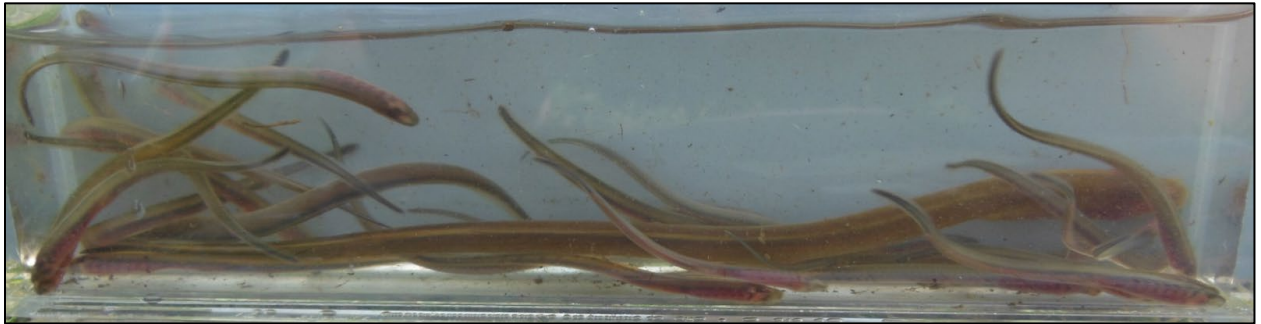


2020 Regional Implementation Plan

for the

Alaska Regional Management Unit



Submitted to the Conservation Team July 29, 2020

Primary Authors

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Game

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Five species of lamprey are known to occur in the Alaska Regional Management Unit (RMU): Arctic lamprey *Lethenteron camtschaticum*, Pacific lamprey *Entosphenus tridentatus*, Western river lamprey *Lampetra ayresii*, Western brook lamprey *Lampetra richardsoni*, and Alaskan brook lamprey *Lethenteron alaskense*. Previous research efforts within the Alaska RMU have primarily focused on Arctic lamprey because of their value as a subsistence and commercial resource; however, our understanding of their basic biology (e.g., time spent at sea, migration timing, abundance, etc.) remains limited. Unfortunately, even less is known about the four remaining lamprey species within the Alaska RMU. Developing management plans for lampreys are primarily inhibited by our limited understanding of lamprey status and distribution in Alaska. In addition, procuring funds for directed lamprey research is difficult considering their relatively limited consumptive uses and low priority classification by many state and federal agencies. Although five species of lamprey are present within the Alaska RMU, this document will focus on synthesizing available information for (1) Arctic lamprey, due to ongoing harvest pressures within the RMU; and (2) Pacific lamprey, a high priority species of conservation concern within other areas of their distribution (Wang and Schaller 2015). Future versions of this document will outline priority research needs within the RMU for Arctic and Pacific lamprey.

I. Status and Distribution of Lamprey Species in the RMU

A. General description of the RMU

The Alaska RMU encompasses the entire state of Alaska, an area of approximately 632,000 square miles (USGS 2019). The Alaska region is divided into six subregions which are further subdivided into hydrologic units (HUs): southeast (4 HUs), southcentral (7 HUs), southwest (5 HUs), Yukon (8 HUs), northwest (4 HUs), and Arctic (5 HUs; USGS 2019; Fig. 1). Major Alaskan rivers within these subregions includes, the Yukon River (3,185 km), Kuskokwim River (1,130 km), Stikine River (610 km), Susitna River (504 km), Copper River (470 km), and Kobuk River (451 km). Alaska's rivers drain into the Beaufort, Chukchi, and Bering seas as well as the Gulf of Alaska (GOA). While the current implementation plan does not subdivide the Alaska RMU into multiple regions, future plans might consider using subregions defined by the USGS (2019) to assess the status of lamprey at finer regional scales.



Figure 1. The Alaska region subdivided into its six subregion hydrologic unit boundaries. Map adapted from the U.S. Geological Survey (<https://water.usgs.gov/wsc/reg/19.html>).

B. Status of Species

Arctic lamprey

Conservation Assessment and New Updates

Arctic lampreys are afforded no formal protection in Alaska. Baseline information is needed on the distribution, abundance, and life history for all life stages of this species. Although there has been recent research on the genetic structure, distribution, relative abundance/density, and biology of larval *Lethenteron* spp. in spawning tributaries within the Yukon River drainage (Sutton 2017; Shink et al. 2018), similar studies need to be conducted in other Alaskan tributaries of the Yukon River as well as the Kuskokwim and Susitna River drainages. Larval lampreys serve a role as ecological engineers in the freshwater environments, and their burrowing and feeding behaviors induce increased oxygen conditions in the streambed, maintain the relative softness of the streambed, and increased the abundance of fine-particulate-organic matter on the streambed surface (Shirakawa et al. 2013). Given this importance, studies on the abundance, age structure, growth rates and patterns, and movements and distribution are essential for a more complete

understanding of larval lampreys. Research that focuses on the macrophthalmia and adult life stages (e.g., migration rates and patterns, timing of downstream and upstream migrations, spawning habitats and locations, population dynamics, etc.) is also necessary. Additional research is also needed to examine the role of Arctic lamprey in marine and freshwater ecosystems (Sutton 2017; Shink et al. 2019). Further, it remains unclear if Alaskan brook lamprey is truly a distinct species or if it is a life-history variant (i.e., freshwater resident) of Arctic lamprey (Docker et al. 2009; Sutton 2017; Shink et al. 2018). By developing a more thorough understanding of Arctic lamprey, fisheries scientists in Alaska will be able to develop sustainable harvest regulations and conservation plans within the context of ongoing anthropogenic and climate changes.

Yukon River

Arctic lamprey subsistence and commercial harvests are regulated by the Alaska Department of Fish and Game (ADF&G) and are restricted to the lower and middle Yukon River. Historically, subsistence fishers primarily used dip nets and eel sticks from the beach or the edge of shorefast ice to harvest Arctic lamprey during their upstream spawning migration under the ice from late October to early December (Brown et al. 2005). These harvests were not only important to supplement summer and fall salmon harvests for human consumption and dog food, but lamprey skins and oil have functional uses such as small bags for holding fish and conditioning for animal skin boots (Brown et al. 2005). Subsistence harvest was, on average, one or two buckets per family or between three and five buckets for households with dogs. Relative run strength indexed by commercial harvests have indicated poor returns in the past three years, and subsistence users have expressed difficulty in meeting their subsistence needs in the same time period (Estensen et al. 2018a, 2018b, Jallen 2018).

Since 2003, ADF&G has annually issued a Commissioner's permit for an Arctic lamprey commercial fishery in the lower Yukon River. Commissioner's permits are issued for the commercial harvest of species not managed under existing State of Alaska commercial fishing regulations. The Arctic lamprey commercial fishery started with the purpose of determining gear characteristics, biological information, and to a lesser extent, abundance. Annual permits have allocated between 5,000 and 49,080 pounds (2.27 and 22.26 metric tons) of Arctic lamprey for commercial harvest. Fishing gear is restricted to one hand dip net, eel stick, fyke net, or hoop net per Freshwater Commercial permit holder. Any individual possessing a valid Crewmember's License or a current year limited entry commercial fishing permit may assist the freshwater

commercial permit holder and participate in fishing activities. As per permit stipulations, lamprey harvest and fishing location are recorded on a fish ticket and sent to the department. In addition, a sub-sample of harvested Arctic lamprey are sent to the department for biological sampling (Hayes and Salomone 2004; Brown et al. 2005; S. Garcia, ADF&G, unpublished data). Lamprey harvested in the Alaskan fishery have been primarily sold to Asian pharmaceutical markets, Eurasian food markets, and research institutions (Renaud 1997, 2011). Despite the commercial and subsistence harvest of Arctic lamprey in Alaska, the status of Arctic lamprey populations and ancestral genetic relationships among aggregations in different drainages within the state and throughout its distribution in North America are currently unknown (ADF&G 2006; Thorsteinson and Love 2016).

In an attempt to learn more about Arctic lamprey and facilitate lamprey harvests, the Yukon Delta Fisheries Development Association (YDFDA) has operated a test fishery for Arctic lamprey since 2013 in the lower Yukon River. The objectives of the test fishery were twofold: to evaluate river entry and run timing and to generate catch-per-unit-effort (CPUE) data to serve as an index of abundance (Hayes et al. 2004; Bower 2014). Six index sites established in 2013 have been fished consistently through 2018 (Fig. 2). Catches from test fish index sites have been highly variable among years, ranging from 336 – 9,008 lamprey (Estensen et al. 2018b). The mechanisms driving inter-annual run size variability are unknown. In 2016, a mark-recapture project was initiated at the test fish sites to generate an estimate of in-river Arctic lamprey abundance. Despite multiple years of effort, no reliable population estimates have been possible using mark-recapture techniques due to the low number of recaptures (Garcia 2017). Without an estimate of population abundance, the sustainability of the lamprey harvest within the Yukon River is difficult to assess.

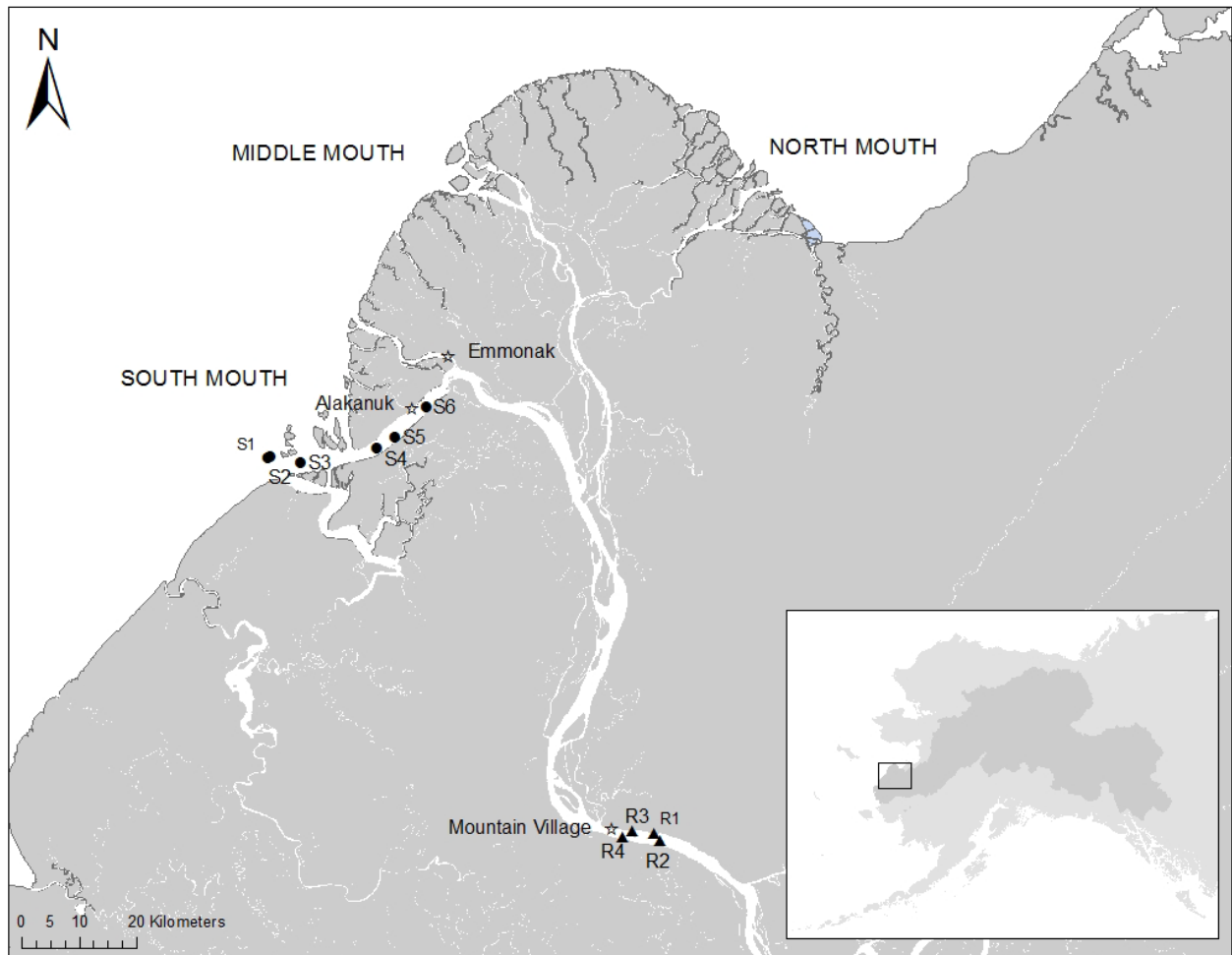


Figure 2. Fyke net test fishing locations (black circles), S1–S6, used as tagging sites for Arctic lamprey in the lower Yukon River from 2016–2018. Fyke net recapture sites (black triangles), R1–R4, used to intercept tagged lamprey. Lower Yukon River communities of Alakanuk, Emmonak, and Mountain Village denoted by stars.

Kuskokwim and Susitna rivers

Although Arctic lampreys are known to occur within the Kuskokwim and Susitna river drainages, a population estimate is not available for either system. Consequently, we do not know if Arctic lamprey populations in those systems are increasing, stable, or decreasing. Unlike the Yukon River, neither of these systems support commercial or subsistence fisheries (Shelden et al. 2016). There are currently no assessment projects occurring within the Kuskokwim drainage. However, a recent assessment project within tributaries of the Susitna drainage documented spawning-phase Arctic lamprey and Alaskan brook lamprey.

Distribution and Connectivity

In Alaska, Arctic lamprey spawn in the Yukon, Kuskokwim, and Susitna River drainages (Morrow 1980; Mecklenburg et al. 2002; Sutton 2017; Shink et al. 2018; Fig. 3). The population structure within and among Alaskan spawning tributaries and drainages is largely unknown. Shink et al. (2018) examined genetic variation within and among three aggregations of *Lethenteron* spp. larvae in the Yukon River drainage using microsatellite genotypes and found that gene flow was restricted but continuous among aggregations, which is in agreement with observations of gene flow among *Lethenteron* spp. populations throughout their geographic range (Artamonova et al. 2011; Yamazaki et al. 2011, 2014; Artamonova et al. 2015).

Pacific lamprey

Conservation Assessment and New Updates

The population status of Pacific lamprey in the Alaska RMU is unknown. Due to the absence of both subsistence and commercial fisheries for Pacific lamprey in Alaska, this species has not been a management priority for state or federal agencies. As a result, monitoring and survey efforts have only recently (June 2019) been initiated on Susitna River tributaries. Although no spawning-phase Pacific lampreys were collected during sampling surveys in 2019, water samples were collected for the examination of environmental DNA (results are pending).

Distribution and Connectivity

The distribution of Pacific lamprey in the Alaska RMU is poorly understood. Specimens have been documented near Nome and St. Matthew Island, but are thought to be rare north of the Alaska Peninsula (Mecklenburg et al. 2002; Fig. 3). Pacific lamprey have been observed in the Gulf of Alaska (e.g., Copper River) and drainages in southeast Alaska (e.g., Stikine, Unuk, Chilkat, and Naha rivers). To date, no comprehensive larval or adult Pacific lamprey surveys have been conducted in the Alaska RMU. Unlike areas of the Pacific Northwest (PNW), passage barriers are not believed to be a major threat to Pacific lamprey populations in Alaska because major river drainages remain relatively unobstructed by man-made dams and artificial barriers.

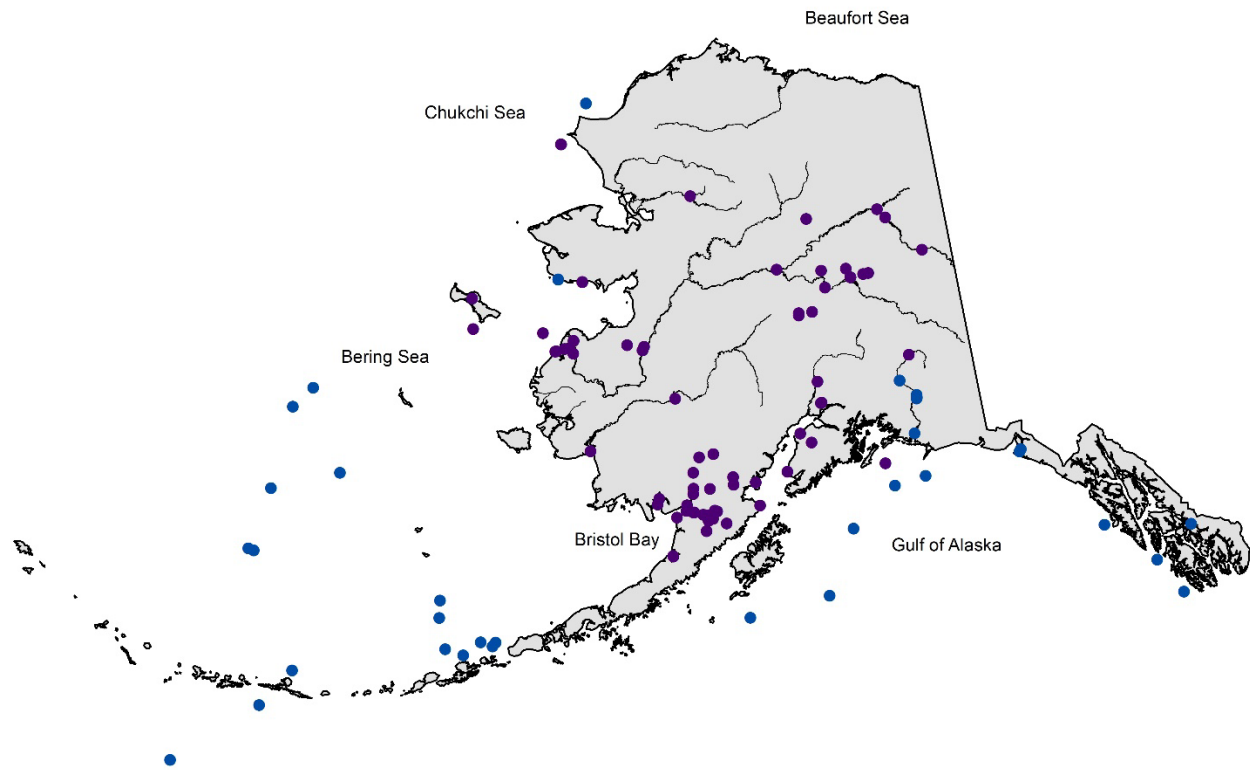


Figure 3. Global Biodiversity Information Network (GBIF) specimen records of Arctic lamprey (purple) and Pacific lamprey (blue) in the Alaska RMU.

C. Threats

Summary of Major Threats

Given our limited knowledge on the distribution, abundance, and life history of Arctic lamprey, the greatest threat to this species currently is a lack of information (Sutton 2017; Shink et al. 2018, 2019). Unfortunately, our knowledge of Pacific lamprey in Alaska is even less than what is known for Arctic lamprey. This limited knowledge is particularly problematic due to the lack of baseline ecological information as freshwater and marine ecosystems are altered by ongoing environmental changes due to rapid warming in high-latitude ecosystems (Serreze et al. 2000; Reist et al. 2006; Solomon et al. 2007). For example, climate warming is a potential threat for the distribution of larval life stages of Arctic lamprey. Arakawa et al. (2018) estimated that the upper lethal water temperature of larval Arctic lamprey larvae was 29.3°C and that growth rate declined with increasing water temperatures, with peak growth occurring at 18°C. In a river located at the southern limit of their distribution in Japan, summer water temperatures already exceed 30°C, and larvae have been detected burrowing in the cooler fine sediments as refugia to avoid warmer surface waters. In addition, high water temperature promotes the activity of harmful microorganisms, which results in sediments becoming anaerobic in depositional areas with slow

water. Arakawa and Yanai (2017) reported that larval Arctic lamprey do not inhabit areas where sediments have become excessively anaerobic. Further, food webs in the North Pacific and Arctic oceans are complex, dynamic, and support important fisheries, yet the role of marine-phase lampreys as both predator and prey are poorly understood (Aydin and Mueter 2007; Yamazaki et al. 2014; Alabia et al. 2018; Shink et al. 2019). It remains unclear if current harvest levels for Arctic lamprey in the lower Yukon River are sustainable and how this might impact the relationship between the Arctic lamprey-Alaskan brook lamprey species complex (Hayes and Salomone 2004; Sutton 2017; Shink et al. 2018). Although there are numerous other threats for lampreys elsewhere in North America (e.g., upstream passage, dewatering and flow management, watershed degradation, water quality, predation, competition, etc.), it is not clear what role and degree of impact these stressors may have on Arctic and Pacific lampreys in Alaska.

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II. Selection of Priority Actions

A. Prioritization Process

Proposals were solicited for consideration of prioritization.

B. High Priority Proposed Project Information

The following project was submitted by RMU partners for the Alaska RMU in 2020:

Project Title: Distribution, Habitat Use, and Life History of Pacific Lamprey in the Susitna River Drainage, Alaska

Project Applicant/Organization: University of Alaska Fairbanks

Contact Person: Trent M. Sutton

Email: tmsutton@alaska.edu

Phone: 907-474-7285

Project Type: Assessment

Lamprey RMU population(s): Alaska

Multi-RMU project? N/A

Watershed (5th HUC Field): Alaska (HUC 19), Southcentral Alaska (HUC 1902), Susitna River drainage (HUC 190205)

NPCC Subbasin (4th HUC Field) name: Lower Susitna River (HUC 19020505)

Project Location: Tributaries of the Susitna River Drainage, Alaska, which will include Meadow, Caswell, Rabideaux, Montana, Willow, and Birch creeks

Project Coordinates (latitude and longitude, decimal degrees, NAD 1983):

Meadow Creek: 61.5191 N, 149.7600 W through 61.5647 N, 149.8075 W

Caswell Creek: 62.0098 N, 149.9817 W through 61.9454 N, 150.0760 W

Rabideaux Creek: 62.2860 N, 150.2469 W through 62.1892 N, 150.2104 W

Montana Creek: 61.1047 N, 150.0484 W through 62.1800 N, 149.9567 W

Willow Creek: 61.820301 N, 145.212433 W

Birch Creek: 62.2543 N, 150.0848 W

Total Requested funds: \$25,000

1. Short Project Summary (200 words or less):

- *Provide a brief overview of your project including goals*
- *This information will be used to describe your project to potential funding entities*

The lack of information on lamprey species globally hinders ongoing management and conservation efforts. The Pacific lamprey *Entosphenus tridentatus*, a species of conservation concern in North America, is of particular interest in Alaska because this region marks the northern extent of its range. Further, the Susitna River drainage, a 504-km glacial river that discharges into Cook Inlet and the Gulf of Alaska, is the northernmost river-system that supports a spawning population of Pacific lamprey (Mecklenburg et al. 2002). However, the status and distribution of Pacific lamprey populations in Alaska is poorly documented, which includes lower Susitna River tributaries where Pacific lamprey have been reported to spawn as adults and rear as larvae. To address this data deficiency, the objectives of this project, which will take place in clearwater tributaries of the lower Susitna River, include: (1) assessment of the distribution and relative abundance of larval and adult Pacific lamprey; (2) examination of the rearing (larval) and spawning (adult) habitat use attributes of Pacific lamprey; (3) determination of the size and age structure of larval and adult Pacific lamprey; and (4) use of eDNA from collected water samples to detect the presence of Pacific lamprey.

2. Detailed Project Description (500 words or less):

- *Describe the proposed work including specific objectives (subcomponents of your stated goals)*

Sampling efforts for larval and spawning adult Pacific lamprey in Meadow, Caswell, Rabideaux, Montana, Willow, and Birch creeks will be conducted from early June through July 2021 and/or 2022. If weather and river conditions are favorable, then every attempt will be made to sample these systems in both years. For larval lamprey, collections will be made in areas of suitable habitat (e.g., depositional areas with fine substrate; Sutton 2017) using a low voltage backpack electrofishing unit (Model ABP-2, ETS Electrofishing LLC, Verona, Wisconsin) that is specifically designed for the collection of larval lampreys. Adult lamprey will be visually located by scanning shallow, riffle areas where lamprey spawning activity occurs. Once located, adult spawners will be collected using dip nets. A maximum of 10 larvae and 10 adult lamprey will be retained at each collection location, euthanized using tricaine methanesulfonate (MS-222), measured for total length and weight, and stored in ethanol pending subsequent laboratory analyses. Collected lamprey in excess of the 10 individuals of each life stage retained for laboratory analyses will be measured for length and weight and released alive near the capture locations. Genetic tissue samples will be collected from the caudal fin of captured lampreys and archived at the UA Museum of the North Genetics Repository. At each capture location, a suite of physical and chemical environmental data (e.g., water

depth, temperature, dissolved oxygen content, conductivity, predominant substrate type, presence of woody debris) will be collected to characterize lamprey habitat. Protocols for habitat assessment will follow those that have been used for other lamprey species as outlined in Mullett and Bergstedt (2003), Zerrenner and Marsden (2006), and Sutton (2017). In addition, photos will be taken at each collection location to photo-document lamprey habitat, particularly if lamprey are visible at a sampling area (e.g., adult lamprey are building redds, exhibiting spawning activities, etc.). At each sampling location, a 5-L water sample will be simultaneously collected and filtered using a SmithRoot eDNA backpack. Filters will be stored in 15-mL conical tubes with silica desiccant beads which has shown to be stable for several weeks prior to DNA isolation in the laboratory (Carim et al. 2016).

In the laboratory, lamprey will be positively identified to species using morphological and meristic characteristics, remeasured for length and weight, and their statoliths will be removed, dried, and stored in vials. All procedures for statolith removal, preparation, and age estimation will follow standard procedures for larval lampreys as described in Medland and Beamish (1987), Beamish and Medland (1988), Docker and Beamish (1994), and Meeuwig and Bayer (2005). To test for the presence of Pacific lamprey eDNA, quantitative polymerase chain reaction (qPCR) will be conducted using the targeted-species detection method (which has been established for Pacific lamprey; Carim et al. 2016; Ostberg et al. 2018). Replicate qPCRs will be conducted on each DNA extract to improve detection probability because eDNA often occur at low concentrations in the environment which may result in inconsistent results between PCR replicates.

3. *Descriptive Photographs-Illustrations-Maps (limit to three total):*

Below are two maps (entire Susitna River drainage and the lower Susitna River subbasin) and a collage of two images of a Pacific lamprey collected in fall 2019 in Willow Creek of the lower Susitna River drainage).

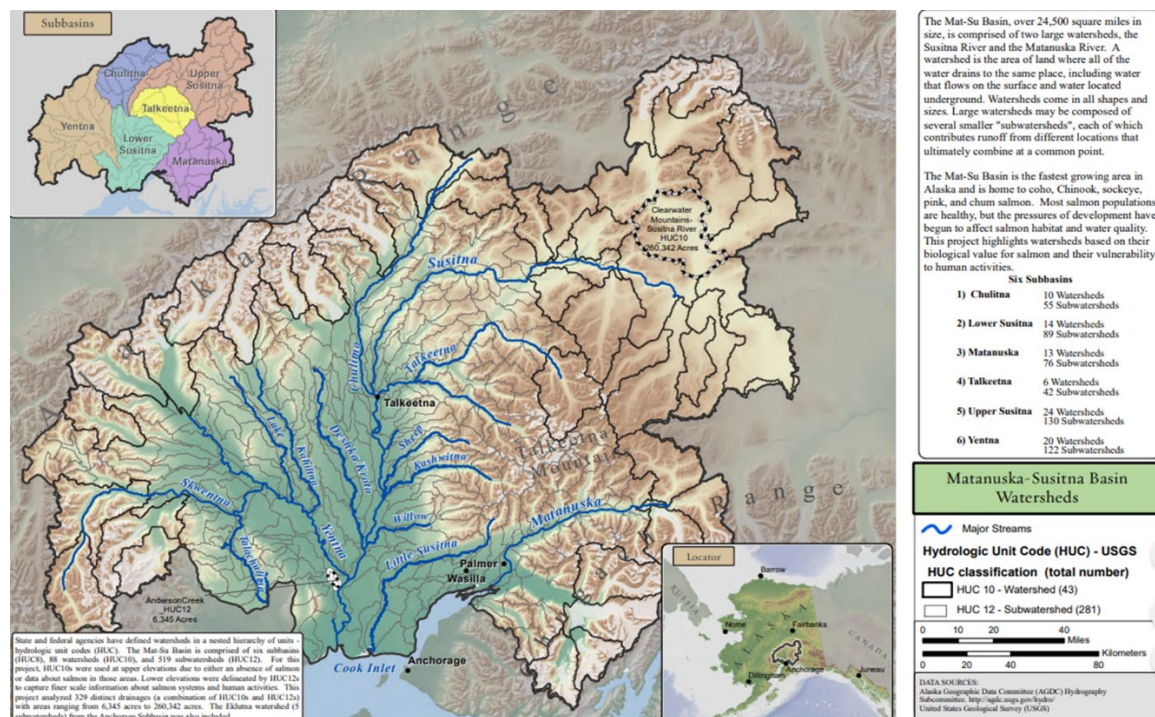


Figure 1. Susitna River drainage, with its individual subbasins and watersheds, located in southcentral Alaska (image credit: Mat-Su Salmon Habitat Partnership).

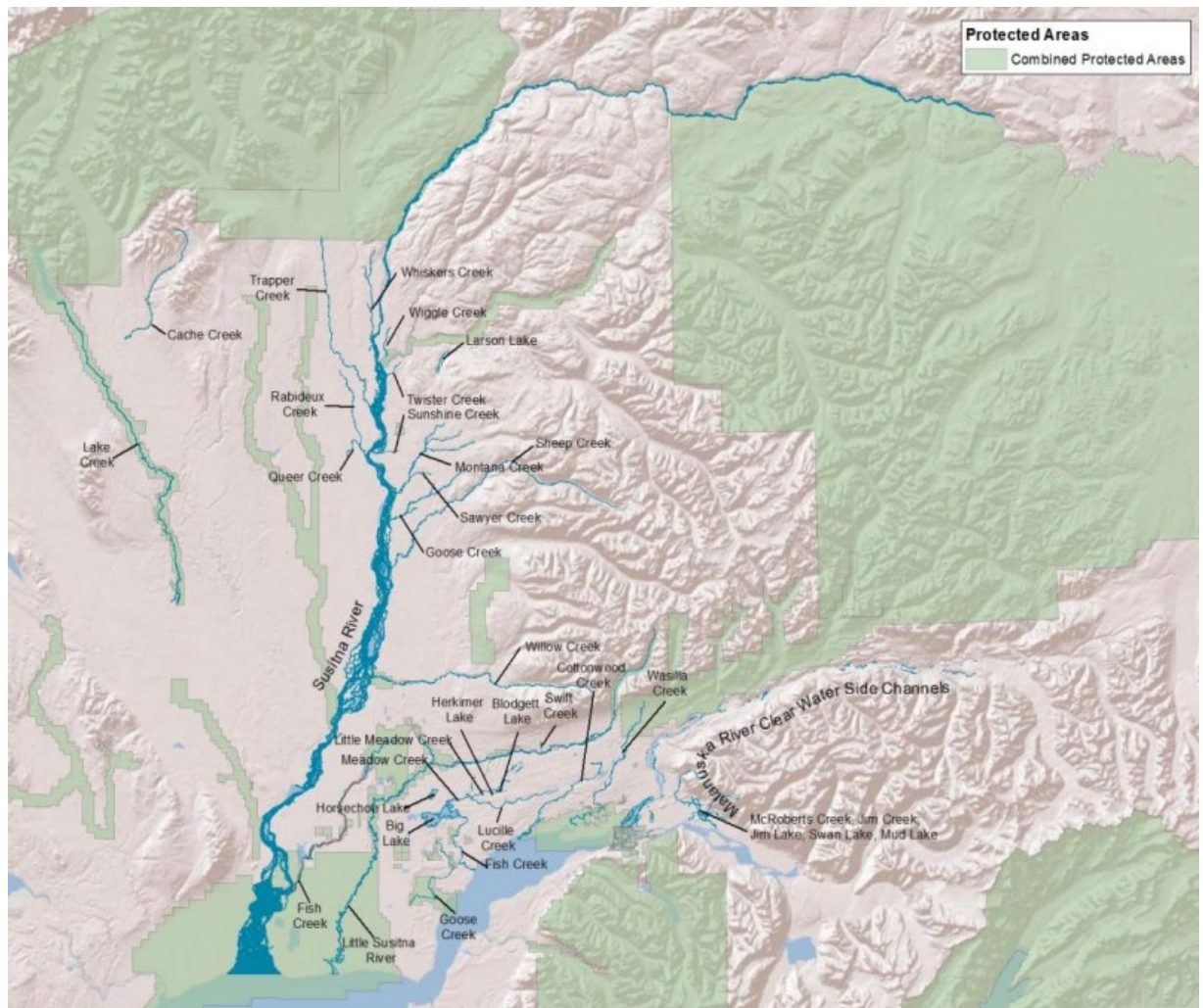


Figure 2. Primary tributaries in the lower Susitna River subbasin (image credit: U.S. Geological Survey National Hydrography Dataset).



Figure 3. Images of a dead, post-spawn Pacific lamprey found in September 2019 on the shore of Willow Creek, a tributary of the Susitna River, Alaska (photo credit: N. Cathcart, ADF&G).

4. Linkage of Actions to Identified Threats for Lampreys in RMU(s) (300 words or less):

- What threat(s) to lampreys does this project address? (See your [RIP\(s\)](#) for key threats)
Lack of Awareness Climate Change Water Quality Stream and Floodplain Degradation

- Does this project address threat(s) to lampreys specific to this RMU only, or does the project address the threat(s) prevalent in multiple RMUs?

Single RMU ☒, Multiple RMUs ☐ list additional RMUs:

- Describe how this project addresses key threat(s) to lampreys within the HUC(s) where project is proposed.

Given our limited knowledge on the distribution, abundance, and life history of Pacific lamprey, the greatest threat to this species currently is a lack of information. This limited knowledge is problematic due to the lack of baseline ecological information as freshwater and marine ecosystems are altered by ongoing environmental changes due to rapid warming in high-latitude ecosystems (Serreze et al. 2000; Reist et al. 2006; Solomon et al. 2007). Wang et al. (2020) evaluated impacts of climate change on Pacific lamprey. Although some populations are more vulnerable than others, Pacific lamprey are increasingly at risk under high greenhouse gas scenarios. Because of the absence of subsistence and commercial fisheries for Pacific lamprey in Alaska, this species has not been a management priority. As a result, limited monitoring and survey efforts have only recently (June 2019) been initiated in Susitna River tributaries. To date, there have been no comprehensive larval or adult Pacific lamprey surveys conducted in the Alaska RMU. Unlike areas of the Pacific Northwest, passage barriers are not a major threat to Pacific lamprey in Alaska because major river drainages remain relatively unobstructed by man-made dams and artificial barriers. Although there are numerous other threats for lampreys elsewhere in North America (e.g., upstream passage, dewatering and flow management, watershed degradation, water quality, predation, competition, etc.), it is not clear what role and degree of impact these stressors may have on Pacific lamprey in Alaska.

5. Species/Habitat Benefits (200 words or less):

- Provide citation of literature, distribution maps, and/or surveys demonstrating lampreys are currently and/or were historically present in the project area.
- How will the project provide meaningful measureable results to improve lamprey populations and/or their habitat conditions?

- *What life stage or stages will benefit from action? How?*
- *What other species may benefit from action?*

The distribution of Pacific lamprey in the Alaska RMU is poorly understood. Specimens have been documented north of the Alaska Peninsula and in drainages that discharge into the Gulf of Alaska as well as transboundary waters in southeastern Alaska (Mecklenburg et al. 2002; see Figure 3, Sutton et al. 2019). However, no comprehensive larval or adult Pacific lamprey surveys have been conducted in the Alaska RMU. This study will not only contribute to the literature on critical habitat needs for larval and adult Pacific lampreys, but will provide a benchmark from which to evaluate changes in habitat quality and lamprey distribution within this poorly studied RMU. More immediately, observations of Pacific lamprey within these systems will be nominated to the Anadromous Waters Catalog (AWC), which serves to offer an additional level of protection for water bodies that provide critical rearing and spawning habitat for anadromous fishes. Ultimately, this nomination will not only benefit other lamprey species that co-occur within this system, but also other species, such as Pacific salmon *Oncorhynchus* spp., that utilize these important habitat areas.

6. **Priority Objectives and Goals:**

- *Indicate the strategies, and/or restoration/management plans are addressed by this project (when available relevant documents/websites are hyperlinked below for reference):*
 - [PLCI Conservation Agreement](#) ☒
 - [National Fish Habitat Partnership National Conservation Strategies](#) ☒
 - [USFWS Climate Change Strategies](#) ☒
 - [Bonneville Power Administration Northwest Power and Conservation Council Columbia River Basin Fish and Wildlife Program](#) ☐
 - [CRITFC Tribal Pacific Lamprey Restoration Plan for the Columbia River Basin](#) ☐
 - [US Army Corps of Engineers Pacific Lamprey Passage Improvement Implementation Plan](#) ☐
 - *PUD Management Plan (please name below)* ☐
 - *Other (please name below)* ☐
- *Clearly describe how the project addresses the goals and objectives in the strategies, restoration/management plans indicated above (200 words or less).*
This proposed project meets the PLCI Conservation Agreement by providing critical information needs on Pacific lamprey as identified in the Alaska RIP through scientific research and monitoring of spawning populations within the Susitna River drainage in Alaska. Further, collecting baseline information on habitat use and availability is consistent with NFHP National Conservation Strategies that involve protecting intact and healthy waters and identify whether there is a need to restore hydrologic conditions, reconnect fragmented habitats, and/or restore water quality required by larval and spawning adult lampreys in this drainage. Finally, given the rapid rate and impacts of climate change in subarctic and Arctic Alaska, this project is entirely consistent with the USFWS Climate Change Strategies of (1) Adaptation (minimizing the impact of climate change on fish and wildlife through the application of cutting-edge science in managing species and habitats) and (2) Engagement (joining forces with others to seek solutions to the challenges and threats to fish and wildlife conservation posed by climate change). A key element in addressing these two strategies is the collection of baseline lamprey data that can serve as a benchmark for future evaluations as the climate in this region continues to change.

7. **Project Design / Feasibility:**

- *Have the designs for the project been completed already or will they be completed before planned project implementation?* Yes ☒ No ☐
- *Are the appropriate permits (e.g., ESA consultation, Scientific Collection, fish health/transport, etc.) in place already or will they be in place before planned project implementation?* Yes ☒ No ☐
- *Can the project be implemented within the defined timeframe? (See BPA & NFHP requirements in the accompanying PLCI RIP Priority Project Guidance document).* Yes ☒ No ☐
- *Please provide a brief description (200 words or less):* A pilot evaluation for this study was conducted in June 2019 to assess the feasibility of sampling in clearwater tributaries of the lower Susitna River for larval and spawning adult Pacific lamprey. Although sampling efforts were successful for collecting larval *Lethenteron* spp., actively spawning Alaskan brook lamprey *L. alaskense* and a dead, post-spawn Arctic lamprey *L. camtaschaticum*, Pacific lamprey were not collected during sampling surveys. Water samples were collected during this sampling and are currently being evaluated for the presence of Pacific lamprey eDNA. A dead, post-spawn Pacific lamprey was located in Willow Creek, a tributary of the Susitna River, in September 2019 (N. Cathcart, ADF&G, personal communication). As a result, Pacific lamprey may not have been collected because we sampled too early and/or not at the correct location within the drainage. Our plan is to resample these same areas in summer 2021 and 2022 following a similar sampling approach. An Aquatic Resource Permit (collection permit) from the Alaska Department of Fish & Game will still be secured to complete sampling activities. An IACUC (Institutional Animal Care and Use Committee) protocol is already in place for this study at UAF (#1401687). The project will be completed within the defined time period.

8. Partner Engagement and Support (200 words or less):

- *What partners are supporting the project?*
- *What partners are active in implementing the project?*
- *What partners are providing matching funds or in-kind services that directly contribute to the project?*

The partners that are supporting as well as active in implementing this project include the University of Alaska Fairbanks (Trent Sutton and Mary Spanos), U.S. Fish and Wildlife Service (Katie Shink), and the Alaska Department of Fish & Game (Sabrina Garcia). All three partner institutions will provide in-kind support in the form of their time to assist with sampling efforts, sampling gear for field collections (e.g., canoes for travel in sampling tributaries, eDNA backpack for collection of water samples, larval lamprey backpack electrofishing unit, dip nets, etc.), and camping equipment (e.g., tents, sleeping bags, etc.) for multi-day sampling trips. Further, the University of Alaska Fairbanks will provide in-kind laboratory space for the processing of lamprey and water samples (for eDNA). No direct matching funds will be provided in direct support of this project by any of the project partners.

9. Monitoring and Reporting (200 words or less):

- *How is completion of the project going to be documented? (See BPA and NFHP requirements in the accompanying PLCI RIP Project Proposal Guidance document).)*
- *How will the project's benefits to lampreys be monitored over time?*

All reporting requirements will be met as listed, which include a PLCI mid-term update report no later than December 2021 and a final written PLCI report no later than December 2022. Additional reporting to the scientific community may occur through a published, peer-reviewed manuscript. There is the possibility that this project could be reported as part of a graduate student thesis/dissertation (if funding to support a graduate student to complete the work is secured concurrent to the project period). Given the

dearth of information on Pacific lamprey in Alaska, the data collected in this project will provide essential information on the distribution, relative abundance, and habitat quality and quantity, as well as other life-history information, on larval and spawning adult Pacific lamprey at the northernmost extent of its geographic distribution. Further, this project will also allow for the collection of similar data on two sympatric lampreys at the southern edge of their distribution, Arctic and Alaskan brook lamprey. Given the rapid pace of changing climate conditions in subarctic and Arctic regions of Alaska, the data collected through this project will provide critical baseline information that will serve as a benchmark for future assessments as the environment continues to be altered.

10. Project Budget (including overhead):

- See budget below and the attached budget.

11. Timeline of major tasks and milestones:

EXAMPLE:

<i>Workflow</i>	<i>Start Date/Month</i>	<i>End Date/Month</i>	<i>Responsible Party</i>
Environmental compliance/permits	<i>Feb 2021</i>	<i>April 2021</i>	<i>UAF, USFWS, ADFG</i>
Pre-project preparation	<i>Feb 2021</i>	<i>May 2021</i>	<i>UAF, USFWS, ADF&G</i>
Field surveys	<i>June 2021</i>	<i>July 2021</i>	<i>UAF, USFWS, ADF&G</i>
Laboratory analyses	<i>July 2021</i>	<i>Sept 2021</i>	<i>UAF</i>
Data analyses	<i>Sept 2021</i>	<i>Oct 2021</i>	<i>UAF, USFWS, ADFG</i>
ADF&G ARP Reporting and PLCI Mid-Term Reporting	<i>Nov 2021</i>	<i>Dec 2021</i>	<i>UAF, USFWS, ADFG</i>
Environmental compliance/permits	<i>Jan 2022</i>	<i>March 2022</i>	<i>UAF, USFWS, ADFG</i>
Pre-project preparation	<i>Jan 2022</i>	<i>May 2022</i>	<i>UAF, USFWS, ADF&G</i>
Field surveys	<i>May 2022</i>	<i>July 2022</i>	<i>UAF, USFWS, ADF&G</i>
Laboratory analyses	<i>July 2022</i>	<i>Sept 2022</i>	<i>UAF</i>
Data analyses	<i>Sept 2022</i>	<i>Oct 2022</i>	<i>UAF, USFWS, ADFG</i>
Final reporting	<i>Nov 2022</i>	<i>Dec 2022</i>	<i>UAF, USFWS, ADFG</i>

12. References (if applicable):

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Project Budget:

	Items	# Hours or Units	Cost per Unit (\$)	RIP Funds Requested (\$)	Cost Share (\$)	Total Cost (\$)
A	<i>Personnel:</i>	-	-	\$14,015.00		\$14,105.00
	a. Field/lab technician salary	856.4 hours	\$15.00/hr	\$12,776.00		\$12,846.00
	b. Field/lab technician fringe	856.4 hours	9.1%	\$1,239.00		\$1,169.00
	c.					
B	<i>Equipment & Supplies:</i>	-	-	\$5,000.00	-	\$5,000.00
	a. eDNA lab analyses	100 samples	\$30/sample	\$3,000.00		\$3,000.00
	b. eDNA water bottles	140 bottles	\$12/bottle	\$1,680.00		\$1,680.00
	c. Whirlpak bags	2 boxes	\$125/box	\$250.00		\$250.00
	d. ethanol	2 gal	\$35/gallon	\$70.00		\$70.00
C	<i>Travel:</i>	-	-	\$1,600.00	-	\$1,600.00
	a. Truck rental	4 weeks	\$400.00/week	\$1,600.00		\$1,600.00
D	<i>Other:</i>	-	-	\$900.00	-	\$900.00
	a. Truck fuel	4 weeks	\$100.00/week	\$400.00		\$400.00
	b. Field camp food	4 weeks	\$125.00/week	\$500.00		\$500.00
E	<i>Administrative:</i>	-	-	\$1,600.00	-	\$1,600.00
	Overhead (17.5%)			\$1,600.00		\$1,600.00
	Indirect Costs (%)					
	Total (Sum of A - E)	-	-	\$25,000.00		\$25,000.00