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An Ecological, Cultural, and Legal Review of Pacific Lamprey in the Columbia River Basin

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AN ECOLOGICAL, CULTURAL AND LEGAL REVIEW OF PACIFIC LAMPREY IN THE COLUMBIA RIVER BASIN

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ABSTRACT

Pacific lamprey (Entosphenus tridentatus) is an anadromous species in an ancient lineage of jawless fishes. The species is native to the North Pacific and its marine-accessible freshwater rivers and streams. Pacific lamprey are understudied relative to other anadromous fishes and has severely declined in abundance throughout the Columbia River Basin. Indigenous people of the Snake and Columbia River Basins have long recognized the ecological role and value of lamprey through their spiritual and cultural practices connected to Pacific lamprey. The combined effects of poor passage at dams, historic and continued habitat degradation, and altered marine host conditions have contributed to the observed decline in abundance and distribution. The unique characteristics and management history have placed Pacific lamprey in a legal and cultural grey area and provide a useful foil to Pacific salmon in considering protections for migratory fish. Here we provide a review of legal protections and recovery actions throughout the Columbia River Basin, including an analysis of the Fish and Wildlife Service's 2004 denial of a petition to list Pacific lamprey under the Endangered Species Act. The current patchwork of measures fails to provide integrated protections across the life history of the species. This stems from a complex lifecycle spanning dozens of local, state, tribal, federal, and international jurisdictions as well as a cultural legacy of lamprey being considered "trash fish" by western society and early fishery managers. However, recent shifts in perceptions about the ecological value of the species and increased co-management of anadromous species within the Columbia River Basin have elevated the species as a management priority. Continued efforts to conserve and recover Pacific lamprey pose a complex and honorable challenge for fisheries managers within the Columbia River Basin.

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I. INTRODUCTION

Pacific lamprey (*Entosphenus tridentatus*) is a fascinating, understudied, culturally significant anadromous fish species with an eel-like appearance. Native to most marine-accessible freshwater rivers and streams in the North Pacific, Pacific lamprey can be found in Mexico, the United States, Canada,¹ Russia, and Japan.² Referred to by native peoples in the Columbia River Basin as the ancient ones, older than time immemorial, lamprey have contributed to the characteristics and behavior of both salmon and the salmon eaters.³ Indigenous peoples of the Columbia River Basin have learned the lamprey’s story through observation and celebration honoring the continuation of life.⁴ Because of Pacific lamprey’s complex life history, downward population trends, and uncharismatic appearance, the current regulatory scheme provides a patchwork of measures that fail to provide substantive protections across the different stages of their life history.

The lack of an effective regulatory framework is the result of a single life cycle spanning dozens of local, state, tribal, federal, and international jurisdictions. Coupled with disconnects between western and native value systems, recovery of Pacific lamprey poses a complex and honorable challenge for fisheries managers within the Columbia River Basin.⁵

Pacific lamprey possess life history traits beyond anadromous migration that contribute to management challenges. Pacific lamprey are unlike salmon: they are not entirely philopatric, meaning they do not necessarily return to their natal streams and do not share the degree of genetic differentiation that is observed in salmon populations.⁶ As we will show in following sections, Pacific lamprey are characterized by a three-to-seven-year filter-feeding, larval phase while residing in fine sediments of freshwater streams followed by a smolt-like transformation, prior to migrating to the marine environment. While in the ocean, lamprey migrate as

1. See David A. Close et al., *The Ecological and Cultural Importance of a Species at Risk of Extinction, Pacific Lamprey*, 27 FISHERIES 19, 20 (2002).
2. U.S. FISH & WILDLIFE SERV., FACT SHEET PACIFIC LAMPREY (LAMPERTA TRIDENTATA) 2 (2008), <https://www.fws.gov/oregonfwo/Species/Data/PacificLamprey/Documents/012808PL-FactSheet.pdf>; see also Benjamin J. Clemens et al., *Conservation Challenges and Research Needs for Pacific Lamprey in the Columbia River Basin*, 42 FISHERIES 268, 269 (2017).
3. *Tribal Pacific Lamprey Restoration Plan for the Columbia River Basin*, COLUMBIA RIVER INTER-TRIBAL FISH COMM’N 1 (Dec. 19, 2011), http://www.critfc.org/wp-content/uploads/2012/12/lamprey_plan.pdf [hereinafter TRIBAL PACIFIC LAMPREY RESTORATION PLAN] (quoting Elmer Crow Jr., former Vice Chair, Nez Perce Fish and Wildlife Committee: “The lamprey is our elder, without him the circle of life is broken.”).
4. *Id.* at 2.
5. Clemens et al., *supra* note 2, at 268–280.
6. See *infra* Section II.A.ii.

ectoparasites, attaching to whales, salmon, and other marine organisms to feed on blood and other body fluids.⁷ After two to three years of marine growth, Pacific lamprey embark on extended upstream migrations and may reside in freshwater without feeding for a year before spawning in late spring and early summer in similar habitats as Pacific salmonids (salmon and steelhead).⁸

Pacific lamprey face unique threats throughout their life cycle and in different geographic areas, with unimpounded coastal systems facing declines as well. In the Columbia River Basin, Pacific lamprey abundance has severely declined over the last century.⁹ While the conservation status varies among both domestic and international jurisdictions, the broadly consistent classification of population status indicates that fisheries and natural resource managers acknowledge Pacific lamprey as imperiled to varying degrees across their entire range.¹⁰ Poor upstream and downstream passage, along with water quality issues and historic commercial overharvest,¹¹ have been implicated in the observed decline in Pacific lamprey run sizes in the Columbia River Basin,¹² but relatively little work has explored population trends in other geographic areas.¹³ Additionally, recent research suggests that Pacific lamprey abundance is strongly influenced by ocean conditions similar to many salmonid populations.¹⁴ Recent dam removal actions in the Pacific Northwest have demonstrated Pacific lamprey's ability to recolonize historic habitats, supporting the idea that dam removal can be a successful tool for ecosystem recovery efforts in the Columbia River Basin.¹⁵ Such evidence suggests the

7. See Adare Evans et al., *Pacific Lamprey*, 27 WILDLIFE EXPRESS 1, 2 (2013).

8. See *id.* at 2.

9. Close et al., *supra* note 1, at 21; Benjamin J. Clemens et al., *supra* note 2, at 269.

10. See *infra* Table 1. While an ideal conservation might require some kind of international cooperation and coordination, this paper focuses mainly on the biophysical, cultural, and legal aspects of Pacific lamprey within the Columbia River Basin. Although there is a domestic coalition of agencies and interested stakeholders in U.S., to date, there is no international effort aimed to address Pacific lamprey's international life history. And while there are international agreements and treaties tailored to Pacific salmon, such as the Pacific Salmon Treaty; there are no international agreements or coordinated research efforts addressing Pacific lamprey's international life history. True conservation of this ancient species may very well necessitate such an international effort.

11. Beyond commercial overharvest, within the Columbia River Basin, Pacific lamprey have long since battled a reputation as a "trash fish." The historic thought of Pacific lamprey being a "trash fish" is evidenced by repeated application of lampricides and other poisons to multiple rivers in Oregon in an attempt to eradicate lamprey. Robin S. Peterson Lewis, *Yurok and Karuk Traditional Ecological Knowledge: Insights into Pacific Lamprey Populations of the Lower Klamath Basin*, in *Biology, Management, and Conservation of Lampreys in North America* 1–39 (2009); see also George Plaven, *Lamprey Harvested at Willamette Falls, Distributed to Tribes*, E. OREGONIAN (June 15, 2015), <http://www.eastoregonian.com/eo/local-news/20150615/lamprey-harvested-at-willamette-falls-distributed-to-tribes> (explaining how and when the Umatilla River was poisoned in 1967 and 1974).

12. See *infra* Figure 5.

13. See Peter B. Moyle et al., *Status and Conservation of Lampreys in California*, in *BIOLOGY, MANAGEMENT, AND CONSERVATION OF LAMPREYS IN NORTH AMERICA* 279, 279 (Larry R. Brown et al. eds., 2009); see also Michael C. Hayes et al., *Distribution of Pacific Lamprey *Entosphenus tridentatus* in Watersheds of Puget Sound Based on Smolt Monitoring Data*, 87 NW. SCI. 95 (2013) (providing lamprey conservation statuses and trend information outside of the Columbia River Basin).

14. Joshua G. Murauskas et al., *Relationships Between the Abundance of Pacific Lamprey in the Columbia River and Their Common Hosts in the Marine Environment*, 142 TRANSACTIONS AM. FISHERIES SOC'Y 143, 146 (2013).

15. See Michael C. Blumm & Andrew B. Erickson, *Dam Removal in the Pacific Northwest*:

importance of coordinated conservation efforts coupled with legal protections that embrace Pacific lamprey's unique life history and importance to Columbia River Basin tribes and first nations.

While Pacific salmon have received substantial regulatory attention and conservation actions exceeding a billion dollars in costs,¹⁶ Pacific lamprey restoration is a relatively new concept in the Columbia River Basin.¹⁷ Furthermore, unlike many Pacific salmon species which are listed under the federal Endangered Species Act, Pacific lamprey do not receive federal protections.¹⁸ In 2003, as a result of dramatic declines in lamprey populations and an increased understanding of ecological and cultural values of lamprey, several environmental groups petitioned the United States Fish and Wildlife Service (USFWS) to list Pacific lamprey, and three other lamprey species, under the Endangered Species Act.¹⁹ Due to a lack of information and Pacific lamprey's unique anadromous life history, the USFWS determined that listing was not warranted because Pacific lamprey were not a "listable entity" meaning that lamprey within the United States did not constitute a sufficient subset of the overall Pacific lamprey population.²⁰ The decision served as a catalyst for the tribes along with state and federal agencies to conduct further research to increase our understanding of these species, and to implement novel lamprey restoration measures.

Tribal leadership in Pacific lamprey conservation is borne out of a deep connection between native peoples and this species.²¹ Since time, immemorial

Lessons for the Nation, 42 ENVTL. L. 1043, 1050–58 (2012); T. Royal, *Lamprey Returning to a Dam-Free Elwha River*, NW. TREATY TRIBES (Mar. 31, 2016), <http://nwtreatytribes.org/lamprey-returning-dam-free-elwha-river/>; Press Release, Emily Washines (Yakama Nation) & Amanda Smith (USFWS), Partnership Powers Pacific Lamprey Return Upstream of Former Condit Dam Site, (Mar. 10, 2016), <http://www.fws.gov/news/ShowNews.cfm?ID=66F2C9DB-95B1-34EB-938BE2D12E5C86DD> (however western brook lamprey, a non-migratory, species were observed both upstream and downstream of Condit Dam).

16. *BPA's Annual Costs for Basin Fish and Wildlife Mitigation Expected to Nudge Above \$500 Million*, COLUMBIA BASIN BULL. (July 11, 2014), <http://www.cbbulletin.com/431437.aspx>.

17. See Clemens et al., *supra* note 2.

18. See U.S. FISH & WILDLIFE SERV., SPECIES FACT SHEET PACIFIC LAMPREY (*LAMPETRA TRIDENTATA*) 3–4, https://www.fws.gov/wafwo/species/Fact%20sheets/Pacific_lamprey_final.pdf (although Pacific lamprey are not listed under the Endangered Species Act, federal agencies do coordinate conservation actions with state and tribal agencies) [hereinafter SPECIES FACT SHEET PACIFIC LAMPREY].

19. KLAMATH-SISKIYOU WILDLANDS CTR. ET AL., PETITION FOR RULES TO LIST: PACIFIC LAMPREY (*LAMPETRA TRIDENTATA*), RIVER LAMPREY (*LAMPETRA AYRESI*), WESTERN BROOK LAMPREY (*LAMPETRA RICHARDSONI*), AND KERN BROOK LAMPREY (*LAMPETRA HUBBSI*) AS THREATENED OR ENDANGERED UNDER THE ENDANGERED SPECIES ACT 3 (Jan. 28, 2003), http://www.biologicaldiversity.org/species/fish/Pacific_lamprey/pdfs/petition.pdf.

20. Endangered and Threatened Wildlife and Plants; 90-Day Finding on a Petition to List Three Species of Lampreys as Threatened or Endangered, 69 Fed. Reg. 77,158, 77,166 (Dec. 27, 2004) (codified at 50 C.F.R. pt. 17). Finding that

the petition did not attempt to describe or justify a listable entity within the petitioned area, stating only that, 'Pacific lamprey populations could be subdivided into distinct population segments at spatial scales similar to the ESUs developed for listed salmon species. Petitioners believe that delineation of distinct population segments is best left to the discretion of USFWS.'

Id. (citing the 2003 petition list).

21. Close et al., *supra* note 1, at 22.

Pacific lamprey have been prized and honored by indigenous people of the Columbia River Basin.²² This reverence for Pacific lamprey continues today through the concert of restoring Pacific lamprey habitat on the landscape and continuing celebrations and ceremonies to honor lamprey. Pacific lamprey are considered tribal trust resources and thus, due to their cultural importance and treaty obligations, the federal government owes the tribes a federal trust responsibility to ensure lamprey's continued existence.²³

Today in the Columbia River Basin, the Willamette Falls fishery is the primary place of harvest and is limited to a treaty fishery, permit-holding federally recognized tribes, or individuals who obtain a permit from the state of Oregon.²⁴ However, due to the extirpation of lamprey across a significant portion of their historic range, tribal members throughout the Columbia River Basin are impacted by the drastic decline in lamprey abundance.²⁵ These impacts are evidenced through diminished harvest opportunity, which limits the extent to which tribes can eat lamprey and use them in culturally significant ceremonies.²⁶ These losses can only be remedied through lamprey recovery actions which improve habitat, increase the lamprey population and expand their range.²⁷

Currently, within the Columbia River Basin there are three large-scale Pacific lamprey management and conservation plans: (1) the Columbia River Inter-tribal Fish Commission's (CRITFC) Tribal Pacific Lamprey Restoration Plan,²⁸ which underscores both the ecological and cultural significance of Pacific lamprey; (2) the Pacific Lamprey Assessment Template for Conservation Measures, set forth by the USFWS in conjunction with other agencies, and stakeholders;²⁹ and (3) the United States Army Corps of Engineers' (USACE) 10 Year Passage Improvement Plan.³⁰

In recognition of the challenge of Pacific lamprey conservation in the Columbia River Basin, CRITFC and its member tribes (the Nez Perce Tribe, the Confederated Tribes of the Umatilla Indian Reservation, the Confederated Tribes of the Warm Springs Reservation of Oregon, and the Confederated Tribes and Bands of the Yakama Nation) released the Tribal Pacific Lamprey Restoration Plan for the Columbia River Basin.³¹ This plan highlights the importance of Pacific lamprey in the

22. *Id.*

23. See Treaty with the Nez Perce, 1855, U.S.-Nez Perce Tribe of Indians, art. 3, June 11, 1855, 12 Stat. 957.

24. See OR. ADMIN. R. 635-017-009 (2017).

25. Close et al., *supra* note 1, at 19.

26. See *id.*

27. *Id.* at 24.

28. See TRIBAL PACIFIC LAMPREY RESTORATION PLAN, *supra* note 4.

29. See *generally* U.S. FISH & WILDLIFE SERV., PACIFIC LAMPREY (ENTOSPHENUS TRIDENTATUS) ASSESSMENT AND TEMPLATE FOR CONSERVATION MEASURES (2011), http://www.fwspubs.org/doi/suppl/10.3996/112015-JFWM-112/suppl_file/112015-jfwm-112.s3.pdf [hereinafter ASSESSMENT AND TEMPLATE FOR CONSERVATION MEASURES]. Notably, USFS incorporated many of the goals and initiatives from CRITFC's plan into the Pacific Lamprey Assessment Template for Conservation Measures, which is a product of and one of the guiding documents for their Conservation Initiative, guiding research and recent restoration actions for federal and state agencies. See *id.* at 271–76 app. E.

30. U.S. ARMY CORPS OF ENG'RS NW. DIV., PACIFIC LAMPREY PASSAGE IMPROVEMENTS IMPLEMENTATION PLAN: 2008-2018 (2014) [hereinafter IMPROVEMENTS IMPLEMENTATION PLAN].

31. TRIBAL PACIFIC LAMPREY RESTORATION PLAN, *supra* note 4.

cultures of CRITFC member tribes, identifies specific knowledge gaps, and proposes a framework for collaboratively restoring lamprey runs to a level adequate for “ecological health and tribal cultural use” throughout their range by 2050.³²

The plan highlights six objective areas critical to Pacific lamprey conservation: mainstem passage and habitat, tributary passage and habitat, supplementation and augmentation, contaminants and water quality, public outreach and education, and research and monitoring.³³ CRITFC warns that harm to lamprey and their habitat equates to a loss of a critical part of the ecosystems they inhabit, a loss of cultural heritage, and a loss of fishing opportunities, which were guaranteed to its member tribes by the treaties of 1855 from which the tribes retain the right to fish at “usual and accustomed places” on and off reservations.³⁴ Though this right to fish has historically been viewed as salmon and steelhead-centric, the right to harvest fish includes many species including Pacific lamprey, sturgeon, and other first foods.³⁵

This Article identifies the need for coordinated legal protection and restoration measures to assure the survival of Pacific lamprey. This Article begins in Part II with documenting the Pacific lamprey ecology and decline of the species in the Columbia River Basin.³⁶ Part III highlights the critical role of survival of the species to the culture of indigenous peoples of the Pacific Northwest.³⁷ And, Part IV analyzes the current fragmented and inadequate legal landscape for protection of Pacific lamprey in the Columbia River Basin.³⁸ This Article concludes with recommendations for both legal and physical measures to ensure the continuation of this ancient species.³⁹

II. AN ECOLOGICAL REVIEW OF PACIFIC LAMPREY

Conservation of highly migratory species with complex life histories presents challenges for policy and management of those species. Species of this type require protection spanning multiple jurisdictions across multiple ecosystems as well as providing connectivity through migratory corridors to complete life cycles. Effective evaluation of policy and management decisions necessitates an understanding of the life history and ecology of migratory species and their ecosystems. The following section reviews current understandings of the life history and ecological role of Pacific lamprey across life stages and is focused within the Columbia River Basin.

32. *Id.* at iv.

33. *Id.* at iv–v.

34. *Id.* at 2.

35. *See* United States v. Washington, 827 F.3d 836, 849 (9th Cir. 2016) (“The right of taking fish, at all usual and accustomed grounds and stations, is further secured to said Indians, in common with all citizens of the Territory, and of erecting temporary houses for the purposes of curing . . .”) (quoting the 1855 Treaties); *see also* Idaho v. Tinno, 497 P.2d 1386, 94 Idaho 759 (1972) (finding that harvest is not limited to fish but also includes other forms of subsistence hunting and gathering).

36. *See infra* Part II.

37. *See infra* Part III.

38. *See infra* Part IV.

39. *See infra* Part V.

A. Pacific Lamprey Life History

i. Adult Lamprey in the Marine Environment

Young adult lamprey migrate to the ocean throughout the year, but most of their migration is observed during spring months.⁴⁰ The marine phase of lamprey begins as young adults reach estuaries during downstream migration.⁴¹ During this phase, the skin color of a lamprey changes from dark brown freshwater colors to silvery marine colors and the lamprey begins an ectoparasitic phase where it will attach to the skin of a prey species.⁴² Using a combination of sharp tooth-like cusps along the mouth opening and a rasping motion of the toothed tongue,⁴³ a lamprey will create a wound in the host.⁴⁴ From this wound, lamprey feed on body fluids extracted from the host.⁴⁵ Lampreys lack a developed stomach and digestion occurs in a simple intestine.⁴⁶ Lamprey's high-quality food sources allow rapid growth and energy accrual during a short period of time in the marine environment.⁴⁷

Hosts of Pacific lamprey in the marine environment are predominantly larger-bodied fish with a typical salmon-like body shape and are found in moderate to deep depths.⁴⁸ Alexei Orlov found these hosts to include salmonids, cod, pollock, hake, herring, lingcod, mackerel, rockfish, ocean perch, halibut, and flounder.⁴⁹ They found that most lamprey wounds were found in specific locations on certain species.⁵⁰ For example, most wounds on halibut were on the blind side of the body.⁵¹ Similarly, the ventral sections of pollock and flounder were commonly attacked.⁵² Pacific lamprey have also been observed feeding on finback, humpback, sei, and sperm whales in the North Pacific.⁵³ Although the marine stage of Pacific lamprey is not well studied, it is thought that Pacific lamprey spend only one to three years in the ocean prior to beginning the spawning migration.⁵⁴

In the marine environment, adult lamprey may be adversely affected by commercial harvest and bycatch of their prey species where fishing pressure is high.⁵⁵ Additionally, changes in ocean conditions that limit overall productivity may

40. See Close et al., *supra* note 1, at 20–21.

41. TRIBAL PACIFIC LAMPREY RESTORATION PLAN, *supra* note 3, at 12.

42. *Id.*

43. See *infra* Figure 1.

44. See TRIBAL PACIFIC LAMPREY RESTORATION PLAN, *supra* note 3, at 13.

45. Evans et al., *supra* note 7, at 2.

46. PETER B. MOYLE & JOSEPH J. CECH, FISHES: AN INTRODUCTION TO ICHTHYOLOGY 250 (2004).

47. *Id.*

48. Alexei Orlov et al., *Feeding and Prey of Pacific Lamprey in Coastal Waters of the Western North Pacific*, in CHALLENGES FOR DIADROMOUS FISHES IN A DYNAMIC GLOBAL ENVIRONMENT: PROCEEDINGS OF THE INTERNATIONAL SYMPOSIUM "CHALLENGES FOR DIADROMOUS FISHES IN A DYNAMIC GLOBAL ENVIRONMENT" HELD IN HALIFAX, NOVA SCOTIA, CANADA, JUNE 18-21, 2007, 875, 875–76 (Alex Haro et al. eds., 2009).

49. *Id.* at 875.

50. *Id.* at 876.

51. *Id.*

52. *Id.*

53. Gordon C. Pike, *Lamprey Marks on Whales*, 8 J. FISHERIES RES. BOARD CAN. 275, 275 (1951).

54. U.S. FISH & WILDLIFE SERV., PACIFIC LAMPREY LONG VERSION FACT SHEET 1 (2016), <https://www.fws.gov/pacificlamprey/FactSheets.cfm> [hereinafter *Lamprey Overview*].

55. See generally Joshua G. Murauskas et al., *Relationships Between the Abundance of Pacific Lamprey in the Columbia River and Their Common Hosts in the Marine Environment*, 142 TRANSACTIONS

also limit the growth capacity of Pacific lamprey in the marine phase.⁵⁶ For example, the cyclical nature of Pacific lamprey return sizes in the Columbia River Basin are correlated most strongly with commercial landings of top prey species and that including broad-scale ocean productivity increased their model precision.⁵⁷ Thus, ocean productivity and commercial harvest of prey species together likely affect the abundance of lamprey.

ii. Adult Lamprey in Freshwater

The specific cues inducing lamprey maturation and return to freshwater have yet to be resolved, but likely relate to a combination of individual body condition, photoperiod (length of daily exposure to sunlight), and changes in discharge and temperature of rivers entering the ocean.⁵⁸ Adult lampreys are not known to feed after freshwater re-entry and thus migration and spawning are fueled by fat reserves obtained in the ocean.⁵⁹ Pacific lamprey enter the estuary of the Columbia River in winter months and the peak of migration past Bonneville Dam (the first dam encountered during upstream migration) occurs in mid- to late-July.⁶⁰ The majority of lamprey migration continues through late September.⁶¹ Early migrants may enter headwater tributaries, though the late season and long-distance migrants often overwinter in main stem rivers.⁶² As rivers warm in the spring, a final spawning migration occurs in which lamprey enter inland tributaries.⁶³

The mechanisms controlling migration and route selection by adults during upstream migration are poorly understood in lamprey, but appear to differ in fundamental ways from salmonids.⁶⁴ It is widely accepted that salmonids use sequential imprinting on olfactory cues, whereby adults select between streams during upstream migration using memories of olfactory cues present in the water.⁶⁵ Homing is best demonstrated using marked individuals, which are tracked throughout their lives.⁶⁶ Although no known studies have reported the entire life history of marked individual lampreys, genetic evidence and behavioral observations provide strong indirect evidence that homing is absent or much

AM. FISHERIES SOC'Y 143, 143–45, 152–54 (2013).

56. See *id.* at 152–54.

57. *Id.* at 153–54.

58. Mary L. Moser et al., *Lamprey Spawning Migration*, in *LAMPREYS: BIOLOGY, CONSERVATION AND CONTROL* 215, 218–19 (Margaret F. Docker ed., 2015).

59. *Id.* at 226–29.

60. Laurie A. Weitkamp et al., *Seasonal Abundance, Size, and Host Selection of Western River (Lampetra ayresii) and Pacific (Entosphenus tridentatus) Lampreys in the Columbia River Estuary*, 113 NAT'L MARINE FISHERIES SERV. FISHERY BULL. 213, 220 (2015).

61. *Id.* at 219–21.

62. *Id.* at 221.

63. See Brian J. McIlraith et al., *Seasonal Migration Behaviors and Distribution of Adult Pacific Lampreys in Unimpounded Reaches of the Snake River Basin*, 35 N. AM. J. FISHERIES MGMT. 123, 124 (2015).

64. See Lucy Odling-Smee & Victoria A. Braithwaite, *The Role of Learning in Fish Orientation*, 4 FISH & FISHERIES 235, 242 (2003).

65. *Id.* at 242–43.

66. *Id.*

weaker than observed in Pacific salmon.⁶⁷ Rather, adult lampreys have been shown to respond and orient to pheromones released by juvenile lamprey during upstream migration.⁶⁸ This response is possibly because the presence of juveniles is a reliable signal of suitable spawning and rearing habitat from past cohorts.⁶⁹

Peak spawning occurs as flows decline and river temperatures increase.⁷⁰ In coastal systems, lamprey may spawn as early as March and the peak may be as late as mid-May to mid-July in inland tributaries.⁷¹ Nest site selection appears to be driven by a combination of hydraulic and geomorphic factors with the majority of nests located in transition zones between riffle-to-pool zones, run-to-pool zones, or at the tail-crest of pools. Substrate in and around nests tend to be smaller cobbles with fine sand and gravel inside the nest.⁷² Both males and females have been observed participating in nest building;⁷³ building activity often involves the movement of moderate-sized cobbles with the buccal funnel and finer sediment with caudal fins.⁷⁴ When the female is prepared to release eggs in a nest, a male will attach to the female's head or substrate around the nest and wrap around the female's body.⁷⁵ Together, they gyrate as eggs and milt are released.⁷⁶ Eggs are laid in small bursts in multiple nests and subsequently covered with sand or fine gravel.⁷⁷

During both the migratory and spawning phase, Pacific lamprey provide a resource in freshwater food webs.⁷⁸ It has been suggested that migratory lampreys were historically a "prey buffer," meaning they reduced predation on co-migrating salmon because predators selected the slower swimming lamprey with higher per mass caloric value.⁷⁹ Currently, Pacific lamprey are still utilized as a food resource by Columbia and Snake River White sturgeon (*Acipenser transmontanus*), marine mammals, riparian scavengers, and tribal peoples.⁸⁰ Further research is needed to elucidate the role of adult Pacific lamprey and associated marine-derived nutrients in stream food webs.

67. Sang-Seon Yun et al. *Identification of Putative Migratory Pheromones from Pacific Lamprey* (Lampetra Tridentata), 68 CANADIAN J. FISHERIES & AQUATIC SCI., 2194, 2194–95, 2199 (2011).

68. *Id.* at 2195; Nicholas S. Johnson et al., *A Synthesized Pheromone Induces Upstream Movement in Female Sea Lamprey and Summons Them into Traps*, 106 PROC. NAT'L ACAD. SCI. U.S. 1021, 1021 (2009).

69. *See* Yun et al. *supra* note 67, at 2195; Johnson et al., *supra* note 68, at 1024–26.

70. Benjamin J. Clemens et al., *Do Summer Temperatures Trigger Spring Maturation in Pacific Lamprey*, Entosphenus Tridentatus?, 18 ECOLOGY FRESHWATER FISH 418, 418–19 (2009).

71. *See id.* at 419.

72. Abel Forest Brumo, *Spawning, Larval Recruitment, and Early Life Survival of Pacific Lampreys in the South Fork Coquille River, Oregon* 18–19 (Sept. 22, 2006) (unpublished M.S. thesis, Oregon State University) (on file with Oregon State University Library).

73. *See id.* at 29–30.

74. *Id.* at 18–19.

75. Nicholas S. Johnson et al., *Reproductive Ecology of Lampreys*, in LAMPREYS: BIOLOGY, CONSERVATION, AND CONTROL 265, 285 (Margaret F. Docker ed., 2015).

76. *Id.*

77. *See id.*

78. *See* Kevin McCullen, *Low Lamprey Runs in Columbia Worry Biologists, Tribes*, SEATTLE TIMES (Sept. 6, 2010), <http://www.seattletimes.com/seattle-news/low-lamprey-runs-in-columbia-worry-biologists-tribes/>.

79. *Id.*

80. *See id.*

iii. Larval Lamprey

Pacific lamprey are hatched in the gravels and cobbles of tributary streams.⁸¹ They have an extended larval phase characterized by three to eight years of freshwater residence.⁸² Young lamprey larvae are eyeless and worm-like.⁸³ After absorption of the yolk sac, young larvae migrate out of the nest site and colonize stream margins and backwater eddies and burrow into sediment containing organic matter.⁸⁴ Larval lamprey filter small drifting leaf litter, diatoms, and other organic matter out of the water column using an oral hood.⁸⁵

Distribution of larvae within a reach, and at the watershed scale is not well understood, but their distribution has been found to be correlated with specific habitat variables, such as water depth, canopy cover, gradient, and current, with evidence of selection for slower pool habitats.⁸⁶ Stone and Barndt found similar selection for fine sediments, canopy cover, and water velocity.⁸⁷ At a river scale, distribution of larvae is also associated with spawning site distribution⁸⁸ as larvae disperse downstream at low to moderate rates every year. Heather Dawson reported anecdotally that age-0 larvae are often found in slow-water-depositional areas at tributary confluences along the Columbia River.⁸⁹ This suggests that long-distance migration in young-of-the-year larvae is possible (more than 75 river kilometers (km)), though this may result from unobserved spawning in lower main stem river segments.⁹⁰

Many threats exist to lamprey in the larval phase.⁹¹ For example, the U.S. Fish and Wildlife Service noted at least seven major threats to larval lamprey in the freshwater phase: passage barriers for downstream movement (including irrigation diversions and culverts), dewatering events and changes to flow regimes, poisoning from chemical spills and other environmental toxins, poor water quality (including lethal temperatures), dredging for channel maintenance and mining, stream channelization and floodplain disturbance limiting fine sediment and habitat complexity, and predation by non-native species (e.g. smallmouth bass).⁹² Nilsen

81. See Benjamin J. Clemens et al., *Similarities, Differences, and Unknowns in Biology and Management of Three Parasitic Lampreys of North America*, 35 FISHERIES 580, 582–83 (2010).

82. *Id.* at 582.

83. See U.S. FISH & WILDLIFE SERV., PACIFIC LAMPREY (*LAMPETRA TRIDENTATA*), 1 (2007), <https://www.fws.gov/pacific/fisheries/sphabcon/lamprey/pdf/111407%20PL%20Fact%20Sheet%20-%20Short%20Version.pdf>; see *infra* Figure 4.

84. Heather A. Dawson et al., *The Ecology of Larval and Metamorphosing Lampreys*, in LAMPREYS: BIOLOGY, CONSERVATION AND CONTROL 75, 78–84 (Margaret F. Docker ed., 2015).

85. *Id.* at 83.

86. Christian E. Torgersen & David A. Close, *Influence of Habitat Heterogeneity on the Distribution of Larval Pacific Lamprey (*Lampetra tridentata*) at Two Spatial Scales*, 49 FRESHWATER BIOLOGY 614, 623 tbl.2, 625 (2004).

87. Jen Stone & Scott Barndt, *Spatial Distribution and Habitat Use of Pacific Lamprey (*Lampetra tridentata*) *Ammocoetes* in a Western Washington Stream*, 20 J. FRESHWATER ECOLOGY 171, 171 (2005).

88. Torgersen & Close, *supra* note 86, at 620–22.

89. Dawson et al., *supra* note 84, at 103.

90. *Id.*

91. See *Lamprey Overview*, *supra* note 54, at 4.

92. *Id.* at 4–5.

and colleagues found bioaccumulation of many potentially detrimental chemicals, including flame retardants, pesticides, and heavy metals in the tissues of larval lamprey in the Columbia River Basin.⁹³

iv. Migrating Juvenile Lamprey

After a period of three to seven years of filter-feeding, and likely spurred by a number of cues including attainment of sufficient body condition, larvae cease to feed and begin metamorphosing to the parasitic juvenile form.⁹⁴ During this period, juveniles begin a process somewhat similar to smolting in Pacific salmon, where changes in internal organs, external coloration, physiology, and the development of large eyes prepares the lampreys for transition to the marine environment.⁹⁵ A relatively large change in mouthparts occurs, allowing a switch from filter/deposit feeding to ectoparasitism.⁹⁶ This change typically begins in spring or summer and continues through the winter until outmigration the following spring.⁹⁷

While migration of juvenile lampreys is poorly understood, downstream migration is generally thought to be timed to coincide with spring flows and other increased discharge events.⁹⁸ Changes in flow regimes—the amount and timing of flow—and the creation of reservoirs in the Columbia River Basin have likely contributed to an increased bioenergetic cost of downstream migration in juvenile lamprey. Changes in river conditions that favor invasive warm-water predator species, such as bass, sunfish, and pike, have likely contributed to a mortality bottleneck during the juvenile life phase.⁹⁹ Recent studies of smallmouth bass (*Micropterus dolomieu*) stomach content in the reservoirs behind The Dalles, John Day, and McNary Dams found that 2.5% of stomachs sampled contained migrating juvenile lampreys.¹⁰⁰ Juvenile lamprey impingement in screens, designed to safely deter juvenile salmonids, at diversions and hydroelectric facilities are also known sources of mortality.¹⁰¹ Simulated passage of juvenile lampreys through hydroelectric turbines suggest that lamprey may be somewhat impervious to

93. See generally Elena B. Nilsen et al., *Reconnaissance of Contaminants in Larval Pacific Lamprey (Entosphenus tridentatus) Tissues and Habitats in the Columbia River Basin, Oregon and Washington, USA*, 201 ENVTL. POLLUTION 121 (2015).

94. Richard G. Manzon et al., *Lamprey Metamorphosis*, in LAMPREYS: BIOLOGY, CONSERVATION AND CONTROL 139, 141–42 (Margaret F. Docker ed., 2015).

95. *Id.* at 142–47; see *infra* Figure 4.

96. Manzon et al., *supra* note 94, at 147.

97. *Id.* at 147. (As evidenced by observed rates of captures of juvenile lampreys in smolt traps, which peak in late spring).

98. FPC *Lamprey Data Queries*, FISH PASSAGE CTR. (2014), http://www.fpc.org/smolt/currentsmppsubmitdata_lamprey.html (last visited Jan. 31, 2018) [hereinafter Fish Passage Center].

99. See generally Frank J. Rahel & Julian D. Olden, *Assessing the Effects of Climate Change on Aquatic Invasive Species*, 22 CONSERVATION BIOLOGY 521 (2008).

100. ERIC TINUS ET AL., OR. DEP'T FISH & WILDLIFE OCEAN SALMON & COLUMBIA RIVER PROGRAM, 2008-718-00, ABUNDANCE AND DIET OF SMALLMOUTH BASS AT THE DALLES, JOHN DAY, AND MCNARY DAMS, MAY THROUGH AUGUST 2012, at 14 (2013).

101. ASSESSMENT AND TEMPLATE FOR CONSERVATION MEASURES, *supra* note 29, at 282.

negative effects of large pressure changes and other injury because they lack a swim bladder; although, direct field observations of passage survival are lacking.¹⁰²

B. Overview of the Conservation Genetics of Pacific Lamprey

The Pacific lamprey is an anadromous member of the family *Petromyzontidae*, which encompasses thirty-seven of the forty-one recognized lamprey species globally.¹⁰³ Although lampreys have been a common specimen for teaching in biological and medical science for over a century due to the presence of many ancestral features, relatively little research has been conducted on the ecology of lamprey species in their native range compared with other anadromous fishes.¹⁰⁴

Lamprey ancestors diverged from other vertebrate lineages shortly after vertebrates appeared ~400-500 million years ago, and the oldest known fossil classified as a lamprey has been dated to ~360 million years old.¹⁰⁵ Because lampreys contain cartilaginous vertebrae-like structures, they are thought to be representative of the earliest vertebrates still remaining on the planet.¹⁰⁶ Along with 18 other lamprey species globally, Pacific lamprey express an ectoparasitic adult phase.¹⁰⁷ Of those eighteen, only nine are anadromous and parasitic in the marine environment.¹⁰⁸ Of the nine anadromous species, Pacific lamprey returning to the state of Idaho make some of the longest known migrations of any lamprey species in the world, in some cases exceeding 1,000 km.¹⁰⁹

Although Pacific lamprey spawn in similar areas as Pacific salmon, they do not show evidence of natal philopatry (the tendency to return to their stream of origin) or genetic structuring as seen with Pacific salmon.¹¹⁰ In their 2012 study, Spice and colleagues explored the genetic structuring of 965 individuals collected throughout the North American range of Pacific lamprey at twenty different sites.¹¹¹ They analyzed nine microsatellite markers (repeated sections of gene sequences often subject to mutations which may be tracked in related populations) of each individual for evidence of population structuring indicative of natal homing (philopatry) or broad mixing among geographic populations (panmixia).¹¹² The

102. Mary L. Moser et al., *Behavior and Potential Threats to Survival of Migrating Lamprey *Ammocoetes* and *Macrophthalmia**, 25 REV. FISH BIOLOGY & FISHERIES 103, 112 (2015).

103. Ian C. Potter et al., *The Taxonomy, Phylogeny, and Distribution of Lampreys*, in LAMPREYS: BIOLOGY, CONSERVATION AND CONTROL 35, 35–37 (Margaret F. Docker ed., 2015).

104. Moser et al., *supra* note 102, at 113.

105. Robert W. Gess et al., *A Lamprey from the Devonian Period of South Africa*, 443 NATURE 981, 981 (2006).

106. MICHAEL J. BENTON, VERTEBRATE PALAEOLOGY 3–12 (4th ed. 2015).

107. Potter, *supra* note 103, at 43.

108. *Id.*

109. Moser et al., *supra* note 58, at 218–19.

110. Jon E. Hess, *Insights Gained Through Recent Technological Advancements for Conservation Genetics of Pacific Lamprey (*Entosphenus tridentatus*)*, in JAWLESS FISHES OF THE WORLD 149, 153–159 (Alexei Orlov & Richard Beamish eds., 2016).

111. Erin K. Spice et al., *Neither Philopatric nor Panmictic: Microsatellite and mtDNA Evidence Suggests Lack of Natal Homing but Limits to Dispersal in Pacific Lamprey*, 21 MOLECULAR ECOLOGY 2916, 2916–2919 (2012).

112. *Id.*; see also Binbin Lin et al., *Fragment Length Polymorphism Assessment of Genetic*

researchers found evidence leading to low population structuring based on a broad geographic region, suggesting some limits to dispersal in the marine phase.¹¹³ They did not find evidence of natal homing to the extent seen in Pacific salmon, suggesting that Pacific lamprey use a combination of other cues to locate viable spawning habitats.¹¹⁴ This method of spawning site selection has been referred to as the “suitable river strategy,”¹¹⁵ whereby individuals use a variety of cues to locate available spawning habitats in proximity to where they are located at the onset of maturation. The apparent lack of philopatry has several implications for management of populations. Perhaps most important, unlike many fish species, lamprey populations within rivers are probably strongly ecologically and evolutionarily connected to populations in other rivers.

The motivation of individual lampreys with respect to upstream migration distance remains somewhat unclear. Individual migratory histories, as shown by radio telemetry, have revealed complex and often erratic movements during upstream migration.¹¹⁶ If we assume lamprey spawning distribution is random and saturates all easily accessed high-quality habitats before spreading into less desirable habitats, then the long upstream movements of some individuals would be difficult to justify. Conversely, if natal philopatry is present, population structuring would be evident in DNA microsatellites. To date, insufficient scientific research has been done on the distinctions of anthropogenic causes or natural patterns and, thus, how to determine causation to the lack of philopatry.

Recent studies in the Columbia River Basin have found that lampreys which migrate further tend to be larger-bodied¹¹⁷ and have genetic markers linked with larger body size,¹¹⁸ which indicates that there is stock structure assorting to interior versus coastal streams. However, more data is needed. The body size-migratory distance association may be a result of active selection in the current altered river system, though information on genetic structuring of Columbia River lamprey from the pre-dam period is unavailable. There is, however, potential natural structuring of lampreys based on body size historically in the Columbia River Basin or in undammed rivers because longer migrations may require energetic reserves or swimming capacity only met by larger-bodied individuals.¹¹⁹

It is likely that lampreys use a variety of environmental and biological cues to guide migrations. For example, some lampreys use pheromone cues released by successful larvae to guide spawning migrations.¹²⁰ Pacific lamprey dispersal may

Diversity in Pacific Lamprey, 28 N. AM. J. FISHERIES MGMT. 1182, 1189–90 (2008).

113. Spice et al., *supra* note 111, at 2925–26.

114. *Id.*

115. John Waldman et al., *Sea Lamprey Petromyzon Marinus: An Exception to the Rule of Homing in Anadromous Fishes*, 4 BIOLOGY LETTERS 659, 660–61 (2008).

116. Mark A. Kirk & Christopher C. Caudill, *Network Analyses Reveal Intra- and Interspecific Differences in Behaviour when Passing a Complex*, 54 J. APPLIED ECOLOGY 836, 842–43 (2016).

117. Matthew L. Keefer et al., *Effects of Body Size and River Environment on the Upstream Migration of Adult Pacific Lampreys*, 29 N. AM. J. FISHERIES MGMT. 1214, 1218–19 (2009).

118. Jon E. Hess et al., *Genes Predict Long Distance Migration and Large Body Size in a Migratory Fish, Pacific Lamprey*, 7 EVOLUTIONARY APPLICATIONS 1192, 1203–05 (2014).

119. Interview with Richard Beamish, Emeritus Scientist, Pacific Biological Station (Apr. 2016).

120. Sang-Seon Yun et al., *Sulfated Bile Acids as Putative Sex Pheromones in Pacific Lamprey*, 143 TRANSACTIONS AM. FISHERIES SOC'Y 1455, 1456–68 (2014); Yun et al., *supra* note 67, at 2199–2202; P.

also be driven by discharge, temperature, and other water chemistry cues, which are used to select habitats that may not be the individual lamprey's natal stream but contain suitable habitats for spawning and rearing of offspring.¹²¹ One hypothesis suggests selection of non-natal habitats is adaptive for an ectoparasite, which may be transported long distances in the ocean by its host.¹²² There is some confusion here between structuring and panmixia, or random mating patterns among a species resulting in one general population rather than distinct subpopulations because gaps remain in what is known about lampreys which may impede substantive conservation actions and recovery across their range.

C. Distribution of Pacific Lamprey

The historic distribution of Pacific lamprey includes all ocean-accessible rivers from Baja California in Mexico,¹²³ to the Aleutian Islands in Alaska, to Kamchatka in Russia,¹²⁴ and in the Japanese Archipelago.¹²⁵ While Pacific lamprey are still present throughout the majority of the historic range, recent surveys indicate a contraction in their distribution caused by dams and habitat degradation.¹²⁶ The freshwater distribution of lampreys is somewhat less clear. It is thought that the historic inland range of Pacific lamprey included at least all spawning reaches accessible to Pacific salmonids and potentially extended further due to the ability of lampreys to ascend vertical waterfalls.¹²⁷ In coastal California watersheds, lampreys were found in all watersheds greater than 100 km² and were rare or absent in drainages less than 50 km², suggesting stream or watershed size limits distribution.¹²⁸

The USFWS, using a diagnostic tool developed by NatureServe, created a distribution map of Pacific lamprey in the contiguous United States.¹²⁹ It has predictions of subwatershed-level viability of Pacific lamprey larval populations or adult returns.¹³⁰ This designation compared historic distribution information,

W. Sorensen & T. R. Hoye, *A Critical Review of the Discovery and Application of a Migratory Pheromone in an Invasive Fish, the Sea Lamprey Petromyzon Marinus L.*, 71 J. FISH BIOLOGY 100, 102 (2007).

121. McIlraith et al., *supra* note 63, at 131–32.

122. R. J. Beamish, *Adult Biology of the River Lamprey (Lampetra ayresi) and the Pacific Lamprey (Lampetra tridentata) from the Pacific Coast of Canada*, 37 CANADIAN J. FISHERIES AQUATIC SCI. 1906, 1920–21 (1980) (hosts include Pacific hake, cod, sablefish, flounder, perch, salmonids, and whales).

123. Gorgonio Ruiz-Campos & Salvador Gonzalez-Guzman, *First Freshwater Record of Pacific Lamprey (Lampetra tridentata) from Baja California, Mexico*, 82 CAL. FISH & GAME 144, 144–45 (1996).

124. CLAUDE B. RENAUD, LAMPREYS OF THE WORLD: AN ANNOTATED AND ILLUSTRATED CATALOGUE OF LAMPREY SPECIES KNOWN TO DATE 5 (FAO Species Catalogue for Fishery Purposes No. 5, 2011).

125. Yuji Yamazaki et al., *Occurrence of Larval Pacific Lamprey (Entosphenus tridentatus) from Japan, Detected by Random Amplified Polymorphic DNA (RAPD) Analysis*, 52 ICHTHYOLOGICAL RES. 297 (2005).

126. Stewart B. Reid & Damon H. Goodman, *Pacific Lamprey in Coastal Drainages of California: Occupancy Patterns and Contraction of the Southern Range*, 145 TRANSACTIONS AM. FISHERIES SOC'Y 703, 709 (2016).

127. See generally U. G. Reinhardt et al., *Pacific Lamprey Climbing Behavior*, 86 CANADIAN J. ZOOLOGY 1264 (2008); see generally K. E. Frick et al., *Climbing Success of Adult Pacific Lamprey on a Vertical Wetted Wall*, 24 FISHERIES MGMT. & ECOLOGY 230 (2017).

128. Reid & Goodman, *supra* note 126, at 706–707.

129. See *infra* Figure 3.

130. See generally L. L. MASTER ET AL., NATURESERVE CONSERVATION STATUS ASSESSMENTS: FACTORS FOR

provided by expert opinion and available data, with current monitoring information for presence or absence of adults or juveniles, as well as predictions based on potential threats and limiting factors of population viability.¹³¹ Additionally, the USFWS has delineated ten Regional Management Units (RMU)¹³² as an effort to focus conservation efforts to specific watersheds. Notably, the RMUs exhibit some geographic overlap with the species status designations of the NatureServe map.¹³³ The true historic distribution is likely inaccessible to western science but may be gathered through Traditional Ecological Knowledge (TEK).¹³⁴ TEK could be especially powerful with a species like Pacific lamprey because it plays an important role in many indigenous cultures in the region (as discussed in *infra* Part II).¹³⁵ Through the interpretation of traditional place names in native languages, TEK has been used to assess historic distribution in California.¹³⁶

D. Passage at Hydroelectric Facilities and Current Distribution

Pacific lamprey have been negatively impacted throughout their range by passage barriers and other anthropogenic changes to river conditions.¹³⁷ This is particularly evident in the Columbia River Basin, where a complex system of large hydroelectric dams, tens of thousands smaller irrigation diversions, and other barriers have been built in the last century, despite the presence and ecological, cultural, and economic importance of many migratory species in the basin. A variety of fish passage structures have been created to facilitate passage of migratory fish across these barriers but the design criteria have focused on salmonids.¹³⁸ For adult salmonids, passage success in modern fishways is now greater than 95%¹³⁹ compared to about 50% for adult Pacific lamprey.¹⁴⁰ Many structures designed to facilitate efficient upstream and downstream passage of salmon have been detrimental to lamprey passage.¹⁴¹ For example, screens used to direct salmon smolts into bypass channels cause impingement of migrating juvenile lampreys.¹⁴² Efforts in the past two decades have begun to address lamprey-specific needs,

EVALUATING SPECIES AND ECOSYSTEM RISK (Apr. 2012), http://www.natureserve.org/sites/default/files/publications/files/natureserveconservationstatusfactor_s_apr12.pdf; see *infra* Figure 3.

131. *Id.*

132. See *infra* Figure 2.

133. See *infra* Figure 3.

134. See generally Eugene Hunn, *Columbia Plateau Indian Place Names: What Can They Teach Us?*, 6 J. LINGUISTIC ANTHROPOLOGY 3 (1996); see David A. Close et al., *supra* note 1, at 19.

135. Close et al., *supra* note 1.

136. *Id.*

137. See *infra* Figure 5.

138. Reinhardt et al., *supra* note 127, at 1264.

139. Matthew L. Keefer et al., *Escapement, Harvest, and Unknown Loss of Radio-Tagged Adult Salmonids in the Columbia River – Snake River Hydrosystem*, 62 CANADIAN J. FISHERIES & AQUATIC SCI. 930, 934 (2005).

140. Mary L. Moser et al., *Passage Efficiency of Adult Pacific Lampreys at Hydropower Dams on the Lower Columbia River, USA*, 131 TRANSACTIONS AM. FISHERIES SOC'Y 956, 960–62 (2002).

141. See, e.g., R.A. MOURSUND ET AL., U.S. ARMY CORPS OF ENG'RS, EFFECTS OF DAM PASSAGE ON JUVENILE PACIFIC LAMPREY (*LAMPETRA TRIDENTATA*) 1.2 (2001).

142. *Id.*

including construction of lamprey specific passage structures and modification of fishway operations to benefit lamprey without impacting salmon.¹⁴³

The impediments to adult lamprey passage posed by hydroelectric facilities have been implicated as the major limiting factor in the size of returns to inland watersheds.¹⁴⁴ In their 2009 publication, Matthew L. Keefer et al. found that of the roughly 3600 lamprey radio-tagged at Bonneville Dam over the period 2005-2007, roughly half were able to pass one dam, only about 30% were able to pass two dams, about 18% passed three dams, and 1% were able to pass the first dam on the Snake River.¹⁴⁵ Counts of untagged lampreys at dams between 1998 and 2016 follow similar patterns.¹⁴⁶ They also found evidence for size-selective passage at all monitored dams, which suggests larger-bodied individuals are more likely to pass multiple hydroelectric facilities than smaller-bodied individuals.¹⁴⁷

These findings were summarized, along with other lamprey passage research conducted during the period 2000-2010, in a 2012 report to the U.S. Army Corps of Engineers by Keefer and colleagues.¹⁴⁸ They found that PIT-tagged lamprey passed with greater efficiency than radio tagged lamprey, due to tagging and handling effects.¹⁴⁹ Despite improved performance with PIT-tagged lamprey, only about 50% were able to pass Bonneville Dam, 28% were able to pass The Dalles Dam, 18% were able to pass John Day Dam, and 5% passed McNary Dam.¹⁵⁰ Less than 1% of lamprey passed Ice Harbor and Priest Rapids Dams on the Snake River and Middle Columbia River, respectively.¹⁵¹ This high attrition, in tagged adult fish moving upstream, corroborates the declining trends in passage observations at count windows inside Columbia River dams.¹⁵² Notably, the proportion of lamprey migrating long distances to interior streams in unimpounded systems remains unknown.

In 2012, Keefer et al. summarized the underlying factors that shape the passage success of lamprey in the Columbia River Basin.¹⁵³ They found that at multiple scales, from dam-to-dam escapement to individual performance within a fishway, larger-bodied individuals were more successful at navigating the altered river environment.¹⁵⁴ They suggested that larger individuals may be stronger and faster swimmers within fishways than smaller fish, that larger lamprey may have

143. M.L. Moser et al., *Development of Pacific Lamprey Fishways at a Hydropower Dam*, 18 FISHERIES MGMT. & ECOLOGY 190, 191 (2011) (describing Lamprey Flume Structures (LFS), Lamprey Passage Structures (LPS), bollard fields and passage orifices in the Portland District dams); see also Eric L. Johnson et al., *Movement of Radio-Tagged Adult Pacific Lampreys During a Large-Scale Fishway Velocity Experiment*, 141 TRANSACTIONS AM. FISHERIES SOC'Y 571, 572 (2012).

144. See IDAHO DEP'T OF FISH & GAME, THE STATUS OF PACIFIC LAMPREY (*ENTOSPHEUS TRIDENTATUS*) IN IDAHO 43-47 (2011).

145. See Keefer et al., *supra* note 117, at 1218.

146. See *infra* Figure 5.

147. Keefer et al., *supra* note 117, at 1218; see also *infra* Figure 5.

148. See generally MATTHEW L. KEEFER ET AL., U.S. ARMY CORPS OF ENG'RS, REPORT NO. 2012-8, ADULT PACIFIC LAMPREY PASSAGE: DATA SYNTHESIS AND FISHWAY IMPROVEMENT PRIORITIZATION TOOLS (2012).

149. *Id.* at 100-01.

150. *Id.* at 90-91.

151. See *infra* Figure 6.

152. KEEFER ET AL., *supra* note 148, at 90-91.

153. *Id.* at 100-01.

154. *Id.*

greater energy reserves required for long-distance migrations, and that negative handling effects may be reduced for larger-bodied individuals.¹⁵⁵ They also highlighted the potential that larger-bodied individuals may be from distinct upriver populations, though they note that this would be at odds with the common consensus of fully mixed stock structure in Pacific lamprey.¹⁵⁶ Historic genetic structuring of upriver stocks of Pacific lamprey in the Columbia River Basin are unknowable at this point, but assessment of fine-scale genetic structuring in unimpounded large river systems, such as the Fraser River Basin in British Columbia or the Yukon River in Alaska, using previously applied sampling designs, could guide future restoration efforts.

Fishways and reservoir environments present drastically different river environments than were present during much of the evolution of Pacific lamprey.¹⁵⁷ Matthew L. Keefer et al. in 2012, noted that escapement rates vary across years and may be linked to environmental conditions.¹⁵⁸ Reservoir passage was found to be lowest during periods of very high water temperatures and that this trend increased with further inland reservoirs.¹⁵⁹ Altered conditions in fishways were found to influence passage success.¹⁶⁰ Lamprey passage through dams was observed to be most successful during periods of low discharge and least successful during periods of high discharge.¹⁶¹ Keefer et al. in 2012, noted that fine-scale conditions in fishways likely influence passage success of lamprey at Columbia River dams because high velocity and turbulent conditions at dam tailraces and forebays are particularly challenging for lamprey migration.¹⁶² These findings suggest lamprey passage may be increasingly threatened by climate induced changes in thermal and hydraulic conditions in the Columbia River Basin.

Additionally, other passage bottlenecks have been identified at Columbia River dams.¹⁶³ For example, in 2013, Keefer et al. identified four fishway segments at Bonneville Dam that contributed to 65% of all turnaround events across the years studied.¹⁶⁴ Turnaround events in the upper ladder segments resulted in lamprey which were least likely to attempt to pass the dam again, suggesting a high energetic cost to passage combined with an apparent lack of motivation to return to natal spawning grounds in lamprey.¹⁶⁵ Kirk and others found additional evidence that passage bottlenecks are created by a combination of both high turbulence and

155. *Id.*

156. *Id.* at 101.

157. See generally DAMS, FISH AND FISHERIES, FAO FISHERIES TECHNICAL PAPER NO. 419. (Gerd Marmulla ed., 2001); see generally NAT'L RESEARCH COUNCIL COMM. ON PROT. & MGMT. OF PAC. NW. ANADROMOUS SALMONIDS, UPSTREAM: SALMON AND SOCIETY IN THE PACIFIC NORTHWEST 26 (1996).

158. KEEFER ET AL., *supra* note 148, at 101.

159. *Id.*

160. *Id.*

161. *Id.*

162. *Id.*

163. E.g., Matthew L. Keefer et al., *Fishway Passage Bottleneck Identification and Prioritization: A Case Study of Pacific Lamprey at Bonneville Dam*, CANADIAN J. FISHERIES & AQUATIC SCI. 1551, 1565 (2013).

164. Matthew L. Keefer et al., *Factors Affecting Dam Passage and Upstream Distribution of Adult Pacific Lamprey in the Interior Columbia River Basin*, 22 ECOLOGY FRESHWATER FISH 1, 5 (2013).

165. See *id.* at 7.

high-velocity flows.¹⁶⁶ Sharp corners may also impede lamprey in areas of high water velocity.¹⁶⁷

The poor passage environment within the Columbia River Basin has likely resulted in a contracted upstream distribution for adults.¹⁶⁸ Historic estimates of lamprey returns to the Columbia River generally and to specific subbasins, in particular, are lacking. Despite this, the Idaho Department of Fish and Game has identified restoration goals of greater than 30,000 spawning lamprey per year returning to the Clearwater and Salmon River basins combined.¹⁶⁹ In the last decade, an average of fewer than thirty Pacific lamprey have been observed passing Lower Granite Dam on the Snake River in Washington, the last dam before a fish may reach the Clearwater or Snake River.¹⁷⁰ The CRITFC and its member tribes have also set a goal of restoring harvestable lamprey runs in the inland Columbia River Basin by 2050.¹⁷¹ Without drastic improvements to lamprey run size and passage rates in the Columbia River Basin, the established goal of lamprey restoration set by the State of Idaho and the CRITFC, and its member tribes, will not be possible.

E. Pacific Lamprey Response to Dam Removal

The challenges to comply with the Federal Power Act and the Endangered Species Act have resulted in the removal of hydroelectric facilities across the Pacific Northwest.¹⁷² Pacific lamprey genetics, life history, and recolonization following barrier removal suggest rapid ability to recolonize historic habitat.¹⁷³ Because of their lack of natal philopatry and ability to rapidly colonize newly accessible territory, Pacific lamprey may be a species with high recovery potential when barriers are removed.¹⁷⁴ Recent dam removal actions in the Pacific Northwest, specifically on the White Salmon, and Elwha in Washington, provide relevant case studies for lamprey conservation.¹⁷⁵ In the first two years of recovery of the former reservoir sites of both Elwha and Condit Dams, Pacific lamprey were observed migrating to spawn in upriver sections.¹⁷⁶ Subsequently, larval and juvenile Pacific lamprey have been observed, indicating successful recolonization of historic

166. Mark A. Kirk, Migration Behaviors of Adult Pacific Lamprey (*Entosphenus tridentatus*) at Large Hydropower Dams on the Columbia River, at 75, 90–91 (Feb. 2015) (unpublished M.S. thesis, University of Idaho) (on file with the University of Idaho Library).

167. *Id.* at 94.

168. Clemens et al., *supra* note 2, at 269.

169. See IDAHO DEP'T OF FISH & GAME, DOCUMENT ID No. P111657, EVALUATE STATUS OF PACIFIC LAMPREY IN THE CLEARWATER RIVER AND SALMON RIVER DRAINAGES, IDAHO 14 (2009).

170. Fish Passage Center, *supra* note 98.

171. TRIBAL PACIFIC LAMPREY RESTORATION PLAN, *supra* note 3, at 6.

172. See generally Blumm & Erickson, *supra* note 15.

173. Lamprey show little apparent genetic structuring by fine-scale natal philopatry and use alternative cues to determine potential spawning habitat. See Spice et al., *supra* note 111, at 2916, 2917 (2012).

174. See *id.*

175. Linda V. Mapes, *More Elwha Fish Find Way to Dam-free Upper Watershed*, SEATTLE TIMES (Oct. 18, 2016), <https://www.seattletimes.com/seattle-news/environment/more-elwha-fish-find-way-to-dam-free-upper-watershed/>.

176. See *id.*

habitats.¹⁷⁷ Pacific lamprey have also demonstrated the ability to naturally recolonize historic habitats on the Hood River, following the 2010 removal of the Powerdale Dam.¹⁷⁸

Prior to dam removal on the Elwha River, the Lower Elwha Klallam Tribe had documented and studied lamprey in the lower Elwha. Observations of adult, juvenile, and larval lamprey were limited to sites downstream of the lower dam.¹⁷⁹ Since dam removal in 2012, the Tribe has documented adults migrating to previously blocked habitat.¹⁸⁰ Biologists for the Tribe observed lamprey in their larval stage in 2013 and 2014.¹⁸¹ Notably, in February of 2016, the Tribe observed a juvenile lamprey making its downstream migration to the ocean.¹⁸² These observations demonstrate successful nest building and larval rearing. The rapid recolonization of Pacific lamprey into previously blocked habitats suggests dam removal as a viable tool for lamprey conservation efforts and demonstrates that the presence of larval pheromones is not a prerequisite for spawning.

Similarly, Pacific lamprey have begun to recolonize habitat following removal of Condit Dam on the White Salmon River.¹⁸³ Removal of the Condit Dam was precipitated by the FERC relicensing process.¹⁸⁴ Privately owned and operated by PacifiCorp, Condit Dam first received a 25-year FERC license in 1968.¹⁸⁵ In 1982, the Northwest Power and Conservation Council suggested that relicensing be conditioned on PacifiCorp providing fish passage at Condit Dam for ESA listed salmon and steelhead.¹⁸⁶ Additionally, the Yakama Nation, CRITFC, and environmental organizations advocated that if PacifiCorp did not install fish passage facilities, dam removal would be the reasonable alternative.¹⁸⁷ Pursuant to the National Environmental Policy Act (NEPA), FERC issued a final environmental impact statement (EIS), which conditioned relicensing on the construction fish passage facilities.¹⁸⁸ With a price tag of over \$30,000,000 PacifiCorp opted for “the most economically efficient alternative: dam removal.”¹⁸⁹

177. Royal, *supra* note 15.

178. *Hood River Habitat Program*, DEP’T FISHERIES CONFEDERATED TRIBES WARM SPRINGS, <http://wsfish.org/hood-river-habitat/> (last visited Jan. 20, 2018).

179. Royal, *supra* note 15.

180. *Id.*

181. *Id.*

182. *Id.*

183. Tammy Ayer, *Lamprey Found Above Condit Dam Site on White Salmon River*, YAKIMA HERALD (Mar. 12, 2016), http://www.yakimaherald.com/news/local/lamprey-found-above-condit-dam-site-on-white-salmon-river/article_7869617a-e8ea-11e5-a5d2-ef3fc0cee45c.html.

184. See Blumm & Erickson, *supra* note 15, at 1061.

185. *Id.* at 1060–61.

186. *Id.* at 1062.

187. *Id.*

188. *Id.* at 1062–63.

189. *Id.* at 1063. Due to excessive buildup of sediment behind the face/forebay, removal of Condit Dam required section 401 certification to ensure the dam removal project complied with the Washington State Water Quality Standards. See David H. Becker, *The Challenges of Dam Removal: The History and Lessons of the Condit Dam and Potential Threats from the 2005 Federal Power Act Amendments*, 36 ENVTL. L. 811, 836 (2006).

The Condit Dam was breached and removed in 2011 resulting in the opening of substantial habitat that had been blocked since 1917.¹⁹⁰ Prior to dam removal, biologists of the Yakama Nation and U.S. Fish and Wildlife Service conducted surveys that demonstrated no presence of Pacific lamprey upstream of Condit Dam.¹⁹¹ In the summer of 2015, as part of the post-dam removal monitoring project, surveys by the U.S. Fish and Wildlife Service observed larval lamprey at three locations upstream of the former dam site.¹⁹² Former reservoir sites may also contain highly productive larval lamprey habitat in areas of fine sediment, especially when dam removal is paired with floodplain reconnection.¹⁹³ Although juvenile lamprey have not yet been observed to demonstrate successful larval rearing, the removal of Condit dam provides a novel case study for natural recolonization of historic habitat in the Columbia River Basin.

Removal of dams in the Pacific Northwest, such as the Glines Canyon and Elwha dams on the Elwha River, and Condit Dam on the White Salmon River have opened miles of spawning habitat that have been blocked from lamprey passage for decades.¹⁹⁴ Recent observations of larval and juvenile lamprey upstream of former dam sites on the Elwha and White Salmon rivers indicate that Pacific lamprey can naturally recolonize historic habitats following dam removal.¹⁹⁵

i. Conclusion: Unique Life History of Pacific Lamprey Demands Holistic Conservation

Pacific lamprey are a unique and fascinating native component of the ecology of the Pacific Western United States. Though lampreys have existed for millennia, recent anthropogenic disturbances have contributed to the decline in abundance and contraction in the distribution of anadromous Pacific lamprey throughout their historic range. Understanding the specific life-history and stage-specific constraints on Pacific lamprey is critical to evaluating the legal status and conservation of this species. Of these constraints, passage of adult and juvenile lamprey through hydroelectric facilities and highly altered watersheds are likely the strongest limiting factors to lamprey populations that may be directly remedied by managers. Furthermore, the strength of these constraints compounds for the interior Columbia River Basins, where lamprey have to pass up to nine major hydroelectric facilities and other barriers resulting in a dramatically limited functional range of this species.

190. Blumm & Erickson, *supra* note 15, at 1060.

191. Washines & Smith, *supra* note 15 (however, western brook lamprey, a non-migratory species, were observed both upstream and downstream of Condit Dam).

192. *Id.*

193. See JEFFREY JOLLEY ET AL., U.S. FISH & WILDLIFE SERV. OCCURRENCE, DETECTION, AND HABITAT USE OF LARVAL LAMPREY IN THE LOWER WHITE SALMON RIVER AND MOUTH: POST-CONDIT DAM REMOVAL: FY 2012 ANNUAL REPORT 15 (Feb. 25, 2013).

194. Washines & Smith, *supra* note 15.

195. *Id.*

III. A CULTURAL REVIEW OF PACIFIC LAMPREY IN THE COLUMBIA RIVER BASIN

Spiritually, he's [the Pacific lamprey] one of us How do we let something that's 450 to 500 million years old go extinct? Shame on us - the whole bunch of us People better realize what they're doing, because we are a big family. We are the circle. That's what life is about. We take care of one another. So, when we have someone [the lamprey] in trouble, that's when the rest of us have to step in.¹⁹⁶

A. A Cultural Connection with Pacific Lamprey in the Columbia River Basin

For indigenous peoples of the Columbia and Snake River basins, the cultural connection and importance of Pacific lamprey (or "eels") is high, and the impacts of the species' severe decline in the Pacific Northwest cannot be overstated.

i. A Native Worldview, Evident in the Creation Story of Lamprey

The sustenance, culture, and way of life of indigenous peoples in the Snake and Columbia River Basins are inextricably intertwined with fish, animals, and plants, and the waters, land, and air they depend upon. This indigenous worldview encompasses a respect for all things in nature and for Mother Earth herself; an acknowledgement that each life form serves an important role and no life form is more important than any other; a belief that the fish and animals give themselves up to humans for subsistence or for use in daily life; and a responsibility of reciprocity, to respectfully care for these fish and animals, to use them, and honor them.

The creation story of eel, told by Jerrid Weaskus of the Nez Perce Tribe in the powerful and provocative film about Pacific lamprey, *The Lost Fish*, captures this worldview:

Creation story is this; Lamprey was a gambler, okay. He was a gambler. Coyote was the Creator. . . . He's going about his business and he's along the river, there. And [then t]here's Lamprey . . . he's down there, and he's been talking to Beaver and Muskrat. Coyote [comes along and] says, "What's going on?" [Beaver and Muskrat say,] "Lamprey is down there and he's playing stick game, bone game, and he's beating everybody." So, Coyote walks down to the bank and says, "Hey what's going on? . . . [Hey Lamprey] let me play you?" [And Lamprey says,] "Alright." Coyote beats him on the first round, and he's taking his stuff. Then he beats him again. Now Eel is sitting there and he has no possessions, nothing no more to gamble with [and he says,] "One more game, [come'on] Coyote, one more?" Coyote asks, "What you gonna bet with?" [Lamprey,] "I'm gonna bet you my arm, that I'm gonna beat you finally." So, Coyote plays him again, and beats him [Lamprey says,] "I'm gonna beat you this time Coyote. I'm gonna gamble you my leg." [He loses]. Lamprey is sitting there

196. THE LOST FISH (Freshwaters Illustrated & Columbia River Inter-Tribal Fish Comm'n 2013), <http://www.critfc.org/fish-and-watersheds/columbia-river-fish-species/the-pacific-lamprey/lost-fish-film/>.

with no arms, and no legs. Coyote looks at him and says, “You have nothing to gamble with anymore” and he kicks him into the river, “and because your mouth got you into trouble, that’s what you’re going to suck on the rocks with”. . . . He is a fish. He belongs to this river. He’s Native to this . . . system This river needs him. And that’s the bottom line.¹⁹⁷

Weaving morality, justice, traditional ecological knowledge,¹⁹⁸ humor, and entertainment, this story is shaped from a long, ancestral existence connected to a particular landscape. Its bottom line is that Pacific lamprey are an inseparable part of the river: they need the river and the river needs them to maintain a balanced and sustainable existence.

B. The Cultural Significance and Value of Pacific Lamprey

“The lamprey is our elder, without him the circle of life is broken.”¹⁹⁹

For tribes in the Snake and Columbia River Basins, Pacific lamprey are just as important as salmon.²⁰⁰ However, due to the extirpation and decline in abundance throughout the Columbia River Basin, some tribes have a greater opportunity to interact with and honor Pacific lamprey within their cultural practices. Currently, upriver and interior tribes, located above migratory blockages such as the Grand Coulee Dam and the Hells Canyon Complex, have not seen Pacific lamprey in their waters since the construction of the respective dams.²⁰¹ Therefore, unless actions are taken to restore the Pacific lamprey’s range, interior tribes will continue to be faced with barriers as to their ability to incorporate lamprey as medicine, food or in ceremonies.

Additionally, there are many upriver and interior tribes who have not seen Pacific lamprey in their ancestral waters since the construction of dams without fish passage facilities. For example, Grand Coulee Dam extirpated Pacific lamprey from the Upper Columbia River so that tribes such as the Spokane Tribe of Indians, the Sinixt, Ktunaxa First Nation, and other upriver tribes are losing their cultural

197. *Id.*

198. Prior to European settlement, Native Peoples carefully attended to and upheld laws and policies based on what can be understood as indigenous knowledge of science, contemporarily known as Traditional Ecological Knowledge (TEK). *See generally* FIKRET BERKES, SACRED ECOLOGY (3d ed. Routledge, 2012). Indigenous peoples use an oral tradition in contrast to a written code, and although different, oral traditions are equally as important to the passing of ecological knowledge, values, and norms through the knowledge-practice-belief-complex. Fikret Berkes et al., *Rediscovery of Traditional Ecological Knowledge as Adaptive Management*, 10 *ECOLOGICAL APPLICATIONS* 1251, 1251–52 (2000). Similarities between Western Science and TEK include integrating observation with conceptual models of the world (paradigms), (implicit) hypotheses, strong recognition of cause and effect, and (explicit and implicit) predictions for outcomes given a set of conditions. *See id.* Although TEK does not have a formal scientific method and written transmission of ideas, the cultural transmission of ideas has proven responsive to prudent management, conservation and legal decisions. *See generally id.*

199. TRIBAL PACIFIC LAMPREY RESTORATION PLAN, *supra* note 3, at 1.

200. *Id.* at iii.

201. PUB. UTIL. DIST. NO. 1 OF CHELAN CTY., FILE E4(2) NO. 67, A STATUS OF PACIFIC LAMPREY IN THE MID-COLUMBIA REGION 3 (Dec. 15, 2000).

connection to them.²⁰² Likewise, because of low returns into the Salmon River drainage, the Shoshone-Bannock have not seen or harvested lamprey in places where they were once abundant like Salmon, Idaho.²⁰³ The ‘townsite’ of the northern band of Shoshone known as the *Agai-Dika* or Salmon eaters is now present-day Salmon, Idaho.²⁰⁴ Additionally, in the Upper Snake River Basin, the Shoshone-Paiute, Burns Paiute, and Fort McDermitt Paiute Shoshone tribes are above the Hells Canyon Complex of dams, which do not have fish passage facilities²⁰⁵ and thus have been denied the opportunity to honor and celebrate lamprey in their ancestral territories. The losses of cultural connection and indigenous knowledge for upper-river and interior tribes cannot be overstated. And future lamprey restoration efforts should consider translocation programs into historic habitats.

For generations, indigenous peoples of the Snake and Columbia River Basins have harvested lamprey for subsistence, medicinal, and religious purposes.²⁰⁶ Lamprey are among the first foods (along with water, salmon, deer, roots, and berries) that are present at tribal longhouses, ceremonies, and celebrations.²⁰⁷ These gatherings serve as a reminder of the promise of these foods to take care of the people and for “the people’s reciprocal [promise] to respectfully use and take care of the[se] foods.”²⁰⁸ Lamprey and their oil are important in the diets of tribal people.²⁰⁹ Lamprey have medicinal value to tribal people.²¹⁰ “Oil collected from drying lamprey is applied to skin or ailing parts of the body in conjunction with a purifying sweat bath . . . [and] historically [was used] to condition hair and cure earaches.”²¹¹ Indigenous knowledge of Pacific lamprey are woven with myths and legends into sacred law that reinforces how humans are “to live with our brothers and sisters of the natural world” and respect them.²¹² Pacific lamprey are honored in “songs [and ceremonies] that are specific for different animals, plants, or other beings [that] help people pay respect . . . before and sometimes after their harvest.”²¹³

Pacific lamprey migrate to habitats inaccessible to salmon, which is supported by indigenous place names indicating lamprey presence or harvest in areas that are naturally blocked to salmon.²¹⁴ In the Nez Perce language, Pacific lamprey are “he

202. See Close et al., *supra* note 1.

203. J.E. Booth, *Local Intelligence*, 16 IDAHO RECORDER 3, Aug. 23, 1893.

204. LEMHI-SHOSHONE TRIBES, <http://www.lemhi-shoshone.com/> (last visited Jan. 14, 2018).

205. DON CHAPMAN, IDAHO POWER CO., FEASIBILITY OF REINTRODUCTION OF ANADROMOUS FISH ABOVE OR WITHIN THE HELLS CANYON COMPLEX: HISTORY OF THE HELLS CANYON COMPLEX 7, 37 (James A. Chandler ed., 2003), https://docs.idahopower.com/pdfs/relicensing/hellscanyon/hellspdfs/techappendices/Aquatic/e31_02_ch02.pdf.

206. TRIBAL PACIFIC LAMPREY RESTORATION PLAN, *supra* note 3, at 8.

207. *Id.*

208. *Id.*

209. Close et al., *supra* note 1, at 22.

210. *Id.*

211. *Id.*

212. *Id.*

213. *Id.*

214. See generally David A. Close et al., *Traditional Ecological Knowledge of Pacific Lamprey (Entosphenus tridentatus) in Northeastern Oregon and Southeastern Washington from Indigenous*

su;” in other Sahaptin languages they are “asum” or “ksuyas.”²¹⁵ The Nez Perce also have place names associated with Pacific lamprey, such as the place “where the eels feed away at” (“hesu nmptipinwes”), which is present-day Council, Idaho.²¹⁶ Other place names such as Asotin Creek, a tributary of the Snake River in Washington, are commonly viewed as derivations from “he su.”²¹⁷ Indigenous place names are an important and applicable use of traditional ecological knowledge that can be used to infer the past expanse of Pacific lamprey’s range, and thereby bolster restoration efforts and educate people to the reverence held for lamprey.

To the tribes of the Snake and Columbia River Basins, Pacific lamprey are fundamentally important and linked to the ecological health of the basin in a similar manner as salmon and steelhead.²¹⁸ From a tribal cultural perspective, it is impossible to place a value, in economic terms, on any animal or plant, whether it be salmon or Pacific lamprey—they are invaluable. Other cultures have not viewed Pacific lamprey, which is not a charismatic species, so kindly. Western culture has widely considered lamprey to be an ugly fish, a trash fish, or even likened to varmints.²¹⁹ This has been due in part to an unfortunate association with the invasive Great Lakes sea lamprey, as well as a limited understanding of the ecological and cultural importance of Pacific lamprey in the Columbia and Snake Basin.²²⁰

C. Securing Tribal Culture and Way of Life in Treaties with the United States

The United States acknowledged the pre-existing sovereignty of tribes in the Snake and Columbia River Basin by entering into treaties. During the treaty negotiations for the 1855 Treaty with the Nez Perce, the United States, through Governor Isaac Stevens, assured leaders like Chief Looking Glass of the Nez Perce about the continuation of off-Reservation rights as follows:

I will ask of Looking Glass whether he has been told of our council. Looking Glass knows that in this reservation settlers cannot go, that he can graze his cattle outside of the reservation on lands not claimed by settlers, that he can catch fish at any of the fishing stations, that he can kill game and go

Peoples of the Confederated Tribes of the Umatilla Indian Reservation, 38 J. NW. ANTHROPOLOGY 141 (2004).

215. *he su*, NEZ PERCE DICTIONARY 120 (1994); Close et al., *supra* note 1, at 22.

216. *hesu nmptipinwes*, *supra* note 215, at 120.

217. E.g., Phil Dougherty, *Asotin County – Thumbnail History*, HISTORY LINK (Feb. 14, 2006), <http://www.historylink.org/File/7643>.

218. *Pacific Lamprey: A Cultural Resource*, COLUMBIA RIVER INTER-TRIBAL FISH COMM’N, <http://www.critfc.org/fish-and-watersheds/columbia-river-fish-species/lamprey/> (last visited Jan. 20, 2018) [hereinafter *Pacific Lamprey: A Cultural Resource*].

219. Michael Milstein, *A Desperate Fight to Save an Ugly, Fat Fish*, SEATTLE TIMES (Sept. 22, 2008), <http://www.seattletimes.com/seattle-news/a-desperate-fight-to-save-an-ugly-fat-fish/>; Cliff Newell, *Trash Fish a Big Key to Sustainability*, PORTLAND TRIB. (Apr. 9, 2008), <http://portlandtribune.com/component/content/article?id=65636>; TuckRussell, *The Lamprey, Close to Extinction, Could Bring down NW Salmon Too*, CROSSCUT (Mar. 2, 2012), <http://crosscut.com/2012/03/the-lamprey-close-extinction-could-bring-down-nw-s/>.

220. TRIBAL PACIFIC LAMPREY RESTORATION PLAN, *supra* note 3, at 2.

to buffalo when he pleases, that he can get roots and berries on any of the lands not occupied by settlers.²²¹

The United States Treaty with the Nez Perce and other tribes' treaties reserves to the Tribes the right to take fish at all usual and accustomed places, and to hunt, gather, and pasture on open and unclaimed lands.²²² Indian treaties are, under the U.S. Constitution, part of "the supreme Law of the Land."²²³ These Treaty-reserved rights to take fish at all usual and accustomed places, in the words of the United States Supreme Court, were "part of larger rights possessed by the Indians, upon exercise of which there was not a shadow of impediment, and which were not much less necessary to the existence of the Indians than the atmosphere that they breathed."²²⁴ These treaty fishing rights include salmon, steelhead, sturgeon, lamprey, and other species.²²⁵

The United States also has a fiduciary relationship with federally recognized tribes resulting from Treaties, federal statutes, Executive Orders, and court rulings.²²⁶ This federal trust responsibility encompasses protection of treaty fishing rights and other tribal trust resources. For example, the United States has initiated lawsuits on behalf of tribes with Treaty fishing rights, as their trustee, to give meaning to Tribes' Treaty-reserved rights.²²⁷ In the USFWS's 2011 Pacific lamprey conservation initiative, acknowledged that "Pacific lamprey is a tribal trust species and as such the USFWS recognizes tribal treaty and other rights . . . and strives to conduct its programs and actions in a manner that protects tribal trust resources, including fish and wildlife resources and their associated habitat."²²⁸

D. Declines in Pacific Lamprey Severely Impact Tribes

As a Tribe [the Nez Perce], we are witnessing a severe decline in Pacific lamprey throughout Idaho, Washington, and Oregon. The species is in severe decline in both the Snake and upper Columbia Rivers. As a result, tribal members who remain reliant on Pacific lamprey for spiritual, physical, and economic well-being now treat Pacific lamprey as a rare delicacy. This severe decline, and change in tribal members'—including my own—relationship to the Pacific lamprey, has occurred during my lifetime.

221. LAWRENCE KIP & BUREAU INDIAN AFFAIRS, THE WALLA WALLA TREATY COUNCIL OF 1855 at 64 (2014).

222. 1855 Treaty with the Nez Percés, Nez Perce-U.S., June 11, 1855, 12 Stat. 957. This language is similar to provisions in other treaties that tribes in the Pacific Northwest negotiated with Governor Stevens.

223. U.S. CONST. art. VI, § 2.

224. *United States v. Winans*, 198 U.S. 371, 381 (1905). The Treaty with the Eastern Band Shoshone and Bannock, of July 3, 1868, (also referred to as the Fort Bridger Treaty) reserved the right "to hunt on the unoccupied lands of the United States so long as game may be found thereon, and so long as peace subsists among the whites and Indians on the borders of the hunting districts." Treaty with the Eastern Band Shoshone and Bannock, Jul. 3, 1868, 15 Stat. 673. In *Idaho v. Tinno*, the Idaho Supreme Court affirmed a District Court's construction of that treaty that "hunt" encompasses "fishing". 497 P.2d 1386, 1390, 94 Idaho 759, 763 (1972).

225. Tribal Pacific Lamprey Restoration, *supra* note 3, at 2.

226. *See United States v. Navajo Nation*, 537 U.S. 488, 490 (2003).

227. *See infra* note 240 and accompanying text.

228. ASSESSMENT AND TEMPLATE FOR CONSERVATION MEASURES, *supra* note 29, at 7.

Unfortunately, the decline continues, a fact that is deeply concerning to the Tribe and to me.²²⁹

From an indigenous perspective, the decline of Pacific lamprey in the Snake and Columbia River Basins has severe negative impacts. These negative impacts include, at a minimum, the loss to the ecological circle and tribal way of life; loss of cultural heritage; and loss of fishing opportunities in traditional fishing areas.²³⁰ Tribes are concerned about losing a piece of the ecological circle and losing a fish that they consider to be a sacred elder without which the circle of life is imbalanced.²³¹ Tribes are concerned about losing part of their cultural heritage because many young tribal members have not had the opportunity to harvest lamprey and prepare them, and important stories and legends associated with these fish are becoming lost.²³² Indigenous people are concerned that the declines in Pacific lamprey mean that they will not be able to harvest Pacific lamprey in their usual and accustomed fishing places, and are instead being forced to travel long distances to places such as Willamette Falls on the Willamette River to pursue severely limited harvest opportunities on these fish.²³³ This is especially troubling because seasonal gathering expeditions for Pacific lamprey have for generations defined harvest locations and guided the movements of people at certain times to various locations throughout the Snake and Columbia River Basins.²³⁴

For indigenous cultures throughout the Columbia Basin, Pacific lamprey is a fundamental staple of spiritual experiences providing connections to the water and the land. If native traditions and spirituality are treated with the same dignity as Western or other religions, then allowing the extirpation or extinction of Pacific lamprey or allowing it to persist but only as a museum-like curiosity would not be tolerated any more than elimination of any other religion's sacraments or texts. Therefore, from a tribal perspective, it is imperative that restoration goals for Pacific lamprey abundance in the Columbia River Basin provide for ecological functioning and sustainable harvest.

E. Tribal Leadership in the Era of Fish and Wildlife Co-Management

In landmark cases where states attempted to restrict Native American Treaty fisheries as in *United States v. Oregon* and *United States v. Washington*, the Courts held that the Treaty-reserved fishing rights secure a "fair and equitable share" of the fish runs, which in turn means "up to 50% of the harvestable surplus as

229. Declaration of Daniel Kane at 16, *Idaho Rivers United v. U.S. Army Corps of Eng'rs* (W.D. Wash. Feb. 9, 2016) (No. 2:14-cv-01800-JLR).

230. TRIBAL PACIFIC LAMPREY RESTORATION PLAN, *supra* note 3, at 2; Close et al., *supra* note 1, at 19.

231. TRIBAL PACIFIC LAMPREY RESTORATION PLAN, *supra* note 3, at 2.

232. *Id.*; Close et al., *supra* note 1, at 19.

233. TRIBAL PACIFIC LAMPREY RESTORATION PLAN, *supra* note 3, at 2; Close et al., *supra* note 1, at 19. Recently, tribal treaty fishermen were arrested for fishing for Pacific lamprey at Willamette Falls; although Oregon claimed the treaty did not reserve the right to fish for lamprey at Willamette Falls, the charges were dismissed. Kasia Hall, *Latest Fishing Clash Between Oregon, Native American Tribes is Dispute Dismissed*, OREGONIAN/OREGONLIVE (Aug. 7, 2015), <http://s.oregonlive.com/O1FI3tb>.

234. Close et al., *supra* note 1.

necessary to satisfy a moderate living.”²³⁵ Most recently, the Ninth Circuit Court of Appeals in *United States v. Washington* affirmed that Treaty fishing rights impose a duty on the State of Washington to refrain from building or operating culverts under State-maintained roads that hinder fish passage and thereby diminish the number of fish that would otherwise be available for Tribal harvest.²³⁶ The *United States v. Oregon* and *United States v. Washington* Treaty fishing rights cases, which remain under the continuing jurisdiction of the federal courts, also ushered in an era of fish and wildlife co-management among tribes, the United States, and states. Tribes have supplemented their traditional ecological knowledge and stewardship with technical and scientific expertise.²³⁷ Tribes have and are continuing to play significant roles as the United States administers environmental laws, such as the Endangered Species Act (ESA). For example, the listing of salmon in the Pacific Northwest began with the Shoshone-Bannock Tribes’ petition to list Snake River sockeye under the ESA in April 1990,²³⁸ and the Nez Perce Tribe is actively involved in decades-long litigation over the impact of the operation of the dams that make up the Federal Columbia River Power System (FCRPS) on salmon and steelhead.²³⁹ Over the years of conflict, litigation and hearings, the tribes have united their efforts and leadership through organizations such as the Northwest Indian Fisheries Commission, Upper Columbia United Tribes (UCUT), Columbia River Inter-Tribal Fish Commission (CRITFC), the Upper Snake River Tribes Foundation (USRT), and the Okanagan Nation Alliance and the Canadian Columbia River Intertribal Fisheries Commission (CCRIFC), which comprise the interests of nearly 50 different tribes or tribal groups, and many tribal elders, and council leaders.²⁴⁰

F. Conclusion: Advancing Pacific Lamprey Restoration Consistent with an Indigenous Worldview, Conservation Biology, and the Endangered Species Act

Pacific lamprey are a critical part of the ecosystem and are a critical part of the cultural practices, the way of life, and the spiritual and religious practices of the native tribal people of the Snake and Columbia river basins. The impact to indigenous cultures that the severe declines of Pacific lamprey in Idaho, Oregon, Washington and British Columbia, Canada cannot be overstated.

235. *United States v. Oregon*, Civ. No. 68-513-KI (D. Or. 1969); *United States v. Washington*, 384 F. Supp. 312 (W.D. Wash. 1974), *aff’d*, 520 F.2d 676 (9th Cir. 1975), *cert. denied*, 423 U.S. 1086 (1976); *Washington v. Wash. State Commercial Passenger Fishing Vessel Ass’n*, 443 U.S. 658, 686–687 (1979).

236. *United States v. Washington*, 827 F.3d 836, 848 (9th Cir. 2016).

237. Jeremy FiveCrows, *Introduction* to ALVIN M. JOSEPHY JR., *I AM OF THIS LAND*, at xvi (2007) (“Every year we have more and more Nez Perce fish biologists, environmental engineers, and other scientists who are offering their minds as well as their hearts for the protection of the salmon, the water, and, ultimately, the Nez Perce way of life.”).

238. NAT’L OCEANIC & ATMOSPHERIC ADMIN. (NOAA), NMFS-NWFSC-33, STATUS REVIEW SOCKEYE SALMON WASHINGTON & OREGON (1997), https://www.nwfsc.noaa.gov/assets/25/5589_06172004_120234_sockeye.pdf.

239. *Nat’l Wildlife Fed’n v. Nat’l Marine Fisheries Serv.*, 184 F. Supp. 3d 861 (D. Or. 2016).

240. See generally, NW. INDIAN FISHERIES COMM’N, <https://nwifc.org> (last visited Oct. 30, 2017); UPPER COLUMBIA UNITED TRIBES, <https://ucut.org> (last visited Oct. 30, 2017); COLUMBIA RIVER INTER-TRIBAL FISH COMM’N, <http://www.critfc.org> (last visited Oct. 30, 2017); UPPER SNAKE RIVER TRIBES FOUND., <http://www.uppernakerivertribes.org> (last visited Oct. 30, 2017); CANADIAN COLUMBIA INTER-TRIBAL FISHERIES COMM’N, <http://ccrirc.org/> (last visited Oct. 30, 2017).

The indigenous peoples of the Columbia River Basin have a generations-long knowledge, history, and experience with stewardship of the lands and water that existed prior to European settlement. Treaties with the United States, in which tribes reserved the right to take fish including Pacific lamprey, mean that Tribes are not only entitled to a right to harvest these fish but also are co-managers of Pacific lamprey just like they are with salmon. The United States' trust obligations with respect to Pacific lamprey, both as a Treaty-reserved resource and as a trust resource, mean that the federal government has a significant obligation with respect to Pacific lamprey in the Snake and Columbia River Basins. Just as Treaties ensure that harvest is shared, so too is the conservation burden of restoring Pacific lamprey equitably shared as well as the honor and redemption associated with this endeavor.

The worldview described above is remarkably consistent with the fundamental tenets of public land stewardship and conservation biology. It is also remarkably consistent with the intent of the Endangered Species Act, which provides protections for endangered or threatened species and their habitat. Tribes have provided sound stewardship for generations, and have, in the era of co-management, supplemented their traditional ecological knowledge with substantial technical expertise. Tribes also have a long history of leadership, especially with respect to salmon restoration and its intersection with the Endangered Species Act. This is likely to continue to be brought to bear with respect to Pacific lamprey.

IV. A LEGAL REVIEW OF PACIFIC LAMPREY IN THE COLUMBIA RIVER BASIN

The current regulatory scheme fails to provide substantive conservation measures across the complex, anadromous life cycle of Pacific lamprey, which spans multiple jurisdictions and fails to account for native value systems. Notably, across the species range, regulatory authorities have assigned legal conservation statuses demonstrating that Pacific lamprey are imperiled throughout a majority of their range.²⁴¹ This consensus warrants a renewed analysis to determine whether listing under the Endangered Species Act may be warranted. While the USFWS denied a petition to list Pacific lamprey and three other lamprey species in 2004, based on the cursory information available, it encouraged the gathering and research of additional information to increase the understanding of Pacific lamprey, which has been occurring.²⁴² As Pacific lamprey populations continue to decline in the Columbia River Basin, substantive legal protections will become imperative to ensure their continued existence.

While there is a general consensus that lamprey face an increasing threat to their populations throughout their entire range, their legal conservation status varies both on an international and federal level, as well as domestically, from state to state. Furthermore, the anadromous nature of this ancient fish ensures that, in the course of a single life, Pacific lamprey are moving fluidly in and out of different regulations and different scales of protection. This Section begins broadly with an

241. See *infra* Table 1.

242. See *infra* Section IV.B.

international overview of how lamprey are treated throughout their range. From there, the Section focuses on the United States' federal policy and the different jurisdictions therein; then it turns to different states, and finally focuses on a discussion of Tribal law and its influence on Pacific lamprey within the Columbia River Basin.

A. Review of Jurisdictions, Current Legal Status, and State Regulations

As an anadromous species, the life history of the Pacific lamprey ensures it will cross many different jurisdictions, each replete with its own rules, regulations, and value systems. Generally, the USFWS administers the ESA for terrestrial and freshwater species and the National Marine Fisheries Service (NMFS) administers the ESA for marine species.²⁴³ While Pacific lamprey are anadromous, they spend the majority of their life in freshwater and are designated as a freshwater species.²⁴⁴ Thus for ESA purposes, Pacific lamprey fall under the jurisdiction of the USFWS.²⁴⁵ Because Pacific lamprey spend a majority of their life in freshwater, the USFWS, rather than the National Marine Fisheries Service (NMFS), has federal jurisdiction and authority to review petitions for listing under the ESA, implement conservation initiatives, and issue rules or policy.²⁴⁶ The USFWS classifies Pacific lamprey as species of concern.²⁴⁷ While in their marine migration, however, Pacific lamprey fall under the jurisdiction of the National Marine Fisheries Service (NMFS).²⁴⁸ A range-wide analysis is also pertinent in that listing under the ESA may be warranted if a species is threatened or endangered across a significant portion of their range. Additionally, states may classify and, if warranted, list species on state endangered or threatened lists.²⁴⁹ Finally, as a tribal trust resource, tribes within the Columbia River Basin serve as co-managers with state and federal agencies.

While legal conservation status varies across jurisdictions within Pacific lamprey's range, there is a general consensus that Pacific lamprey face an increasing threat to their existence.²⁵⁰ In 2001, the State of Idaho classified Pacific lamprey as

243. NAT'L OCEANIC & ATMOSPHERIC ADMIN., *Endangered and Threatened Species under NMFS' Jurisdiction*, NOAA.GOV, <http://www.nmfs.noaa.gov/pr/species/esa/listed.htm> (last updated Aug. 17, 2017).

244. *Pacific Lamprey*, U.S. FISH & WILDLIFE SERV., <https://www.fws.gov/oregonfwo/articles.cfm?id=149489457> (last visited Jan. 20, 2018).

245. *USFWS History: A Timeline for Fish and Wildlife Conservation*, U.S. FISH & WILDLIFE SERV., <https://training.fws.gov/history/USFWS-history.html> (last visited Jan. 20, 2018) (The USFWS falls under the authority of the Department of the Interior while NMFS is a regulatory agency within the Department of Commerce).

246. *Listing and Critical Habitat Petition Process*, U.S. FISH & WILDLIFE SERV., <https://www.fws.gov/endangered/what-we-do/listing-petition-process.html> (last updated Jan. 9, 2018).

247. SPECIES FACT SHEET PACIFIC LAMPREY, *supra* note 18.

248. *About Us: Our Mission*, NAT'L OCEANIC & ATMOSPHERIC ADMIN., <https://www.fisheries.noaa.gov/about-us> (last visited Jan. 20, 2018). Although there are few conservation measures NMFS can or does implement to protect Pacific lamprey while at sea individual states have primary jurisdiction over freshwater and coastal fisheries, which include Pacific lamprey. *Id.*

249. Ryan Pellerito, *State Endangered Species Chart*, <https://www.animallaw.info/article/state-endangered-species-chart> (last visited Feb. 7, 2018).

250. *See infra* Table 1.

endangered.²⁵¹ In Oregon, Pacific lamprey are designated as a vulnerable and sensitive species, and in Washington, Pacific lamprey are a state-monitored species.²⁵² California has designated Pacific lamprey to be species of special concern.²⁵³ Although minimal studies have been conducted in Alaska, the Alaska Fish and Game Department designates Pacific lamprey as a species in need of conservation.²⁵⁴ Federally, the USFWS considers Pacific lamprey to be a species of concern.²⁵⁵ However, in Canada, the Committee on the Status of Endangered Wildlife (COSEWIC) has nominated Pacific lamprey to be a high priority candidate for endangered species designation.²⁵⁶ Pacific lamprey are designated as threatened in Mexico²⁵⁷ and are listed as “data-deficient” on the Red List of Threatened species in Japan.²⁵⁸ The Ministry of Natural Resources and Environment of the Russian Federation has not published a conservation status nor a management plan.

States within the Columbia River Basin have issued regulations affording Pacific lamprey protections to varying degrees. For example, in Washington State, it is illegal for any person to harvest Pacific lamprey.²⁵⁹ Likewise under Oregon law, with the exception of Willamette Falls, “it is unlawful for any person to hunt, trap, pursue, kill, take, catch, angle for, or have in possession, either dead or alive, whole or in part, any” Pacific lamprey.²⁶⁰ However, these state laws do not generally apply to tribal members exercising treaty rights. Idaho, because Pacific lamprey are classified as endangered, prohibits the harvest, take, or have possession of Pacific lamprey.²⁶¹

Willamette Falls on the Willamette River in Oregon is the primary site of lamprey harvesting in the Columbia River Basin.²⁶² Tribes, such as the Nez Perce,

251. *Pacific Lamprey (Lampetra tridentata)*, IDAHO FISH & WILDLIFE INFO. SYS. (2005), <https://fishandgame.idaho.gov/ifwis/cwcs/pdf/pacific%20lamprey.pdf>.

252. Letter from Kelly Coates, Program Manager, Cow Creek Umpqua Tribe Water and Env'tl. Res. to Or. Watershed Enhancement Bd. (Oct. 15, 2014) (on file with Or. Watershed Enhancement Bd.); *Washington State Species of Concern Lists*, WASH. DEP'T FISH & WILDLIFE, <http://wdfw.wa.gov/conservation/endangered/list/Fish/> (last visited Jan. 20, 2018).

253. *Fish Species of Special Concern*, CA. DEP'T FISH & WILDLIFE, <https://www.wildlife.ca.gov/Conservation/SSC/Fishes> (last visited Jan. 20, 2018).

254. U.S. FISH & WILDLIFE SERV., CONSERVATION AGREEMENT FOR PACIFIC LAMPREY (*ENTOSPHENUS TRIDENTATUS*) 3 (June 20, 2012); see also *Pacific Lamprey (Lampetra tridentata)*, ALASKA DEP'T FISH & GAME, <http://www.adfg.alaska.gov/index.cfm?adfg=pacificlamprey.research> (last visited Sept. 11, 2017).

255. SPECIES FACT SHEET PACIFIC LAMPREY, *supra* note 18.

256. Committee on the Status of Endangered Wildlife in Canada, *COSEWIC Candidate Wildlife Species*, GOV'T CAN., <https://www.canada.ca/en/environment-climate-change/services/committee-status-endangered-wildlife/candidate-wildlife-species.html#MM002> (last updated July 10, 2017).

257. *Protección ambiental-Especies nativas de México de flora y fauna silvestres-Categorías de riesgo y especificaciones para su inclusión, exclusión o cambio-Lista de especies en riesgo*, NORMA 46 (Dec. 30, 2010), http://www.biodiversidad.gob.mx/especies/pdf/NOM_059_SEMARNAT_2010.pdf.

258. *Red List of Threatened Fishes of Japan*, BIODIVERSITY CTR. JAPAN (on file with the Idaho Law Review).

259. WASH. ADMIN. CODE § 220-312-080(4) (2017).

260. OR. ADMIN. R. 635-044-0430(1)(C)(O) (2017).

261. IDAHO ADMIN. CODE r. 13.01.06.300.02 (2017).

262. *Pacific Lamprey: A Cultural Resource*, *supra* note 218.

Umatilla, Yakama, and Warm Springs harvest lamprey at Willamette Falls pursuant to tribal self-regulation.²⁶³ Furthermore, in light of severe declines in Pacific lamprey abundance throughout the Columbia River Basin, the harvest that does occur at this location is very limited and restricted.²⁶⁴ And, as the USFWS acknowledged in its Conservation Assessment, such harvest is not a significant factor in the decline of Pacific lamprey.²⁶⁵

The relatively pristine freshwater habitats along the British Columbia coast, Alaska, and parts of Russia provide refuge for Pacific lamprey in their freshwater phases, but climate change and associated ocean conditions may be a limiting factor to achieving historical abundances and distributions. Furthermore, although Canada provides substantial coastal and freshwater habitat, the recent listing of Pacific lamprey as a high priority candidate for listing exemplifies lamprey's potentially imperiled conservation status across a substantial portion of their range.

B. Pacific Lamprey and the Endangered Species Act

The Endangered Species Act (ESA), the Nation's most prominent conservation law, offers substantive protections to species and the ecosystems on which they depend. The ESA's purposes are well-aligned with the multi-jurisdictional challenges that Pacific lamprey face. This section analyzes the intersection of Pacific lamprey with the ESA. Here we discuss the ESA's purposes, its protections, its process for listing species as endangered or threatened, and an analysis of a 2003 petition to list lamprey and the USFWS response to that petition. To receive the protections of the ESA, which focuses efforts and directs resources on recovering species, a future petition will have to present information that can serve as the basis for the USFWS to determine that Pacific lamprey—as a species, as a distinct population segment, or as a species across a significant portion of their range—are endangered or threatened.²⁶⁶

i. The Endangered Species Act, the ESA's listing process, and the ESA's protections

The ESA's purposes are to “provide a program for the conservation of such endangered species and threatened species,” and to “provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved.”²⁶⁷ The ESA's goal is to recover species found to be threatened or

263. *Id.*

264. *See id.*

265. ASSESSMENT AND TEMPLATE FOR CONSERVATION MEASURES, *supra* note 29, at 21. Although harvesting is not listed as a significant factor on page 21 of this source, on page 24 the document does indicate that harvesting can threaten to reduce population numbers. *Id.* at 24.

266. *See Endangered Species*, U.S. FISH & WILDLIFE SERV., <https://www.fws.gov/endangered/what-we-do/listing-petition-process.html>. (last updated Apr. 4, 2017).

267. 16 U.S.C. § 1531(b) (2012).

endangered and remove them from the ESA list.²⁶⁸ Practically, the ESA focuses efforts and directs resources towards recovering such species.²⁶⁹

The ESA defines an endangered species as “any species which is in danger of extinction throughout all or a significant portion of its range,”²⁷⁰ and defines a threatened species as “any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.”²⁷¹

A species that is listed as endangered or threatened receives substantial protections under the ESA. The species “critical habitat”—the habitat needed for its conservation—must be designated, and all federal agencies must, in consultation with the FWS or NMFS,

insure that any action authorized, funded, or carried out by such agency . . . is not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of habitat of such species which is determined . . . to be critical.²⁷²

Additionally, the ESA and its implementing regulations broadly prohibit the “take” of any species that has been listed as endangered or threatened.²⁷³

The ESA sets forth five factors, and provides that any one or any combination of these, may serve as the basis for listing a species as endangered or threatened: “(A) the present or threatened destruction, modification, or curtailment of its habitat or range; (B) overutilization for commercial, recreational, scientific, or educational purposes; (C) *disease* or predation; (D) the inadequacy of existing regulatory mechanisms; or (E) other natural or manmade factors affecting its continued existence.”²⁷⁴

The listable entities under the ESA are a species, a subspecies, a distinct population segment (DPS), or a species throughout a significant portion of its range.²⁷⁵ A DPS, according to a 1996 USFWS and NMFS joint policy, involves consideration of three elements: the “[d]iscreteness of the population segment” relative “to the remainder of the species[,]” “[t]he significance of the population segment” relative “to the species to which it belongs[,]” and “[t]he population segment’s conservation status” relative to the ESA’s standards for listing.²⁷⁶ Significantly, the USFWS and NMFS acknowledge the case-by-case and fact-specific nature of applying the DPS policy.²⁷⁷ It is important to note that the DPS policy

268. *ESA Basics: 40 Years of Conserving Endangered Species*, U.S. FISH & WILDLIFE SERV. 1 (2013), https://www.fws.gov/endangered/esa-library/pdf/ESA_basics.pdf.

269. *See id.*

270. § 1532(6).

271. § 1532(20).

272. § 1536(a)(2).

273. § 1538(a).

274. § 1533(a)(1)(A–E) (emphasis added); *see also* 50 C.F.R. § 424.11(c) (2017) (ESA’s implementing regulations).

275. § 1532(16).

276. Policy Regarding the Recognition of Distinct Vertebrate Population Segments Under the Endangered Species Act, 61 Fed. Reg. 4722, 4725 (Feb. 1, 1996).

277. *Id.* (“Because precise circumstances are likely to vary considerably from case to case, it is

emphasizes that application of a DPS to stocks of Pacific salmon set forth in the NMFS 1991 “evolutionarily significant unit” (ESU) policy that relied heavily on genetic distinctions, applies only to those particular species of salmon.²⁷⁸ Finally, there is widespread acknowledgment that the USFWS and NMFS may list a species throughout “a significant portion of its range,” although the understanding of this latter phrase has been, and continues to be, the subject of a variety of administrative and judicial interpretations.²⁷⁹

The ESA provides that listing determinations are to be made “solely on the basis of the best scientific and commercial data available.”²⁸⁰ This means that the USFWS or NMFS cannot deny listing by awaiting the development of the best possible data or by requiring conclusive proof of a particular threat or impact. The ESA’s implementation of regulations also emphasizes that listing determinations are to be made “without reference to possible economic or other impacts of such determination.”²⁸¹

ii. A 2003 Petition to List Four Lamprey Species and 2004 U.S. Fish and Wildlife Service’s Response

In January 2003, eleven environmental groups,²⁸² led by the Siskiyou Regional Education Project, petitioned the USFWS to list as threatened or endangered and designate critical habitat for four lamprey species (Pacific lamprey, river lamprey, western brook lamprey, and kern brook lamprey) found in California, Oregon, Washington, and Idaho under the ESA.²⁸³ Alternatively, petitioners requested the Secretary of the Department of the Interior list as threatened or endangered and designate critical habitat for one or more distinct population segments of those four species “comprised of one or more major river basins within California, Oregon, Washington, and Idaho.”²⁸⁴ The petition indicated that “[g]enetic and life history data suggest that for federal listing and recovery purposes Pacific lamprey

not possible to describe prospectively all the classes of information that might bear on the biological and ecological importance of a discrete population segment”).

278. Policy on Applying the Definition of Species Under the Endangered Species Act to Pacific Salmon, 56 Fed. Reg. 58,612 (Nov. 21, 1991) [hereinafter *Applying Definition*] (concluding by confirming that federal agencies “will rely on the biological expertise of the agency and the scientific community in making ‘species’ determinations under the ESA”; that a species determination must be “supported by scientific evidence”; and that “the lack of direct genetic or any other type of information does not preclude consideration of a population as a ‘species’ under the ESA if such finding is supported by other information.”).

279. Final Policy on Interpretation of the Phrase “Significant Portion of Its Range” in the Endangered Species Act’s Definitions of “Endangered Species” and “Threatened Species,” 79 Fed. Reg. 37,578 (July 1, 2014) (The policy describes the consequences of listing a species throughout a SPR: “the entire species is listed as endangered or threatened, respectively, and the Act’s protections apply to all individuals of the species wherever found.” The policy then offers definitions of “significant” and “range.”).

280. § 1533(b)(1)(a) (2012).

281. 50 C.F.R. § 424.11(b) (2017).

282. No co-managing tribes or tribal entities participated in the 2003 petition.

283. CTR. FOR BIOLOGICAL DIVERSITY, PETITION TO LIST FOUR LAMPREY SPECIES AS THREATENED OR ENDANGERED UNDER THE ENDANGERED SPECIES ACT 1–3 (2003), http://www.biologicaldiversity.org/species/fish/Pacific_lamprey/pdfs/petition.pdf.

284. *Id.*

populations could be subdivided into distinct population segments at spatial scales similar to the ESUs developed for listed salmon species” while emphasizing that “delineation of distinct population segments is best left to the discretion of the FWS.”²⁸⁵

The petitioners claimed listing of these four species was warranted under each of the five factors set forth in Section 4 of the ESA.²⁸⁶ However, the bulk of the petition focused on two of the listing factors: the “present or threatened destruction, modification or curtailment of its habitat or range” and the “inadequacy of existing regulatory mechanisms.”²⁸⁷ The petition cited population declines, the impact of dams and other artificial barriers on upstream and downstream migration, de-watering of streams, and habitat degradation as among the threats that justified listing.²⁸⁸ Regarding the three remaining listing factors—other natural or manmade factors affecting continued existence, predation, and the overutilization for commercial or recreational purposes—the petition identified a lack of monitoring data or a lack of information.²⁸⁹

In response to the petition, and after a significant delay, in December 2004, the FWS published its ninety-day finding.²⁹⁰ With respect to Pacific lamprey, the USFWS acknowledged that “[o]ur evaluation of the petition and other information indicates there is a decline in Pacific lamprey historical abundance and distribution throughout California, Oregon, Washington, and Idaho and that threats to the species occur in much of the petitioned range of the species.”²⁹¹ The FWS then observed that “the petition did not attempt to describe or justify a listable entity within the petitioned area”²⁹² The USFWS found that “[n]either the information provided in the petition nor otherwise available in service files presents substantial scientific or commercial information to demonstrate that the petition to list Pacific lamprey located in the lower 48 states may be warranted” and that “[a]ccordingly, we are unable to define a listable entity of the Pacific lamprey.”²⁹³ The USFWS concluded that “[s]ince the population of Pacific lamprey cannot be defined as a DPS at this time, [it is] thus ineligible to be considered for listing. . . .”²⁹⁴ As a result of this conclusion, the FWS did not evaluate Pacific lamprey’s status as threatened or endangered under the five ESA listing factors.²⁹⁵

While the Secretary’s finding did not trigger a formal status review, the USFWS did pledge to continue to work with co-managers to further research and gather information related to lamprey conservation measures.²⁹⁶ Specifically, the USFWS

285. *Id.* at 14.

286. *Id.* at 44–53.

287. *Id.*

288. *Id.* at 44–47.

289. CTR. FOR BIOLOGICAL DIVERSITY, *supra* note 283, at 48–51.

290. See 90-Day Finding on a Petition to List Three Species of Lampreys as Threatened or Endangered, 69 Fed. Reg. 77,158, 77,158 (proposed Dec. 27, 2004).

291. *Id.*

292. *Id.*

293. *Id.* at 77,166.

294. *Id.* at 77,167.

295. See *id.*

296. 90-Day Finding on a Petition to List Three Species of Lampreys as Threatened or

encourage[d] additional information gathering and research to increase our understanding of these species on such topics as . . . : (1) the Pacific . . . lamprey biology and ecology, their current and historical distribution and abundance, and habitat needs during all life stages; (2) the range, status, and trends of these species; (3) specific threats to these species or habitats; (4) techniques for improving identification of lamprey ammocoetes to species; (5) any other information that would aid in determining these species, population status, trends, and structure; and (6) the adequacy of existing regulatory mechanisms to protect or conserve lampreys and their habitat.²⁹⁷

As discussed below, this encouragement has led to a substantial body of new information that goes far beyond the cursory information provided in the petition, and in turn, provides a better understanding of Pacific lamprey and their status. In light of this new information, there are several noteworthy observations about the petition and the USFWS's response. First, the petitioners' suggestion that for listing purposes Pacific lamprey "could be subdivided into distinct population segments at spatial scales similar to the ESUs developed for listed salmon species" contains some subtleties that could inadvertently introduce some confusion.²⁹⁸ As we have seen above, NMFS's 1991 ESU policy for Pacific salmon is predominantly—if not exclusively—focused on genetic distinctions between salmon while the joint USFWS and the NMFS 1996 DPS policy makes it clear that genetic differences are only one of the many bases that may support listing as a DPS.²⁹⁹ Thus, the petitioners' suggestion is best understood as simply offering an analogy to give a rough sense of scale (for example, considering a DPS at the scale of the Snake River basin). Second, putting aside the nuance that Pacific salmon are a DPS under a specific ESU policy and that Pacific lamprey could be considered a DPS under the 1996 DPS policy, the analogy to Pacific salmon provides a helpful context of listable entities. Third, to the extent the USFWS's response to the petition implies or can be read to suggest that it is the petitioners' burden to identify the specific listable unit, this cannot be squared with the agencies' obligations to administer the ESA and apply that law to the information presented in the petition. In other words, it is appropriate that petitioners would leave the specific delineation of a DPS to the USFWS. Furthermore, it is the petitioners' duty to present compelling science and the USFWS's job to make a determination based on the best available science and commercial data.

That said, future petitioners seeking to have any species listed are well-advised to marshal the best available scientific and commercial data in the way they believe best identifies a listable unit and satisfies one or more of the five factors that will support a listing.

Endangered, 69 Fed. Reg. at 77,158.

297. *Id.* at 77,167.

298. *Id.* at 77,166.

299. *Compare Applying Definition, supra* note 278, with Policy Regarding the Recognition of Distinct Vertebrate Population Segments Under the Endangered Species Act, 61 Fed. Reg. 4722, 4725 (Feb. 1, 1996).

iii. Future pathways for Pacific Lamprey Conservation and Recovery under the ESA

The USFWS's invitation to increase the understanding of Pacific lamprey is the most significant legacy of the agency's 2003 ninety-day finding.³⁰⁰ As a matter of law and fact, there is nothing in the 2003 finding that prejudices any future petition seeking to list Pacific lamprey.³⁰¹ Any future finding by the USFWS will have the benefit of a substantially more comprehensive scientific understanding of Pacific lamprey and their status.

A future petition to list Pacific lamprey under the ESA must present substantial biological and commercial data that would support listing Pacific lamprey as a listable entity (a species, a subspecies, a distinct population segment, or a species at risk throughout a significant portion of its range) based on the five listing factors of the ESA.³⁰² The USFWS would review the petition and analyze Pacific lamprey at the listable unit of species; the listable unit of a DPS (which is a very case-specific and fact-specific inquiry); and the listable unit of a species throughout a significant portion of its range.³⁰³

There are multiple options that the USFWS could evaluate for listing, considering what is currently the best available scientific and commercial data with respect to Pacific lamprey.

iv. The Current Regulatory Scheme Fails to Adequately Protect and Conserve Pacific Lamprey Across Life Stages

An examination of the existing regulatory mechanisms reveals, that although they may benefit Pacific lamprey to some degree, they are inadequate to protect and conserve Pacific lamprey across all life stages.

At the state level, harvest regulations are in place to govern harvest by state citizens, and tribal regulations are in place to govern tribal members' limited harvest pursuant to treaty-reserved rights. It is widely acknowledged that harvest has not been, and is not, a significant factor in the current status of Pacific lamprey.³⁰⁴ At the federal level, the Clean Water Act may provide some protection to Pacific lamprey and its habitat. This protection may be direct or indirect, either by ensuring the water quality criteria are met or by designating uses set forth in federally-approved water quality standards. The Federal Power Act also requires that private hydropower facilities comply with federally-approved state water quality standards and other facets of state law.³⁰⁵ Where applicable, the FERC relicensing process

300. See generally ASSESSMENT AND TEMPLATE FOR CONSERVATION MEASURES, *supra* note 29 (The USFWS has overseen the implementation of the Pacific Lamprey Conservation Initiative and a comprehensive agreement among sovereigns, agencies and NGOs known as the Conservation Agreement for Pacific Lamprey).

301. *Id.*

302. See *supra* Section IV.B.i.

303. 16 U.S.C. § 1533(b)(3)(A) (2012).

304. ASSESSMENT AND TEMPLATE FOR CONSERVATION MEASURES, *supra* note 29, at 174–75.

305. *Federal Power Act, HYDROPOWER REFORM COAL.*, <http://www.hydroreform.org/policy/fpa> (last visited Jan. 20, 2018).

imposes further substantive standards under the Federal Power Act (mandatory conditioning authority for USFWS, BIA, etc.).³⁰⁶

NEPA requires federal agencies to take a “hard look” at the environmental impact of major federal actions.³⁰⁷ One would expect that this would ensure that federal agencies have analyzed the effects of their proposed actions on Pacific lamprey. However, NEPA allows an agency to rely on existing data in conducting its analysis; it does not require an agency to do additional monitoring or conduct additional studies or surveys to fully assess baseline conditions.³⁰⁸

The limited protection afforded to Pacific lamprey under NEPA is illustrated in a case where Idaho Rivers United and the Nez Perce Tribe, among other plaintiffs, requested a preliminary injunction to halt a proposed dredging project in the Lower Snake River.³⁰⁹ The plaintiffs sought to enjoin the dredging so as to afford time for updated surveys to occur to demonstrate whether lamprey were present or not.³¹⁰ However, the Court held that the Army Corps of Engineers was entitled to rely on its existing data (indicating that no lamprey were observed in the area) despite the significant limitations of the underlying survey and the lack of additional surveys which prevented the plaintiffs from showing the irreparable harm necessary to obtain an injunction.³¹¹ And, NEPA only requires a “full analysis” of the environmental impacts and alternatives; it does not dictate that an action agency select the most beneficial alternative for Pacific lamprey.³¹²

While the Clean Water Act and state regulations do provide some protections and conservation measures, they are limited to reactive measures of specific impacts from hydro-electric projects rather than addressing Pacific lamprey across their life history.

C. Voluntary Agreements and Comprehensive Conservation Plans

For the last decade, stakeholders have engaged in multiple forums addressing Pacific lamprey conservation in the Columbia River Basin. In 2008, several Columbia basin tribes memorialized an agreement with the federal government that provided funds for Tribes to implement some important, albeit limited, conservation and research initiatives for Pacific lamprey.³¹³ This agreement was part of what was known as the “Columbia Basin Fish Accords” (Accords), which were a set of agreements among the FCRPS action agencies, states, and six Columbia River Basin Tribes.³¹⁴ Although these agreements focused on protecting and conserving ESA

306. *See id.*

307. *Kleppe v. Sierra Club*, 427 U.S. 390, 410 n.21 (1976) (establishing the hard-look doctrine which states that in a NEPA analysis, the court’s sole role is to insure the agency take a hard look at the potential environmental impacts).

308. *Nw. Envtl. Advocates v. Nat’l Marine Fisheries, Serv.*, 460 F.3d 1125, 1139 (9th Cir. 2006).

309. *Idaho Rivers United v. U.S. Army Corps of Eng’rs*, 156 F. Supp. 3d 1252, 1255 (W.D. Wash. 2015).

310. *Id.* at 1258.

311. *Id.* at 1262.

312. *See* 42 U.S.C. § 4332 (2012).

313. *See* IMPROVEMENTS IMPLEMENTATION PLAN, *supra* note 30, at 1–2 (Dec. 2014 revision).

314. COLUMBIA RIVER BASIN FED. CAUCUS, *Columbia Basin Fish Accords*, SALMONRECOVERY.GOV, <https://www.salmonrecovery.gov/Partners/FishAccords.aspx> (last visited Jan. 20, 2018).

listed salmonids, Pacific lamprey and other components of the Columbia River Basin ecosystem were also considered.³¹⁵ In order to implement the conservation actions in a coordinated manner, the USFWS spearheaded the Pacific Lamprey Conservation Agreement (PLCA).³¹⁶ The PLCA built upon the Tribal Pacific Lamprey Restoration Plan put forward by the member tribes of CRITFC.³¹⁷ These voluntary agreements serve as the primary vehicle to implement conservation actions within the Columbia River Basin.

i. The Columbia Basin Fish Accords Between the FCRPS Action Agencies and Certain States and Tribes

The 10-year Accords focused on providing substantive commitments for fish and wildlife in exchange for state and tribal support for, and defense of, the 2008 and subsequent FCRPS Biological Opinions during the term of the agreement (that were overturned by the Oregon District Court).³¹⁸ The Accords included some beneficial actions for lamprey protection, research funding, and passage enhancement projects.³¹⁹ Notably, however, the Accords, which are set to expire in 2018, also included a forbearance provision, which prevents the signatory tribes from petitioning or engaging in a Pacific lamprey ESA listing effort.³²⁰ If subsequent Accords are renegotiated, and they include a similar forbearance provision, non-signatory tribes or environmental organizations will continue to be the only entities capable of initiating or supporting an ESA listing petition for Pacific lamprey.

a. Translocation Programs in the Columbia River Basin

One of the commitments in the Accords provides funding for continuing and expanding Pacific lamprey translocation programs.³²¹ In recent years, CRITFC

315. *Id.*

316. See generally U.S. FISH & WILDLIFE SERV., CONSERVATION AGREEMENT FOR PACIFIC LAMPREY (*ENTOSPHENUS TRIDENTATUS*), *supra* note 254.

317. See generally TRIBAL PACIFIC LAMPREY RESTORATION PLAN, *supra* note 3.

318. See generally 2008 Columbia Basin Fish Accords Memorandum of Agreement Between the Three Treaty Tribes and FCRPS Action Agencies, May 2, 2008, <http://www.critfc.org/wp-content/uploads/2012/10/moa.pdf> [hereinafter Treaty Tribes Accord]; 2008 Columbia Basin Fish Accords Memorandum of Agreement between the Shoshone-Bannock Tribes and FCRPS Action Agencies, Nov. 7, 2008, <https://www.salmonrecovery.gov/Files/BiologicalOpinions/ShoBan-AA%20MOA%20FINAL%20PACKAGE.pdf>; 2008 Columbia Basin Fish Accords Memorandum of Agreement between the Colville Tribes and FCRPS Action Agencies, May 2, 2008, <https://www.salmonrecovery.gov/Files/BiologicalOpinions/Colville-Tribes-Action-Agency-Agreement.pdf>. The Nez Perce Tribe and the State of Oregon did not sign an accord, and have continued to actively participate in the FCRPS BiOp litigation. See *Nat'l Wildlife Fed'n v. Nat'l Marine Fisheries Serv.*, 184 F. Supp. 3d 861 (D. Or. 2016).

319. Treaty Tribes Accord, *supra* note 318, at 6–9 (providing commitments from Bonneville Power Administration, Army Corps of Engineers, and Bonneville Power administration in the form of financial guarantees, management plans and lamprey passage enhancements throughout the FCRPS).

320. *Id.* at 21. “[T]he Action Agencies’ commitments under this Agreement for lamprey actions are adequate for the duration of this Agreement such that the Tribal parties will not petition to list lamprey or support third party efforts to list lamprey as threatened or endangered pursuant to the ESA.”

321. *Id.* at attachment B-8.

members (Yakama, Umatilla, and Nez Perce) have begun a targeted trap and translocation program to move adult lamprey from lower Columbia River dams to historic spawning grounds above these dams.³²² Translocation involves trapping migrating adult lamprey in fishways, transporting these lamprey by truck to holding facilities for overwintering (approximately 6–18 months), and releasing them before or at maturation.³²³ This is a critical conservation measure for small populations of lamprey.³²⁴ The Tribes have expressed goals of: (1) increasing larval lamprey numbers in historic systems, which may in turn attract future adult returns through pheromone cues;³²⁵ (2) retaining lamprey-derived ecosystem services in these systems until passage issues can be addressed; and (3) restoring run sizes to harvestable levels across their historic range.³²⁶

In the Umatilla River basin, where lamprey translocation has occurred since 1999, larval lamprey have increased in density and distribution throughout the upper river system.³²⁷ Adult returns to the Umatilla River basin also increased following establishment of larval lamprey.³²⁸ Adults translocated above Snake River dams continued their migrations and were distributed across the upper basin at the time of spawning.³²⁹ Results from these efforts suggest that habitats for migration, spawning, and larval lamprey still exist above impoundments and that improvements in passage success could dramatically improve lamprey distribution in the Columbia River Basin.

b. Passage Enhancements at Federal Dams on the Lower Columbia River

Over the last two decades, several alterations have been made to facilitate passage of Pacific lamprey through complex hydropower facilities.³³⁰ These changes include hydraulic and structural alterations to existing fishways as well as the addition of lamprey-specific passage structures.³³¹ Through the passage research summarized in section II.D,³³² scientists at CRITFC, Columbia basin Tribes, NOAA, USFWS, University of Idaho, Pacific Northwest National Laboratories, and other institutions identified critical passage bottlenecks at certain facilities.³³³ Bottlenecks at some fishway entrances have been addressed through alterations to nighttime

322. TRIBAL PACIFIC LAMPREY RESTORATION PLAN, *supra* note 3, at 65.

323. David Ward et al., *Translocating Adult Pacific Lamprey Within the Columbia River Basin: State of the Science*, 37 FISHERIES 351, 352 (2012).

324. Peter S. Maitland et al., *Conservation of Native Lampreys*, in LAMPREYS: BIOLOGY, CONSERVATION & CONTROL 375, 410–11 (Margaret Docker ed., 2015); Ward et al., *supra* note 323, at 352.

325. Yun et al. *supra* note 67, at 2195.

326. Ward et al., *supra* note 323, at 352.

327. See *Lamprey on the Rise in Umatilla River; Tribes Embark on Ambitious Artificial Propagation Program*, COLUMBIA BASIN BULL. (Feb. 6, 2015), <http://www.cbbulletin.com/433111.aspx>.

328. See *id.*

329. McIlraith et al., *supra* note 63, at 132.

330. See, e.g., M. L. Moser et al., *Development of Pacific Lamprey Fishways at a Hydropower Dam*, 18 FISHERIES MGMT. & ECOLOGY 190 (2011).

331. *Id.* at 191.

332. *Supra* Section II.D.

333. See generally Matthew L. Keefer et al., *Fishway Passage Bottleneck Identification and Prioritization: A Case Study of Pacific Lamprey at Bonneville Dam*, 70 CANADIAN J. FISHERIES & AQUATIC SCI. 1551 (2013).

attraction flows.³³⁴ A study of that action found that reduced nighttime flows at fishway entrances increased lamprey movements into upstream sections of fishways, but found little evidence for improved overall lamprey passage efficiency.³³⁵ Supported by experimental and observational studies, fish ladders and passage structures designed primarily for Pacific salmon are not as effective for Pacific lamprey passage.³³⁶ While Pacific salmon are great jumpers and can pass hundreds of steps in a fish ladder, Pacific lamprey, on the other hand, are poor swimmers and use their suction capabilities to move along the walls and floors of the passage structure.³³⁷ Enhancements such as slot openings in concrete fishway walls, attraction flows, and lamprey-specific passage structures should be implemented and studied further to increase lamprey passage success rates.

Identifying bottlenecks has also led to specific structural additions that allow lamprey to bypass problematic sections.³³⁸ These include devices referred to as lamprey flume structures (LFS) or lamprey passage structures (LPS), which have been implemented at lower and mid-Columbia River dams as well as at smaller barriers on tributary rivers.³³⁹ These structures often consist of aluminum ramps leading to boxes which serve as resting pools.³⁴⁰ Flumes contain minimal flow and lamprey use a suck-and-burst type of movement to ascend them.³⁴¹ Moser and others found that of the lamprey that entered these experimental structures, greater than 90% were able to successfully ascend them.³⁴² Similarly, LPS consist of multiple flumes and rest boxes, which are designed to promote passage success rates.³⁴³ Currently, LPS have been constructed at several federal and privately owned hydropower facilities.³⁴⁴ Results from these limited-scale projects are encouraging, but significant challenges remain to improve lamprey passage at hydropower facilities.

334. Eric L. Johnson et al., *Movement of Radio-Tagged Adult Pacific Lampreys During a Large-Scale Fishway Velocity Experiment*, 141 TRANSACTIONS AM. FISHERIES SOC'Y 571, 577 (2012).

335. *Id.* at 577.

336. Matthew L. Keefer et al., *Testing Adult Pacific Lamprey Performance at Structural Challenges in Fishways*, 30 N. AM. J. FISHERIES MGMT. 376, 382 (2010).

337. ASSESSMENT AND TEMPLATE FOR CONSERVATION MEASURES, *supra* note 29, at 104.

338. Moser et al., *supra* note 330, at 191.

339. *Id.*

340. *Id.*

341. *Id.*

342. *Id.* at 195.

343. Steve C. Corbett et al., *Adult Pacific Lamprey Passage Structures: Use and Development at Bonneville Dam and John Day Dam South Fishway*, 2014 at 1–2 (2015).

344. Emily Anderson & Bao Le, Pub. Util. Dist. No. 1 of Chelan Cty. Pacific Lamprey Upstream Passage Modifications Literature Review and Analysis and Recommendations for Passage Improvements in the Rocky Reach Fishway 1 (2010), http://www.chelanpubd.org/departments/licensingCompliance/rr_implementation/ResourceDocuments/34952.pdf; *14-011 Prototype Passage Structure Eases Lampreys' Upstream Journey*, U.S. Army Corps of Eng'rs (Feb. 27, 2014), <http://www.nwww.usace.army.mil/Media/News-Releases/Article/482640/14-011-prototype-passage-structure-eases-lampreys-upstream-journey/>

ii. USFWS Pacific Lamprey Conservation Initiative

In 2011, the USFWS issued an “Assessment and Template for Conservation Measures” for Pacific lamprey.³⁴⁵ In this document, USFWS developed a range-wide method for assessing the current status and potential trends of Pacific lamprey based on a modification of the NatureServe ranking system.³⁴⁶ The assessment incorporated Hydrologic Unit Codes (HUC) to analyze specific watersheds.³⁴⁷ The conservation rank system identifies the specific threat of lamprey extirpation at the 4th Field HUC watershed level using a variety of existing population data, trends, and potential threats to the population.³⁴⁸ Where little data was available, expert opinion was used.³⁴⁹ This system identified seven possible ranks for Pacific lamprey status: Presumed Extinct, Possibly Extinct, Critically Imperiled, Imperiled, Vulnerable, Apparently Secure, and Secure.³⁵⁰

USFWS also identified threat scope, threat severity, population size, and trends for individual watersheds.³⁵¹ USFWS concluded that: first, lamprey are highly threatened in all of their inland range and moderately threatened in coastal systems; second, lamprey populations are small in much of the inland range; and lastly, lamprey are rapidly declining throughout much of the range in general and most rapidly in the Upper Columbia River and Snake River basins.³⁵² Throughout their report, the USFWS identified passage issues, instream flow from diversions, stream and floodplain degradation, and water quality as major limiting factors in lamprey abundance across the range evaluated.³⁵³

D. Clean Water Act, State Water Quality Standards, and FERC Licensing

Recently, privately owned hydropower facilities have begun implementing Pacific lamprey management plans (PLMPs) pursuant to conditioned approval of their re-licensing and operating permits.³⁵⁴ The nexus between the Clean Water Act (CWA) and the Federal Power Act is exemplified by FERC's re-licensing requirement that hydropower facilities must receive compliance certification from the state agency that implements the CWA.³⁵⁵ In *PUD No. 1 of Jefferson County v. Washington Department of Ecology*,³⁵⁶ the Supreme Court upheld the state's authority to

345. See generally ASSESSMENT AND TEMPLATE FOR CONSERVATION MEASURES, *supra* note 29.

346. See generally Master et al., *supra* note 130; see *infra* Figure 3.

347. ASSESSMENT AND TEMPLATE FOR CONSERVATION MEASURES, *supra* note 29, at 34–41.

348. *Id.* at 93.

349. *Id.*

350. See *infra* Figure 3.

351. ASSESSMENT AND TEMPLATE FOR CONSERVATION MEASURES, *supra* note 29, at 34–41.

352. *Id.* at 46–52.

353. *Id.* at 84, 85, 117, 119.

354. *Pacific Lamprey Management Plan*, DOUGLAS CTY. PUB. UTIL. DIST., <http://www.douglaspud.org/wells-project/aquatic-settlement-agreement/pacific-lamprey-management-plan>. (last visited Jan. 18, 2018) [hereinafter *Douglas County Management Plan*]. See also GRANT CTY. PUB. UTIL. DIST., <http://www.grantpud.org/your-pud/media-room/publications/bill-inserts?task=document.viewdoc&id=1313> (last visited Jan. 18, 2018).

355. PUB. UTIL. DIST. NO. 1 OF DOUGLAS CTY, PACIFIC LAMPREY MANAGEMENT PLAN WELLS HYDROELECTRIC PROJECT FERC PROJECT No. 2149 at 2 (Sept. 2009).

356. 511 U.S. 700 (1994).

condition 401 certification on compliance with state water quality standards.³⁵⁷ Washington State includes aquatic life uses as a designated use for many portions of the state's waters.³⁵⁸ In an effort to attain state water quality standards and not impair designated uses such as wildlife habitat and aquatic life uses, private dam owners such as PUDs have begun implementing conservation plans, some of which target Pacific lamprey.³⁵⁹

The purpose of the CWA is to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters."³⁶⁰ In addition to regulating the discharge of pollutants into the waters of the United States, the CWA is a substantive mechanism for aquatic ecosystem conservation. The second express goal of the act is to achieve "water quality which provides for the protection and propagation of fish, shellfish, and wildlife."³⁶¹ The CWA is implemented through a cooperative federalism approach that "anticipates a partnership between the States and the Federal Government" to establish state water quality standards.³⁶²

Section 1313 of the CWA gives states the primary responsibility to establish water quality standards.³⁶³ A state water quality standard "shall consist of the designated uses of the navigable waters involved and the water quality criteria for such waters based upon such uses."³⁶⁴ Furthermore, the state must take into consideration the "propagation of fish and wildlife."³⁶⁵ For example, the states of Washington, Oregon, and Idaho include aquatic life, salmon rearing and migration, and cold water fisheries and warm water fisheries among others as designated uses for the Columbia and Snake Rivers.³⁶⁶ Lamprey conservation efforts under the CWA are typically housed within the designated use of supporting aquatic life and migration.³⁶⁷

For example, Washington State includes aquatic life uses as a designated use.³⁶⁸ Therefore, the projected impacts of a hydroelectric project must be consistent with, and take into account, state water quality standards, including the designated use to provide for fish migration or supporting aquatic life.

i. Pacific Lamprey Management Plans at Private Hydroelectric Facilities

Here, we examine how Pacific lamprey management plans (PLMP) are implemented at two privately owned hydroelectric projects in the mid-Columbia

357. *Id.* at 722.

358. WASH. ADMIN. CODE § 173-201A-200 (2017) ("It is required that all indigenous fish and nonfish aquatic species be protected in waters of the state.").

359. As evidenced by the implementation of PLMPs at the PUD owned and operated mid-Columbia River dams. See *Douglas County Management Plan*, *supra* note 354.

360. 33 U.S.C. § 1251(a) (2012).

361. § 1251(a)(2).

362. § 1251(b).

363. § 1313(a).

364. § 1313(c)(2)(A).

365. *Id.*

366. WASH. ADMIN. CODE § 173-201A-602 (2017).

367. See PUB. UTIL. DIST. NO. 1 DOUGLAS CTY., PACIFIC LAMPREY MANAGEMENT PLAN 10 (2009).

368. See WASH. ADMIN. CODE § 173-201A-200 (2017).

River. Under the Federal Power Act, the Federal Energy Regulatory Commission (FERC) has authority to issue licenses for hydroelectric facilities.³⁶⁹ Hydroelectric projects cause an impoundment of navigable waters and create a discharge, which constitutes a pollutant under the CWA, thus necessitating compliance with state water quality standards.³⁷⁰ In *PUD No. 1 v. Washington Department of Ecology*, the Supreme Court upheld the state's authority to condition 401 certification on compliance with state water quality standards.³⁷¹ Therefore, because a FERC license is conditioned on receipt of 401 certification, non-federal hydroelectric projects must be consistent with state water quality standards. Furthermore, because 401 certification evaluates the entire project, not just the discharge, states have wide latitude to impose conditions on their approval.³⁷²

For purposes of the CWA, the state of Washington divides the river into four sections, which have their own respective designated uses.³⁷³ There are five non-federal, mid-Columbia River dams located within the same reach of the Columbia River as designated by the Department of Ecology and the Water Resource Inventory Area (WRIA).³⁷⁴ These hydroelectric projects all must maintain, and not result in the degradation of, the following relevant designated uses: salmonid spawning/rearing, primary contact, wildlife habitat, harvesting, and aesthetics.³⁷⁵ Accordingly, project managers, agencies, and tribes may engage in cooperative agreements to mitigate those threats to designated uses and attainment of state water quality standards.³⁷⁶

a. Priest Rapids Hydroelectric Project

The implementation of a Pacific Lamprey Management Plan (PLMP) is an express requirement within the 401 Water Quality Certificate for the Priest Rapids Hydroelectric Project.³⁷⁷ The initial 2009 PLMP set forth four objectives: (1) to achieve no net impact; (2) provide safe, effective, and timely volitional passage for adult upstream and downstream migration; (3) provide safe effective, and timely volitional passage for juvenile downstream migration; and (4) avoid and mitigate project impacts on rearing habitat.³⁷⁸ Additionally, the 2009 PLMP recommended

369. FERC, 18 C.F.R. § 5.1 (2017).

370. See *PUD No. 1 of Jefferson Cty. v. Wash. Dep't of Ecology*, 511 U.S. 700, 723 (1994).

371. *Id.*

372. *Id.* at 713.

373. WASH. ADMIN. CODE § 173-201A-602 (2017).

374. See WASH. DEP'T ECOLOGY, PUBL'N NO. 06-10-091, WATER QUALITY STANDARDS FOR SURFACE WATERS OF THE STATE OF WASHINGTON (2017).

375. See WASH. ADMIN. CODE § 173-201A-602 (2017).

376. See Wells Hydroelectric Project, *Aquatic Settlement Agreement* (Oct. 2008), http://www.douglaspud.org/ASA%20Documents/2009_Aquatic_Settlement_Agreement_with_signatu re_pages_and_MPs.pdf.

377. Letter from State of Wash. Dep't of Ecology to Tim Culbertson, Gen. Manager of Pub. Util. Dist. No. 2 of Grant Cty. (Apr. 3, 2007) (on file with Grant Cty. Pub. Util. Dist.).

378. PUB. UTIL. DIST. NO. 1 DOUGLAS CTY, *supra* note 367. (The PLMP was drafted in consultation with the members of the Priest Rapids Fish Forum, whose members include: Washington Department of Ecology, National Marine Fisheries Service, U.S. Fish & Wildlife Service, Washington Department of Fish & Wildlife, Colville Confederated Tribes, Yakama Nation, the Confederated Tribes of the Umatilla Indian Reservation, the Wanapum Indians, the Columbia River Inter-tribal Fish Commission, and the Bureau of

installing structural passage enhancements, such as plates along the fishway, ramps, and rounding of edges within the fish ladder.³⁷⁹ These recommendations were actualized in 2010 and Grant PUD continues to monitor their impacts on lamprey passage and possible interactions with salmon passage rates.³⁸⁰ Furthermore, condition 6.2(5)(6) of the 401 Water Quality Certificate, requires the licensee, in this case, Grant County Public Utilities District (Grant PUD), to file Annual Pacific Lamprey Management Reports.³⁸¹

b. Wells Hydroelectric Project

Similarly, the Public Utility District No. 1 of Douglas County (Douglas PUD) issued a PLMP for the Wells Hydroelectric Project.³⁸² The PLMP is one of six Aquatic Resource Management Plans within the Aquatic Settlement Agreement.³⁸³ In concert with the Wells Anadromous Fish Agreement and Habitat Conservation Plan, the resource management plans direct implementation of protection, mitigation, and enhancement measures.³⁸⁴ These plans function as a Water Quality Attainment Plan pursuant to the Wells Hydroelectric Project's 401 Water Quality Certificate.³⁸⁵ The Wells Hydroelectric Project PLMP puts forth three objectives: (1) identify and address any adverse project-related impacts on passage of adult Pacific lamprey; (2) identify and address any project-related impacts on downstream passage and survival, and rearing of juvenile Pacific lamprey; and (3) participate in the development of regional Pacific lamprey conservation activities.³⁸⁶

In 2013, Douglas PUD conducted the Adult Pacific Lamprey Passage and Enumeration Study, which provided recommendations for fishway modifications.³⁸⁷ These modifications included installing enhanced lamprey entrance structures modifying the fish count stations to improve enumeration of lamprey in the fish ladder.³⁸⁸ Due to construction delays, these modifications have been postponed until the 2016 lamprey passage season.³⁸⁹

Indian Affairs).

379. *Id.* at 11.

380. 2015 GRANT PUB. UTIL. DIST. PAC. LAMPREY MGMT. PLAN COMPREHENSIVE ANN. REP. (2016).

381. Letter from State of Wash. Dep't of Ecology, *supra* note 377, at 71–72; 2015 GRANT PUB. UTIL. DIST. PAC. LAMPREY MGMT. PLAN COMPREHENSIVE ANN. REP. (2016) (the 2015 comprehensive annual report provides a substantial overview of lamprey activities in the Columbia River Basin and the status of activities at the Priest Rapids facility).

382. PUB. UTIL. DIST. NO. 1 DOUGLAS CTY, *supra* note 367.

383. *Id.* at 1.

384. *Id.*

385. *Id.*

386. *Id.*

387. David Robichaud & Chas Kyger, *Adult Lamprey Passage and Enumeration Study, Wells Dam, 2013: The Effects of Head Differential on Entrance Efficiency, and of Picketed Leads on Count Window Enumeration Efficiency*, PUB. UTIL. DIST. NO. 1 DOUGLAS CTY. (Sept. 2014), [http://www.douglaspub.org/ASWG%20Documents/2014_09_09%20Douglas%20-%202013%20Lamprey%20Passage%20and%20Enumeration%20Study%20Report%20\(Final%2009-08-14\).pdf](http://www.douglaspub.org/ASWG%20Documents/2014_09_09%20Douglas%20-%202013%20Lamprey%20Passage%20and%20Enumeration%20Study%20Report%20(Final%2009-08-14).pdf).

388. See 2014 GRANT PUB. UTIL. DIST., PAC. LAMPREY MGMT. PLAN COMPREHENSIVE ANN. RPT. (2015).

389. *Id.* at 63.

While these are only two examples of how the CWA and FERC re-licensing process interacts with Pacific lamprey conservation, other hydroelectric facilities within the basin also implement lamprey-specific measures or conservation plans.³⁹⁰ These efforts might be enhanced through the adoption of an adaptive management strategy to inform future actions. Although the owners and operators of these hydroelectric facilities are taking Pacific lamprey into consideration, there are no substantive requirements to meet specific passage rates under current agreements.

V. CONCLUSION

Effective conservation of Pacific lamprey requires an understanding of this species' population and genetic structuring, life history patterns, general ecology, and constraints on migration, dispersal, population viability, and importance among the human cultures across its range. Current research has found that Pacific lamprey have a unique life history and one that is very different from other anadromous fish such as salmon and steelhead; for example, the cues employed by lamprey to select spawning habitat probably do not result in strong philopatry—return to stream of origin—as observed in salmon.³⁹¹

Native storytelling, passed on from generation to generation, is analogous to a library of information as a form of knowing the landscape, species interactions, policy, laws, ethics, and values. There is likeness and commonality between European language and thought and indigenous peoples' ways of knowing. At the same time, there are distinct differences. Pacific lamprey have persisted through treaties to settle the land, and the subsequent homogenization of those lands which led to manipulation of waterways, overharvest, and overexploitation of lamprey. Native stories tell us that as humans begin to act with honor and reverence, the land and Pacific lamprey will respond positively. Unfortunately, range-wide declines in Pacific lamprey abundance and distribution reveal that Pacific lamprey are telling us that we are not yet there.

Due to the complexity of Pacific lamprey life history and their extensive range, conservation statuses vary across jurisdictions. Notably, like salmon, Pacific lamprey are a tribal trust resource and thus the federal government has a heightened responsibility to ensure the continued existence of the species.³⁹² Although the species is listed as endangered by the state of Idaho and similarly identified by other states and is considered a "species of concern" by the USFWS, conservation actions predominantly stem from voluntary agreements and conservation plans.³⁹³ While there are some positive activities happening with regard to lamprey, including some limited funding committed through the accords, it's a drop in the bucket compared to what lamprey need. Since 2008, substantial advancements in the understanding of lamprey have contributed to successful and novel restoration measures such as artificial propagation, targeted translocations from lower Columbia River dams to

390. See PUB. UTIL. DIST. NO. 1 CHELAN CTY, PACIFIC LAMPREY COMPREHENSIVE MANAGEMENT PLAN (2004); see also IMPROVEMENTS IMPLEMENTATION PLAN, *supra* note 30.

391. *E.g.*, Hess et al, *supra* note 118; Spice et al., *supra* note 111; Lin et al., *supra* note 112.

392. *Id.*

393. *Id.*

historic spawning grounds, and the addition of lamprey-specific passage structures at impoundments.³⁹⁴ Pacific lamprey were not listed under the Endangered Species Act in 2004 because at the time the best available science was insufficient to support the identification of a “listable unit” of Pacific lamprey.³⁹⁵ Since then, advancements in understanding Pacific lamprey ecology and causes of population declines support a renewed look at listing lamprey under the Endangered Species Act. These advancements also support an examination of potential federal obligations for explicit protection of the species under tribal trust responsibilities.

394. *Id.*

395. Endangered and Threatened Wildlife and Plants; 90-Day Finding on a Petition to List Three Species of Lampreys as Threatened or Endangered, 69 Fed. Reg. 77,158, 77,166 (Dec. 27, 2004) (codified at 50 C.F.R. pt. 17).

TABLES AND FIGURES



Figure 1(a) — Buccal opening of juvenile Pacific lamprey at the onset of exogenous feeding (Courtesy of USFWS, public domain).



Figure 1(b) — Matthew Dunkle (co-author) holding an adult Pacific lamprey.

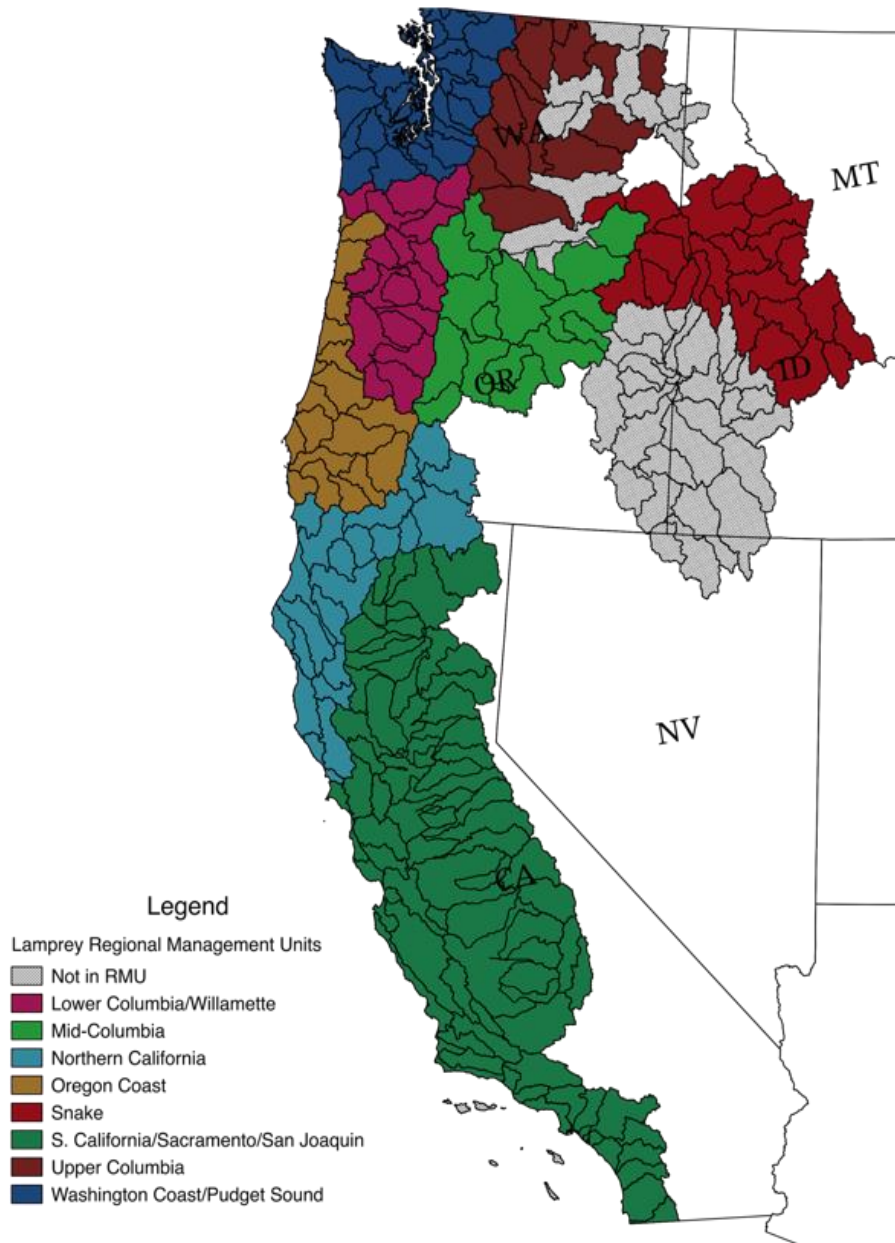


Figure 2—USFWS Regional Management Units (available at <https://www.fws.gov/pacificlamprey/images/Regional%20Management%20Units.jpg>)

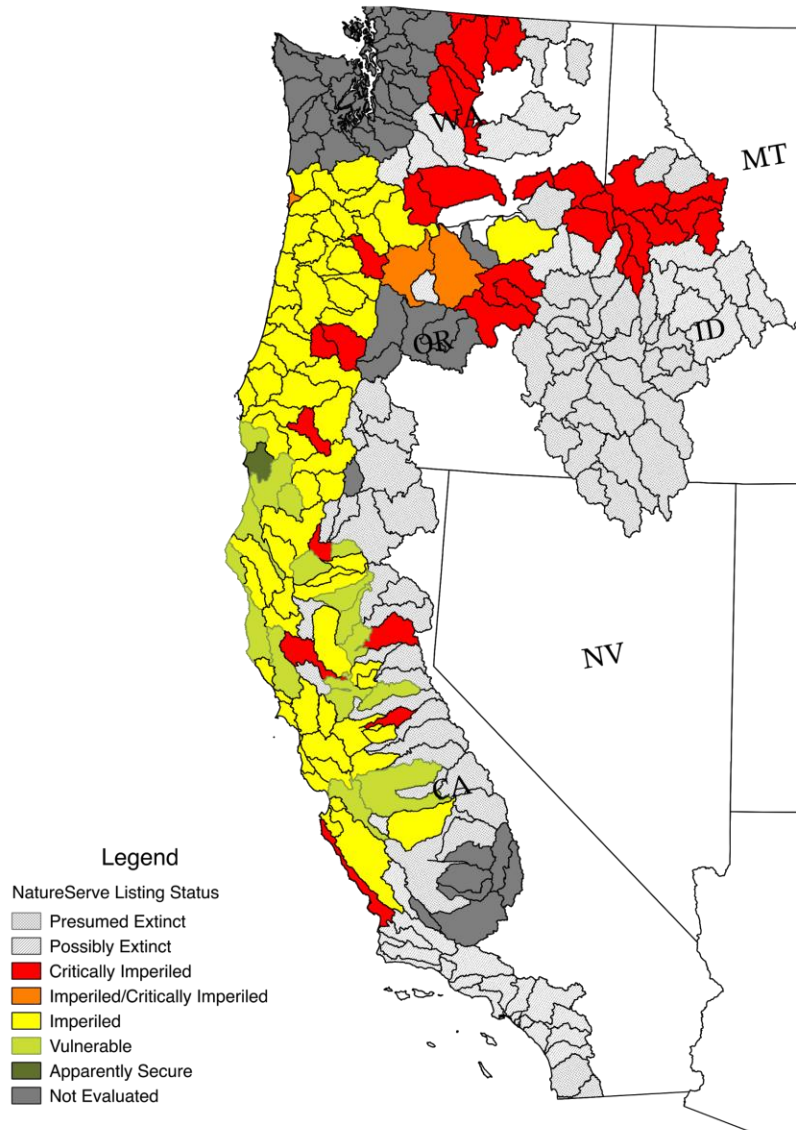


Figure 3—Pacific lamprey NatureServe listing status (*Pacific Lamprey NatureServe Rankings Map. Credit: USFWS Credit: USFWS available at <https://www.fws.gov/landscape-conservation/stories/applying-strategic-habitat-conservation-to-the-pacific-lamprey-conservation-initiative.html>*)



Figure 4—Pacific lamprey (top) and recently transformed juveniles (below)
(Courtesy of USFWS, public domain).

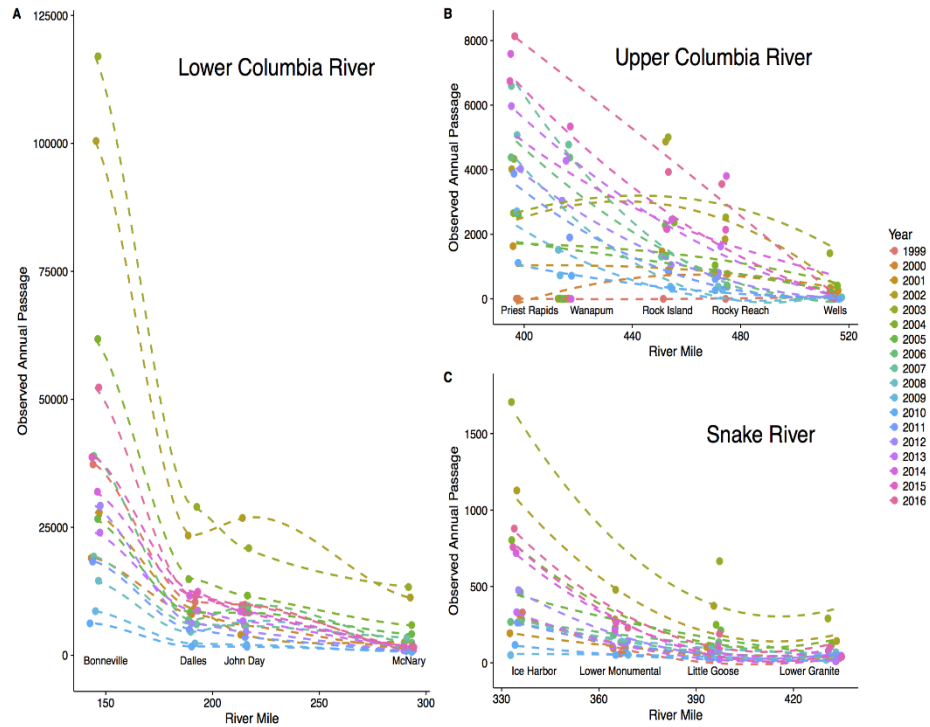


Figure 5—Modern annual total observations of Pacific lamprey passage at four lower Columbia River (A) dams, five dams in the upper Columbia River (B), and four dams on the lower Snake River (C) during the period 1999-2016 (points) with loess smoothing functions representing yearly upstream attrition due to spawning tributary entry, poor passage, or mortality (lines). Note that some years show more observations at upstream dams than downstream dams, suggesting limited capacity to effectively monitor lamprey passage through the Columbia River hydrosystem.

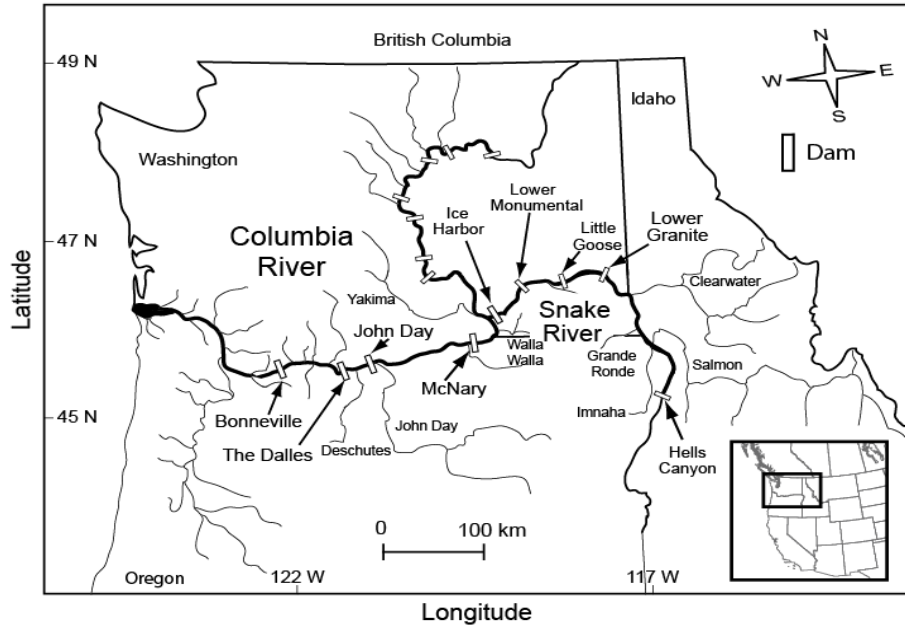


Figure 6—Map of Columbia River Basin dams in the United States.

Country / Regulatory Entity	Conservation Status	Mechanisms for conservation actions
International		
IUCN (2013)	Unassessed	n/a
NatureServe (2013)	G4 - Apparently Secure / Moderately Vulnerable	Diagnostic tools, International Extinction Risk estimates (multi-jurisdictional)
USA		
Fish and Wildlife Service	Species of Concern	Pacific Lamprey Conservation Initiative, Endangered Species Act
Bureau of Land Management	Type 2 (rangewide/Globally imperiled)	Resource Management Plans, NEPA (Biological assessment/Environmental Impact Statement)
Forest Service	Sensitive species regions 1 & 4	Resource Management Plans, NEPA, habitat restoration
Columbia River Inter-Tribal Fisheries Commission	Tribal Trust Resource	Tribal Pacific Lamprey Restoration Plan, research program and Treaty Rights
Nez Perce Tribe	Tribal trust species/resource	Treaty of 1855
Alaska Dept. of fish and Game	Species in need of conservation	None - Recommends more research to occur.
Idaho Dept. of Fish and Game	Endangered	Research, tributary passage, habitat mitigation
California Dept. of Fish and Wildlife	Species of Special concern	Harvest limit of 5 Pacific Lamprey per day
Oregon Dept. Fish and Wildlife	Sensitive -Vulnerable	Fish passage, Native fish recovery, harvest restrictions
Washington Dept. of Fish and Wildlife	State monitored (lowest level)	Species of Concern List, research, habitat restoration programs, tributary passage
Canada		
Committee on the Status of Endangered Wildlife in Canada (COSEWICK)	<i>High Priority Candidate Endangered Species designation (2016)</i>	<i>Species at Risk Act (SARA)</i>
Mexico		
Secretariat of Environment and Natural Resources (SEMARNAT)	<i>Threatened (2010)</i>	<i>Norma Oficial Mexicana (NOM)</i>
Russia		
Ministry of Natural Resources and Environment of the Russian Federation	n/a	Red Data Book of the Russian Federation (RDBRF)
Japan		
Ministry of the Environment	<i>Red List of Threatened Species: data deficient (Japan Integrated biodiversity system)</i>	Act on Conservation of Endangered Species

Table 1— Range-wide legal conservation statuses, mechanisms for conservation actions.