamprey populations throughout their historical range requires that more information be obtained to halt and reverse the downward trend of Pacific lampreys. However, comprehensive historical and current distribution and abundance data for anadromous lampreys is lacking. Lack of knowledge of lamprey status in the Columbia Basin will make successful implementation of a conservation plan a challenge.

#### Population Delineation

Understanding population delineation and structure is important for management and conservation of anadromous lampreys. Increased knowledge of lamprey population structure will enhance our ability to evaluate the relative effectiveness of priority management actions.

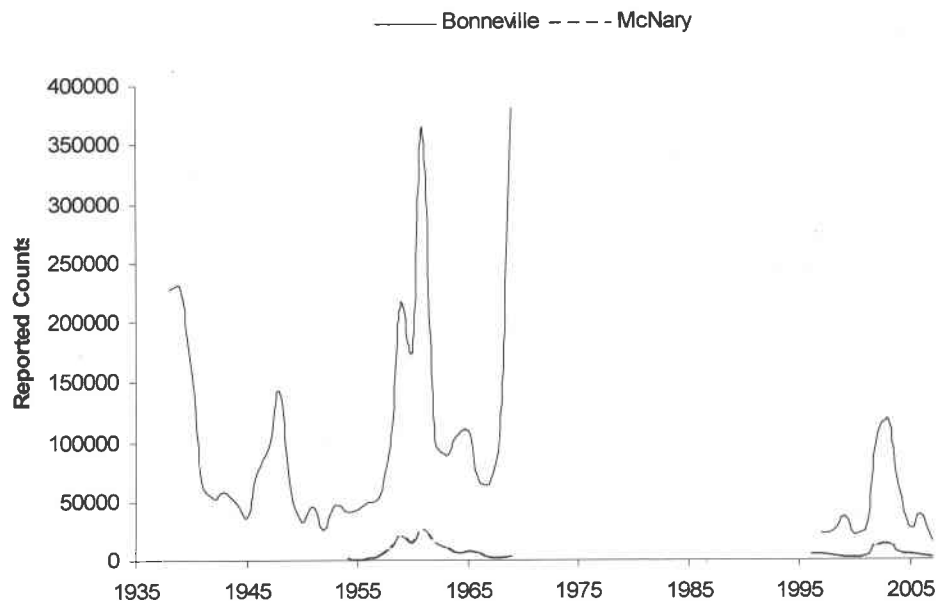


Figure 1. Annual counts of adult lamprey at Bonneville (start 1938) and McNary (start 1954) dams to present. No counts were made during 1970's and 1980's.

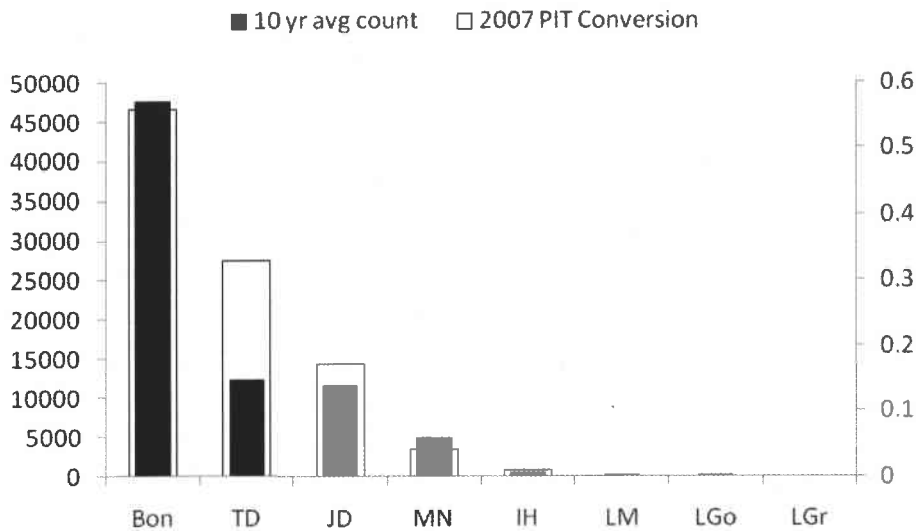


Figure 2 Comparison of ten year average counts (1998-2007) of adult lamprey at Columbia and Snake river dams (solid bars) and conversion of PIT-tagged adult lamprey through Ice Harbor Dam for fish released downstream of Bonneville Dam in 2007 (Chris Peery University of Idaho, personal. communication). Bon = Bonneville, TD = The Dalles, JD = John Day, MN = McNary, IH = Ice Harbor, LM = Lower Monumental, LGo – Little Goose, and LGr = Lower Granite.

## **Limiting Factors and Threats**

### Passage

In the Columbia River Basin, anadromous lampreys may migrate hundreds of kilometers through both mainstream and tributary habitats. Artificial barriers, such as large main stem and tributary hydropower dams, can impede or block upstream migrations by adult lampreys and downstream movement of larval and juvenile lampreys. Downstream migrating juveniles may be entrained in water diversions or turbine intakes and due to their size and swimming ability, they are often impinged on the diversion and intake screens resulting in injury or death. Many fish ladders and culverts designed to pass salmonids do not effectively pass lampreys due to sharp angles and high water velocities. Lampreys travel deeper in the water column compared to salmonids, therefore, traditional spill gates may block passage. Culverts that have a drop at the outlet or insufficient resting areas will block passage. Anadromous lamprey populations persist for only a few years above impassable barriers before dying out.

### Habitat Degradation

Degradation of aquatic habitats limits lamprey. Physical habitat quality and quantity has diminished, which may especially limit larval and juvenile rearing. Fluctuations in reservoir and stream water levels, irrigation diversions, and stream dewatering can strand larval lampreys in the substrate. A single event can have a significant effect on a local lamprey population. Channel alterations causing the loss of riffle and side channel habitats may reduce areas for spawning and larvae rearing.

### Water Quality

Degradation of water quality (contaminants and elevated water temperatures) from various land use practices reduces lamprey abundance and productivity. Accumulated toxins in the lower reaches of streams/rivers may affect larval lampreys because they are often found in these substrates of these areas.

### Predation

Nonnative fishes such as bass, sunfish, walleye, striped bass, and catfish prey on lampreys. As anadromous lampreys migrate through reservoirs, they may be more susceptible to predation

## **Strategies and Measures**

### **Strategy 1 Improve anadromous lamprey (larval, transforming, juvenile, adult) passage in main stem rivers and tributaries**

#### **Measures:**

- 1a** Develop aids to better attract adults to fish ladders at dams.
- 1b** Develop aids to improve passage of adults through fish ladders at dams.
- 1c** Assess impact on larvae/macrothemia migrating through dams.
- 1d** Assess the capability of juvenile fish bypass systems for larvae/juveniles.
- 1e** Develop aids to passage at known and suspected lamprey passage obstacles.
- 1f** Identify additional specific structures or operations that delay, obstruct, or kill migrating lampreys of all stages.
- 1g** Monitor lamprey passage (all stages) to evaluate passage improvement actions and to identify additional passage problem areas.
- 1h** Assess passage efficiency, direct mortality, and/or other metrics for all stages of anadromous lampreys that relate to migratory success.
- 1i** Assess influence of reservoirs on migratory success of all stages of anadromous lampreys.
- 1j** Assess influence of flow fluctuations (magnitude and timing) on ability of juvenile lamprey to successfully move from substrate to the water column

### **Strategy 2 Improve the understanding of anadromous lamprey status**

#### **Measures:**

- 2a** Compile and evaluate current and historical information on anadromous lamprey distribution, abundance, and status within the Columbia Basin.
- 2b** Develop methods to differentiate among species at all life stages (field-based).
- 2c** Develop standardized sampling protocols and conduct systematic basin-wide surveys to assess adult and juvenile abundance and distribution.
- 2d** Define, improve, and continue historic distribution and abundance indices (e.g., dam counts, tribal harvest records, smolt trap collections, etc).
- 2e** Coordinate information exchange with existing and future projects not targeting lamprey specifically.

### **Strategy 3 Delineate anadromous lamprey populations in the Columbia Basin**

#### **Measures:**

- 3a** Supplement existing libraries of genetic markers for lamprey (e.g., micro satellites, single nucleotide polymorphisms).
- 3b** Collect and maintain lamprey tissue samples from the Columbia River Basin and neighboring basins.
- 3c** Investigate and determine population characteristics.

**Strategy 4: Improve our understanding of limiting factors and threats**

**Measures:**

- 4a Document habitat preferences and habitat availability for all life stages.
- 4b Evaluate the physiological and behavioral responses to a variety of environmental stressors.
- 4c Assess trophic relationships.
- 4d Assess the potential magnitude and effect of predation on lamprey productivity.
- 4e Assess the influence of disease.
- 4f Assess the influence of contaminants.
- 4g Assess the influence of current and forecasted climate change to adult holding and juvenile incubation temperature tolerances.
- 4h Identify threats to all stages of anadromous lampreys.
- 4i Prioritize actions to address threats.

**Strategy 5: Continue restoring freshwater spawning and rearing habitat for anadromous lampreys**

**Measures:**

- 5a Develop, implement, and evaluate lamprey-specific restoration projects (restoring natural processes in the absence of information on limiting factors).
- 5b Identify ongoing restoration and safety-net activities and evaluate their effects on lamprey.
- 5c Restore passage to, and habitat of, extirpated areas where lamprey have been extirpated to facilitate recolonization.

**Strategy 6: Improve scientific understanding of anadromous lamprey biology and ecology**

**Measures:**

- 6a Understand the ecological function of anadromous lampreys.
- 6b Understand the biology of anadromous lampreys.
- 6c Develop methodology for gender identification in the field and laboratory.
- 6d Develop aging techniques.
- 6e Assess life history characteristics of freshwater and ocean-phase anadromous lampreys.

**Strategy 7: Improve scientific understanding of anadromous lamprey population dynamics**

**Measures:**

- 7a Estimate demographic rate parameters capable of changing the size of populations such as birth, death, immigration, and emigration rates.

- 7b Develop a predictive model to assess the rate of change of lamprey populations in the Columbia River Basin including abiotic and biotic factors.

**Strategy 8: Develop a collaborative lamprey conservation, restoration, and management plan.**

**Measures:**

- 8a Improve our understanding and documentation of critical uncertainties by updating the Columbia River Basin Lamprey Technical Workgroup Critical Uncertainties document as part of a Columbia Basin lamprey conservation plan.
- 8b Support development of a Columbia Basin lamprey conservation plan as part of the range wide Pacific Lamprey Conservation Plan\*. The plan should include, but not limited to: (1) abundance targets measured at main stem dams and tributaries, and (2) adult and juvenile passage efficiency targets and performance standards for main stem dams.
- 8c Identify research and analyses that address critical uncertainties regarding lamprey habitat, status, distribution, and genetic structure.
- 8d Identify and implement methods that reduce or eliminate threats, restore habitat and restore access into spawning and rearing habitat.
- 8e Develop a public outreach and information program specific to anadromous lampreys.