# Oregon Department of Fish & Wildlife

# Fish Screening and Passage Program

## 2019 Statewide Fish Passage Priority List

April 19, 2019

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## Executive Summary

Populations of migratory fish are dependent on their ability to access quality habitat in order to complete important ecological life history strategies. In Oregon, this often means migratory fish must travel extensive distances through various habitats to complete these life histories. Unfortunately, their passage is often blocked by man-made (anthropogenic) features which act as barriers to fish movement, defined in Oregon Revised Statutes (ORS) 509.580 (1) as Artificial Obstructions. There are currently 42,780 inventoried artificial barriers in Oregon that can potentially inhibit fish movement. Due to the volume of these barriers and the associated cost of repairing them, only a small proportion receive attention each year. Oregon Department of Fish and Wildlife (ODFW) has constructed a prioritization list of 591 barriers (Appendix A) to identify barriers that maximize the return of native migratory fish to critical habitats. Scoring criteria are calculated to estimate the amount of habitat gained for purposes of prioritizing artificial obstructions at which fish passage would benefit native migratory fish in the State of Oregon.

As had been completed in previous efforts, we used the methodology of ranking high priority barriers within the State of Oregon following the scoring equation developed by ODFW and approved by the Oregon Fish and Wildlife Commission (OFWC) in 2013. In developing the 2019 prioritization list we made changes in habitat quality, grouping of barriers, and weighting parameters based on the presence of listed endangered and threatened species that were adjusted from the 2013 report. Efforts were made to better quantify parameters within the 2013 model while attempting to limit subjective criteria. The specific details of these changes are explained within the prioritization methodology section of this report. Despite improvements within the methodology there are still assumptions made in the development of the 2019 list that are based on professional judgement by ODFW staff. Many fish passage barrier models use a cost-benefit analysis that we determined to not be appropriate for such a large scale statewide prioritization list that lacks cost estimates for each barrier and subsequently cost estimates are not used within this prioritization effort. The prioritization list continues to be a robust methodology that builds upon the 2013 effort by representing the highest priority barriers for native migratory fish passage in the state. Instead of ordering each artificial obstruction numerically, the 2019 prioritization has been organized into the top ten and an additional 16 groups, with each group representing barriers of similar priority ranking rather than a sequential numbering approach. We used a K-means cluster analysis to partition the data into the respective groupings.

**Accomplishments Report (2013-2018 (Appendix B)**: The final priority list from 2013 contained 534 high priority fish passage barriers. In 2013, there were 27,800 artificial obstructions documented in Oregon within the Oregon Fish Passage Barrier Data Standard (OFPBDS) database. Current inventory of barriers in Oregon has been a major task by many stakeholders and ODFW resulting in a two fold increase in the number of artificial obstructions within the inventory over the past 5 years, however, many more barriers exist that have not been identified. Since the development of the 2013 prioritization list, 75 of the barriers have had projects implemented to restore fish passage, comprising 14% of the total high priority barriers. We identify some projects in Appendix B that illustrate the work and importance of this tool to improve access of native migratory fish to critical habitat that was previously inaccessible.

## Introduction

Connectivity of aquatic habitat is important to Pacific Northwest fish populations because access to specific and varied stream habitats are important elements for sustained fish production and maintenance of habitats. When streams are fragmented, restricted movement of fish is just one impact. Reduced connectivity also affects water flow, alters the streams capacity to acquire, move, and deposit soil and sediments; and changes the stream's ability to modify the stream-bed and channel through erosion. Improving connectivity between the Pacific Ocean and their tributary streams support increased production of native migratory fish populations. Because fish require different physical and chemical conditions as they grow and reproduce, connected habitats are essential to their survival and reproduction. Generally, sustained fish production is compromised when habitats become poorly connected or of poor quality; ensuing declines in fish populations often lead to repercussions throughout the fish community. Loss and degradation of fish habitat, and fish passage barriers, have reduced the capacity of many Pacific Northwest fisheries to permit maximum sustained productivity for desired fish populations.

Policy framework in Oregon: Fish passage prioritization and inventory is a requirement of the ODFW's Fish Passage Program (FPP) through Oregon Revised Statute (ORS) 509.585 (3). This statute states that ODFW shall "complete and maintain a statewide inventory in order to prioritize enforcement actions based on the needs of native migratory fish." Furthermore the statute states that the Department shall update the priority list every 5 years. The last fish passage priority list was approved by the Oregon Fish and Wildlife Commission in 2013.

As noted, the priority list shall be based on the needs of native migratory fish. More specifically, the base requirements of the priority list are identified in Oregon Administrative Rule (OAR) 635-412-0015 (2). This rule states the following:

> The priority list shall be based on the needs of native migratory fish.
>
> (a) The prioritization shall consider the following factors relative to each artificial obstruction for all native migratory fish currently or historically present at the artificial obstruction:
>
> (A) the quantity of native migratory fish habitat which is inaccessible,
>
> (B) the quality of native migratory fish habitat which is inaccessible,
>
> (C) unique or limited native migratory fish habitat which is inaccessible, or should remain inaccessible for fish management purposes,
>
> (D) the biological status of the native migratory fish,
>
> (E) the level of fish passage currently provided at the artificial obstruction,
>
> (F) the presence of other artificial obstructions upstream and downstream and the timeframe native migratory fish will be able to utilize restored passage, and
>
> (G) existing agreements with the Department regarding fish passage.
>
> (b) The prioritization may utilize existing Department information or professional judgment in the absence of information specific to a given site.
>
> (c) The priority list shall contain one artificial obstruction per Oregon sub-basin, which shall be ranked across the state.

Various spatial planning techniques for fish passage project prioritization have been used across the country. Frequently, fish passage restoration occurs at the site-scale opportunistic approach. More recent efforts to increase habitat gain have addressed fish passage at the watershed-scale. Fish passage prioritization techniques include scoring and ranking, stepwise scoring and ranking, scenario analysis, optimization, or complete enumeration. Complete enumeration is an obvious approach to examine all potential combinations of barrier removals, but is only practical for small sets of barriers. Scoring and ranking entail assigning each option a score based on associated criteria and sorting that list to identify top projects. This method has the advantages of being computationally efficient, flexible, transparent, and does not require a high degree of technical expertise or computer software. Stepwise scoring and ranking includes spatial interdependence that ranks each barrier independently and as projects are completed all other barriers are re-scored, a new ranked list is created, and the process is repeated. Optimization can be used to find efficient solutions when multiple barriers are selected and spatial interdependence between costs and benefits is a factor. Optimization is advantageous in that it provides techniques to identify efficient sets of projects from an extremely large number of possible alternatives. Disadvantages of Optimization include uncertainties with knowing project costs and enumerating large numbers of barriers in a typical watershed and computing connectivity indices.

This document outlines the approach that was used to score high priority barriers identified by ODFW District Fish Biologists and group the barriers into similar levels of priority. The general approach was to select a priority barrier, summarize upstream mapped fish habitat metrics in miles, by species, and to assess mapped habitat (either current or historical) upstream of priority barriers for quantification and habitat quality purposes. Blocking and partially blocking barriers, upstream of the priority barrier, also were summarized specific to species and habitat metrics. The Oregon Fish Passage Barrier Data Standard (OFPBDS) specifies a common model be used to represent geospatial fish passage barrier information which is central to the spatial analysis of this prioritization methodology. The Utility Network Analyst toolbar in ArcMap was used to trace the geometric network upstream from each artificial obstruction and select the habitat distribution reaches. Once the reaches were selected the length of upstream habitat was quantified, the closest upstream barrier was identified and the total number of upstream barriers was summarized. In ArcGIS 10.6 the geometric network tools require manual input for setting trace start points and for running traces. The ArcGIS 10.6 geometric network tracing capabilities are built so they will support improved automation of tracing from each barrier. Geometric network takes this a step further and builds connectivity and flow direction into the stream dataset, enabling analysis up or down the stream network. Additionally, barriers can be built into the network and can be used to initiate or stop network tracing operations. Questions such as, "how many miles of coho habitat are located upstream from this barrier?" can be answered by analyzing the data on a geometric network. While this data model supports the measurement of habitat gains at any particular barrier and other barrier prioritization metrics, it also requires that data inputs meet stringent criteria in order to provide viable results. Therefore the OFPBDS provides a tool to support our resource planning to ensure limited restoration dollars are spent addressing priority barriers.

A consistent and accurate spatial model of a watershed and stream network provides the backbone of a successful prioritization effort. A spatial model of the stream network helps pull together disparate datasets into an analytical framework by building spatial relationships between barriers, habitat measures, and the stream network itself. Accurately locating and compiling physical characteristics of each anthropogenic barrier on the stream network is an essential step for prioritization. Artificial obstructions are defined as any dam, water diversion, dike, berm, levee, tide or flood gate, road, culvert, or other human-made device placed in the waters of this state that precludes or prevents the migration of native migratory fish. Although infrequently included in prioritization efforts, natural barriers such as waterfalls, estuary sedimentation, beaver dams, and debris jams can influence the outcome of connectivity analyses. These barriers are natural components of the landscape, are often transient, and can be advantageous for some species (e.g. prey refugia). Natural barriers are omitted from this prioritization ranking as directed in ORS 509.585 (3) and OAR 635-412-0015 (1) to prioritize artificial obstructions that are human-made structures.

**Prioritization Methodology**

In order to score and rank artificial obstructions each barrier received a score based on the associated habitat and fish metrics. The list was then sorted to identify projects that maximize the amount of habitat made accessible to native migratory fish. The equation has been set up so that habitat is a multiplicative portion of the model and fish species are an additive portion of the model. Therefore, the habitat metrics comprise 60% of the total points and the fish species metrics comprise 40% of the points. The 2013 prioritization model provided the framework for the updated 2019 prioritization model as described here:

$$\left((Quantity\ x\ Quality)x\left(\frac{Level\ of Passage}{5}\right)\right) + (n(\#listedNMF) + 20(\#NMF) + 15(\#autoup) - 15(\#autodown)$$

Habitat Quantity: In the past iteration of this list from 2013, river habitat quantity has been quantified using stream length and was used in the 2019 process to be consistent. This factor is the amount of habitat accessible to native migratory fish if passage were provided at the priority barrier. It is averaged across the species that would most likely utilize that habitat. This factor is based on the linear distance (miles) of fish habitat that would become accessible to the species currently present below the barrier, if passage were provided. This value is summed by the amount of miles between the priority barrier and the next complete barrier upstream, or the amount of habitat available up to an upstream barrier, natural barrier, or the end of fish use. Habitat quantity is scaled by using a ranking system that assigns a point value according to the range of average miles of inaccessible habitat upstream from the artificial obstruction. This point system is based on a weighted average score from the fish habitat distribution mapping in order to balance the habitat and fish parameters of the equation. The mileage ranking classes are as follows:

- >300 miles = 130 points
- 200-299 miles = 115 points
- 100-199 miles = 100 points
- 50-99 miles = 85 points
- 25-49 miles = 70 points
- 10-25 miles = 55 points
- 3-9 miles = 40 points
- 1-2 miles = 25 points
- < 1 mile = 10 points

Habitat Quality: Few prioritization projects address habitat quality beyond a general notion of the expected habitat condition of a focal taxa. Habitat Quality could be incorporated into these analyses through pre-existing mapping projects, surrogates for habitat quality (e.g. land use) or environmental variables (e.g. stream temperature, catchment area, or low flow yield). We developed a multivariate regression tree analysis based on environmental variables including catchment area, mean summer water temperature, and species association abundances. Mean summer water temperature was the highest 30 day average water temperature between the months of July and August. Regression tree analyses distinguished seven segment types based on mean summer temperature and network catchment area (Figure 1). Nonmetric multidimensional scaling analyses suggested that fish assemblages differed among segment types. Species that were indicative of specific segment types generally had habitat requirements that matched stream segment attributes. The classification system we developed performed significantly better than subjective weighting of habitat quality metrics.

We developed four categories of species associations (SA I–IV) that represented distinct thermal and physical characteristics of Oregon Rivers based on known fish species distributions. Species associations were truncated based on 32 species of native migratory fish as defined under OAR 635-007-0501. Development of the first level of the classification system was a multi-step process in which differences in fish abundance in SA I–IV (Table 1) were related to differences in mean summer stream temperature and catchment area using regression trees. Multivariate regression tree analysis was used to relate differences in fish abundance to differences in mean summer stream temperature and catchment area with regression tree sizes constructed using a complexity parameter of 0.01 (Figure 1). Because of the connection between rivers and the Pacific Ocean, drastically different ocean-influenced fish assemblages can occur within large rivers depending on habitat conditions and therefore the similarity of species associations in large river habitats was a result of the non-migratory behavior where coefficient of concordance tests allowed to test whether the species associations in large rivers were significantly co-occurring. This resulted in a distinct tree for species associations in medium to large rivers (Figure 1).

After running the multi-variate regression tree analysis, river segment classification was determined using a nonmetric multidimensional scaling (NMDS) technique to summarize patterns of fish assemblage structure and habitat variables. Multivariate analysis of variance was used to test for differences in segment scores. SA I was the most abundant assemblage at summer stream temperatures less than 18.1 °C (Figure 1). SA I was also the most abundant species association at temperatures as cool as 16.1 °C for segments with catchment areas between 74 and 250 km². Similarly, SA III was the most abundant species association when catchment areas were less than 74 km² and summer stream temperatures were warmer than 19.0 °C; it was also the most abundant species association at catchment areas between 250 and 735 km² with summer stream temperatures warmer than 18.1 °C (Figure 1). Based upon the attribute partitions identified by multivariate regression tree and the resulting changes in presence of the species associations, seven river segment types were identified as: cold headwater (CDH), cold stream or river (CDS), cool headwater (CLH), cool stream (CLS), warm headwater (WH), medium river (MR), and large river (LR). Three additional segment types were eliminated based on non-concordance. Because physical habitat provides the template for evolution of organisms and organization of communities, physical attributes are considered adequate for developing biologically meaningful classifications (Frissell et al. 1986; Imhof et al. 1996). Additionally, the wide availability of GIS databases of landscape attributes (e.g., catchment area, surficial geology, landscape topography, and climate conditions) that control instream features, such as water temperature and discharge, makes it possible to classify streams across large areas such as the state of Oregon.

This parameter of the prioritization model represents the quality of habitat upstream of the priority barrier that fish would gain access to if the barrier were passable. Habitat quality is quantified based on the river segment classification with points associated with biologically meaningful characteristics. Habitat Quality scores are assigned based on the connectivity to upstream habitat within each of the seven river segment types from 7 points (access to all segment types), 6 points (access from Warm River to multiple upstream segment types)…..to 1 (point) for connectivity with a single river segment type. Scoring habitat quality based on this system provides an increase in the overall habitat value based on the physical habitat benefits provided by fish passage above the artificial obstruction. Connectivity to multiple river segments is possible with each segment type contributing to the cumulative habitat quality score. The assumption is made that the more accessible specific and varied stream habitats (number of different segment types) above the barrier, the higher the value of habitat gained and therefore potential fish production is increased. Furthermore, the cumulative scoring of habitat quality provides benefits to barriers that increase access to cold water refuge that may benefit fish stocks under future climate change scenarios.

Level of Fish Passage: Large and small barriers differentially affect the ability of an organism to move, and no two barriers in a watershed perform identically. The proportion of organisms passing a structure is typically summarized as a passage rate (i.e. passage efficiency or barrier passability). Ideally, each barrier would have a unique site-specific value of passability. However, passage rates must often be estimated for many barriers within a watershed, and a site-by-site analysis is often cost-prohibitive. Depending on the scope of the analysis, a binary view of passage may be sufficient (i.e. pass or no pass) or a continuous view of passage may be required (i.e. a rate between 0 and 100%). Passage rates can be categorized based on empirically derived passage rates (e.g. direct observation and filming) or analytically derived passage rates (e.g. genetics, statistical models, Fishxing software). In the absence of empirically derived passage rates at each artificial obstruction we developed a standardized rating methodology. The scale, values, and descriptions used at each barrier in this prioritization are provided below:

- 5 - barrier to all native migratory fish,
- 4 - barrier to some native migratory fish adults and/or species,
- 3 - barrier to some native migratory fish adults and/or species for only part of migration period,
- 2 - barrier to all native migratory fish juveniles,
- 1 - barrier to some native migratory fish juveniles and/or for only part of migration period.
- 0 - Full volitional passage for all native migratory fish species, adults and juveniles.

Anything ranked less than a 5 (complete barrier) will reduce the overall priority (cannot receive full credit for habitat being blocked if not a complete barrier). The "level of passage" rating will reduce the priority score based on the relative degree (percentage) of complete blockage at the barrier. The level of passage is applied to the upstream habitat value (Quantity and Quality), because anything less than a complete barrier indicates that fish are already accessing the habitat upstream at varying degrees depending on the severity of the blockage. Therefore, any score less than 5 for the "Level of Passage" ranking will **reduce** the overall score for habitat upstream by a factor of 20 percentage points.

Listed Native Migratory Fish: This factor addresses fish in need of passage below the barrier that are listed as "threatened" or "endangered" under ODFW state listed species or the federal Endangered Species Act (ESA). The presence of listed fish increases the priority ranking of a barrier. For each "listed" fish species present at the barrier, respective status points will be added to the priority ranking. There is no maximum score possible for this factor; however, the highest number of ESA listed fish at any given site was four during the 2013 and 2019 review of current native migratory fish species present below a barrier. A greater weighting factor was applied to a barrier where the presence of listed species occur as follows:

a. 40 Points associated with "Endangered" status
b. 30 Points associated with "Threatened" status
c. 15 Points associated with "Special Concern" status

Species Diversity: This factor addresses the number of native migratory fish species or stocks in need of passage at the priority barrier (# of species or stocks that would utilize the habitat upstream of the barrier). For each native migratory fish species or stock present there is 20 points awarded. The highest number of native migratory species present at a barrier on the 2019 list was eleven species, therefore the maximum number of points allocated was 220 points. Native migratory fish species are identified in OAR 635-412-0005 and include 32 fish species.

Auto up Factors: This category provides ODFW District Biologists the opportunity to incorporate additional point values to an artificial obstruction based on un-quantifiable factors. For various reasons there are management options to protect natural resources and fish populations by prevention of invasive species, inaccessible upstream habitat gain, inaccessible estuarine habitat gains, ecological gain, and fish management alternatives. Estuarine habitat gains and upstream habitat gain are of immediate importance. For each "auto up" factor identified, 15 points will be added to the prioritization scoring. A maximum of 60 points (4 auto ups) can be supplementary to the overall score for each site. Auto-up categories may include, but not be limited to the following:

- Historical habitat inaccessible for a unique stock of fish or limited species distribution
- Access to Estuarine habitat
- Artificial obstruction affects large population of fish

- Access to side channels or limited habitat types within a stream reach blocked by the barrier
- Over 100 miles of additional potential fish habitat = 3 "auto-ups" (45 points)
- Over 50 miles of additional potential fish habitat = 2 "auto-ups" (30 points)
- Conservation need/uplift

Auto down Factors: This category has been identified by ODFW staff as factors that should be considered to decrease the overall priority of a barrier. For each "auto-down" factor identified, 15 points are subtracted from the prioritization ranking. A maximum of 60 points (4 auto-downs) can be subtracted for each site. Auto down factors may include the following, but are not limited to this list:

- Complete blocked barriers downstream prevent historic or current native migratory fish
- Fish management concerns (non-native fish, or other concerns)
- 10 or more complete barriers upstream = 2 "auto-downs" (-30 points)
- Multiple complete barriers upstream where the habitat gain is less than one mile of inaccessible habitat
- Waiver or exemption has been granted through existing ODFW agreements

**Summary:** The final priority list contains 591 high priority artificial obstructions partitioned into 16 groups. Of the 42,780 artificial obstructions inventoried in Oregon as of January 2019, these high priority obstructions comprise less than 2% of the overall known barriers to fish passage in the state. The priority list represents the highest priority barriers for fish passage in the state. Providing fish passage at artificial obstructions for complete barriers will increase habitat that was previously inaccessible to native migratory fish, while addressing passage at partial passage sites will increase the duration of fish passage. The overall priority ranking and the prioritization model is primarily based on biology. This assumption is supported by Oregon Administrative Rules, which state that "the priority list shall be based on the needs of native migratory fish." ODFW also recognizes that other factors also come into play when prioritizing sites for fish passage restoration. Whether the other factors are socio-economic in nature, or common sense driven, they help to provide a more complete picture of important considerations for a given site. The list is comprised of barriers in each of the 18 fish districts across the state, providing a good geospatial representation of barriers. During this revision of the fish passage prioritization, efforts were made to quantify habitat quality with less subjective results. The prioritization model serves as a tool to assist in making natural resource decisions based on where the greatest habitat gains can be expected to benefit native migratory fish. ODFW recognizes that the science and information regarding fish passage barriers is ever evolving and future prioritization will be updated as new information becomes available.

Figure 1. Multivariate regression tree showing the habitat quality divisions within Oregon rivers. Abbreviations are as follows: CDH = cold headwater, CDS = cold stream or river, CLH cool headwater, CLS = cool stream, WH=warm headwater, MR=medium river, LR = large river, JUL is mean summer stream temperature between the months of July and August (°C), and AREA is stream catchment area (km²).

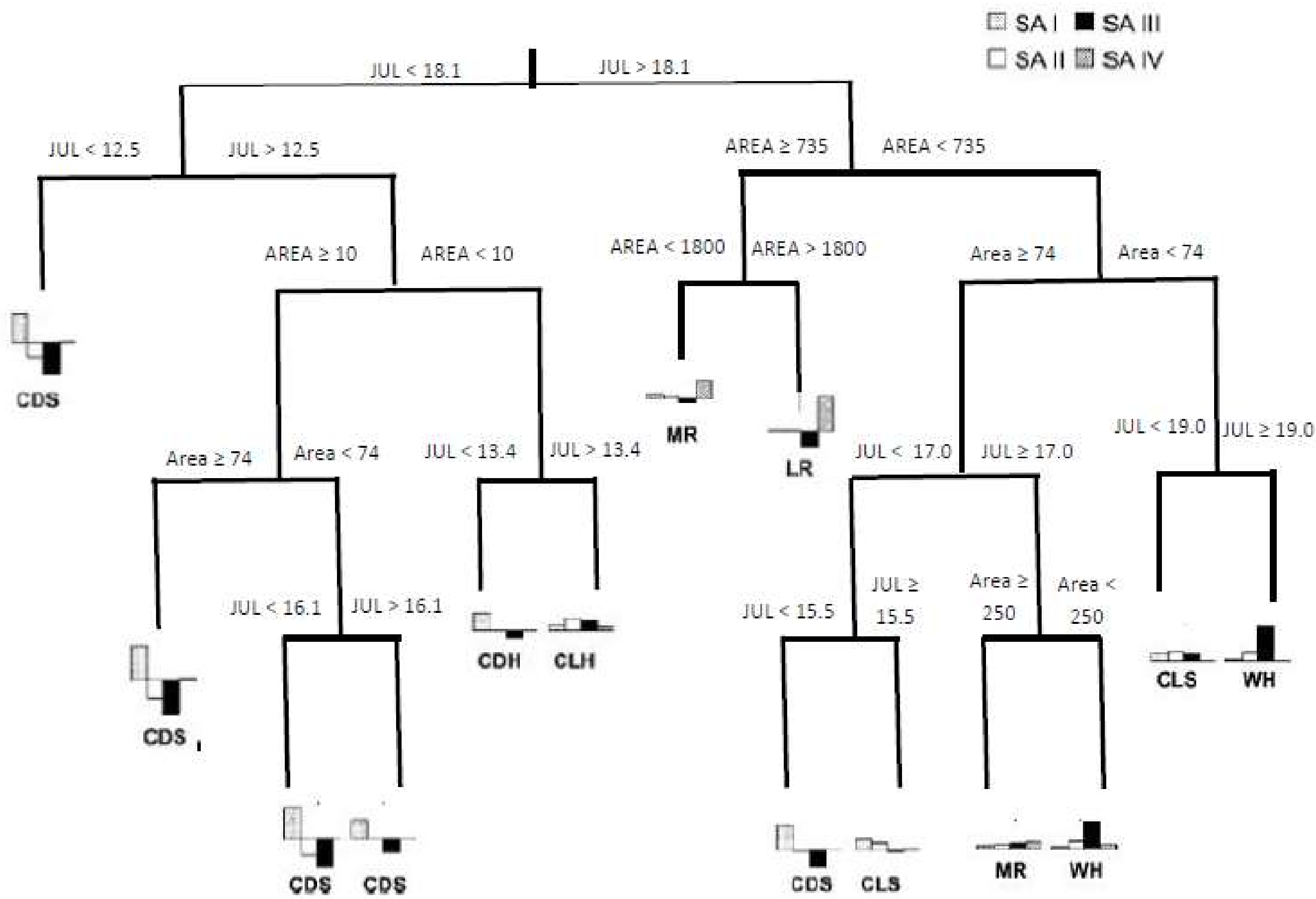

Table 1. Fish species associations (SA) used in developing habitat quality metrics for Oregon river segments. SAII, low species associations had a significantly low level of concordance, but were clustered in proximity to each other.

| SA I | SAII | SAII, low | SA III | SA IV |
|---|---|---|---|---|
| Bull trout | Chum Salmon | | Bridgelip Sucker | Green Sturgeon |
| Cutthroat trout | Coho Salmon | Pit-Klamath lamprey | Lost River Sucker | White Sturgeon |
| Rainbow trout | Chinook Salmon | Sockeye salmon | Largescale Sucker | Redtail Surfperch |
| Miller Lake Lamprey | Pacific lamprey | Klamath lamprey | Modoc Sucker | Eulochan |
| Mountain whitefish | | Northern Pikeminnow | Klamath smallscale Sucker | Surf smelt |
| Redband Trout | | | Klamath Largescale Sucker | |
| Mountain Sucker | | | Tahoe Sucker | |
| Goose Lake Sucker | | | Warner Sucker | |
| | | | Shortnose Sucker | |
| | | | River lamprey | |
| | | | Redband Trout | |

# APPENDIX A

2019 Prioritization list

(See attached spreadsheet)

# APPENDIX B

Accomplishments Report (2013-2018)

The final priority list from 2013 contained 534 high priority fish passage barriers. In 2013, there were 27,800 artificial obstructions documented in Oregon. Since the development of the 2013 prioritization list, a total of 75 barriers have been addressed for fish passage or removal, comprising 14% of the total high priority barriers. Some of the key accomplishments during this time are:

**Brownell Dam Removal (NE Oregon, Group 3 Barrier Removal)**

The Umatilla River has historically been diverted for agricultural purposes. The Umatilla Basin Project allows water users to have their water pumped from the Columbia River in exchange for water to remain in the channel of the Umatilla River for fish. Therefore, diversion dams, such as Brownell Dam (RM 1.0) are no longer needed to divert water. This dam was identified as a high priority on the 2013 ODFW Statewide Fish Passage Barrier Inventory list. The Brownell diversion dam was one of the oldest dams on the river and was the first passage impediment fish encounter on their upstream migration. Brownell Dam was approximately 4 feet high and 395 feet long, with a fish passage channel that was blasted into the bedrock in the early 1980's. It provided inadequate jump pools during low flows, with reports and observations of fish jumping in bedrock areas in year's past. The dam had not been used for diversion purposes in over 20 years and had since fallen into disrepair, with one side being breached. This breach had caused the majority of the water to flow through the area, and not through the fish notch. This structure was documented as a fish passage impediment, for all life stages of native fish species including steelhead, Chinook salmon, coho salmon, lamprey, and redband trout. A major dam failure in 2011 further compromised fish passage. A study conducted by the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) in 2017, showed that of 60 fish radio tagged, only 18 fish passed the dam. It also showed that 16, of the 18 fish, passed through the breached section of the dam where there was exposed rebar and cable, while none utilized the fish passage notch, and two moved through the west portion where there is no passage. Removal of the Brownell dam structure and curb will decrease passage delays, therefore allowing fish to move upstream faster and arrive at spawning grounds in better condition for spawning activities. Removal will also benefit passage for juvenile downstream migration, since the majority of the flow was being funneled through the breached portion of the dam and not the fish passage notch.

**Walcott Fish Ladder (Little Butte Creek, Group 3 Barrier)**
The Walcott diversion structure is a seasonal concrete stop-log irrigation dam that blocks fish passage when in use, particularly during the late summer/early fall period when fall Chinook salmon are starting to move into the upper reaches of Little Butte Creek. During the offseason when the stop-logs are out, the diversion structure is an impediment to fish passage at low flows. Upstream migration of winter Steelhead, Klamath Smallscale Suckers and Pacific Lamprey are impacted as well as juvenile fish and federally listed Coho salmon. ODFW staff constructed a concrete pool and weir fishway with a dual orifice configuration to meet the needs of all native migratory fish present. Walcott Diversion is a State of Oregon high priority fish passage restoration project that opened up significant amounts of native migratory fish habitat. In particular, fall Chinook will have improved access to 25 miles of the Little Butte Creek system, increasing their total habitat in the upper Rogue River watershed by 23 percent.

**Wiwaanaytt Creek (John Day Watershed, culvert replacement)**
The purpose of this project is to remove two corrugated metal culverts that are fish passage barriers on Wiwaanaytt Creek. The first culvert is located at milepost 3.46 on Forest Service RD 2645. The bottomless arch culvert spans 12 feet, with a height 6'3" and a length of 84 feet. The second culvert is located at milepost 0.04 on Forest Service Rd #295, off of Forest Service Rd 2645. The bottomless arch culvert spans 13 feet with a height of 5.1 feet and length of 70 feet. Wiwaanaytt Creek is listed as designated critical habitat for Mid-Columbia River Steelhead by National Marine Fisheries Service. These culvert replacements are a high priority for the Middle Fork John Day River steelhead population (2nd priority) in the Mid-C Plan for the limiting factor of impaired fish passage. Replacing the current culverts which were fish passage barriers with bottomless arch culverts will benefit stream channel function and increase aquatic connectivity for Mid-C steelhead, redband trout and resident fish species present.

**E. Fork S. Fork Trask River Dam Removal** (North Coast, Group 5 barrier removal)

The EFSF Trask Dam, built in 1970, was 9 feet tall and 100 feet wide. It had been operating as a diversion structure that delivered water to an existing fish rearing pond. This project restored the site to pre-dam conditions by completely removing the existing dam and associated structures including the dam apron, cutoff walls, sheet piling, concrete abutments, fish ladder, and fish screen. Dam removal was completed in 2016 during two phases. The stream was re-graded and a low flow passage channel was constructed. Phase two included removal of the remainder of the dam and the fish screen. This project improved passage for multiple species to gain access to habitat in the upper East Fork Trask. The dam previously acted as a partial barrier due to difficulty of some species navigating the steep pass ladder, and due to reduced flows in the ladder during use of the rearing pond in summer. Natural passage restoration at this side provided multiple benefits to native migratory fish species.

**Wimer Dam** (SW Oregon, Top 10 barrier removal) Wimer Dam (RM 10.3) was an irrigation dam located on Evans Creek, a major tributary to the Roque River in Jackson County, Oregon. Wimer Dam removal was a top restoration priority for the upper Rogue District. The dam was a concrete arch structure with a weir crest length of 93 ft and average height of 9 ft. Dam removal resulted in improving longitudinal stream connectivity and fish passage for endangered Southern Oregon/Northern California Coast Coho salmon, fall Chinook salmon, summer and winter steelhead, native suckers, Pacific lamprey, and resident trout. The relic concrete diversion structure was not used for diverting water and served no functional purpose. Large amounts of quality habitat exist above Wimer Dam including West Fork Evans Creek which maintains good flow and cold summer temperatures.

*Figure 1 and 2 River Design Group photo credit*

**North Unit Diversion Dam (Central Oregon, Group 10 ).** Located in Bend, Oregon, the North Canal Dam fish ladder is a vertical slot fish ladder intended to pass native redband trout and other native migratory fish present in the upper Deschutes River. The fish ladder is comprised of 50 pools measuring 5' wide by 6'-8" long, and a 9-inch pool to pool differential. The fish ladder is owned and operated by three irrigation districts: Swalley, Central Oregon Irrigation District, and North Unit Irrigation District. Fish Passage by redband trout was confirmed through the use of PIT tag Array technology installed in the lower and upper pools of the ladder.

**Oak Ranch Creek (North Coast, Group 6 culvert replacements)** Oak Ranch Creek is a tributary stream of the Nehalem River. Fish passage issues have persisted for decades at two crossings on Oak Ranch Creek along Apiary Road in Columbia County, Oregon. The mainstream of Oak Ranch Creek at the Apiary road crossings were a native migratory fish impediment until each crossing was removed and replaced with a pre-cast concrete open bottom arch. Each crossing now provides access into the upper basin for native migratory fish species. These culverts were limiting fish access to seven miles of essential habitat for Chinook salmon, Coho salmon, winter steelhead, and cutthroat trout.